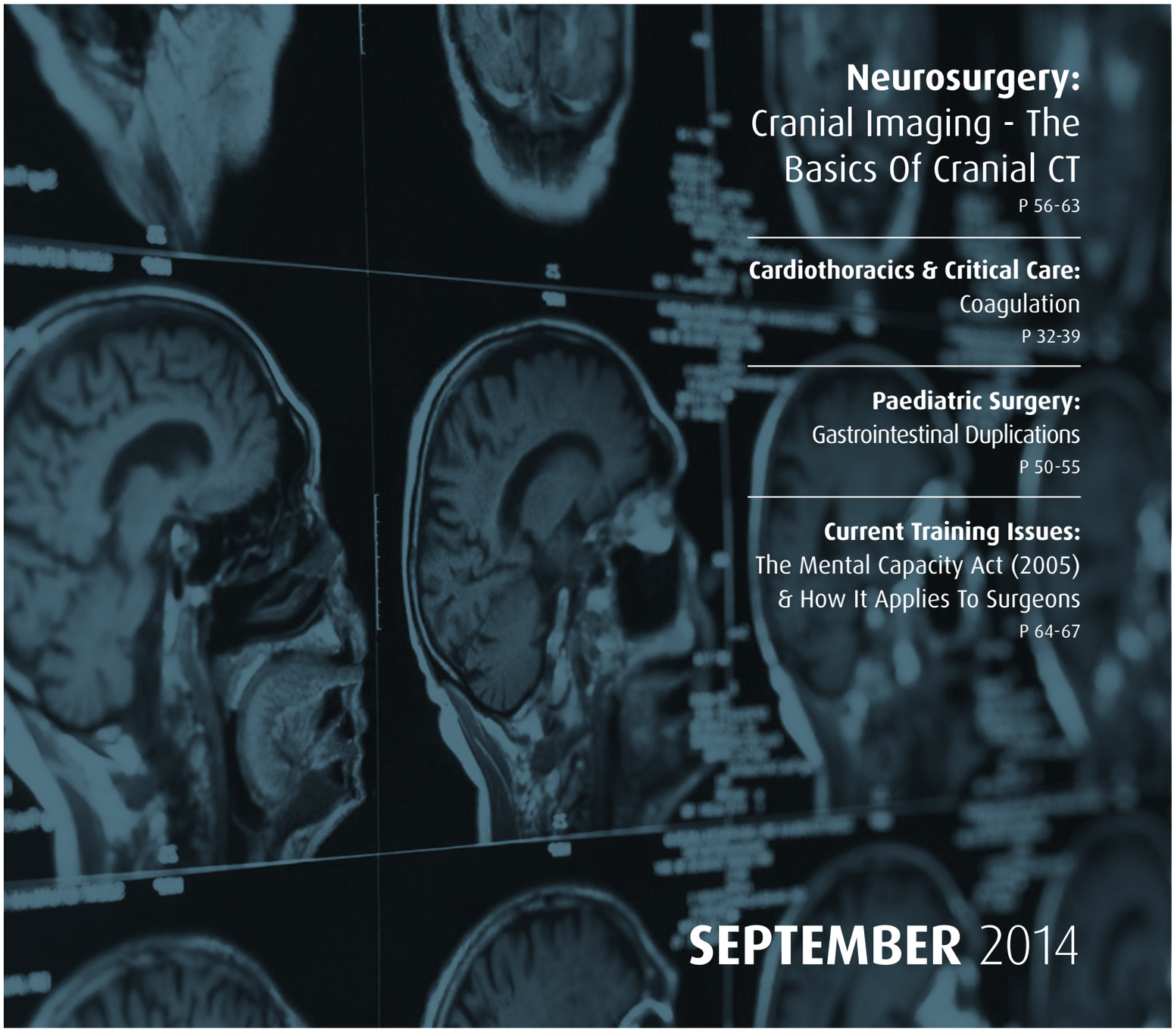
123Library

CORE SURGERY JOURNAL

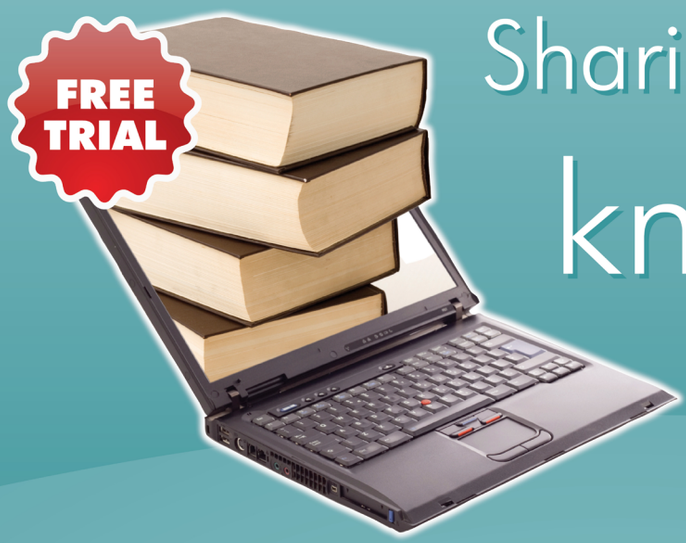
Volume 4, Issue 5



SEPTEMBER 2014

123Library

www.123Library.org



Sharing **more** knowledge



Contact us on
0207 253 4363
or email
sales@123library.org
for a
FREE TRIAL

What is 123Library?

123Library is a fast growing and innovative eBook and **digital content provider for libraries** in the field of healthcare.

What are the benefits for your library?

1. FULL FLEXIBILITY ✔
2. KNOWLEDGE ✔
3. CUSTOMER CARE ✔
4. NO HASSLES ✔
5. FULL SECURITY ✔
6. GET FEEDBACK ✔
7. SUPPORT ✔
8. EASE OF USE ✔
9. SAVING MONEY ✔

Benefit today, visit **www.123Library.org**

123Library

Contents

CORE SURGERY JOURNAL

Volume 4, Issue 5

Financial Statement

The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources, and authors are not paid. The decision to accept or refuse an article for publication in the Core Surgery Journal is free from financial considerations and is solely the responsibility of the Editorial Panel and Editor-in-Chief.

Conflict Of Interest

The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors".

The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

Animal & Human Rights

When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Informed Consent

123library recognises patients' right to privacy. We require Authors to maintain patients' anonymity and to obtain consent to report investigations involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

CORE SURGERY JOURNAL

Volume 4, Issue 5

Reviewers

TRAUMA & ORTHOPAEDIC SURGERY	
Mr DP Forward	Consultant, Queen's Medical Centre, Nottingham
Mr J Geoghegan	Consultant, Queen's Medical Centre, Nottingham
Mr T Westbrook	Consultant, Queen's Medical Centre, Nottingham
Mr A Tambe	Consultant, Royal Derby Hospital, Derby
Mr J Hutchinson	Consultant, Royal Derby Hospital, Derby
Mr A Stephen	Consultant, Royal Derby Hospital, Derby
Mr S Auplish	Consultant, Queen's Hospital, Romford
Mr O Sabri	Consultant, Bristol Royal Infirmary, Bristol
Mr J Clamp (Spines)	Consultant, Queens Medical Centre, Nottingham
Mr R Bommireddy (Spines)	Consultant, Royal Derby Hospital, Derby
Mr P Kothari	Consultant, King's Mill Hospital, Mansfield
Mr. M. Espag	Consultant, Royal Derby Hospital, Derby
Mr D Clark	Consultant, Royal Derby Hospital, Derby
Mr A Khurana	Senior Registrar, Queen's Medical Centre, Nottingham

CARDIOTHORACIC SURGERY	
Mr A Singh	Consultant, Nottingham City Hospital, Nottingham

GENERAL SURGERY	
Mr K Thiruppathy	Senior Registrar, Whipps Cross University Hospital, London
Mr H Yow	Senior Registrar, Whipps Cross University Hospital, London
Mr AS Fawole	Consultant, Dewsbury & District Hospital, Dewsbury
Mr JR Saunders	Consultant, Newham University Hospital, London
Mr J Hossain	Consultant, Pinderfields Hospital, Wakefield
Mr M Dube	Consultant, King's Mill Hospital, Mansfield
Mr D Gomez	Consultant, Queens Medical Centre, Nottingham
Mr AB Hariskrishnan	Consultant, Doncaster Royal Infirmary, Doncaster
Mr M Brett	Consultant, Warrington NHS Foundation Trust, Warrington
Mr D Vimalachandran	Consultant, Countess of Chester Hospital, Chester
Mr Pranesh	Consultant, Warrington NHS Foundation Trust, Warrington
Mr G Sen	Consultant, Freeman Hospital, Newcastle

OTORHINOLARYNGOLOGY & NECK SURGERY	
Mr Olarinde	Consultant, Chesterfield Royal Infirmary, Chesterfield
Mr J Sharp	Consultant, Royal Derby Hospital, Derby
Prof N Jones	Consultant, Queen's Medical Centre, Nottingham
Mr A Sama	Consultant, Queen's Medical Centre, Nottingham
Mr I De	Consultant, Royal Derby Hospital, Derby
Mr D Choa	Consultant, Royal National Throat, Nose and Ear Hospital, London
Miss K Midwinter	Consultant, Chesterfield Royal Infirmary, Chesterfield
Mr P Andrews	Consultant, Royal National Throat, Nose & Ear Hospital, London

PAEDIATRIC SURGERY	
Mr S Singh	Consultant, Queen's Medical Centre, Nottingham
Mr A Williams	Consultant, Queen's Medical Centre, Nottingham
Mr M Shenoy	Consultant, Queen's Medical Centre, Nottingham
Mr N Patwardhan	Consultant, Leicester Royal Infirmary, Leicester
Mr B Eradi	Consultant, Leicester Royal Infirmary, Leicester
Mr R Stewart	Consultant, Queen's Medical Centre, Nottingham

PAEDIATRIC SURGERY	
Mr S Singh	Consultant, Queen's Medical Centre, Nottingham
Mr A Williams	Consultant, Queen's Medical Centre, Nottingham
Mr M Shenoy	Consultant, Queen's Medical Centre, Nottingham
Mr N Patwardhan	Consultant, Leicester Royal Infirmary, Leicester
Mr B Eradi	Consultant, Leicester Royal Infirmary, Leicester
Mr R Stewart	Consultant, Queen's Medical Centre, Nottingham

UROLOGY	
Mr D Shipstone	Consultant, Chesterfield Hospital, Chesterfield
Mr D Bodiwala	Consultant, King's Mill Hospital, Mansfield
Mr H Ratan	Consultant, Royal Derby Hospital, Derby
Mr V Kumar	Consultant, Doncaster Royal Infirmary, Doncaster
Mr S Pathak	Consultant, Doncaster Royal Infirmary, Doncaster
Ms S Reid	Consultant, Northern General Hospital, Sheffield
Mr R Inman	Consultant, Royal Hallamshire Hospital, Sheffield
Mr I Eardley	Consultant, Leeds Royal Infirmary, Leeds
Mr J Patterson	Consultant, Royal Hallamshire Hospital, Sheffield

NEUROSURGERY	
Mr D Ramnarine	Consultant, Frenchay Hospital, Bristol
Mr L Thorne	Consultant, Royal Free Hospital, London
Mr G Dow	Consultant, Queen's Medical Centre, Nottingham
Mr A Helmy	Senior Registrar, Addenbrookes Hospital, Cambridge

PLASTIC & RECONSTRUCTIVE SURGERY	
Mr A Mahajan	Consultant, Bradford Royal Infirmary, Bradford
Mr S Al-Ghazal	Consultant, Bradford Royal Infirmary, Bradford
Mr T Rasheed	Consultant, Nottingham City Hospital, Nottingham
Mr P Russell	Consultant, Royal Derby Hospital, Derby
Ms A Raurell	Consultant, Nottingham City Hospital, Nottingham
Mr P Brooks	Consultant, Nottingham City Hospital, Nottingham
Professor P McArthur	Consultant, Whiston Hospital, Merseyside
Mr I Mackie	Consultant, Frenchay Hospital, Bristol

ALLIED SPECIALTIES	
Dr S Sarker	Consultant ITU, King's Mill Hospital, Mansfield
Mr A Malik	Consultant Emergency Medicine, Queen's Medical Centre, Nottingham
Dr A Kathirgamanathan	Consultant Anaesthetist, Kings Mill Hospital, Mansfield
Prof S Maxwell	Consultant, Professor of Clinical Pharmacology, University of Edinburgh
Dr J Davies	Consultant Anaesthetist, Nottingham City Hospital, Nottingham
Dr G Jones	Consultant Paediatric Anaesthetist, Leicester Royal Infirmary, Leicester
Dr G Gibbon	Consultant Intensive Care, Queens Medical Centre, Nottingham
Dr E Rodrigues	Consultant Cardiologist, University Hospital Aintree, Liverpool
Prof R Bayston	Consultant, Professor of Surgical Infection, University of Nottingham
Dr S Ralph	Consultant Anaesthetist, Royal Derby Hospital, Derby
Mr J Tingle	Consultant, Reader in Health Law, Director of the Centre for Health Law, Nottingham Law School, Nottingham
Mr J Punts	Consultant, Barrister, Former Consultant Neurosurgeon

CORE SURGERY JOURNAL

Volume 4, Issue 5

Guidelines For Authors: Core Surgery

Dear Prospective Author,

Thank you for considering the submission of an article to 'Core Surgery'. Our journal aims to educate and inform junior surgical trainees about relevant 'core' subject topics. Each issue will cover a topic from selected subspecialty fields; General Surgery, Orthopaedics and Trauma, Plastic Surgery, Ear Nose and Throat Surgery, Neurosurgery, Urology, Paediatric Surgery and Intensive Care Medicine. Articles will be required to be broad enough to help with preparation for the intercollegiate MRCS examination but also focus on key hints and tips on becoming a higher surgical trainee.

A list of core topics in each subspecialty has therefore been agreed by the editors based on a selection of key topics in the MRCS curriculum. Authors are advised to agree a topic with the editors before writing an article. We strongly recommend that all articles have a senior author of registrar level or above.

Types of Article

Manuscripts are considered under the following sections:

1) Case based discussions
2) Practical procedures
3) Review articles
4) Research papers
5) Back to basics
6) Careers focus: Current training issues, course reviews, audit, charitable experiences, career pathway

Submission of Manuscript & Covering letter

Submissions will only be accepted via email and must be accompanied by a covering letter bearing the corresponding author's signature. Please submit your article to **coresurgery@123doc.com.** The covering letter must contain an acknowledgement that all authors contributed significantly and are in agreement with the content of the manuscript. In addition any financial or other conflict of interest must be declared. All submissions must be accompanied by a electronic copies of the transfer of copyright and conflict of interest disclosure forms (see below).

Papers are accepted for publication in the journal on the understanding that the content has not been published or is being considered for publication elsewhere; this must be stated in the covering letter. If authors submit manuscripts relating to original research, the corresponding author must state in the covering letter that the protocol for the research project has been approved by a suitably constituted ethics committee and that it conforms to the provisions of the Declaration of Helsinki (as revised in Brazil 2013), available at **http://www.wma.net/en/30publications/10policies/b3/**

All investigations involving human subjects must include a statement that the subject gave informed consent and patient anonymity should be preserved. This statement must be included in the covering letter and duplicated at the end of the main manuscript.

Conflict of interest

All authors must complete an individual conflict of interest declaration form which should be downloaded from **http://www.icmje.org/coi_disclosure.pdf** and submitted electronically to **coresurgery@123doc.com.** Instructions for completion can be found at the ICMJE website as above: **http://www.ICMJE.org/.**

Copyright

Articles accepted for publication become copyright of Core Surgery and the corresponding author will be asked to sign a transfer of copyright form on behalf of all the authors. All authors must read and agree to the conditions and it is assumed that authors have gained permission to use any copyrighted or previously published material including all images taken or copied from books, articles, websites etc. The copyright form must be competed and submitted electronically to **coresurgery@123doc.com** at the time of article submission; please contact the journal at the same address to obtain a copy for completion.

Manuscript Style

Submissions should follow the style of the Vancouver agreement detailed in the International Committee of Medical Journal Editors' revised 'Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication', as found at **http://www.ICMJE.org/**

References

All articles must be referenced appropriately. The Vancouver system of referencing should be used; details can be found at **https://workspace.imperial.ac.uk/library/Public/Vancouver_referencing.pdf.** References should be cited using bracketed numerals in the order in which they appear e.g. (1). The list of references should reflect this order and names of journals should be abbreviated in the style used in Index Medicus **ftp://nlmpubs.nlm.nih.gov/online/journals/ljiweb.pdf.**

Format of Articles

Guidelines for the format of respective article types are as follows. All articles must contain an abstract of 150-250 words, and must include up to five keywords for indexing purposes. A title page must be included containing the title of the article and full details for all authors including forename, initials, surname, specialty, grade, institute and email address. A contact postal mailing address should also be supplied for the corresponding author who should be separately identified.

CORE SURGERY JOURNAL

Volume 4, Issue 5

Case based discussions

Should be about 1000-1500 words long and should focus on clinical assessment, differential diagnosis or treatment. The basic structure should be as follows:

- **Abstract: The salient points of the case and discussion.**
- **Case history: Including the initial presentation, clinical setting and problem, investigation and treatment.**
- **Discussion: Covering the critical aspects of the management and the treatment options.**

Practical Procedures

Should be about 1000-1500 words long. Although not essential it is highly advantageous if pictures and diagrams are supplied to illustrate the most salient points. Articles should be set out as follows:

- **Abstract (Essential) –A summary of the article structure and salient features.**
- **History and pathology**
- **Indications and contraindications**
- **Gaining informed consent/ explaining procedure to patient**
- **Equipment required**
- **Draping / sterile field preparation**
- **Patient positioning and relevant anaesthetic points**
- **Documentation of procedure / recording of complications and management of such**

Review articles

The topic should be relevant to core surgical trainees, and a maximum of 2500 words long. The review should include an abstract, and a clinical vignette of a case relevant to the topic. The aim of including a clinical case is to provide a focus for discussion, and to ensure that the review is relevant and useful to our readership.

Research papers

Although the publication of research articles is not a core aim of the journal, Core Surgery welcomes research submissions if thought to be of interest to the readership. Articles should be written using the following headings (title page, abstract, introduction, methods, results, discussion, references). They should be a maximum of 2500 words of text including abstract, 30 references, 3 illustrations or figures. The abstract should be a maximum of 250 words and use the following headings (introduction, methods, results, conclusion). The title page should contain the title of the paper, the full names of the authors, the addresses of the institutions at which the research was carried out and the full postal address, email address and telephone number of the corresponding author.

Back to basics

These are articles covering basic principles and practice of surgery and should include general topics pertinent for the core surgical trainee. A topic or subject should be agreed with an editor prior to submission; please email **coresurgery@123doc.com** for further details. Articles should be a maximum of 1500 words long and must include an abstract.

Careers focus

Articles in this section may include course reviews, audits, description of charitable experiences, discussion of current training issues, and 'career pathway' articles providing an overview of training with hints and tips for aiding progression. Topics should be agreed with an editor prior to submission; please email **coresurgery@123doc.com** for further details. Course reviews should describe a course which is either mandatory or desirable for core trainees and junior higher surgical trainees. Audits should preferably be those where the cycle is complete, or have led to guideline development.Each article must contain an abstract.

MCQs / EMQs (All Articles)

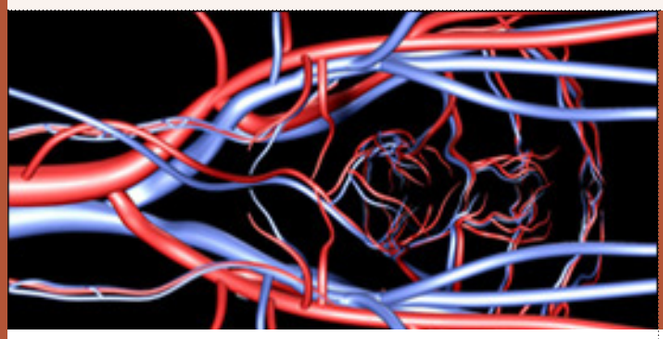
Please note that all articles should be submitted with five multiple choice questions (MCQs) or extended matching questions (EMQs) attached, in the style of the Member of the Royal College of Surgeons (MRCS) 'Part A' examination. These questions should have answers and brief teaching notes/discussion included in a separate paragraph following the questions. Examples of the requirements for question style can be found here: **http://www.intercollegiatemrcs.org.uk/new/pdf/part_a_sample_mcqs.pdf**

Summary

Articles considered for publication will be sent for review by our panel of consultants and junior surgical trainees. We wish you every success with your submission. Please contact the editorial team with any questions.

GAINING ACCESS: RATIONALE & METHODS

D Ojo



Abstract

Vascular access is easily one of the most fundamental skills required by any healthcare worker directly involved in patient care. As a junior doctor, being asked to gain access for a patient is a daily task, and for simple access such as cannula insertion, often thought process is not involved.

The more challenging forms of access on the contrary can easily put the junior doctor off. However, a solid basis of anatomy, with prior teaching, training and practice can aid the transition into becoming confident in performing the more difficult vascular access, and is particularly imperative for the junior doctor who is making the transition from a junior role to a more senior role.

This short article aims to familiarise the junior doctor with various different forms of access that can be considered, and for which setting they should be employed.

Keywords: *Access, peripheral, central, lines, IV.*

Fig. 1 Types of access

Peripheral lines	Central lines
Cannulas	Femoral line
PICC line	Internal jugular/Subclavian line
Arterial line	Hickman line
Intraosseus	Portacath

Fig. 1: The available types of access, divided into central and peripheral insertion.

Rationale For Access

When access is indicated, there should be a number of aspects taken into consideration. Is access required in an elective or emergent setting? In a emergency setting, particularly where trauma is involved, access is needed rapidly, therefore a central line may not be your first initial choice. Is short term access acceptable or does the patient require long term treatment whereby frequent access insertion is impractical to the patient (eg. fluid resuscitation vs. long term antibiotics or chemotherapy). What treatment is planned to be administered, and can it be given via a peripheral line? All these factors should be commensurate with the choice of access.

It is important to apply basic physics and remember that a short wide tube will deliver a larger volume of fluid essential in a trauma scenario than a thin narrow tube such as a PICC line.

Before any form of access is carried out, it is imperative that informed consent is gained from the patient if the setting permits. This should involve clear delivery of information elucidating benefits, risks and potential alternatives to the procedure. In the case of an invasive procedure, written consent should be obtained alongside verbal consent (1).

Peripheral Access

Intravenous cannulas is the most basic form of vascular access, with most NHS hospitals training most healthcare workers (paramedics, nurses, doctors, healthcare assistants) with this indispensable skill. Cannulae can be used in both elective and emergency settings, and tend to be inserted into an appropriate vein in the forearm from the cubital fossa distally. In an emergent setting, where circulatory resuscitation is vital, the opted site for cannula insertion is usually in the antecubital fossa of the arm where fluid and another medication can be given as a bolus. As aforementioned the size of the cannula determines the flow rate of fluid, and therefore for resuscitation at least 16 or 14 gauge cannula is recommended.

Peripheral long lines, such as a PICC line (Peripherally Inserted Central Catheter), are preferred to cannulas in a non-emergent setting, where administration of treatment (e.g. extended intravenous antibiotics, total parenteral nutrition) is required usually for a period greater than 1 week.

GAINING ACCESS: RATIONALE & METHODS

D Ojo

In the modern age, the insertion of PICC lines are performed under ultrasound guided technique, to identify a deep vein in the upper forearm (usually the brachial, basilic or cephalic), increasing the success rate of venous cannulation. The line is inserted via Seldinger technique (see below), and advanced proximally to the junction between the superior vena cava and right atria. The location of the tip is usually confirmed either via a chest radiograph or fluoroscopy.

Fig. 2 Peripheral cannulae

Cannula size (gauge)	Colour	Flow rate (ml/min)
24G	Yellow	
22G	Blue	25
20G	Pink	55
18G	Green	90
16G	Grey	170
14G	Orange	265

Fig. 2: Peripheral intravenous cannulae and their flow rate (2).

The complication risk associated with PICC lines are less common compared to central line insertion, and this is principally due to the site of insertion (away from major viscera and vessels).

It reduces hospital stay, as it enables medically fit patient to receive prolonged treatment in the community by regular visits from the community district team.

Intraosseus

Intraosseus (IO) access is largely reserved for the cardiac arrest setting, and is encouraged by the resuscitation council in the UK to be recruited as more devices are developed. It can be easily trained and promotes a rapid alternative to gaining access compared to peripheral intravenous access. These are useful in delivering large volumes of fluid in a trauma situation where peripheral access via conventional means cannot be achieved. This method can be invaluable in paediatric resuscitation.

The three main sites used are proximal humerus, proximal tibia and distal tibia, all easily identified by bony landmarks (greater tuberosity of humerus, tibial tuberosity and medial malleolus respectively).

Aspirated samples can be sent off to the laboratory but must be labelled clearly as bone marrow aspirate, so as not to be confused with a venous sample.

Intraosseus access is not without its own complications, including fat embolus, fracture of the bone and infection. Compartment syndrome is at risk due to possible extravasation of fluid into surroundings, and fracture of the bone and infection (3).

Fig. 3 Contraindications to using intraosseus access
Fracture or prosthesis in bone
Recent IO access (within last 48 hours)
Signs of infection at site
Unable to locate landmarks.

Fig. 3: Contraindications to using intraosseus access.

Central Access

Consistent anatomy has meant that practical procedures such as femoral lines and central lines have not altered significantly, and with the improved access to more developed radiological technology (e.g. Portable ultrasound machines) the complication rates have also reduced. The most commonly employed Central access are internal jugular lines and femoral lines. Both are inserted under the Seldinger Technique, relying on percutaneous cannulation and the use of a guide wire to safely guide a catheter into a central vessel.

Who is Seldinger?

Dr. Sven Ivar Seldinger (April 19th 1921 - February 21st 1998) is a celebrated Swedish radiologist. The frequently used eponymous procedure 'Seldinger technique', has been described by the American Journal of Neuroradiology as 'without exaggeration the single technical contribution that has impacted the realisation of interventional radiology' (4). The journal describes how Seldinger presented how his method could "reach all arteries of the human body" by percutaneous introduction into central vasculature. The Seldinger technique is used safely in all procedures, from insertion of peripheral lines to nephrostomies to ERCPs.

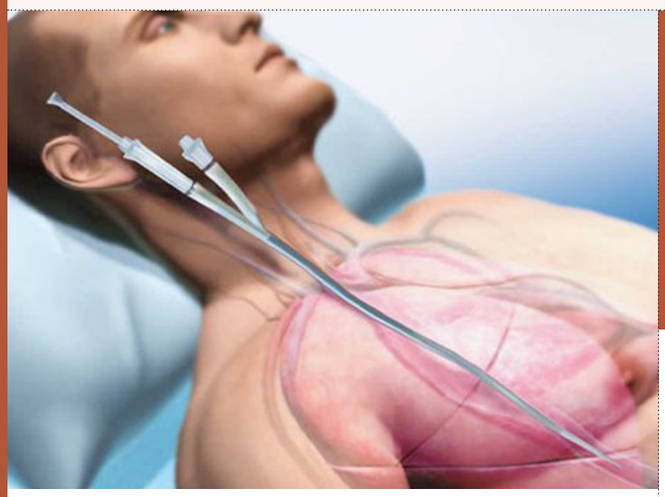
Aseptic technique is key and crucial when electing to insert a central line, in order to preclude an infective complication risk and a possible source of sepsis. This applies particularly to a femoral line, with a greater commensal colonisation risk in the thigh fold and its proximity to the perineum. There is also a definite higher complication rate with attempting central venous access in comparison to peripheral access, and this shall be discussed later.

Fig. 4 Indication for insertion for Internal Jugular line
Central venous pressure monitoring
Total parenteral nutrition
Administering caustic drugs eg. (CaCl, vasopressors)
Renal replacement therapy
Difficult access

Fig. 4: Indication for insertion for Internal Jugular line.

GAINING ACCESS: RATIONALE & METHODS

D Ojo



Internal Jugular Vein (IJV) & Subclavian Lines

The use of a CVC (central venous catheter) has long been an option for more invasive treatment and closer monitoring of the unwell patient. It is a known invasive procedure that is not without its complications and therefore only reserved for patients whose medical management will benefit with its use. It can be used in both an elective and emergency setting.

Insertion & Anatomy

As with any line insertion, preparation to ensure aseptic technique is vital. If possible, an aseptic environment such as theatre should be chosen to minimise infective risk. Bloods should have been checked and confirmed beforehand to ensure no evidence of coagulopathy. The operator is encouraged to be scrubbed an wearing an appropriate sterile gown (5). The neck should be cleaned ideally with chlorhexidine and alcohol solution and draped to create a sterile environment. The ideal position for insertion is the Trendelenberg position. Local anaesthetic should be used to anaesthetise the field as appropriate.

The landmark used for central venous catheter insertion in the neck is the sternocleidomastoid muscle. It's attachment of the two heads to the manubrium medially and medial third of clavicle laterally form an easily found triangle. The cannulating needle should be aimed to the nipple on the same side (ipsilateral), and cannulation is confirmed by flashback of venous blood into a syringe. As per Seldinger technique, a guide wire is carefully passed through the needle, over which dilators and a central catheter can be inserted over.

Fig. 5 Complications arising from internal jugular and subclavian insertion

Immediate: Pneumothorax Haemothorax Chylothorax (left side) Air embolus Arrythmia
Short term: Thrombosis Infection
Long term: Arteriovenous fistula

Fig. 5: Complications arising from internal jugular and subclavian insertion.

Complications with the use of central line are significant and must be deal with immediately in order to prevent morbidity to the patient. Complications have been summarised in figure 5. McGee and Gould (2002) cited that 15% of patients receiving central venous catheters experience complications (6). Rajnikanth et al (2008) indicates that carotid artery puncture is the most common complication with landmark guided IJV line insertion (7). The use ultrasound guidance has promoted reduction risk, and is strongly recommended by NICE (National Institute of Clinical Excellence) (8).

Femoral Lines

Femoral are employed less compared to internal jugular lines, but can be preferred especially when the supraclavicular field may be obstructed by other monitoring devices or if there is any airway compromise in a trauma setting which may preclude an IJV or subclavian line insertion.

GAINING ACCESS: RATIONALE & METHODS

D Ojo

Anatomy & Insertion

The patient should be laid supine when inserting a femoral line. An aseptic approach again should be adopted similar to that of an IJV line, with appropriate skin preparation and a sterile field set up. Local anaesthetic should be used to ensure a painless procedure.

The femoral triangle is bound superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle, and medially by the medial border of the adductor longus muscle. The neurovascular bundle lays midway between the anterior superior iliac spine (ASIS) and pubic symphysis, and the femoral artery.

The position of the femoral vein can be easily made out within the femoral triangle, and is the most medial structure within the neurovascular bundle. From lateral to medial lies the femoral: nerve, artery and vein, or NAV.

The femoral artery pulsation acts as a good landmark for needle insertion for seldinger technique. With one hand on the femoral pulse, the needle should be inserted 1cm below inguinal ligament and 1cm medial to ensure successful femoral vein cannulisation (9). The Seldinger technique can then be employed, with a guidewire introduced, followed by dilators to increase diameter of needle puncture and subsequently allows a catheter to be introduced.

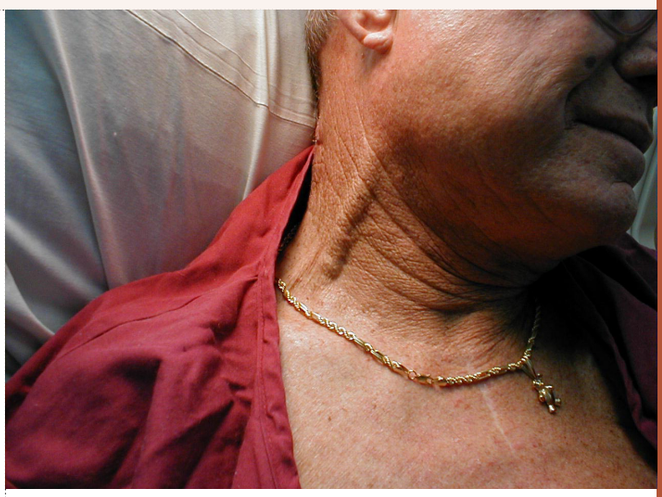
Management & Long-term Care

Careful management of access should begin immediately after insertion and is encouraged in order to preserve the access gained and prevent complications and poor outcome. Lines should be secured fast with dressings. Central venous catheters particularly IJV lines are secured with suture to the skin to prevent inadvertent removal. Insertion site should be monitored for any developing haematoma.

A local plain radiograph should always be performed to confirm the location of a central catheter tip before its use.

Site of insertion should be always monitored and documented daily in order to ensure there are no signs of local infection and phlebitis. A VIP (Visual infusion Phlebitis) score can be used to evaluate insertion sites.

Lines should also be flushed after use to promote patency. Some practices often elect to flushing long lines with a small volume of heparin as well as normal saline to prevent thrombosis occluding the line, although this is often disputed1. When a lumen is used, the end of the line should be cleaned before and after with an alcohol swab.



If there is suspicion of infection related to access, a swab should be taken where at all possible. The tip of a line can also be sent off for microbiology to be analysed and cultured. If this is confirmed as a source of infection ultimately the line used as mode for access must be removed to prevent further harm to patient. Infection control in the local trust can also be involved in these situations.

MCQs

More than one answer can be correct:

1. In a resuscitation setting, how quickly can 1L of 0.9% normal saline be given through a 16G (grey) peripheral cannula (approximately)?

A. 14 minutes

B. 9 minutes

C. 6 minutes

D. 3 minutes

2. Which forms of access require the use of Seldinger technique?

A. Internal Jugular Vein line

B. Peripheral Cannula

C. Intraosseus access

D. Femoral line

E. PICC Line.

GAINING ACCESS: RATIONALE & METHODS

D Ojo

3. What are the principal landmarks identified for insertion of a central venous catheter into to the internal jugular vein?

A. Anterior triangle

B. Posterior triangle

C. Clavicle

D. Sternocleidomastoid heads

4. Where can Intraosseus access be achieved?

A. Proximal humerus

B. Tibial Tuberosity

C. Greater trochanter of femur

D. Distal tibia

E. Olecranon

5. Into which vein(s) in the upper limb is a PICC line normally inserted?

A. Radial Vein

B. Basilic Vein

C. Cephalic Vein

D. Antecubital vein

E. Brachial Vein

MCQ Answers

1. C

2. A, D, E

3. D

4. A, B, C, D

5. B, C, E

Correspondence Address

Mr Dotun Ojo
Core Surgical Trainee Year 1
Kettering General Hospital
Email: dotunojo@gmail.com

References

1. Bishop, L. et al (2007), Guidelines on the insertion and management of central venous access devices in adults. International Journal of Laboratory Haematology.
2. www.vygon.co.uk/products/group/short-peripheral-cannulae.
3. www.resus.org.uk/pages/IOaccess.pdf.
4. Greitz,T., (1999), Sven Ivar Seldinger. American Journal of Neuroradiology 20: 1180 – 1181.
5. O'Grady, N et. al (2002), Guidelines for the Prevention if Intravascular Catheter-Related Infections. Infection Control and Hospital Epidemiology 23(12): 759-769.
6. McGee, D.C. and Gould, M.K., (2003), Preventing complication of central venous catheterisation. New England Journal of Medicine 348(12): 1123-33.
7. Rajnikanth J et al (2008). Complication of Central venous cannulation. Canada Journal of Surgery 51(5): E113-114.
8. NICE (2002), Guidance on the use of ultrasound locating devices for central venous catheters. NICE technology appraisal 49, National institute for Clinical Excellence, London.
9. www.emedicine.medscape.com/article/80279-overview.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

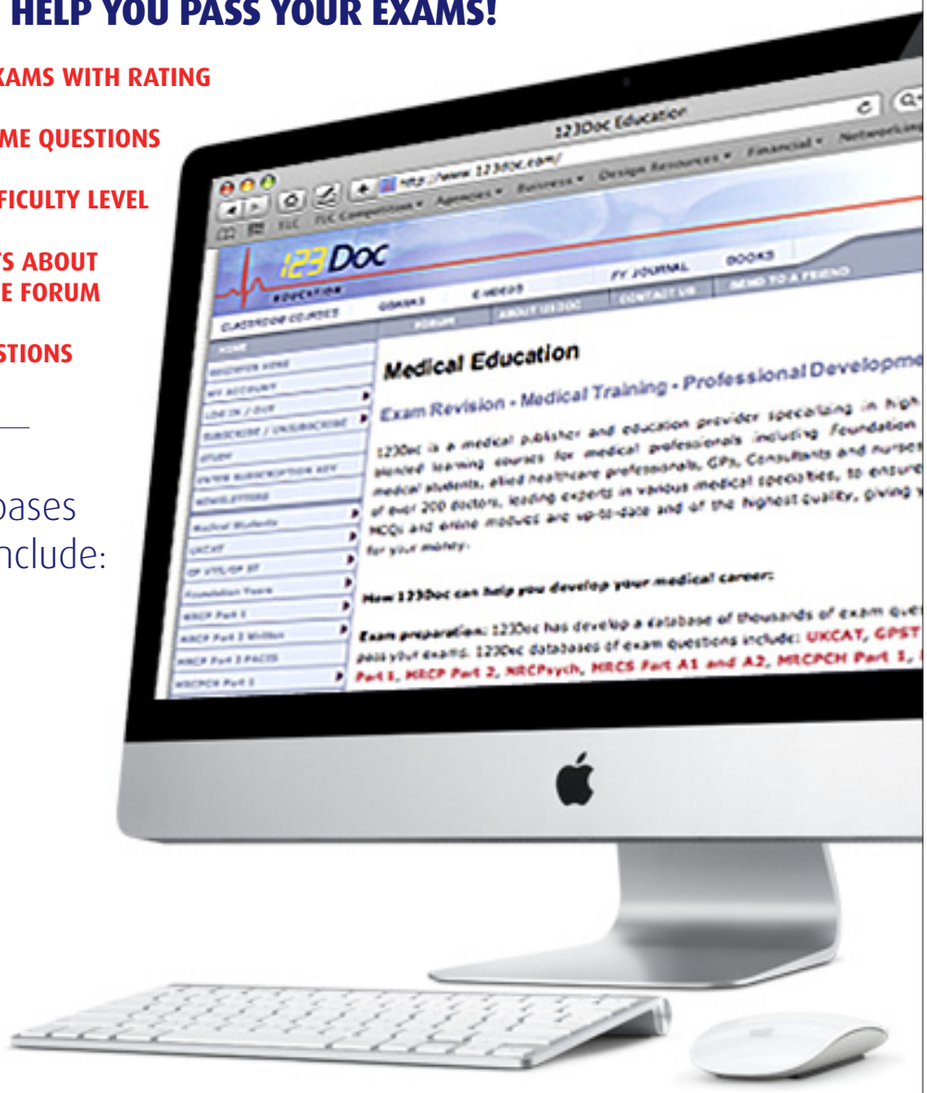
Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

ONLINE COURSES.
YOUR REVISION'S LIFELINE.

123DOC.COM has developed a database of thousands of exam questions to **HELP YOU PASS YOUR EXAMS!**

- **UNLIMITED TIMED MOCK EXAMS WITH RATING**
- **100+ NEW PAST EXAM THEME QUESTIONS**
- **STUDY BY TOPIC OR BY DIFFICULTY LEVEL**
- **OPTION TO POST COMMENTS ABOUT A QUESTION TO OUR ONLINE FORUM**
- **THOUSANDS OF EXAM QUESTIONS**



123DOC.COM databases of exam questions include:

- ✓ **UKCAT**
- ✓ **GPST / GPVTS**
- ✓ **MRCP Part 1**
- ✓ **MRCP Part 2**
- ✓ **MRC Psych**
- ✓ **MRCS Part A1 and A2**
- ✓ **MRCPCH Part 1**
- ✓ **MRCPCH Part 2**
- ✓ **FRCA Primary**
- ✓ **Primary FRCR**
- ✓ **PLAB Part 1**
- ✓ **Medical Student**
- ✓ **MRCOG**

123Doc.com
ONLINE COURSES

VARICOSE VEINS - SURGICAL MANAGEMENT

L Creedon

Varicose Veins - Surgical Management
General Surgery

Abstract

Lower limb venous insufficiency or 'varicose veins' are a common occurrence for both men and women. The vast majority of patients remain completely asymptomatic but significant dislike to their appearance, particularly amongst women, prompts regular presentation to primary care. In the majority of patients explanation and reassurance is the only treatment that should be instigated on initial presentation, unless complications occur. Referral to vascular specialists should take place prior to starting treatment with compression hosiery.

The classic treatment for varicose veins has been surgery in the form of 'high tie and stripping', but there are increasing numbers of interventional treatments being developed that in recent studies show comparable outcomes. This article aims to summarise when a patient should be referred to secondary care, how the varicose veins should be assessed and what treatment options are currently available.

Keywords: *Varicose veins; surgery; management.*

Case Vignette

A 53 year old female was referred to the vascular surgery department after presenting to her GP with a progressive 3 year history of aching pains, swelling and 'terrible lumpy veins' in her right leg. On examination of her leg there were obvious varicosities within the distribution of the great saphenous vein and mild oedema. She reports that her mother suffered with varicose veins for a number of years which resulted in chronic skin changes and venous ulceration. Prior to this there had been no specialist input, investigations or treatment for the venous disease but her GP has advised anti-inflammatory medication for episodes of superficial thrombophlebitis in the past.

A venous duplex scan was arranged that confirmed right sided saphenofemoral junction incompetence and right sided great saphenous vein incompetence. The deep venous system appeared normal. After a discussion of available options, she underwent ultrasound guided foam sclerotherapy under local anaesthetic with good results at 6 month follow up.

Introduction

Lower limb venous insufficiency is a common condition amongst both men and women. Women are most likely to seek medical attention despite more men being affected (32% and 40% respectively) (4). Valvular dysfunction promotes reflux of venous blood with resultant venous hypertension. In 2009/10 there were 35,659 varicose veins procedures carried out in the NHS (5).

Pathophysiology

The normal route for venous blood is from distal to proximal and superficial to deep veins via the deep perforators. A valvular system prevents the reversal of blood flow and ensures venous return from the peripheries through the action of skeletal muscle contraction. It is postulated that valvular degeneration and subsequent incompetence results in venous hypertension and resultant venous dilatation (Figure 1). The evidence to support this theory is however sparse and the mechanism resulting in valvular incompetence is unknown.

Risk factors for varicose veins include age (6), sex (male), pregnancy (7), family history of varicose veins (8), raised body mass index in women (9) and obesity. Although, many people exposed to these risk factors do not go on to develop varicose veins suggesting a genetic predisposition in those affected.

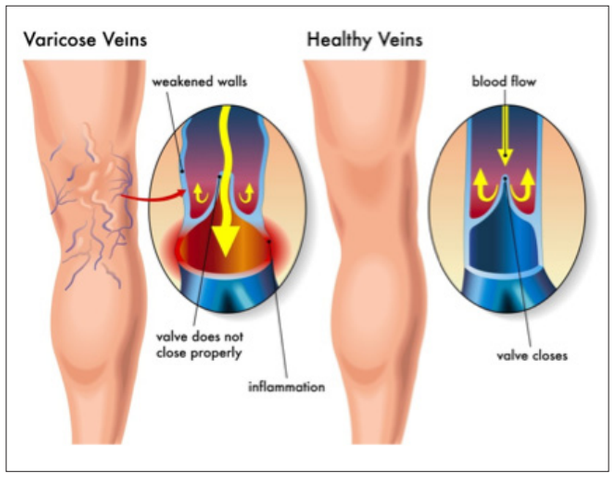


Figure 1: Schematic illustration of the pathology of varicose veins (1).

VARICOSE VEINS - SURGICAL MANAGEMENT

L Creedon

Symptoms

Presentation can vary widely due to cosmetic appearance, symptoms and complications. Intervention is only required in a small number of patients as for the majority, varicose veins cause no symptoms, but dislike of their cosmetic appearance (Figure 2) may result in an increased emphasis on symptomatology.

Symptoms of itching, heaviness and aching were all reported in the Edinburgh vein study but the relationship of these with varicose veins were found to be inconsistent (10). Symptoms tend to be worse after periods of prolonged standing or walking and are often worse towards the end of the day.

Complications

A range of uncommon complications can be associated with chronic, untreated varicose veins and include superficial thrombophlebitis, chronic venous skin changes, venous ulceration and bleeding. Superficial thrombophlebitis is characterised by the appearance of inflamed, tender veins and can be recurrent. Skin changes associated with chronic venous insufficiency often sit within a spectrum extending from venous eczema to brown discoloration (haemosiderin deposition) to lipodermatosclerosis.

This indurated, discoloured skin can become inflamed (Inflammatory lipodermatosclerosis) and can lead to ulceration secondary to minor trauma. Although uncommon, a questionnaire identified that many people with uncomplicated varicose veins worry about the possible future harm that may be caused due to their veins, particularly bleeding, ulceration and deep vein thrombosis (11)

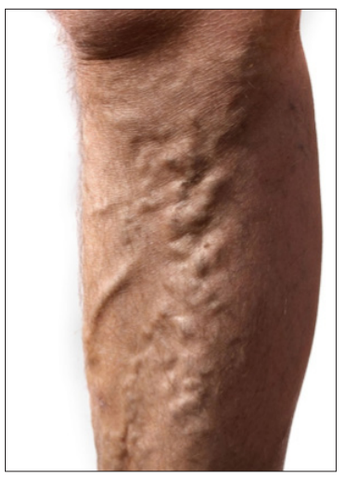


Figure 2: Typical appearance of lower limb varicose veins (3).

Diagnosis/Assessment

With the patient standing, a full visual inspection of both legs should aim to identify the size and distribution of varicose veins. Telangectasia, reticular veins and skin changes should be noted and an assessment for peripheral oedema carried out. Clinical examination using the classic examination techniques (Cough test, the tap test, Trendelenburg's test and Perthes test) have long since been abandoned by vascular specialists due to their inaccuracy (12) and the increasing availability of ultrasonography. However knowledge of the theory of the classic tests are still required for professional examinations (MRCS) despite their limited clinical application.

The use of a hand held Doppler can help to identify reflux at the saphenofemoral junction (SFJ) and reflux at the popliteal fossa into the short saphenous vein. It can be used as a screening tool to select those patients that require further imaging with duplex ultrasound scanning (13). Venous duplex scanning is now firmly established as the investigation of choice in the investigation of varicose veins and can investigate both the superficial and deep venous system as well as the perforating veins. It is able to assess for reflux at the SFJ and sapheno-popliteal junction and also has the ability to assess for vein diameter which is important in some endoluminal approaches.

Varicose veins can be classified according to the CEAP (Clinical, Etiological, Anatomical, Pathophysiological) classification (Table 1) (14). NICE guidance (5) advises that patients should be referred to specialist vascular services if they have:

CEAP classification - C (Clinical component only) (14)	
C0	No visible or palpable signs of venous disease
C1	Telengectasia or reticular veins
C2	Varicose Veins
C3	Oedema
C4	Pigmentation, eczema, lipodermatosclerosis, atrophie blanche
C5	Healed venous ulcer
C6	Active venous ulcer
CA	Asymptomatic
CS	Symptomatic

Table 1

- *Symptomatic primary or symptomatic recurrent varicose veins.*

- *Superficial vein thrombosis and suspected venous incompetence.*

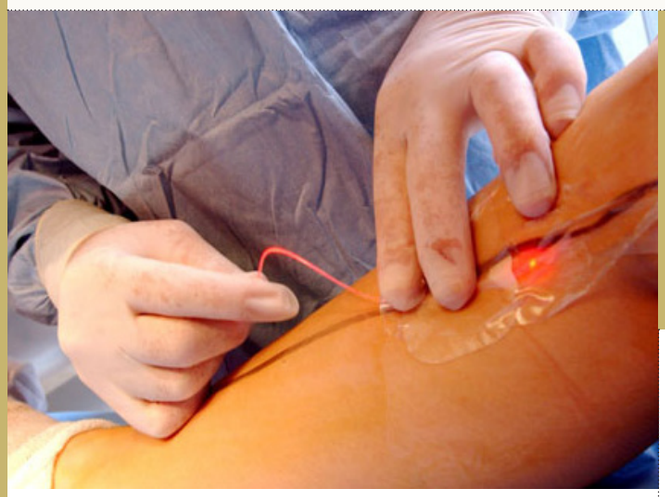
- *Lower-limb skin changes, such as pigmentation or eczema, thought to be caused by chronic venous insufficiency (CEAP Class 4).*

- *A healed venous leg ulcer (CEAP Class 5).*

- *Venous leg ulcer below the knee that has not healed within 2 weeks (CEAP Class 6).*

VARICOSE VEINS - SURGICAL MANAGEMENT

L Creedona



Treatment Options

The mainstay of interventional treatment has for a long time been surgical in nature. A number of different treatments have become available within the last 10 years each with differing benefits. Conflicts in short and long term outcomes have failed to convince the majority of vascular surgeons to change practice at present. NICE guidance recommends (5).

For people with confirmed varicose veins and truncal reflux:

- *Offer endothermal ablation.*

- *If endothermal ablation is unsuitable, offer ultrasound-guided foam sclerotherapy.*

- *If ultrasound-guided foam sclerotherapy is unsuitable, offer surgery.*

- *If incompetent varicose tributaries are to be treated, consider treating them at the same time.*

- *Do not offer compression hosiery to treat varicose veins unless interventional treatment is unsuitable.*

Conservative Management

The majority of people with varicose veins will suffer little in the way of symptoms and will rarely have any form of complication. Therefore all patients should be given a thorough explanation of the cause and natural history of varicose veins and reassured that it is unlikely that they will require treatment unless symptoms or complications develop.

Patients should also be advised that treatment is not without complication and therefore should be reserved for those likely to receive more benefit than cosmesis alone. The elevation of legs affected by oedema may help and non-steroidal anti-inflammatory medication can be useful for painful thrombophlebitis.

Compression hosiery has been used as first line treatment in primary care despite there being little evidence as to its effectiveness (15, 16). It is often difficult to apply and uncomfortable, resulting in poor compliance and poor results. Referral onto secondary care usually comes after failure of improvement with trial of compression hosiery. NICE advise that given the lack of evidence to support its use, it should be reserved only for those patients unsuitable for interventional treatment (5).

Conventional Surgery

Conventional surgery involves either high saphenous vein ligation (Trendelenburg's operation) and stripping of the great saphenous vein (GSV) or saphenopopliteal ligation and stripping of the short saphenous vein (SSV), depending on the source of reflux and associated varicosities (17).

Pre-operative marking of varicosities with the patient standing are required as when the patient lays supine the venous pressure will drop and the vessels become non visible. Incisions are then made over the SFJ and at the knee or ankle, and the vein ligated at both ends. A stripper is then passed through the GSV and the vein is 'stripped' as it is pulled out through one of the incisions. Smaller stab incisions are made over any tributaries and phlebectomies performed. This technique can also be applied to the short saphenous vein with ligation at the saphenopopliteal junction.

There are a number of complications associated with surgery which are listed in table 2. Surgery has been the predominant treatment technique for many years as newer techniques have failed to show improved outcomes. A number of newer techniques have recently been introduced that show comparable results in the short term with a reduction in the associated morbidity that comes with surgery. Despite this, the preferred technique for the majority of vascular surgeons is still surgery (18).

VARICOSE VEINS - SURGICAL MANAGEMENT

L Creedon

Complications of Varicose Vein Surgery
Bleeding and bruising
Subcutaneous haematoma formation
Infection of groin wound or stab incisions
Nerve injury - Numbness, paraesthesia
Skin discolouration or pigmentation
Recurrent varicose veins
Scarring
DVT and pulmonary embolus

Table 2

Endovenous Treatment

There are a number of endovenous treatment modalities that are becoming increasingly popular due to their ability to be used under tumescent anaesthesia, the reduced cost and the reduced post procedure morbidity. Essentially both radiofrequency and laser ablation involve the passage of an intraluminal probe under ultra-sound guidance into the varicosities and ablating the vein in sections (Figure 3). The GSV is entered at the knee via a Seldinger technique and the probe passed up to the groin via the vein, hence avoiding the need for a groin incision.

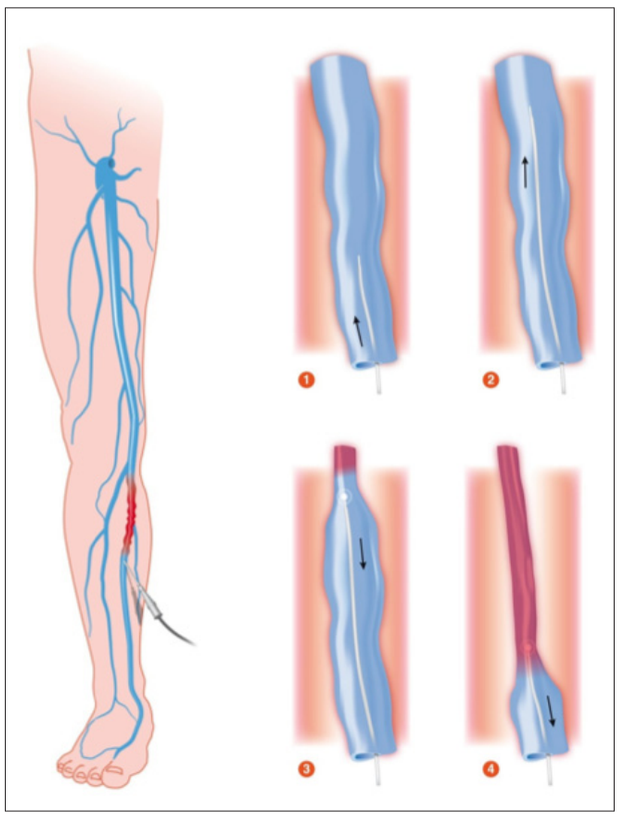


Figure 3: Sequence of events in endovenous ablation therapy (2).

Radiofrequency Ablation (RFA)

A probe delivering high frequency alternating current causes local heating and venous spasm resulting in irreversible denaturation of collagen and intimal destruction (19). Post operative complications are uncommon but include thermal injury to the overlying skin, deep vein thrombosis and paraesthesia. A Cochrane review comparing rates of recurrence of varicose veins after RFA and surgery revealed no difference (20).

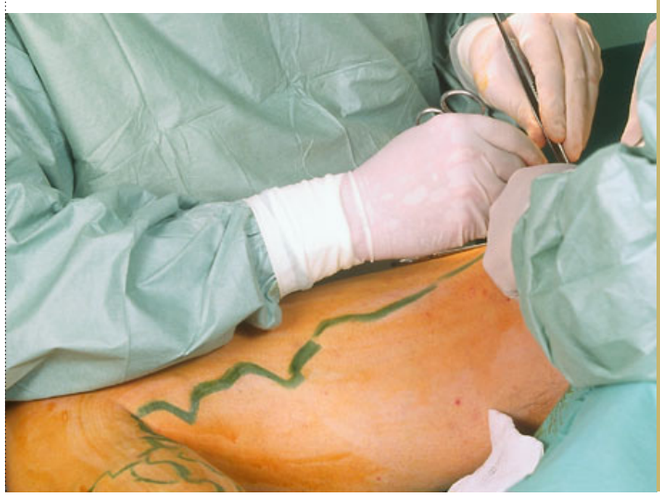
Recanalisation within four months was observed more frequently following RFA compared with conventional surgery although not statistically significant and after four months no difference was observed. A randomised controlled trial comparing RFA with conventional surgery heavily favoured the use of RFA (21). The study reported significantly better technical outcomes as well as improved rates of patient satisfaction, quality of life improvement and reduced analgesic requirements post operatively in the RFA group.

Endovenous Laser Therapy (EVLT)

Laser energy is delivered via a probe into the vein lumen. Five mechanisms have now been identified that at least theoretically contribute to the efficacy of EVLT (22). Four of these mechanisms involve interactions that result in an increase of the vein wall temperature with subsequent obliteration of the lumen. The fifth mechanism theorises that the thermal injury of blood results in coagula formation within the vein lumen. Often phlebectomies are required to deal with tributaries, which requires a general anaesthetic.

Post operative morbidity, as with RFA, tends to be minor and transient. Complications include bruising, tenderness and induration along the treated vessel. DVT has been reported to occur in 0.47% of patients, with an increased risk amongst those undergoing a combination of EVLT and phlebectomy (23).

EVLT has been shown the be at least as effective as surgery with regards improvements in Venous Clinical Severity Score and quality of life but abolition of SSV reflux was significantly higher after EVLT. Additionally postoperative pain was significantly lower after EVLT as was sensory disturbance, allowing an earlier return to work and normal function in a RCT by Samuel at el in 2013 (24).



VARICOSE VEINS - SURGICAL MANAGEMENT

L Creedon

Varicose Veins - Surgical Management
General Surgery

Liquid/Foam Sclerotherapy

Sclerotherapy is a technique in which a sclerosant is injected into a vein under ultrasound guidance that induces intense vasospasm followed by sclerosis of the vein wall. Liquid or 'conventional' sclerotherapy became popular in the 1970's but due to poor long term results its usage declined. Since the mid 1990's when it was discovered that mixture of the sclerosant (Commonly sodium tetradecyl sulphate or polidocanol) with air causes a foam to form, sclerotherapy has again become a popular treatment.

It is thought that the foam spreads throughout the vein lumen pushing blood aside and has been found to be more effective than liquid, but there is little evidence supporting an optimal sclerosant or delivery technique (25). Compression stockings are applied for 1-2 weeks post treatment but there is no evidence to suggest they improve outcomes.

Side effects of sclerosant therapy are rare and include vein tenderness, nerve injury and skin necrosis if the sclerosant is inadvertently injected into the surrounding soft tissues (26). However concern exists regarding the occurrence of neurological symptoms including migraine and visual symptoms post treatment. Stroke post sclerotherapy has been reported and found to be more common in those with cardiac defects, particularly a patent foramen ovale (27).

Sclerotherapy is considerably cheaper than EVLT and a recent study found it to be as effective (28). It did find however that over 50% of patients required repeated treatments after the initial intervention, which is a common issue with sclerotherapy.

Conclusion

At present there is no agreed consensus on the preferred treatment modalities for varicose veins. Short-term outcomes for both thermal ablation and foam sclerotherapy have identified comparable results to surgery with reduced post treatment morbidity and cost. Despite this, patients are often trialled on compression hosiery in primary care prior to referral on for a vascular opinion, although there is little evidence to support this.

Due to insufficient long term evidence for both endothermal therapies and sclerotherapy vascular surgeons are still more likely to offer conventional surgery as a first line approach despite the associated morbidity. In addition to this, a study looking at patients preferences for treatment identified that only a minority of patients were aware of endothermal ablation or foam sclerotherapy (29).

A number of novel therapies are currently being developed including subfascial endoscopic perforator vein surgery (SEPS) for perforator vein incompetence, transilluminated powered phlebectomy (TIPP) where the vein is removed by suction and morcellation, and the use of endoluminal steam as a means of thermal ablation. As with the previously discussed therapies, well designed randomised controlled trials are required to clarify the questions regarding long term outcomes of the various treatment modalities to identify adequate replacements for surgery.

MCQs

1. Complications associated with varicose veins include all of the following except:

a. Varicose eczema
b. Haemosiderin deposition
c. Acute bleeding
d. Thromboangiitis obliterans
e. Lipodermatosclerosis

2. First line treatment according to NICE guidelines should be:

a. Compression hosiery
b. Non-Steroidal anti-inflammatory medication
c. Thermoablative techniques
d. Surgery
e. Foam sclerotherapy

3. Varicose vein surgery was undertaken in how many people in 2009/2010 to the nearest thousand:

a. 15,000
b. 120,000
c. 36,000
d. 22,000
e. 42,000

VARICOSE VEINS - SURGICAL MANAGEMENT

L Creedon

4. Complications associated with conventional surgery include all of the following except:

a. Nerve injury
b. Groin wound infection
c. Bleeding and bruising
d. Deep vein thrombosis
e. Haemosiderin deposition

5. Complications associated with sclerotherapy include all of the following except:

a. Visual disturbance
b. Migraine
c. Stroke
d. Hearing loss
e. Skin necrosis

Answers

1. d
2. c
3. c
4. e
5. d

Correspondence Address

Mr Lee Creedon
Clinical Research Fellow
University Hospitals of Leicester NHS Trust, Leicester
Email: lee.creedon@nhs.net

References

1. Biasini R. varicose veins.
2. Innamorati A. Endovenous laser treatment varicose vein ablation.
3. Taylor A. Cluster of varicose veins on side of mans leg.
4. Lee AJ, Evans CJ, Allan PL, Ruckley CV, Fowkes FG. Lifestyle factors and the risk of varicose veins: Edinburgh Vein Study. J Clin Epidemiol. 2003;56(2):171-9.
5. Marsden G, Perry M, Kelley K, Davies AH, Group GD. Diagnosis and management of varicose veins in the legs: summary of NICE guidance. BMJ. 2013;347:f4279.
6. Robertson L, Evans C, Fowkes FG. Epidemiology of chronic venous disease. Phlebology. 2008;23(3):103-11.
7. Sisto T, Reunanen A, Laurikka J, Impivaara O, Heliövaara M, Knekt P, et al. Prevalence and risk factors of varicose veins in lower extremities: mini-Finland health survey. Eur J Surg. 1995;161(6):405-14.
8. Beebe-Dimmer JL, Pfeifer JR, Engle JS, Schottenfeld D. The epidemiology of chronic venous insufficiency and varicose veins. Ann Epidemiol. 2005;15(3):175-84.
9. Evans CJ, Fowkes FG, Ruckley CV, Lee AJ. Prevalence of varicose veins and chronic venous insufficiency in men and women in the general population: Edinburgh Vein Study. J Epidemiol Community Health. 1999;53(3):149-53.
10. Bradbury A, Evans C, Allan P, Lee A, Ruckley CV, Fowkes FG. What are the symptoms of varicose veins? Edinburgh vein study cross sectional population survey. BMJ. 1999;318(7180):353-6.
11. Campbell WB, Decaluwe H, Macintyre JB, Thompson JF, Cowan AR. Most patients with varicose veins have fears or concerns about the future, in addition to their presenting symptoms. Eur J Vasc Endovasc Surg. 2006;31(3):332-4.
12. Kim J, Richards S, Kent PJ. Clinical examination of varicose veins--a validation study. Ann R Coll Surg Engl. 2000;82(3):171-5.
13. Campbell WB, Niblett PG, Peters AS, MacIntyre JB, Sherriff S, Palfreyman S, et al. The clinical effectiveness of hand held Doppler examination for diagnosis of reflux in patients with varicose veins. Eur J Vasc Endovasc Surg. 2005;30(6):664-9.
14. Vasquez MA, Munschauer CE. Venous Clinical Severity Score and quality-of-life assessment tools: application to vein practice. Phlebology. 2008;23(6):259-75.
15. Shingler S, Robertson L, Boghossian S, Stewart M. Compression stockings for the initial treatment of varicose veins in patients without venous ulceration. Cochrane Database Syst Rev. 2013;12:CD008819.
16. Sell H, Vikatmaa P, Albäck A, Lepäntalo M, Malmivaara A, Mahmoud O, et al. Compression Therapy Versus Surgery in the Treatment of Patients with Varicose Veins: A RCT. Eur J Vasc Endovasc Surg. 2014.
17. Kirk RM. General surgical operations. 5th ed. ed. Edinburgh: Churchill Livingstone Elsevier; 2006.
18. Edwards AG, Baynham S, Lees T, Mitchell DC. Management of varicose veins: a survey of current practice by members of the Vascular Society of Great Britain and Ireland. Ann R Coll Surg Engl. 2009;91(1):77-80.
19. Subramonia S, Lees TA. The treatment of varicose veins. Ann R Coll Surg Engl. 2007;89(2):96-100.
20. Nesbitt C, Eifell RK, Coyne P, Badri H, Bhattacharya V, Stansby G. Endovenous ablation (radiofrequency and laser) and foam sclerotherapy versus conventional surgery for great saphenous vein varices. Cochrane Database Syst Rev. 2011(10):CD005624.
21. Subramonia S, Lees T. Randomized clinical trial of radiofrequency ablation or conventional high ligation and stripping for great saphenous varicose veins. Br J Surg. 2010;97(3):328-36.
22. Neumann HA, van Gemert MJ. Ins and outs of endovenous laser ablation: afterthoughts. Lasers Med Sci. 2014;29(2):513-8.
23. Sutton PA, El-Dhuwaib Y, El-Duhwaib Y, Dyer J, Guy AJ. The incidence of post operative venous thromboembolism in patients undergoing varicose vein surgery recorded in Hospital Episode Statistics. Ann R Coll Surg Engl. 2012;94(7):481-3.
24. Samuel N, Carradice D, Wallace T, Mekako A, Hatfield J, Chetter I. Randomized clinical trial of endovenous laser ablation versus conventional surgery for small saphenous varicose veins. Ann Surg. 2013;257(3):419-26.
25. Myers KA, Roberts S. Evaluation of published reports of foam sclerotherapy: what do we know conclusively? Phlebology. 2009;24(6):275-80.
26. Dickhoff C, Cremers JE, Legemate DA, Koelemay MJ. Medical liability insurance claims after treatment of varicose veins. Phlebology. 2013.
27. Sarvananthan T, Shepherd AC, Willenberg T, Davies AH. Neurological complications of sclerotherapy for varicose veins. J Vasc Surg. 2012;55(1):243-51.
28. Lattimer CR, Azzam M, Kalodiki E, Shawish E, Trueman P, Geroulakos G. Cost and effectiveness of laser with phlebectomies compared with foam sclerotherapy in superficial venous insufficiency. Early results of a randomised controlled trial. Eur J Vasc Endovasc Surg. 2012;43(5):594-600.
29. Shepherd AC, Gohel MS, Lim CS, Hamish M, Davies AH. The treatment of varicose veins: an investigation of patient preferences and expectations. Phlebology. 2010;25(2):54-65.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

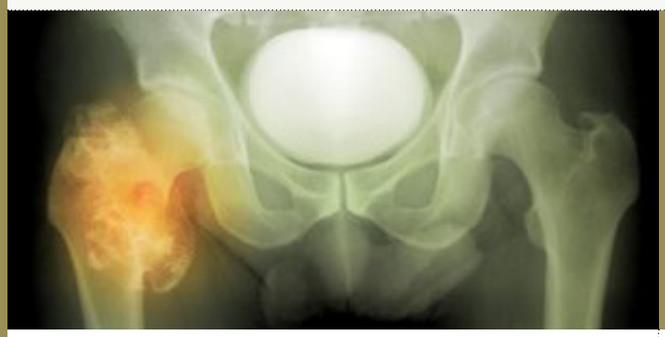
Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

ORTHOPAEDIC ONCOLOGY: PRIMARY BONE TUMOURS

JM Duncan, DLJ Morris, DJ Bryson, JH Visser, RU Ashford



Orthopaedic Oncology: Primary Bone Tumours
Trauma & Orthopaedic Surgery

Abstract

A sarcoma is a malignant tumour of connective tissue origin. Bone and soft-tissue sarcomas are rare and may be overlooked as a differential diagnosis in patients presenting with musculoskeletal pain. This can lead to a delay in diagnosis or inappropriate treatment. In cases of suspected bony malignancy, a cautious but expeditious approach is required. Suspect and detect should be the mantra and clinicians should not hesitate to investigate.

Thorough evaluation of patients with history and examination, followed by initial haematological and radiological investigations is essential in order to correctly diagnose patients, and to allow early referral to an appropriate supra-regional bone sarcoma centre for definitive management. This review is intended to provide an introduction to primary bone malignancy for junior surgical trainees in orthopaedic rotations.

Scenario

A 10 -year-old male is referred to an orthopaedic fracture clinic with persistent knee pain. The young man is a keen footballer but has not played for the past 3 months because of nagging pain. A provisional diagnosis of Osgood-Schlatters disease was originally made by the GP but because of persisting discomfort, including night pain, an outpatient radiograph of the pelvis and knee was performed (Figure 1). Upon receipt of the report the GP organised urgent orthopaedic referral.

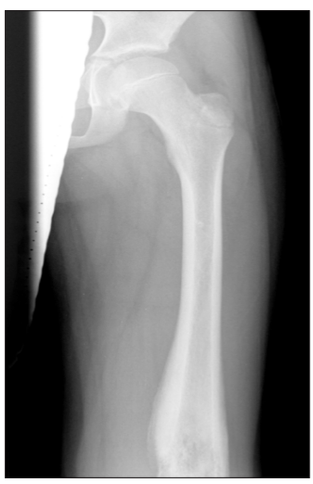


Figure 1

Introduction

A sarcoma is a malignant tumour of connective tissue origin. Bone and soft-tissue sarcomas are rare and represent approximately 1% of all malignant tumours (1). In 2011, there were 559 new diagnoses of bone sarcoma in the UK (2). Osteosarcoma, chondrosarcoma, and Ewing's sarcoma are the most common histological varieties. Historically, prognosis for primary bone malignancy was poor with amputation the default treatment strategy. Survival rates for bone sarcoma have remained static over the past decades with 5-year relative survival rates hovering around 55% (3).

Because these are rare diseases, primary bone malignancies may be overlooked as a differential diagnosis in patients presenting with musculoskeletal pain. This can lead to a delay in diagnosis or inappropriate treatment. In patients with primary malignancy complicated by pathological fracture, inappropriate nailing can disseminate malignant cells throughout the bone rendering the limb unsalvageable and worsening prognosis. In cases of suspected bony malignancy, a cautious but expeditious approach is required. Suspect and detect should be the mantra and clinicians should not hesitate to investigate.

This review is intended to provide an introduction to primary bone malignancy for junior surgical trainees in orthopaedic rotations.

Primary Bone Sarcomas

Osteosarcoma is the most common primary bone malignancy in children and adolescents (4). Subtypes may be divided into intramedullary or surface osteosarcoma. Intramedullary variants include conventional, telangiectatic, low-grade and small cell; surface osteosarcomas include parosteal, periosteal and high-grade varieties. 15% of all osteosarcomas arise from precursor lesions such as irradiated bone or Paget's disease (5). The majority of cases are located in the metaphyseal regions of long bones.

Primary chondrosarcomas have a peak incidence between 50 and 80 years of age (5). They are derived from hyaline cartilage represent approximately 20% of malignant bone neoplasms (6). The majority are primary malignant tumours but secondary transformation can occur from pre-existing benign lesions such as osteochondromas; malignant transformation is more common in individuals with familial conditions such as hereditary multiple exostoses (diaphyseal aclasia), Maffucci's syndrome and Ollier's disease (7). The most common sites of involvement include the pelvis, long bones and ribs.

ORTHOPAEDIC ONCOLOGY: PRIMARY BONE TUMOURS

JM Duncan, DLJ Morris, DJ Bryson, JH Visser, RU Ashford

Ewing's sarcoma is the third most common primary malignancy but is the second most common bone tumour in children and adolescents (8). The peak incidence is in the second decade with 80% of cases occurring in patients under 20 years (5). Flat and long bones are nearly equally affected with pelvic involvement seen in up to 25% of cases (8). When the long bones are involved it is most often seen in the diaphyseal regions.

Table 1 compares the principle features of the three most common primary bone malignancies.

	Osteosarcoma	Chondrosarcoma	Ewing's Sarcoma
Epidemiology (5,6)	35-37% of all malignant primary bone tumours	20% of all malignant primary bone tumours	8-18% of all malignant primary bone tumours
	Peak incidence in 2nd decade of life	Peak incidence between 50-80 years of age	Peak incidence in 2nd decade of life
	Male : Female = 3:2	Males affected slightly more than females	Male : Female = 1.4 : 1
	No racial preference	No racial preference	Almost exclusively in Caucasians
Common Sites (5)	Lower Limb Long Bones (68%) Upper Limb Long Bones (10%) Skull (9%) Pelvis (5%) Clavicle (3%)	Pelvis (23%) Lower Limb Long Bones (22%) Skull (15%) Upper Limb Long Bones (14%) Thorax (9%)	Pelvis (28%) Lower Limb Long Bones (22%) Thorax (14%) Spine (12%) Upper Limb (11%)
Radiological Appearance (5)	Metaphyseal area of long bones	Originates in metaphyseal region, extending to diaphysis	Diaphyseal areas of long bones
	Mixed sclerotic-lytic type lesion	Lytic lesion	Mixed sclerotic-lytic type lesion
	Spicular periosteal reaction (Sunburst) Codman Triangle Lamellated (onionskin) reaction (less common)	Intralesional calcification (rings and arcs calcification)	Spicular periosteal reaction (Sunburst) Codman Triangle

Table 1: Principle features of the three most common primary bone malignancies.

How To Approach A Patient With A Suspicious Bone Lesion

Of critical importance in the assessment of a patient with a possible primary malignancy is the maintenance of a high level of suspicion. Many of these patients will be young and healthy with no preceding significant medical history. It is easy to attribute symptoms to sporting activities, growth pains, or non-specific musculoskeletal aches and pains. A lack of awareness and a failure to give consideration to malignancy as a cause of symptoms can lead to a delay in diagnosis.

Guidelines and algorithms have been published to improve referral pathways and diagnostic and management strategies, to ensure timely intervention and improve outcome in patients with bone and soft tissue tumours (1,9). Any patient presenting with bone pain, in particular non-mechanical or night pain, should be sent for plain radiographs; this should be scrutinized for evidence of lysis, periosteal reaction, new bone formation, and soft tissue swelling, all of which should prompt further investigation (1).

History & Examination

A thorough history and examination is of utmost importance in both the identification and investigation of a suspicious bony lesion.

A frequent presenting complaint in primary bone malignancy is strain-related pain in the affected body region. Non-mechanical pain is also a cause for concern. Patients may attribute these symptoms to an innocuous injury or overuse.

Grimer and Sneath reported a delay of 6 weeks in patients with osteosarcoma, 16 weeks with Ewing's sarcoma and 21 weeks in patients with chondrosarcoma, between symptom onset and presentation to a doctor (10). Night pain is often present. As the disease progresses systemic symptoms may become apparent, including weight loss, fever and general malaise. A pathological fracture is a further unfortunate type of presentation. The incidence of pathological fractures in patients with osteosarcoma is 5-10% (4,11,12).

The epidemiological distribution of primary malignant bone tumours should guide suspicion when confronted with a patient complaining of bone pain. Patient age, sex and race should all be noted. Table 1 outlines the epidemiological distribution of primary bone malignancies and the most commonly affected body regions in each type of malignant bone tumour.

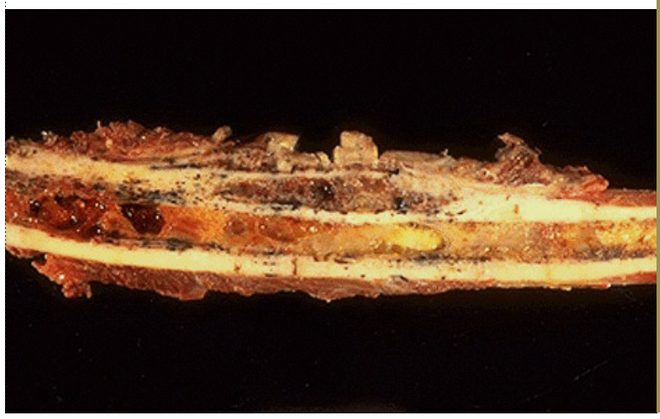
Examination of the patient may reveal a visible or palpable mass in the affected area, localised warmth or erythema, or reduced range of joint movement if there is articular involvement (13).

Initial Radiological Investigation

Orthogonal radiographic views of the area in question should be obtained initially. Most primary tumours are clearly identifiable on plain x-rays (14). If a suspicious lesion is identified, several things should be considered when reviewing these images to help to begin differentiating between the primary malignant bone tumours:

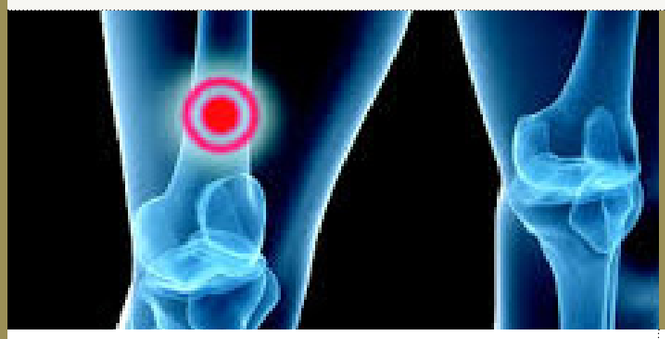
- **Location of the lesion (i.e. diaphysis, metaphysis, epiphysis).**
- **Nature of the lesion (i.e. lytic, sclerotic, mixed).**
- **Pathognomonic features (eg. Codman's Triangle, 'Sunburst' appearance).**
- **Soft tissue features/involvement.**
- **Presence of pathological fractures.**

The different radiological findings of each primary malignant bone tumour are outlined in Table 1.



ORTHOPAEDIC ONCOLOGY: PRIMARY BONE TUMOURS

JM Duncan, DLJ Morris, DJ Bryson, JH Visser, RU Ashford



Orthopaedic Oncology:
Primary Bone Tumours
Trauma & Orthopaedic Surgery

Further Investigation

Upon identification of a suspicious lesion, early discussion with a supra-regional bone tumour unit is advisable (Figure 2).

Figure 2: UK supra-regional bone Sarcoma units - Stanmore, Oxford, Birmingham, Oswestry, Newcastle, Glasgow, Aberdeen & Edinburgh.

In the vast majority of cases further investigations will be required and can be undertaken by the orthopaedic team at the institution to which the patient has presented. These will typically include:

Blood tests: *full blood count, bone profile (for calcium), liver function, renal function, ESR, and a myeloma screen in those >35 years.*

MRI: of the affected area allows for delineation of the intra-osseous and extra-osseous extent of the lesion, soft tissue and neurovascular involvement, and the presence or absence of skip lesions.

Chest X-Ray: *for systemic staging and baseline.*

CT: *in cases of confirmed primary bone sarcoma, CT chest is advised; approximately 20-25% of patients with osteosarcoma present with metastatic disease with the lungs the most common site (15).*

Isotope Bone Scan: *in cases of confirmed primary bone sarcoma, an isotope bone scan is advised to assess for skip lesions and bony metastases. PET-CT scan is replacing isotope bone scans in many centres.*

Referral To A Specialist Centre

If after initial investigation there is a suspicion of primary malignant bone tumour, the patient must be referred on to a supra-regional bone tumour centre (Figure 2). This is a very easy process; a referral letter can be faxed or emailed and all imaging linked electronically.

If there is a cause for concern, the specialist team may request to see the patient and undertake a biopsy to confirm the diagnosis. Biopsy is the definitive investigative test. It is important that biopsies are taken at these centres, as the site for biopsy must be considered with definitive resection planning. Most biopsies are carried out percutaneously with radiological guidance. Other important principles that should be adhered to include:

- **Minimising contamination of normal tissues - only one compartment should be breached.**
- **Excision of the biopsy tract.**
- **Meticulous haemostasis and avoidance of drains.**
- **Samples should also be sent for microbiological analysis.**

Tissue obtained from the biopsy should be analysed by a pathologist experienced in bone and soft tissue malignancy. The results of the biopsy, along with all imaging can be used to formulate a management strategy.

ORTHOPAEDIC ONCOLOGY: PRIMARY BONE TUMOURS

JM Duncan, DLJ Morris, DJ Bryson, JH Visser, RU Ashford

Management Of Primary Bone Malignancy

A multidisciplinary approach involving surgical, radiology, pathology and oncology specialists is required in the management of primary bone malignancy. Treatment is guided by tumour type, stage and grade.

Chondrosarcomas are relatively chemotherapy and radiotherapy insensitive and therefore surgery is the mainstay of treatment. Low grade chondrosarcoma may be treated with intra-lesional curettage. High grade chondrosarcoma and low grade osteosarcoma are treated with en bloc excision.

High grade osteosarcoma, Ewing's sarcoma and mesenchymal chondrosarcoma are treated with neo-adjuvant (pre-operative) multi-agent chemotherapy and limb salvage surgical resection or amputation. Surgery is usually followed by adjuvant (post-operative) multi-agent chemotherapy. Radiotherapy may also have a role, in particular in Ewing's sarcoma and mesenchymal chondrosarcoma.

Intra-Lesional Curettage

A cortical window corresponding to the area of the lesion is created and the underlying tumour is curetted. Liquid nitrogen or phenol or burring may then be used as local adjuvant treatment to reduce microscopic tumour burden. This treatment has been shown to be safe and effective in low grade chondrosarcoma with a Kaplan-Meier survivorship, using freedom from recurrence as the end point, of 90.7% (16).

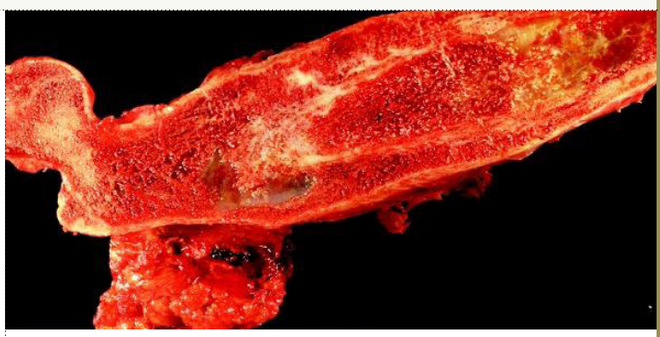
Wide Surgical Resection

During a wide surgical resection the tumour is removed en bloc along with its reactive zone and a cuff of normal tissue in all planes. Axial images on MRI or CT scan are helpful in creating a surgical plan and in delineating the extent of the tumour as well as involvement of neurovascular structures. Complete resection of the primary should be aimed for as there is a strong correlation between surgical margin and local recurrence.

In Ewing's sarcoma, patients treated with adequate margins have been shown to have better 5-year event-free survival than those with inadequate margins (58.2% versus 46.7%). (8). In osteosarcoma, resectable metastases should also be excised. Long-term survival in metastatic osteosarcoma has a fivefold increase with complete resection of both primary and metastatic sites compared with excision of the primary tumour alone (17).

Limb Salvage Surgical Resection

The aim of limb salvage surgical resection is to preserve a functional limb without increasing the risk of local recurrence. Methods include endoprosthetic replacement, arthrodesis, osteoarticular allografting and an allograft/prosthetic composite. This approach is now possible for over 85% of appendicular osteosarcoma (13). Survival outcomes are not compromised with a limb salvage approach in comparison to amputation.



However, absolute and relative contraindications include, inability to obtain wide surgical margins, neurovascular involvement, pathological fracture and a functionless limb (11). Surgical resection often damages or removes the physis. Therefore, extendible endoprostheses are utilised in limb reconstruction in the skeletally immature patient to avoid limb-length discrepancy. The endoprosthesis can be adjusted when the limb length discrepancy reaches 1-2cm (18, 19).

Distal femur or proximal tibia tumours in a skeletally immature patient may be amenable to rotationplasty reconstruction. This technique involves intercalary tumour resection and 180° rotation of the distal leg, creating a new knee joint from the prior ankle joint. This enables active knee motion and a prosthesis is then worn at the knee. Gait analyses demonstrate improved kinematics in patients treated with rotationplasty compared with above-knee amputation (20).

Complications following limb reconstruction include wound complications, infection, mechanical construct failure and non-union.

Amputation

Amputation is performed when resection to disease-free margins leaves a non-functional limb. It should also be discussed when a prosthesis would function better than a salvaged limb. In cases of primary malignancy and pathological fracture where the tumour is not sensitive to chemotherapy, limb salvage therapy may not be feasible (12). Abudu et al, advocate amputation rather than limb salvage surgery when there is important neurovascular involvement, when there is invasion of the joint by the tumour or the associated haematoma, and in cases where muscle loss would preclude adequate limb function (4).

Multi-Agent Chemotherapy

Systemic chemotherapy forms an important part of the treatment of high grade osteosarcoma, Ewing's sarcoma and mesenchymal chondrosarcoma. Neo-adjuvant chemotherapy is used to enhance local tumour control and to better delineate tumour margins making limb salvage surgery more feasible (13). Neo-adjuvant and adjuvant chemotherapy also contribute to the control of visible and invisible metastases. Bernthal et al, demonstrated a 28% survival rate at 25 years for patients with resectable localized osteosarcoma who received adjuvant chemotherapy compared with 15% survival in the group who did not receive adjuvant chemotherapy (21).

ORTHOPAEDIC ONCOLOGY: PRIMARY BONE TUMOURS

JM Duncan, DLJ Morris, DJ Bryson, JH Visser, RU Ashford

A number of combinations of chemotherapy drugs are used and the ideal chemotherapy protocol for each of the different bone tumours has not been established. In osteosarcoma doxorubicin, cisplatin, methotrexate, and ifosamide are the therapeutic agents of choice (22). Drugs used in Ewing's sarcoma includes vincristine, ifosfamide, doxorubicin, etoposide, cyclophosphamide and dactinomycin. A number of different combinations of the same drugs have been used in mesenchymal chondrosarcoma.

The duration of neo-adjuvant chemotherapy ranges from for 10 -18 weeks. Surgery follows upon recovery from the last dose of preoperative chemotherapy. Adjuvant chemotherapy is begun 2 weeks after surgical resection, provided that the surgical wound has completely healed (13). The current duration of adjuvant chemotherapy ranges from 4 - 6 months.

Further international studies are required to establish the ideal duration and combination of drugs for the treatment of primary bone tumours.

Radiotherapy

Irradiation may be used for non-resectable tumours (e.g. large spinal tumours) or in patients who present with widely metastatic disease. It is also used for local disease control in Ewing's sarcoma with poor chemotherapeutic response (8). Functional impairment secondary to radiation complications and radiation-induced sarcomas are increasingly apparent with increasing long-term survival rates. Radiation related complications have been reported in up to 63% of patients and are most pronounced in skeletally immature patients (23).

Conclusion

Primary bone malignancy is a rare condition. It is estimated that a GP with a patient-load of 2,000 may see one or two patients with bone or soft tissue sarcoma during the course of their career (9). Members of the orthopaedic team must maintain a heightened awareness for primary malignancy in patients presenting with bone pain and a suspicious x-ray. In cases of concern, adherence to three simple rules is advisable:

1. Suspect and detect
2. Don't hesitate to investigate
3. If in doubt, discuss with your local supra-regional centre – nobody can fault you for seeking expert guidance

Failure to adhere to these rules can lead to missed diagnosis, delayed diagnosis and, very possibly, inappropriate treatment and compromised outcome.

EMQs

1. Which of the following is NOT an appropriate initial investigations for suspected primary bone malignancy in a patient presenting to a district general hospital?

a) Orthogonal radiographs
b) CT scan
c) MRI
d) Biopsy
e) Bone profile

2. Which of the following is the correct sequence for general incidence of primary bone sarcoma?

a) Chondrosarcoma > Ewing's sarcoma> Osteosarcoma
b) Osteosarcoma> Aneursymal Bone Cyst> Eosinophilic Granuloma
c) Osteosarcoma> Chondrosarcoma> Ewing's sarcoma
d) Osteoid Osteoma> Chrondrosarcoma> Ewing's sarcoma
e) Osteochondroma> Ewing's sarcoma> Chondroblastoma

3. A 12-year old male is referred to the orthopaedic team in a DGH. The young man suffered a simple fall and sustained a distal 1/3 femoral fracture. Radiographs taken in A&E are suspicious with evidence of destructive lesion and periosteal reaction (Codman's triangle). What is the next appropriate step?

a) Surgical fixation of the fracture
b) Application of plaster cast immobilisation and serial follow-up in out-patients
c) Biopsy
d) MRI scan
e) Referral for consideration for radiotherapy

ORTHOPAEDIC ONCOLOGY: PRIMARY BONE TUMOURS

JM Duncan, DLJ Morris, DJ Bryson, JH Visser, RU Ashford

4. All of the following should be adhered to when undertaking biopsy for suspected bony malignancy EXCEPT?

a) The samples should also be sent for microbiological analysis
b) Insertion of a drain is mandatory to avoid haematoma formation
c) Biopsy should be performed by the person/at the centre where definitive treatment will be undertaken
d) Biopsy tract should be excised
e) Only one compartment should be breached

5. Which of the following is characteristic radiographic feature of chrondrosarcoma?

a) Rings, arcs and stipples of calcification
b) Subchondral sclerosis
c) Sunburst spicules
d) Fluid filled cysts
e) Segmental avascular necrosis

Answers

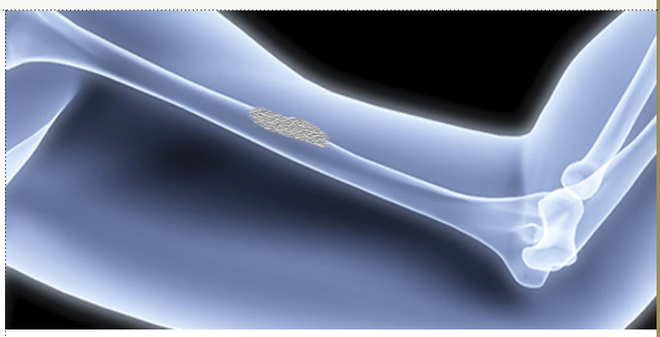
1. c
2. d
3. d
4. b
5. a

Correspondence Address

David J Bryson,
ST3, Trauma and Orthopaedics
King's Mill Hospital, Mansfield Road, Sutton-in-Ashfield,
Nottingham, NG17 4JL
Email: davidjbryson@hotmail.com

References

1. Grimer R, Briggs T (2010) Earlier diagnosis of bone and soft-tissue tumours. J Bone Joint Surg Br. 92(11):1489-92.
2. Cancer Research UK. Bone sarcoma statistics. http://www.cancerresearchuk.org/cancer-info/cancerstats/types/bone/uk-bone-and-connective-tissue-cancer-statistics (accessed 16 June 2014).
3. National Cancer Intelligence Network. Bone sarcoma: incidence and survival rates in England. http://www.ncin.org.uk/search/bone+sarcoma (accessed 21 June 2014).
4. Abudu A, Sferopoulos N, Tillman R, Carter S, Grimer R (1996) The surgical treatment and outcome of pathological fractures in localised osteosarcoma. J Bone Joint Surg Br. 78-B:694-8.
5. Bramer J, Somford M (2010) The epidemiology of primary skeletal malignancy. J Orthop Trauma. 24(4):247-51.
6. Kuchenbecker T, Davies A, James S (2010) The investigation and radiological features of primary bone malignancy. Orthop and Trauma. 24:252-265.
7. Mottard S, Vaiyapuri P, Sumathi L (2010) Chondrosarcomas. Orthop and Trauma. 24:332-341.
8. Maheshwari A, Cheng E (2010) Ewing sarcoma family of tumors. J Am Acad Orthop Surg. 18:94-107.
9. National Institute for Health and Care Excellence. Improving Outcomes for People with Sarcoma. The manual. http://www.nice.org.uk/csgsarcoma (accessed 21 June 2014).
10. Grimer R, Sneath R (1990) Diagnosing malignant bone tumours. J Bone Joint Surg Br. 72-B:754-756.
11. Scully S, Ghert M, Zurakowski D, Thompson R, Gebhardt M (2002) Pathological fracture in osteosarcoma: prognostic importance and treatment options. J Bone Joint Surg Am. 84-A:49-57.



12. Ruggieri P, Mavrogenis A, Casadei R, et al. (2010) Protocol of surgical treatment of long bone pathological fractures. Injury. 41:1161-7.
13. Messerschmitt P, Garcia R, Abdul-Karim F, Greenfield E, Getty P (2009) Osteosarcoma. J Am Acad Orthop Surg. 17(8):515-27.
14. Ashford R, Fairbain K (2009) Investigation of musculoskeletal malignancy. Orthop and Trauma. 23:231-39.
15. National Cancer Institute. Osteosarcoma and MFH of bone with metastatic disease at diagnosis. http://www.cancer.gov/cancertopics/pdq/treatment/osteosarcoma/HealthProfessional/page6 (accessed 17th March 2014).
16. Meftah M, Schult P, Henshaw R (2013) Long-term results of intralesional curettage and cryosurgery for treatment of low-grade chondrosarcoma. J Bone Joint Surg Am. 7;95(15):1358-64.
17. Kager L, Zoubek A, Potschger U et al (2003) Primary metastatic osteosarcoma: Presentation and outcome of patients treated on neoadjuvant Cooperative Osteosarcoma Study Group protocols. J Clin Oncol. 21:2011-2018.
18. Nichter L, Menendez L (1993) Reconstructive considerations for limb salvage surgery. Orthop Clin North Am. 24:511-521.
19. Schindler O, Cannon S, Briggs T, Blunn G. (1997) Stanmore custom-made extendible distal femoral replacements. Clinical experience in children with primary malignant bone tumours. J Bone Joint Surg Br. 79(6):927-37.
20. Fuchs B, Kotajarvi B, Kaufman K, Sim F (2003) Functional outcome of patients with rotationplasty about the knee. Clin Orthop Relat Res. 415:52-58.
21. Berthnal N, Federman N, Eilber F, et al. (2012) Long-term results (>25 years) of a randomized, prospective clinical trial evaluating chemotherapy in patients with high-grade, operable osteosarcoma. Cancer. 118:5888-93.
22. Ritter J, Bielack S (2010) Osteosarcoma. Ann Oncol. 21:320-25.
23. Paulino A (2004) Late effects of radiotherapy for pediatric extremity sarcomas. Int J Radiat Oncol Biol Phys. 60:265-274.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

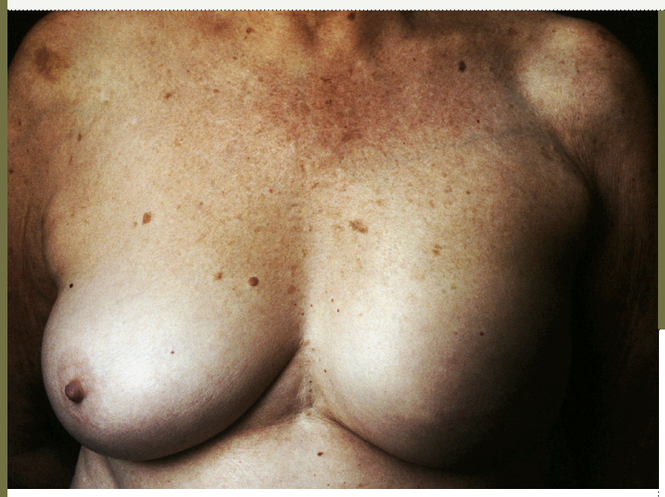
Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY - A REVIEW

BJ Gilbert, TD Dobbs



Breast Reconstruction Following Mastectomy - A Review
Plastic & Reconstructive Surgery

Abstract

Breast cancer is the most commonly diagnosed cancer in the UK, affecting one in nine women at some point in their life. It is also the leading cause of cancer-related death in women worldwide. A diverse therapeutic armamentarium exists for treating breast cancer. This can be principally divided into a surgical arm and a series of adjuvant treatments, including radiotherapy, chemotherapy, hormonal therapy and biological therapy. Within the surgical arm, wide local excision and mastectomy are the most commonly performed procedures.

In terms of improving outcome measures, breast reconstruction constitutes an essential component of the multidisciplinary approach to breast cancer treatment and should be routinely offered to women undergoing mastectomy. There are, at the surgeon's disposal, a plethora of reconstructive techniques available, including a wide range of prostheses and soft tissue reconstructive options. In this article we will discuss several of these techniques and look at where future developments should be expected.

Keywords: *Breast, Reconstruction, Mastectomy, Flap design.*

Clinical Vignette

A 62-year old retired nurse presented in 2011 with a hard, non-tender mass in the upper outer quadrant of her left breast, found on self-examination. She was otherwise fit and well and took no regular medication. Her periods began aged 15 and she reached the menopause at 48. She was nulliparous, a life-long non-smoker and had used the oral contraceptive pill only occasionally in her 20s.

Her mother had died of breast cancer at the age of 65 and her sister was currently undergoing treatment for ovarian cancer at the age of 59. Triple assessment revealed an invasive ductal carcinoma, which after discussion with the patient was managed by wide local excision, sentinel lymph node biopsy and adjuvant chest wall radiotherapy.

In 2014, she presented with a new palpable lesion in the same breast. On stereotactic biopsy, this lesion was confirmed as an invasive ductal carcinoma. After discussing the case at the multidisciplinary team meeting and consulting with the patient, she elected to proceed with bilateral, skin-sparing mastectomies, right sentinel node biopsy and immediate free flap reconstruction. DIEP flap reconstruction was performed, with good results. No immediate flap related complications were noted and the patient left hospital 5 days later. She has been followed up in clinic and is pleased with the aesthetic results of her reconstruction.

Introduction

Breast cancer is the most commonly diagnosed cancer in the UK, affecting one in nine women at some point in their life [1]. It is also the leading cause of cancer-related death in women worldwide [2]. Depending on the grade, type of tumour, staging and patient, the treatment involves surgical excision only, a combination of surgery and radiotherapy, neoadjuvant chemotherapy followed by surgery, or surgery followed by combined chemo-radiotherapy or hormonal therapy.

Breast reconstruction constitutes an essential component of the multidisciplinary approach to breast cancer treatment and should be routinely offered to women undergoing mastectomy. In both the UK and USA, approximately 40% of women undergo breast reconstruction following mastectomy, with the aim of restoring the size, shape and symmetry of the original breast tissue [3, 4]. Breast reconstruction appears to have long-term benefits to a patient's psychological and mental health, with surveys suggest that post-mastectomy patients are otherwise vulnerable to feelings of diminished self-worth, poor body image, and loss of sexual attractiveness [5].

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY - A REVIEW

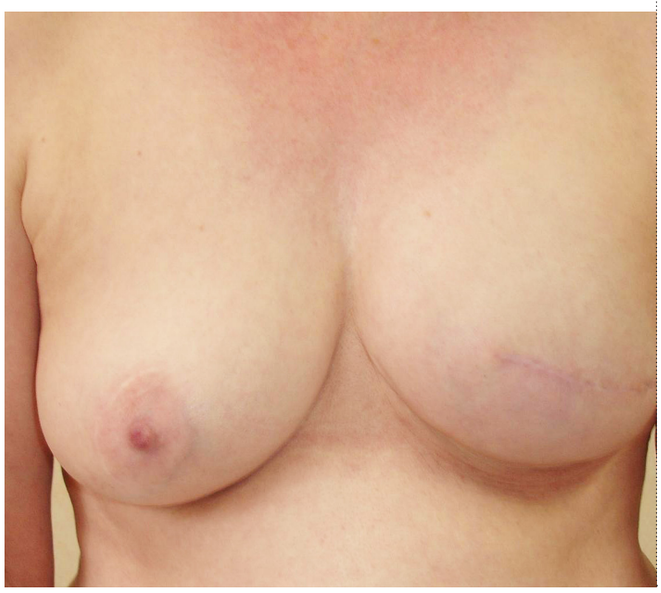
BJ Gilbert, TD Dobbs

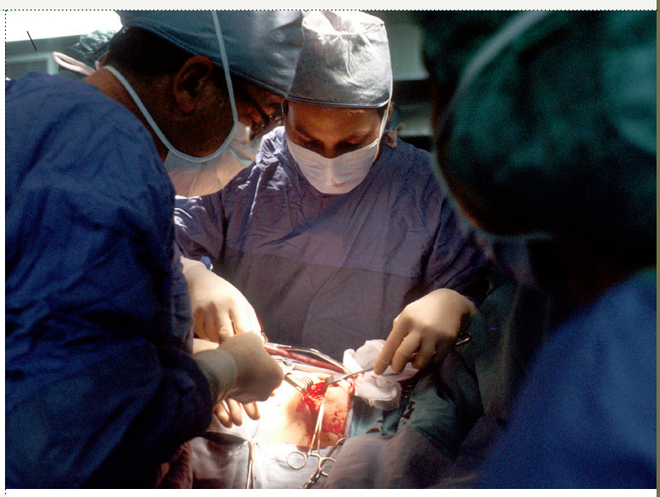
The decision to undergo reconstructive surgery usually follows sensitive discussions between the patient and her family, alongside the respective nursing and surgical teams. Other resources, including the opportunity to speak with women who have previously undergone breast reconstruction, or access to pre - and post-operative photographs, can facilitate the decision-making process [6].

Pre-operatively, numerous factors must be assessed, including disease status, cancer history, surgical history, smoking history, active comorbidities, and plans for future treatment. Patient preferences must also be considered regarding breast size, shape and symmetry, tissue sacrifice and scar location. Overall, breast symmetry is reported as the principal parameter affecting patient satisfaction [7]. Raised BMI also affects reconstructive options, with obesity being shown to yield higher post-operative complication rates, delayed wound healing, and disappointing aesthetic results, particularly following free flap reconstruction [8]. A prior history of radiotherapy is also important, since irradiated skin is more liable to ischaemic changes, infection and eventual implant extrusion. The risk of capsular contraction also makes autologous reconstruction preferable in such cases [9].

Appropriate timing of reconstruction is essential to optimise aesthetic outcome and minimise post-operative complications. Despite increased operative times and complication rates, immediate reconstruction is often preferred due to improved psychosocial morbidity and superior aesthetic outcomes, with a concomitant 60% fall in admission-associated cost [10, 11].

Delayed reconstruction was the favoured option until the early 1990s, owing to perceived benefits in recurrence and mortality rates, as well as psychosocial profile [12, 13]. Delayed reconstruction also has the benefit of ensuring completion of adjuvant treatment such as chemotherapy prior to definitive reconstruction. However, patients may find the need for additional surgery burdensome and are offered fewer reconstructive options following radiotherapy.





Types Of Reconstruction

The reconstructive armoury can be divided into two major limbs: prosthetic devices, including fixed volume saline or silicone implants and tissue expanders, or a combination of the two; and autologous reconstruction, whereby the patient's own tissue is transferred from a donor site to the anterior chest wall.

Implants

The silicone implant was first used in the 1960s, heralding the beginning of the prosthetic era of breast reconstruction. Although implants have since evolved in complexity, the formulation of the implant shell remains much the same.

Implant reconstruction can be a one - or two-stage procedure. In a one-stage procedure, the implant is placed under pectoralis major, with either a dermal sling or acellular dermal matrix (e.g. Permacol, Strattice) placed in the inferior pole. In general, primary implant reconstruction is now reserved primarily for the creation of small, minimally ptotic breasts following skin-sparing mastectomy. More commonly used is the technique of tissue expansion, or two-stage reconstruction, whereby the existing skin and soft tissue envelope is expanded through placement of a submuscular expander, before a permanent implant is inserted. In this way, most of the patient's skin is conserved.

The expander shell is positioned sub-pectorally and inflated incrementally by saline injections until the desired volume is achieved. Replacing the expander with a fixed-volume implant gives a less distorted, better projected breast. However, two-stage reconstruction is not without its setbacks: frequent clinic visits are required for several months, and a second operation is required to position the permanent implant.

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY - A REVIEW

BJ Gilbert, TD Dobbs

Breast Reconstruction Following Mastectomy - A Review
Plastic & Reconstructive Surgery

Overall, implant reconstruction is often preferred by patients with smaller breasts, who lack the excess spare tissue required for autologous reconstruction. In such a decision, however, patient choice must be respected; a patient with larger breasts, for example, may still choose an implant reconstruction after thorough discussion of all available options.

Autologous Reconstruction

Autologous reconstruction constitutes the transfer of tissue from a donor site to a recipient site. Autologous flaps can be either local or distant, and can be pedicled (if transposed with their original blood supply still attached) or free (if the blood supply is fully detached at the donor site and microsurgically anastomosed at the recipient site).

Latissimus Dorsi Flap

The latissimus dorsi (LD) flap is a pedicled flap consisting of the latissimus dorsi muscle and overlying skin paddle. Since the flap is pedicled on the thoracodorsal vessels, its use is contraindicated when these vessels are damaged during mastectomy. Despite a rate of flap necrosis as low as 1%, owing to the rich blood supply of LD, seroma formation can occur in up to 80% of cases (although this risk is significantly reduced through the use of quilting sutures) [14, 15]. Moreover, a supplementary implant is often required and, in time, contour irregularities can develop due to LD atrophy.

TRAM Flap

Myocutaneous transverse rectus abdominis muscle (TRAM) flaps were initially developed by Hartrampf et al as a pedicled flap [16], and involved removing an elliptical island of lower abdominal skin and subcutaneous tissue, alongside a portion of rectus abdominis muscle. The tissue IS then rotated into the breast pocket, with the rectus abdominis muscle attached to the costal margin and an intact blood supply provided by the superior epigastric artery and vein. In this way, using a single rectus muscle, up to three-quarters of the suprapubic skin and fat could be harvested.

More commonly used now is a free flap variant of this technique developed by Grotting et al [17], in which the flap is completely detached and transferred to the mastectomy site, where the inferior epigastric vessels are anastomosed to the internal mammary or thoracodorsal vessels. This has been shown by laser Doppler flowmetry to better maintain bloodflow through the flap [18], with a reduced risk of fat necrosis and improved flap survival, particularly in patients at high risk of ischaemic complications, including smokers and diabetics.

The free TRAM flap may also be preferred when large amounts of skin and soft tissue are required. Interestingly, the proposed aesthetic benefits, for which supporters cite an improved medial contour and increased flexibility, are contested by several surveys in which patients have preferred the look of the pedicled TRAM flap [17, 19].

DIEP Flap

The deep inferior epigastric perforator (DIEP) flap is a muscle-sparing flap, in which the perforating vessels of the deep inferior epigastric artery are dissected free, while the rectus abdominis muscle is spared. Hence, in contrast with TRAM flap procedures, no muscle sacrifice is required. Additionally, the results mimic a 'tummy tuck', adding further appeal to the procedure for many women.

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY - A REVIEW

BJ Gilbert, TD Dobbs

A 10-year retrospective study found that using a DIEP flap significantly reduces the risk of abdominal hernia, which occurs after up to 11% of TRAM flap reconstructions [23]. Post-op0rative pain levels and recovery time also fell, with other complications and aesthetic outcomes comparable to those observed in TRAM flap reconstruction. Teunis et al (2013) found that the complication rate could be further reduced by pre-operative CT angiography of the abdominal blood vessels [21]. Alternatively, non-contrast magnetic resonance imaging (MRI) appears to provide an effective means of perforator mapping, whilst avoiding the problem of radiation exposure [22, 23].

However, DIEP flap reconstruction is not offered by all centres, owing principally to surgical complexity. Significant surgical precision is required to dissect and anastomose perforators of 1mm diameter. However, the procedure can be performed in approximately four hours. Reviewing over 100 patients undergoing DIEP flap reconstruction in Sweden, Acosta et al (2010) reported that two DIEP flap reconstructions can be routinely and safely performed in a working day [24].

Less commonly, tissue is obtained from sites such as the buttock and inner thigh. There are two different buttock flaps: the free SGAP and IGAP flaps (derived from the superior and inferior gluteal artery perforators, respectively). Alternatively, the free TUG flap (derived from the transverse upper gracilis) may be used in patients with small breasts who do not require a significant tissue volume for reconstruction. Such flaps may be preferred if there is abdominal scarring present from previous surgical procedures. In the case of TUG flap surgery, the incision can be well hidden in the groin crease and patients rarely complain of post-procedural weakness, since gracilis is a relatively expendable adductor muscle.

Progress In Flap Design

'Angiosomes'

In recent years, the concept of 'angiosomes', used to describe regions of a flap that are supplied by recognised, named blood vessels, has transformed flap design. For example, it is now recognised that flap survival can be optimised by transferring the vessels that supply the angiosomes as well as the neighbouring vascular territory, according to the principle of territorial 'dominance' [25]. A team of reconstructive surgeons in Melbourne recently looked at the effect of interplay between vascular territories via CT angiography [26]. They identified 'dominance' in several arterial territories, most notably between the deep inferior epigastric and superficial inferior epigastric territories.

Implantable Doppler probes

Following mastectomy, frequent flap monitoring is required to ensure early recognition of flap compromise. Typically, clinical observations such as colour, temperature and capillary refill time are recorded in conjunction with Doppler measurements of the arterial and venous signal. Implantable Doppler probes are becoming more commonly used to aid in flap monitoring. Schmulder et al performed a retrospective analysis to investigate the efficacy of an implantable Doppler in 548 microsurgical procedures, which showed that when a probe was used, flap failure rate was just 3%, compared to 18% with clinical assessment only [27].

By contrast, a retrospective matched cohort study by Whitaker et al (2010) found this technique no different to clinical monitoring alone in terms of flap failure, but cited a significant increase in false positives causing needless further surgery [28]. The same group previously conducted a study in which the audible signal in 15 of 121 free flaps was attenuated. Of these, 14 were revised and all were found to contain compromised anastomoses [29]. Despite this controversy, the literature remains in favour of an empirical benefit for the implantable Doppler device.

Reducing post-mastectomy lymphoedema

Lymphoedema of the chest and arms is estimated to occur in up to 39% of post-mastectomy patients [30]. This figure is further increased by axillary lymph node dissection and/or axillary radiotherapy. Historically, physiotherapy has been the principal means of reducing post-mastectomy lymphoedema.

In the early 1980s, Swedborg and colleagues in Scandinavia trialled various methods, including massage and isometric exercises [31]. The benefits were significant, with circumferential measurements falling by as much as 13% in the first week. Further, the use of an elastic sleeve, worn for up to 6 months after surgery, was found to reduce the swelling by an average of 17%, with no subsequent relapse [32].

One emerging surgical technique involves the use of vascularised groin lymph node flaps in conjunction with TRAM or DIEP flaps to reduce post-mastectomy lymphoedema. In May 2013, Dancey et al at University Hospital Birmingham conducted a pilot study using a chimeric groin node and DIEP flap [30]. They noted symptomatic improvement in all 18 patients, as determined by arm function, appearance, mood, and overall quality of life at a mean post-operative period of 14 months.

Procedurally, little additional operative time was required. The lymph nodes accompanying the superior inferior epigastric vessels were dissected free and elevated to create a vascularised lymph node flap, continuous with the DIEP flap. This was then inserted into the axillary pocket and anastomosed to the thoracodorsal vessels, as per normal. Although the underlying mechanisms are not fully understood, all patients in this study reported significant reduction in arm pain as the lymphoedema resolved.

Lymphoedema can also be effectively managed through lymphaticovenous anastomosis (LVA), which allows lymphatic fluid to drain directly into the venous system through a series of tiny microsurgical channels created through use of a high power microscope and superfine suture. However, in the case of widespread fat or fibrotic deposition, lymphoedema liposuction appears to be a more effective technique. The literature suggests that this specialised procedure, pioneered by Dr Hakan Brorson in Sweden, effectively reduces the size and firmness of the affected limb [33, 34]. However, patients must continue to wear compression garments following surgery to prevent lymphoedema recurrence.

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY - A REVIEW

BJ Gilbert, TD Dobbs

Conclusion

Although prosthetic reconstruction is by no means a dying art, autologous reconstruction tends to achieve superior aesthetic outcomes, fewer complications and higher patient satisfaction overall, due to the natural appearance of the new breast and the rare requirement for surgical revision. However, both operative and recovery times are heightened and significant microsurgical expertise is required.

Hence, in order to rationally decide how to proceed with the reconstructive process, the patient and surgical team must discuss the nuances of the various techniques available. Indeed, these options are ever expanding; perhaps the most exciting area of development is the chimeric groin lymph node flap. At present, there remains a dearth of literature in this area, but future investigators should seek to characterise circumferential limb measurements, as well as symptomatic changes.

MCQs

1. Which one of the following is not a benefit of reconstructive breast surgery?

a) Improved body image

b) Increased sexual attractiveness

c) Reduced risk of breast cancer recurrence

d) Reduced risk of post-mastectomy mental health disorders

e) Improved self-worth

2. Which is a type of pedicled flap used in breast reconstruction?

a) DIEP (Deep Inferior Epigastric Perforator) flap

b) Latissimus dorsi flap

c) Anterolateral thigh flap

d) Gracilis flap

e) Pectoralis major flap

3. Which is a contraindication to abdominal free flap reconstruction?

a) Ex-smoker

b) BMI>32

c) Previous abdominal surgery

d) Diabetes mellitus

e) Pregnancy

4. What percentage of women in the USA have reconstruction following mastectomy?

a) 20%

b) 30%

c) 40%

d) 50%

e) 60%

5. Which one of these is not beneficial in monitoring a flap post-operative?

a) Colour

b) Temperature

c) Capillary refill

d) Sensation

e) Implantable Doppler probe

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY - A REVIEW

BJ Gilbert, TD Dobbs

MCQ Answers

1) b

2) c

3) b

4) c

5) d

Correspondence Address

Mr Barnabas Gilbert,
Green Templeton College,
43 Woodstock Road, Oxford, OX2 6HG.
Email: barnabas.gilbert@gtc.ox.ac.uk

References

1. NHS Choices: Breast cancer (female). http://www.nhs.uk/conditions/cancer-of-the-breast-female/Pages/Introduction.aspx (accessed 09 May 2014).
2. Jemal A, Bray F, Center MM, Ferlay J, Ward E & Forman D. Global Cancer Statistics. CA Cancer J Clin 2011;61(2):69-90.
3. NHS Information Centre: National Mastectomy and Breast Reconstruction Audit 2010 http://www.rcseng.ac.uk/surgeons/research/surgical-research/docs/national-mastectomy-and-breast-reconstruction-audit-third-report-2010 (accessed 09 May 2014).
4. Albornoz CR, Bach PB, Mehrara BJ, Disa JJ, Pusic AL, McCarthy CM, et al. A paradigm shift in U.S. Breast reconstruction: increasing implant rates. Plast Reconstr Surg 2031;131(1):15-23.
5. Ray C. Psychological implications of mastectomy. Br J Soc Clin Psychol 1977; 16(4):373-7.
6. Losken A, Burke R, Elliott LF 2nd, Carlson GW. Infonomics and breast reconstruction: are patients using the internet? Ann Plast Surg 2005; 54(3):247-50.
7. Ramon Y, Ullmann Y, Moscona R, Ofiram E, Tamir A, et al. Aesthetic results and patient satisfaction with immediate breast reconstruction using tissue expansion: a follow-up study. Plast Reconstr Surg 1997; 99(3):686-91.
8. Jandali S, Nelson JA, Sonnad SS, Low DW, Kovach SJ, Wu LC, et al. Breast reconstruction with free transfer from the abdomen in the morbidly obese. Plast Reconstr Surg 2011; 127(6):2206-13.
9. Dickson MG & Sharpe DT. The complications of tissue expansion in breast reconstruction: a review of 75 cases. Br J Plast Surg 1987; 40(6):629-35.
10. Sullivan SR, Fletcher DR, Isom CD & Isik FF. True incidence of all complications following immediate and delayed breast reconstruction. Plast Reconstr Surg 2008; 122(1):19-28.
11. Khoo A, Kroll SS, Reece GP, Miller MJ, Evans GR, Robb GL, et al. A comparison of resource costs of immediate and delayed breast reconstruction. Plast Reconstr Surg 1998; 101(4):964-8.
12. Noone RB, Frazier TG, Noone GC, Blanchet NP, Murphy JB & Rose D. Recurrence of breast carcinoma following immediate reconstruction: a 13-year review. Plast Reconstr Surg 1994; 93(1):96-106.
13. Noguchi M, Fukushima W, Ohta N, Koyasaki N, Thomas M, Miyazaki I, et al. Oncological aspect of immediate breast reconstruction in mastectomy patients. J Surg Oncol 1992; 50(4):241-6.
14. Schwabegger A, Ninkovic M, Brenner E & Anderl H. Seroma as a common donor site morbidity after harvesting the latissimus dorsi flap: observations on cause and prevention. Ann Plast Surg 1997; 38(6):594-7.
15. Titley OG, Spyrou GE & Fatah MF. Preventing seroma in the latissimus dorsi flap donor site. Br J Plast Surg 1997; 50(2):106-8.
16. Hartrampf CR, Scheflan M & Black PW. Breast reconstruction with a transverse abdominal island flap. Plast Reconstr Surg 1982; 69(2):216-25.
17. Grotting JC, Urist MM, Maddox WA & Vasconez LO. Conventional TRAM flap versus free microsurgical TRAM flap for immediate breast reconstruction. Plast Reconstr Surg 1989; 83(5):828-41.
18. Tuominen HP, Asko-Seljavaara S & Svartling NE. Cutaneous blood flow in the free TRAM flap. Br J Plast Surg 1993; 46(8):665-9.
19. Alderman AK, Wilkins EG, Lowery JC, Kim M & Davis JA. Determinants of patient satisfaction in postmastectomy breast reconstruction. Plast Reconstr Surg 2000; 106(4):769-76.
20. Gill PS, Hunt JP, Guerra AB, Dellacroce FJ, Sullivan SK, Boraski J, et al. A 10-year retrospective review of 758 DIEP flaps for breast reconstruction. Plast Reconstr Surg2004; 113:1153-60.
21. Teunis T, van Voss MR, Kon M & van Maurik JF. CT-angiography prior to DIEP flap breast reconstruction: a systematic review and meta-analysis. Microsurgery 2013; 33(6):496-502.
22. Acosta R, Enajat M, Rozen WM, Smit JM, Wagstaff MJ, Whitaker IS, et al. Performing two DIEP flaps in a working day: an achievable and reproducible practice. J Plast Reconstr Aesthet Surg 2010; 63(4):648-54.
23. Rozen WM, Grinsell D, Koshima I & Ashton MW. Dominance between angiosomes and perforator territories: a new anatomical model for the design of perforator flaps. J Reconstr Microsurg 2010; 26(8):539-45.
24. Masia J, Navarro C, Clavero JA, Alomar X. Noncontrast magnetic resonance imaging for preoperative perforator mapping. Clin Plast Surg. 2011; 38(2):253-61.
25. Rozen WM, Stella DJ, Bowden J, Taylor GI, Ashton MW. Advances in the pre-operative planning of deep inferior epigastric artery perforator flaps: magnetic resonance angiography. Microsurgery 2009; 29:119-23.
26. Rozen WM, Ashton MW, Le Roux CM, Pan WR & Corlett RJ. The perforator angiosome: a new concept in the design of deep inferior epigastric artery perforator flaps for breast reconstruction. Microsurgery 2010; 30(1):1-7.
27. Schmulder A, Gur E & Zaretski A Eight-year experience of the Cook-Swartz Doppler in free-flap operations: microsurgical and reexploration results with regard to a wide spectrum of surgeries. Microsurgery 2011; 31(1): 1-6.
28. Whitaker IS, Rozen WM, Chubb D, Acosta R, Kiil BJ, Birke-Sorensen H, et al. Postoperative monitoring of free flaps in autologous breast reconstruction: a multicenter comparison of 398 flaps using clinical monitoring, microdialysis, and the implantable Doppler probe. J Reconstr Microsurg 2010; 26(6):409-16.
29. Smit JM, Whitaker IS, Liss AG, Audolfsson T, Kildal M & Acosta R. Post operative monitoring of microvascular breast reconstructions using the implantable Cook-Swartz doppler system: a study of 145 probes & technical discussion. J Plast Reconstr Aesthet Surg 2009; 62(10):1286-92.
30. Dancey A, Nassimizadeh A, Nassimizadeh M, Warner RM & Waters R. A chimeric vascularised groin lymph node flap and DIEP flap for the management of lymphoedema secondary to breast cancer. J Plast Reconstr Aesthet Surg 2013; 66(5):735-7.
31. Swedborg I. Effectiveness of combined methods of physiotherapy for post-mastectomy lymphoedema. Scand J Rehabil Med 1980; 12(2):77-85.
32. Swedborg I. Effects of treatment with an elastic sleeve and intermittent pneumatic compression in post-mastectomy patients with lymphoedema of the arm. Scand J Rehabil Med 1984; 16(1):35-41.
33. Granzow JW, Soderberg JM, Kaji AH & Dauphine C. Review of current surgical treatments for lymphedema. Ann Surg Oncol 2014; 21(4):1195-201.
34. Granzow JW, Soderberg JM, Kaji AH & Dauphine C. An effective system of surgical treatment of lymphedema. Ann Surgical Oncol 2014; 21(4):1189-94.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

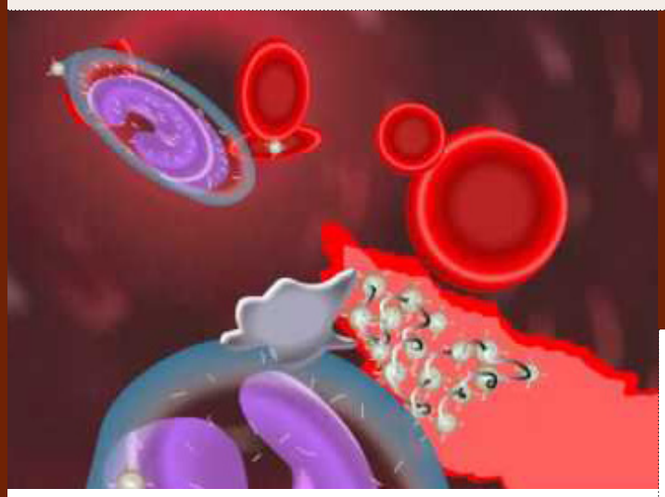
Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

COAGULATION

SJ Sarno



Abstract

Haemostasis is maintained by a fine balance between coagulation and anticoagulation and this balance is in turn maintained by a series of complex biological processes. There are various models that aim to elucidate these processes including Virchow's triad, the classical pathway and the cellular based model. This article aims to: highlight some of the key aspects of coagulation; discuss how it is monitored and look at some of the issues regarding coagulation in sepsis.

Keywords: *Coagulation, Virchow's triad, Point of care testing, Disseminated intravascular coagulation.*

Clinical Vignette

A 60yr old male was admitted to the medical admissions unit with a 2 day history of worsening abdominal discomfort and malaise. Patient's background: ischaemic heart disease, obese and ex-smoker.

Drug History:
glycerol trinitrate, bisoprolol, rampiril, aspirin and simvastatin.

The surgical team was asked to review him in view of his abdominal pain.

On examination:
on 2L of oxygen his oxygen saturation was 94%, he was tachypnoeic, normotensive, pyrexic and had a heart rate of 68. His abdomen was soft and he had right sided tenderness. He was started on intravenous antibiotics after blood cultures were taken and an urgent abdominal CT scan was requested.

Prior to CT, his oxygen requirement increased and he became hypotensive, requiring fluid resuscitation. After stabilisation his CT scan was expedited. The abdominal CT scan showed a thickened biliary tree consistent with the diagnosis of ascending cholangitis. Also to note, he had a small liver and a large spleen, consistent with cirrhosis and portal hypertension causing splenomegaly.

He deteriorated soon after the CT scan due to sepsis, and subsequently was admitted to the intensive care unit due to respiratory failure and unsuccessful fluid resuscitation. On arrival he was ventilated and started on inotropic support. He deteriorated further over the next 24 hours, developing an acute kidney injury requiring haemofiltration and he became coagulopathic (see table 1.). Despite providing respiratory, cardiovascular and renal support and attempting to correct his coagulation abnormalities, he failed to recover and died 48 hours later.

Blood test	**Result** ***(typical normal ranges)***
Platelets	55 *(150-450x10^9/L)*
Activated partial thromboplastin time (APTT)	38 *(21-29sec)*
Prothrombin time (PT)	17 *(10-12sec)*
Thrombin time (TT)	29 *(17-21sec)*
Fibrinogen	0.8 *(1.8-4.0g/L)*
D-dimer	889 *(20-180ng/ml)*

Table 1: Blood Results.

COAGULATION

SJ Sarno

Introduction

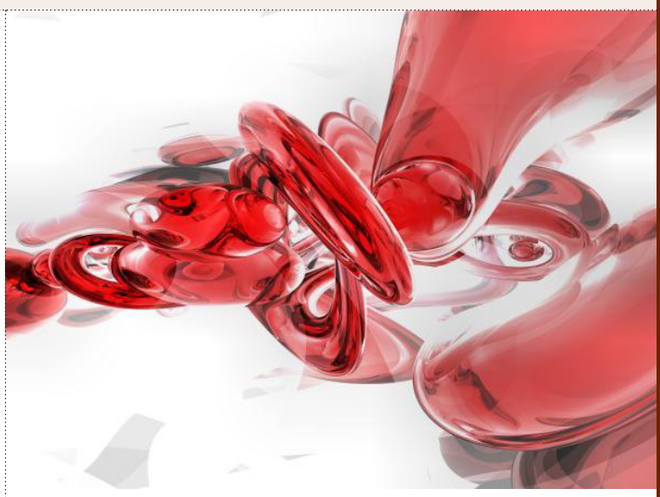
The aim of haemostasis is to maintain blood fluidity within the vasculature. There are multiple components to this system which aim to allow coagulation and anti-coagulation to remain in equilibrium within the body. The balance between the two can be easily disrupted when there is an insult on the body or in disease states. One of the first models of coagulation and thrombosis was devised by Rudolph Virchow in the mid-19th century. His aim was to describe the pathophysiology of a pulmonary embolism, but Virchow's 'triad' is also used for arterial thrombosis. Virchow's 'triad' describes how stasis, endothelial damage and hypercoagulability are required for thrombosis to occur. It is now recognised that thrombosis is likely to occur if abnormal blood flow (stasis) combines with either vessel wall abnormalities (endothelial damage) or blood abnormalities (hypercoagulability) (1,2).

Virchow's Triad

Abnormalities in blood flow

Flow of any fluid is dictated by the driving pressure and the resistance opposed by the conduit in which the fluid travels. The driving pressure is determined by the pressure gradient, whilst the resistance to the fluid is determined by the radius of the tube, the length of tube and the viscosity of the fluid. Therefore, changes in blood flow can arise if the pressure gradient is decreased (hypotension) or increased (hypertension). Blood flow will also be affected if the viscosity of the blood alters (hypo/hyper-viscosity) or the radius of the vessels alters (stenosis/atherosclerosis or presence of local vasodilators – e.g. NO, CO_2, H^+). Length cannot be altered. Resistance can also be defined in terms of wall shear stress (WSS), which is made up of shear rate (rate of flow) and blood viscosity (3).

There is a marked rise in resistance when the radius decreases. When flow is linear, i.e. laminar flow, the resistance is to the fourth power. For example, by halving the radius there will be a 16 fold increase in the resistance. There is also the added effect of vessel wall constriction on the risk of thrombosis; after any constriction of a tube there is an increase in the risk of turbulent flow.



Turbulence is more likely with an increase in velocity (hypertension/atherosclerosis) and density of the fluid, an increase in tube diameter and a decrease in the viscosity of the fluid. The major factors that increase the risk of thrombosis include hypertension and turbulence (both increase arterial risk), hyperviscosity (increases both venous and arterial risk) and stasis (increasing venous risk) (1,3,4).

Vessel wall abnormalities

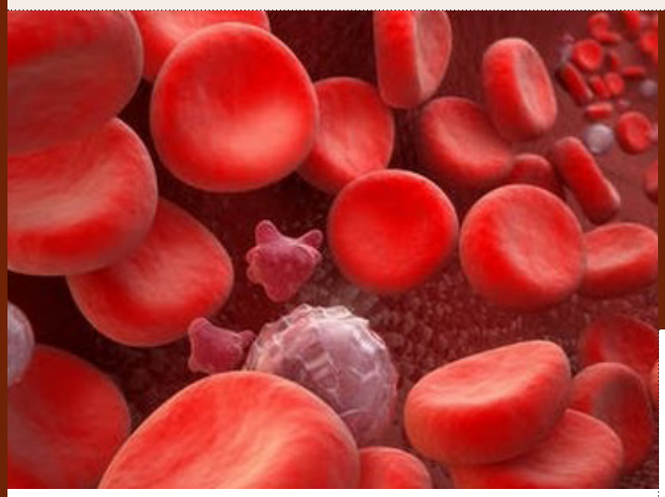
The aim of haemostasis is to contain blood within the vascular compartment, so that when the endothelium is damaged, the coagulation process will aim to 'plug' the endothelial layer by forming a thrombus. In diseased states this can become a disadvantage. For example, in the clinical case above, hyperlipidaemia, hypertension and smoking promote endothelial inflammation and therefore dysfunction, predisposing to thrombus generation(3,4). Factors that increase the risk of thrombus generation include atherosclerosis, trauma, erosion, venous hypotonia (in pregnancy) and reduced fibrinolysis(1).

Blood abnormalities

There are a multitude of transient, genetic and acquired abnormalities that form hypercoagulable states. Transient (temporary) abnormalities include: surgery, immobilisation, pregnancy and heparin induced thrombocytopenia. Both genetic and acquired abnormalities can either involve the coagulation pathway, anti-coagulation pathway or platelets. Acquired abnormalities differ from transient, occurring as a result of disease.

COAGULATION

SJ Sarno



An increased risk of thrombosis occurs in thrombocytosis and high platelet turnover (with reference to the clinical case; this can be seen in hyperlipidaemia and smoking). Alterations to the anti-coagulation pathway can occur with deficiency in inhibitors (factor V Leiden) and enzymes which aid fibrinolysis (1). High fibrinogen, also seen in hyperlipidaemia and smoking, similarly increases the risk of thrombosis. This is via both an increase in platelet aggregation and also blood viscosity (3).

The Coagulation Process

There are two well described models of coagulation, the well-known 'classical pathway' and the more recently accepted 'cell based model'. Both are valid models within clinical use, although the 'cell based model' of initiation, amplification, propagation and clot stabilisation is thought to be a more accurate representation of the coagulation process *in vivo* (5).

It must also be noted that as coagulation is a protein based process it relies upon a stable environment; hence, changes in temperature and pH can have a significant effect, most commonly hypothermia and acidosis. Calcium also plays a key role in coagulation, so as is the case with low levels of any coagulation factor, hypocalcaemia can also reduce the effectiveness of coagulation.

The classical pathway

Consists of an intrinsic and an extrinsic pathway which both activate the final common pathway (Fig 1.). It represents a cascade of proteolytic events which continue to activate coagulation factors subsequently resulting ultimately in a 'tight' fibrin clot. The extrinsic and intrinsic pathways have their different roles. The extrinsic pathway is activated by tissue factor (TF; factor III); it involves factor VII and calcium (factor IV), which then activate the final common pathway. Its function is monitored in vitro by the PT and is responsible for the initial generation of factor Xa, whereas the extrinsic pathway is initiated by collagen and involves factors VIII, IX, XI, XII, phospholipids (PL) and calcium. The final outcome is the amplification of factor Xa formation and it is monitored in vitro by the APTT. The final common pathway is monitored in vitro by the thrombin time; it involves factors V, X and XIII, prothrombin (factor II), fibrinogen (factor I), PL and calcium (6,7).

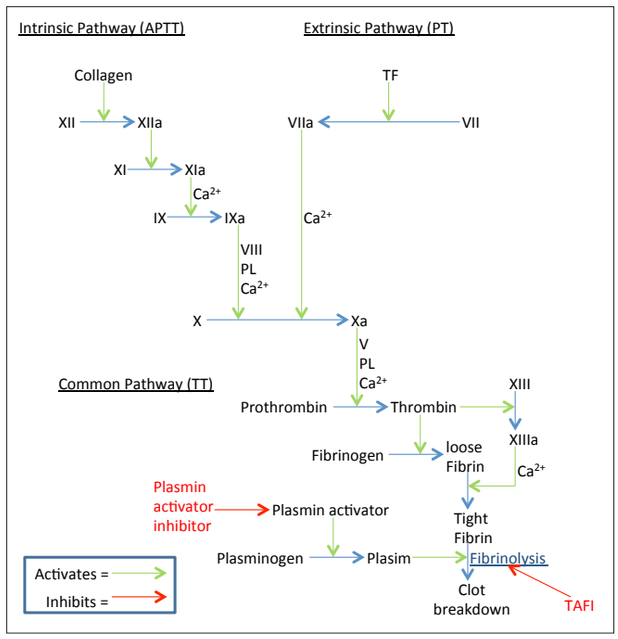


Figure 1: The Classical Pathway.

COAGULATION

SJ Sarno

The cell based model (Fig 2.)

Is based on a series of overlapping phases which take place at cell surfaces and involve protein receptors which help localise the effects of coagulation. Anti-coagulation and fibrinolysis normally dominate in the haemostatic balance. When the coagulation pathway is activated it will override the anticoagulation and fibrinolysis locally. TF determines where this process will occur, whilst TF pathway inhibitor (TFPI) prevents TF having its effects away from the site where coagulation is required. Other mechanisms that prevent widespread coagulation include: antithrombotic features of healthy endothelium and coagulation factor inhibitors (e.g. antithrombin III)(5,7).

Initiation

TF initiates procoagulation, it is released from extravascular cells and is present intravascularly after endothelial damage has occurred. TF binds to factor VII, forming factor VIIa/TF complex which then activates factors X and IX. TFPI prevents TF from having its effect elsewhere, by inhibiting the factor VIIa/TF complex when it leaves the cell surface. Factor Xa can combine with prothrombin to form small quantities of thrombin(5,7). Vasoconstriction of the vessel also occurs in this phase.

Amplification

Platelets start to attach to the site of endothelial damage; the exposed negatively charged PL allow this (8). Platelets provide the cellular surface for amplification to occur through a series of positive feedback mechanisms. The end goal of amplification is to provide enough thrombin to activate fibrinogen and form fibrin monomers. The small amount of thrombin (a potent platelet activator), which is already made in the initiation phase, enhances platelet adhesion and platelet activation; it acts via receptors on the platelet surface called protease-activated receptors (PAR)(7).

Platelet activation is amplified by adenosine diphosphate (ADP), serotonin (5-HT) and von Willibrand Factor (vWF) released by already activated platelets. They are also activated by adrenaline and thromboxane A_2 (TXA_2)(9).

There are 3 main feedback loops that participate in amplification(5):

a) Factors VIIa, IXa and Xa all increase factor VIIa production via factor VIIa/TF complex.

b) Thrombin activates factors V and VIII which accelerate thrombin production via factor Xa and IXa.

c) Thrombin activates factors XI, which increases factor IXa production.

Propagation

In this phase, active factors combine with co-factors on the platelet surface to maintain a continuous supply of thrombin, leading to further platelet aggregation. This burst of thrombin is supplied by the prothrombinase complex (Xa/Va) which is activated by the tenase complex (IXa/VIIIa). Factors IX, X and XI, along with factor VIIa/TF complex aid assembly of prothrombinase and tenase complexes (5,7,8).

Stabilisation

Thrombin generation increases to a maximum and factor XIIIa cross-links the fibrin monomers to form a stable, tight fibrin meshwork. The clot is now formed; the remainder of the stabilisation phase is to prevent it from being broken down by fibrinolysis. Thrombin-activatable fibrinolysis inhibitor (TAFI) prevents fibrinolysis by preventing fibrinolytic proteins from attaching to the clot; it is activated by thrombin (5,7,8).

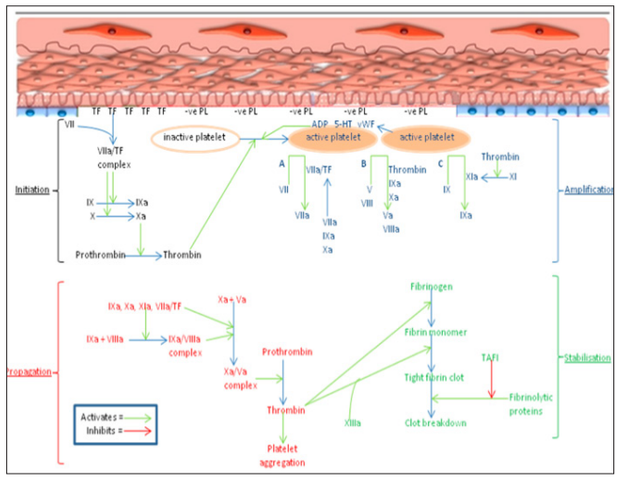
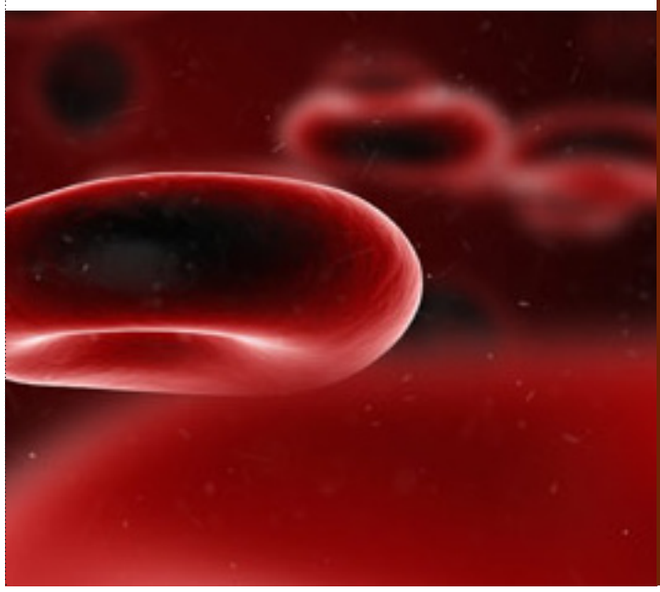


Figure 2: Cell Based Model.



COAGULATION

SJ Sarno

Monitoring of Coagulation

As illustrated above, coagulation is a complex process and it is not fully understood. For this reason, monitoring of coagulation *in vitro* is limited. Blood tests available to most clinicians acutely include platelet levels, fibrinogen levels, d-dimer levels, PT, APTT and TT. If these are all normal and a patient has a prolonged bleeding time, functional platelet tests, immunological and functional vWF assays and specific functional coagulation factor assays can be carried out(8), although these have a limited role in the acute setting. In fact, with the fastest laboratory, coagulation abnormalities are detected at least 1-2 hours behind the dynamic clinical process which is occurring. When a situation is evolving too fast to wait for these results, point of care testing may be of use.

The bleeding time test assesses platelet and vessel wall interaction, but unfortunately it is insensitive and non-specific and therefore rarely used. It involves a standardised cut being made; this is usually made on the anterolateral aspect of the arm(9).

APTT evaluates the intrinsic and common pathways and assesses fibrinogen, thrombin and factors V, VIII, IX, X, XI and XII. It is commonly used to assess the effects of unfractionated heparin and it can be useful in assessing coagulation factor deficiencies (vWF, haemophilia A and B) and the presence of excessive anticoagulants. PT evaluates the intrinsic and common pathways; it assesses fibrinogen, thrombin and factors V, VII and X.

It is commonly used to monitor oral anticoagulants by using the international normalised ratio. It can be prolonged in liver disease, vitamin K deficiency and disseminated intravascular coagulation (DIC). TT is used to assess the common pathway only; it is prolonged if fibrinogen or thrombin levels are low or inactive, for example, due to heparin, DIC or multiple myeloma (9,10).

In situations where results are needed promptly, point of care testing may be of benefit. There are several different types of point of care testing which provide a rapid assessment of coagulation status. Some are able to assess platelet function, whilst others look at whole blood and evaluate different parts of the coagulation process, including fibrinolysis.

Two of the most commonly used point of care tests assess the viscoelastic properties of whole blood; these are thromboelastography (TEG®; Haemonetics Corporartion, Braintree, MA, USA) and rotational thromboelastometry (ROTEM®; Tem International GmbH, Munich, Germany).The viscoelastic properties are evaluated by measuring the resistance the blood sample produces on a pin and this can be measured via a transducer mechanism (TEG®) or via impedance (ROTEM®). Both produce a graph (Fig 3.) which requires interpretation.

Reaction time (R) or clotting time (CT) relate to concentration of clotting factors and it is the time from the start of the process to the initial fibrin formation (2mm amplitude). Clot kinetics (K) or clot formation time (CFT) is the speed at which a specific clot strength is reached (2 to 20mm amplitude). Ð angle is the angle between the horizontal line and the tangent at 2mm; it reflects the acceleration of fibrin build up and cross linking. Maximum amplitude (MA) or maximum clot firmness (MCF) reflects the ultimate strength of the clot and is used as a marker of platelet function and number, along with fibrinogen concentration. Clot lysis (CL) or lysis (LY) 30 and 60 is the percentage reduction in amplitude from the MA or MCF at 30 and 60 minutes respectively, both reflecting fibrinolysis and clot stability.

Each test has a specific algorithm associated with it, to advise on the specific product to transfuse in order to treat the patient (11,12). TEG® and ROTEM® both have additional assays which can be added to assess platelet function or fibrinogen contribution to the clot strength respectively (11). Alternative point of care testing can look solely at platelet function; this can be done with both static and dynamic phase testing.

COAGULATION

SJ Sarno

Static phase testing only captures the function at the point of time of testing (*in vitro*) and therefore has limited value, whereas dynamic phase testing looks at platelet function either by assessment of the viscoelastic properties or by adding a platelet activator (thrombin or collagen). This can be useful in assessing antiplatelet drug activity (12).

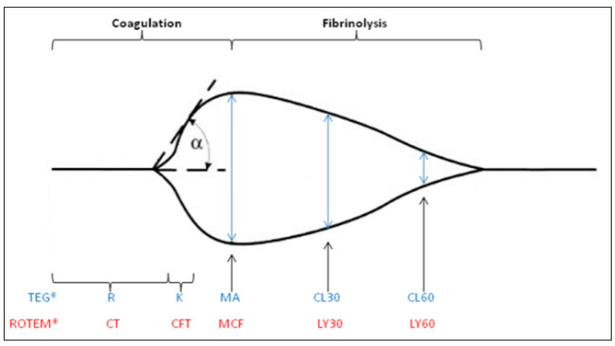


Figure 3: Point of care testing.

Sepsis & Coagulation abnormalities

With respect to our clinical case, this gentleman was suffering from severe sepsis secondary to ascending cholangitis, which resulted in multi-organ failure. His coagulation abnormalities were most likely due to DIC, which is a consumptive coagulopathy resulting from an imbalance between the coagulation and anticoagulation systems.

DIC causes the formation of widespread intravascular thrombi which can lead to multiple microvascular infarcts, compromising organ blood flow and contributing to multi-organ failure. As a result of massive activation of the coagulation system, platelets and coagulation factors are consumed, paradoxically increasing the risk of bleeding (13,14,15). Notably, there is also a reduction in the fibrinolytic and anticoagulation systems, partly due to a reduction in antithrombin III, protein C and its co-factor protein S, and a reduction in TFPI function (16).

Sepsis alone can cause thrombocytopenia due to one or more of the following: impaired platelet production, increased consumption and sequestration into the spleen (13). Impaired production can be secondary to phagocytosis of megakaryoctes by monocytes and marcrophages which are activated in sepsis. Increased thrombin production in sepsis, secondary to an increase in TF and other inflammatory mediators, leads to widespread platelet activation which may subsequently develop into DIC (13,14,15). DIC is more common in bacterial septicaemia and the increase in TF is a result of elevated lipopolysaccharides (14,16).

DIC can be challenging to diagnose; for this reason there are scoring systems based on easily available tests that support the diagnosis. These tests are typically: thrombocytopenia or a rapidly declining platelet count; a prolonged APTT, PT and a grossly prolonged TT; increase in factor VIII; low fibrinogen; elevated d-dimer; decreased protease inhibitors (protein C, protein S and antithrombin III). None of these tests are particularly sensitive or specific, but together they can be useful.

For example, in the clinical case above, thrombocytopenia can be caused by splenomegaly alone; a prolonged APTT, PT, TT and reduced protease inhibitors can be caused by liver failure alone; and a reduced fibrin and increased d-dimer can be caused by sepsis alone (14,16).

Management of DIC is mainly supportive, along with vigorous treatment of the underlying condition. Treatment of coagulation abnormalities via transfusion are only required in actively bleeding patients or those at high risk of bleeding (i.e. those undergoing interventions) and the product required depends on the coagulation abnormality. Prevention of coagulation with anticoagulants in DIC remains controversial. There is no evidence to suggest harm or benefit with heparin or activated protein C, although there is certainly a requirement for prophylactic low molecular weight heparin (13,14,16).

Summary

Coagulation and anticoagulation are two very complex processes that maintain haemostasis. Understanding of the coagulation system has markedly improved and as such, our ability to diagnose and monitor coagulation abnormalities effectively has also improved.

Questions

1. Which one of the following is NOT a risk factor for arterial thrombosis?

a) hyperlipidaemia

b) stasis

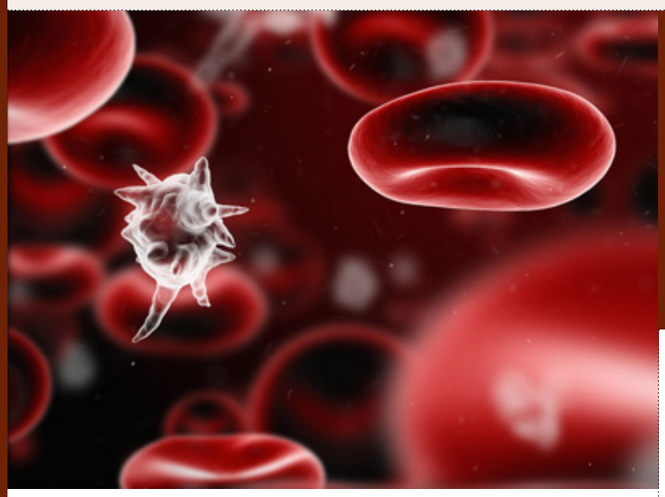
c) smoking

d) hyperviscosity

e) hypertension

COAGULATION

SJ Sarno



Coagulation
Cardiothoracic & Critical Care

2. Which of the following factors can delay coagulation? Can be more than one answer.'

a) anaemia

b) hypothermia

c) high haematocrit

d) normal pregnancy

e) metabolic acidosis

3. The extrinsic pathway is initiated by:

a) factor VII

b) collagen

c) thrombin

d) factor III

e) phospholipids

4. In point of care testing, clot strength correlates to:

a) alpha angle

b) MA

c) K

d) CT

e) LY30

5. Which of the following coagulation blood tests has the highest specificity for DIC?

a) protease inhibitors

b) fibrinogen

c) APTT and PT

d) TT

e) D-dimers

Answers

1. b)

2. b)+e)

3. d)

4. b)

5. a)

COAGULATION

SJ Sarno

Acknowlegments

Dr G Moncaster (Consultant Anaesthetist and Intensive Care) for proof reading the article.

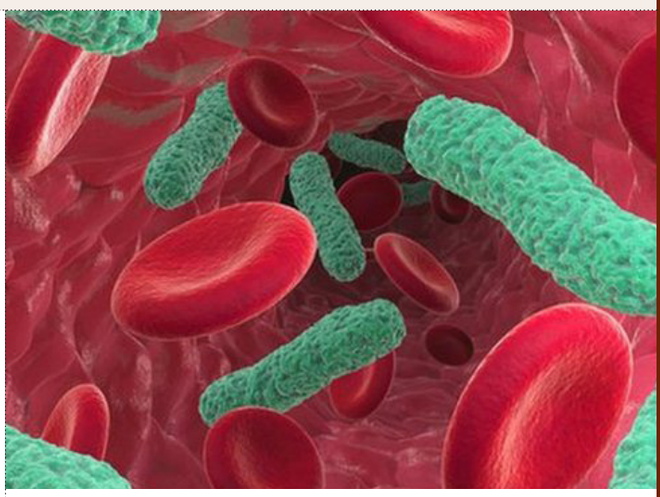
Corresponding Author

S J Sarno,
CT2 Anaesthetics,
Kings Mill Hospital,
Mansfield Road,
Sutton-in-Ashfield,
Nottinghamshire,
NG17 4JL

Email: stephen.sarno1@nhs.net

References

1. Pendleton RC, Rodgers GM, Thrombosis and Antithrombotic Therapy, Wintrobe's Clinical Hematology, 13th edition (2013) 55:1218-1222.
2. Kumar DR, Hanlin ER, Glurich I, Mazza JJ, Yale SH, Virchow's Contribution to the Understanding of Thrombosis and Cellular Biology, History of Medicine, Clinical Medicine & Research (2009) 8:168-172.
3. Bennett PC, Silverman SH, Gill PS, Lip GYH, Peripheral Arterial Disease and Virchow's Triad, Thrombosis and Haemostasis (2009) 101:1032–1040.
4. Makin A, Silverman SH, Lip GYH, Peripheral Vascular Disease and Virchow's Triad for Thrombogenesis, Quarterly Journal of Medicine (2002) 95: 199-210.
5. Bombeli T, Spahn DR, Updates in perioperative coagulation: physiology and management of thromboembolism and haemorrhage, British Journal of Anaesthesia (2004) 93: 275–287.
6. Coagulation cascade, Thrombosis adviser, Available online http://www.thrombosisadviser.com/en/understanding-thrombosis/the-coagulation-cascade/ [Accessed 26th June 2014].
7. Hoffman M, Monroe DM, A cell based model of haemostasis, Thrombosis and Haemostasis (2001) 85:958-965.
8. Dahlbäck B, Blood coagulation, The Lancet (2000) 355:1627-1632.
9. Triplett DA, Coagulation and Bleeding Disorder: Review and Update, Clinical Chemistry (2000) 46:1260-1269.
10. Ehrenschwender M, Koessler J, Brunner K, Steigerwald U, 77-Year-Old Man with a Prolonged Activated Partial Thromboplastin Time, Clinical Chemistry (2012) 58:1402–1407.
11. Srivastava A, Kelleher A, Point-of-care coagulation testing, Continuing education in anaesthesia, critical care and pain (2012) 13:12-16.
12. Enriquez LJ, Shore-Lesserson L, Point-of-care coagulation testing and transfusion algorithms, British Journal of Anaesthesia (2009) 103:14–22
13. Levi M, Opal SM, Coagulation abnormalities in critically ill patients, Critical care (2006) 10:222.
14. Dalainas I, Pathogenesis, diagnosis, and management of disseminated intravascular coagulation: a literature review, European Review for Medical and Pharmacological Sciences (2008) 12:19-31.
15. Riewald M, Ruf W, Science review: Role of coagulation protease cascades in sepsis, Critical Care (2003) 7:123-129.
16. Levi M, Van der Poll T, Disseminated intravascular coagulation: a review for the internist, Internal and Emergency Medicine (2013) 8:23–32.



Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

VARICOCELE

R Sandler

Varicocele
Urology

Abstract

The pampiniform plexus is an anastomosis of vessels, draining the testes and forming the testicular veins in the spermatic cord. The right testicular vein then drains into the inferior vena cava (IVC), whereas the left testicular vein drains into the left renal vein. A varicocele is the result of abnormal dilation of the pampiniform plexus caused by venous reflux. They can be classified as idiopathic or secondary (the latter normally), due to external compression of the renal vein, for example by a renal tumour, retroperitoneal fibrosis/ adhesions or by the superior mesenteric artery and aorta, the "Nutcracker Syndrome" (1). The aim of this article is to present a comprehensive review of this condition highlighting its presentation and management.

Keywords: *varicocele, scrotum, veins.*

Case Study

Mr X, a 22-year-old student, was referred by his GP complaining of a dull ache in the scrotum. He also described the feeling of "a bag of worms" above the left testicle when he examined himself in the shower. He had no urinary symptoms and was not trying to conceive at the time.

On examination, there was a palpable thickening of the spermatic cord on standing, though this was not visible on inspection. The volume of his right testicle was estimated using an orchidometer as 20ml, and the left of 15ml. In light of this, a scrotal ultrasound with colour doppler was performed, revealing right testicular volume of 18ml and left testicular volume of 15ml. 4 veins increased in diameter during a valsalva manoeuver, in keeping with diagnosis of varicocele (2).

Semen analysis was arranged, revealing mild oligozoospermia at 10x106/ mL. As Mr X is not currently conceiving, he was managed with simple analgesia and follow-up was arranged for 12 months to monitor testicular volume and semen parameters. He was counseled that he may experience subfertility in the future but reassured that there were treatment options available, which he can consider at the appropriate time.

Epidemiology & Aetiology

Varicocele is most commonly seen in adolescents with an estimated prevalence of 12.4-17.8% (3–5). Almost 90% are unilateral and occur on the left side, thought to be due to the anatomical differences between the left and right testicular veins (6).

The left testicular vein is longer and drains into the left renal vein, whereas the shorter right testicular vein drains into the inferior vena cava (IVC). One proposed aetiology of idiopathic varicocele is that the left testicular vein is more likely to suffer valvular incompetence as it is longer, at higher pressure and has more valves which may become incompetent (7).

However, valvular competence and incompetence have both been demonstrated in the presence and absence of varicocele (8). Another contributing factor may be the right-angle at which the left testicular vein joins the left renal vein, as opposed to right testicular vein, which joins the IVC obliquely, resulting in increased pressure (9).

VARICOCELE

R Sandler

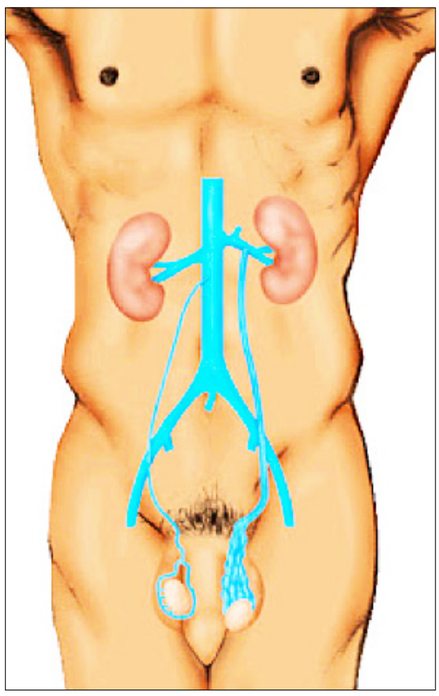


Image 1: Venous drainage of the testes. Reproduced from (10).

Presentation

Varicoceles are often asymptomatic and detected on routine physical examination. However, a large varicocele can present with a vague, dragging sensation and ache in the scrotum or groin. The sudden appearance of a varicocele in middle or old age, or a solitary right-sided varicocele should raise suspicion of an underlying secondary cause, such as a renal tumour, and warrants immediate referral to a urologist (7), (11).

Examination

The aim of examination is to identify and grade a varicocele. When examining the scrotum, the patient must be standing, preferably in a warm room to relax the scrotum and allow the veins to fill. When supine, the veins collapse and can be impossible to visualise or palpate. Inspect the scrotum, at eye level, for tortuous, dilated veins. Gently palpate the testes and cord structures.

A palpable varicocele can be classically described as a bag of worms, but also may feel like a thickened, asymmetric cord. The testicle below a large varicocele may be smaller and softer than the contra-lateral testicle. Finally ask the patient to perform a valsalva manoeuvre, which may distend the pampiniform plexus and aid palpation.

Grade	*Definition*
I	Palpable with valsalva only
II	Palpable without valsalva
III	Visible on inspection without valsalva

Table 1: Grading of varicocele on physical examination (adapted from (12).

Following standing examination, lie the patient supine and inspect the scrotum. Idiopathic varicocele, prominent on standing, should disappear when supine. Inspect and palpate the testes and spermatic cord once more. If visual distention or palpable thickening remains, then a secondary cause should be considered.

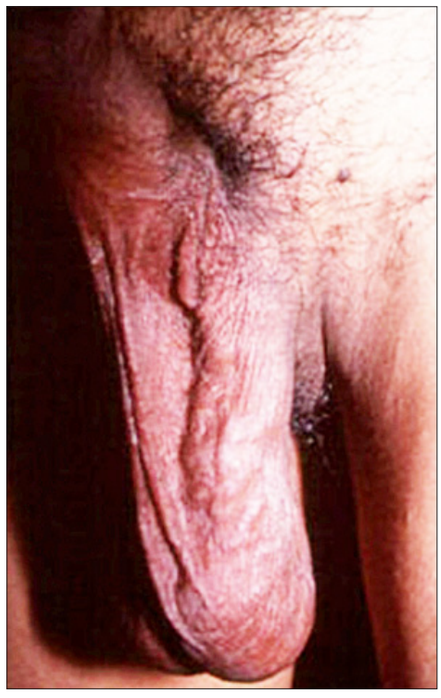
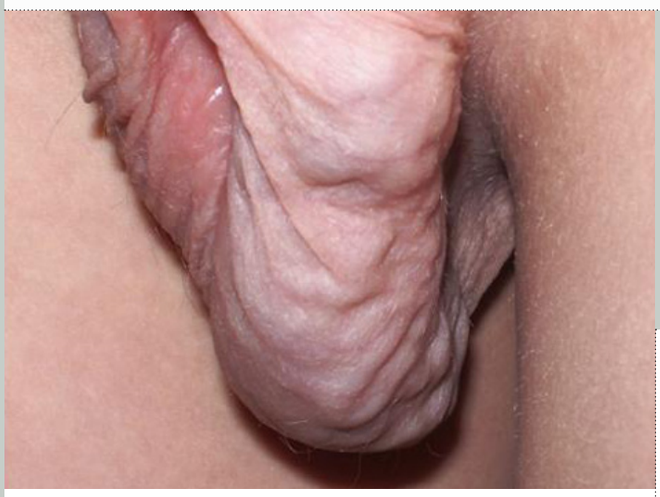


Image 2: A Grade 3 varicocele from (13)

VARICOCELE

R Sandler



Varicocele
Urology

It is important to assess whether the varicocele is having a negative impact on testicular growth. It is important to get an accurate measurement of testicular volume and identify discrepancies (>2mL) between the 2 testes. For its superior accuracy to a Prader Orchidometer, ultrasound with colour doppler (to assess direction of venous flow) is recommended (14)(15)(16).

Effect On Testes & Fertility

The main cause for debate as to the treatment of varicocele is the association with sub - or infertility. The incidence of varicocele in subfertile men is estimated around 37%, as opposed to the aforementioned incidence in the general population of around 12-17% (17).

In men with varicocele, the ipsilateral testicle is commonly smaller than the contralateral (18). The reduction in testicular volume correlates with the grading of the varicocele (19). Patients with varicocele are at risk of semen abnormalities, including oligo- (low sperm count) astheno- (poor sperm motility) or terato- (poor sperm morphology) zoospermia (20)(21).

One reason for these abnormalities may be increased scrotal temperature, normally regulated by a counter-current mechanism derived from the close communication of the pampiniform plexus and testicular arteries (22). In varicocele, this mechanism is inefficient and scrotal temperature increases, which can inhibit spermatogenic DNA and metabolic activity in the testes (23)(24). Other contributors to this effect may be increased oxidative stress and leydig cell atrophy (25)(26). In spite of these theories and findings, there is still debate as to whether the varicocele is causative of these abnormalities.

Treatment

In most patients, varicocele is a benign finding, which does not warrant treatment. Wearing supported underwear and simple analgesia are recommended by the National Institute of Health and Care Excellence (NICE) to manage discomfort (11). NICE do not recommend varicocele surgery as a method of treating infertility, however varicocelectomy performed to relieve pain is effective (27). There has, however, been confusion as to the benefit of varicocelectomy on semen quality, testicular size/development and fertility, as described in a review by Schlesinger et al, calling for appropriately designed trials before recommending treatment (28).

A recent Cochrane review has found benefit, but criticizes the lack of well-designed studies from which they can pool data, having drawn mostly from small studies. Post-varicocelectomy improvement in semen parameters has been observed, however associated improvements in fertility are not as clear and the strongest evidence is for the treatment of bilateral varicocele in known sub-fertile men (29–34). A 2012 meta-analysis concluded that, in children and adolescents with varicocele and testicular size discrepancy, testicular hypotrophy is reduced following varicocelectomy (35). Improvements are most likely to be seen in younger patients (under 25 years of age) within 3 months of surgery (36,37).

Surgical Procedures

The preferred method at our local centre is trans-venous varicocele embolisation, which can be performed under local anaesthetic as an outpatient. This involves catheterisation of the internal spermatic vein followed by occlusion with a sclerosant, metal device or both. In the case of treating a left-sided varicocele, access will be gained using the Seldinger technique to catheterise the internal jugular or common femoral vein until the left renal vein is located. Venography will confirm the location of the catheter and identify any collateral vessels prior to embolization (9). This procedure has a success rate of 92.4%-96% with recurrence rates under 4% (38).

VARICOCELE

R Sandler

The laparoscopic technique typically involves 3 ports; the initial camera port is placed at the umbilicus and additional ports are placed lateral to the rectus muscle. The spermatic veins are flattened by the pneumoperitoneum and therefore the artery appears more tubular than surrounding structures. After incising through the posterior peritoneum the veins are clipped and transected (9). This approach has a recurrence rate of 3–7% (39).

There are 3 open surgical methods, which involve identification and ligation of the dilated veins. The inguinal (Ivanissevich) method involves making an incision parallel to the inguinal ligament, between the internal and external inguinal rings. The spermatic cord is identified and mobilised. Large cremasteric veins are ligated. The coverings of the spermatic cord are opened and the spermatic vessels are exposed. The spermatic artery is isolated and the dilated veins are double-ligated using a non-absorbable suture and divided (9). This approach is associated with 13.3% recurrence rates (40).

The retroperitoneal (Palomo) method uses a 2cm horizontal incision, medial and inferior to the anterior superior iliac spine, to the internal inguinal ring. After dissecting the subcutaneous tissues, the external oblique fascia is identified and incised in the direction of its fibres. Subsequently the internal oblique and transversus abdominus muscles are opened bluntly expose the retroperitoneal space. The spermatic veins are subsequently ligated and divided using non-absorbable sutures with attempts made to preserve the artery (9). This approach has a recurrence rate of 29% (40).

The subinguinal (Marmar) method involves a small incision made just below the level of the external inguinal ring. The spermatic cord is identified, freed from the overlaying fascia and exposed. The spermatic veins are then isolated and double-ligated with a non-absorbable suture (9). The recurrence rate following this method is approx. 0–4% (24) and the outcomes are superior to open inguinal or laparoscopic techniques (41).

MCQs: True/False

1) Regarding the anatomy of the vascular supply of the testes, answer each as true or false:

a. The left testicular vein drains directly into the inferior vena cava (IVC)

b. The pampiniform plexus is comprised of arterial and venous vessels

c. The right testicular vein enters the (IVC) at a right angle

d. The left testicular vein is longer the right testicular vein

e. Varicocele is more common on the right side

2) Regarding the diagnosis of varicocele, answer each as true or false:

a. Most patients will present asymptomatically

b. A grade 1 varicocele is detected on palpation of the scrotum in a supine position with no need for a valsalva manoeuvre to exaggerate it

c. In a patient with a left-sided varicocele contralateral testicle will often be smaller that the ipsilateral

d. Scrotal ultrasound is the gold standard method to identify testicular volume

e. Doppler colour studies are used to measure vascular diameter and blood flow in the pampiniform plexus

3) Regarding the management of varicocele, answer each as true or false:

a. The majority of patients will require no treatment

b. Simple analgesia and supportive underwear are recommended to relieve discomfort resulting from varicocele

c. Varicocele surgery is recommended by NICE as first line for patients with subfertility secondary to varicocele

d. Transvenous varicocele emobolisation has a success rate of 85%

e. The subinguinal (Marmar) approach has superior outcomes to the retroperitoneal (Palomo) and inguinal (Ivanissevich) methods?

VARICOCELE

R Sandler

MCQ Answers

1) F, F, F, T, F

2) T, F, F, T, T

3) T, T, F, F, T

Correspondence Address

Dr Robert Sandler
FY1, Department of Urology,
Sheffield Teaching Hospitals, Sheffield.
Email: robert.sandler@sky.com

References

1. Rudloff U, Holmes RJ, Prem JT, Faust GR, Moldwin R, Siegel D. Mesoaortic compression of the left renal vein (nutcracker syndrome): case reports and review of the literature. Ann Vasc Surg [Internet]. 2006 Jan [cited 2014 Jul 11];20(1):120–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16374539
2. Sakamoto H, Saito K, Shichizyo T, Ishikawa K, Igarashi A, Yoshida H. Color Doppler ultrasonography as a routine clinical examination in male infertility. Int J Urol [Internet]. 2006 Aug [cited 2014 Jul 15];13(8):1073–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16903932
3. Oster J. Varicocele in children and adolescents. An investigation of the incidence among Danish school children. Scand J Urol Nephrol [Internet]. 1971 Jan [cited 2014 Jul 11];5(1):27–32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/5093090
4. Niedzielski J, Paduch D, Raczynski P. Assessment of adolescent varicocele. Pediatr Surg Int [Internet]. 1997 Jul [cited 2014 Jul 11];12(5-6):410–3. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9244112
5. Erokhin AP. [Classification and frequency of varicocele in children]. Klin Khir [Internet]. 1979 Jun [cited 2014 Jul 11];(6):45–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/459263
6. Akbay E, Çayan S, Doruk E, Duce MN, Bozlu M. The prevalence of varicocele and varicocele-related testicular atrophy in Turkish children and adolescents. BJU Int [Internet]. 2000 Sep 2 [cited 2014 Jul 11];86(4):490–3. Available from: http://doi.wiley.com/10.1046/j.1464-410X.2000.00735.x
7. Browse NL, Black J, Burnand KG, Thomas WE. The External Genitalia. Browse's Introduction to the Symptoms and Signs of Surgical Disease. 4th ed. London: Hodder Eduacation; 2005. p. 331–58.
8. Wishahi MM. Anatomy of the spermatic venous plexus (pampiniform plexus) in men with and without varicocele: intraoperative venographic study. J Urol [Internet]. 1992 May [cited 2014 Jul 11];147(5):1285–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1569670
9. Mohammed A, Chinegwundoh F. Testicular varicocele: an overview. Urol Int [Internet]. 2009 Jan [cited 2014 Jul 11];82(4):373–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19506401
10. Primila Ramayya Urology Hospital. Varicocele: All you want to know [Internet]. 2013 [cited 2014 Jul 24]. Available from: http://drramayyas.blogspot.co.uk/2013/03/varicocele-all-you-want-to-know.html
11. NICE CKS. Varicocele [Internet]. 2012 [cited 2014 Jul 14]. Available from: http://cks.nice.org.uk/varicocele#!scenariorecommendation:1
12. Dubin L, Amelar RD. Varicocele size and results of varicocelectomy in selected subfertile men with varicocele. Fertil Steril [Internet]. 1970 Aug [cited 2014 Jul 11];21(8):606–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/5433164
13. Shah B. Varicocele [Internet]. [cited 2014 Jul 24]. Available from: http://drbcshah.com/varicocele/
14. Costabile RA, Skoog S, Radowich M. Testicular volume assessment in the adolescent with a varicocele. J Urol [Internet]. 1992 May [cited 2014 Jul 11];147(5):1348–50. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1569681
15. Diamond DA, Paltiel HJ, DiCanzio J, Zurakowski D, Bauer SB, Atala A, et al. Comparative assessment of pediatric testicular volume: orchidometer versus ultrasound. J Urol [Internet]. 2000 Sep [cited 2014 Jul 11];164(3 Pt 2):1111–4. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10958754
16. TaÐçi AI, Resim S, CaÐkurlu T, Dinçel C, Bayraktar Z, Gürbüz G. Color doppler ultrasonography and spectral analysis of venous flow in diagnosis of varicocele. Eur Urol [Internet]. 2001 Mar [cited 2014 Jul 11];39(3):316–21. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11275726
17. Greenberg SH, Lipshultz LI, Wein AJ. Experience with 425 subfertile male patients. J Urol [Internet]. 1978 Apr [cited 2014 Jul 14];119(4):507–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25971
18. Lipshultz LI, Corriere JN. Progressive testicular atrophy in the varicocele patient. J Urol [Internet]. 1977 Feb [cited 2014 Jul 11];117(2):175–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/833961
19. Sigman M, Jarow JP. Ipsilateral testicular hypotrophy is associated with decreased sperm counts in infertile men with varicoceles. J Urol [Internet]. 1997 Aug [cited 2014 Jul 11];158(2):605–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9224376
20. Christman MS, Zderic SA, Kolon TF. Comparison of semen analyses in youths with a history of cryptorchidism or varicocele. J Urol [Internet]. 2013 Oct [cited 2014 Jul 12];190(4 Suppl):1561–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23416638
21. MacLeod J. Seminal cytology in the presence of varicocele. Fertil Steril [Internet]. [cited 2014 Jul 12];16(6):735–57. Available from: http://www.ncbi.nlm.nih.gov/pubmed/5842235
22. Dahl E V, Herrick. A vascular mechanism for maintaining testicular temperature by counter-current exchange. Surg Gynecol Obstet [Internet]. 1959 Jun [cited 2014 Jul 12];108(6):697–705. Available from: http://www.ncbi.nlm.nih.gov/pubmed/13659355
23. Zorgniotti AW, Macleod J. Studies in temperature, human semen quality, and varicocele. Fertil Steril [Internet]. 1973 Nov [cited 2014 Jul 12];24(11):854–63. Available from: http://www.ncbi.nlm.nih.gov/pubmed/4742006
24. Goldstein M, Eid JF. Elevation of intratesticular and scrotal skin surface temperature in men with varicocele. J Urol [Internet]. 1989 Sep [cited 2014 Jul 12];142(3):743–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/2769853
25. Pasqualotto FF, Sundaram A, Sharma RK, Borges E, Pasqualotto EB, Agarwal A. Semen quality and oxidative stress scores in fertile and infertile patients with varicocele. Fertil Steril [Internet]. 2008 Mar [cited 2014 Jul 12];89(3):602–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17485092
26. Hadziselimovic F, Leibundgut B, Da Rugna D, Buser MW. The value of testicular biopsy in patients with varicocele. J Urol [Internet]. 1986 Apr [cited 2014 Jul 12];135(4):707–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/3083115

VARICOCELE

R Sandler

27. Peterson AC, Lance RS, Ruiz HE. Outcomes of varicocele ligation done for pain. J Urol [Internet]. 1998 May [cited 2014 Jul 14];159(5):1565–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9554356
28. Schlesinger MH, Wilets IF, Nagler HM. Treatment outcome after varicocelectomy. A critical analysis. Urol Clin North Am [Internet]. 1994 Aug [cited 2014 Jul 14];21(3):517–29. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8059505
29. Kroese ACJ, de Lange NM, Collins JA, Evers JLH. Varicocele surgery, new evidence. Hum Reprod Update [Internet]. [cited 2014 Jul 14];19(4):317. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23515200
30. Li F, Chiba K, Yamaguchi K, Okada K, Matsushita K, Ando M, et al. Effect of varicocelectomy on testicular volume in children and adolescents: a meta-analysis. Urology [Internet]. 2012 Jun [cited 2014 Jul 14];79(6):1340–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22516359
31. Pajovic B, Radojevic N. Prospective follow up of fertility after adolescent laparoscopic varicocelectomy. Eur Rev Med Pharmacol Sci [Internet]. 2013 Apr [cited 2014 Jul 14];17(8):1060–3. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23661519
32. Schauer I, Madersbacher S, Jost R, Hübner WA, Imhof M. The impact of varicocelectomy on sperm parameters: a meta-analysis. J Urol [Internet]. 2012 May [cited 2014 Jul 14];187(5):1540–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22425089
33. Agarwal A, Deepinder F, Cocuzza M, Agarwal R, Short RA, Sabanegh E, et al. Efficacy of varicocelectomy in improving semen parameters: new meta-analytical approach. Urology [Internet]. 2007 Sep [cited 2014 Jul 14];70(3):532–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17905111
34. Hassanzadeh-Nokashty K, Yavarikia P, Ghaffari A, Hazhir S, Hassanzadeh M. Effect of age on semen parameters in infertile men after varicocelectomy. Ther Clin Risk Manag [Internet]. 2011 Jan [cited 2014 Jul 14];7:333–6. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3176165&tool=pmcentrez&rendertype=abstract
35. Al Bakri A, Lo K, Grober E, Cassidy D, Cardoso JP, Jarvi K. Time for improvement in semen parameters after varicocelectomy. J Urol [Internet]. 2012 Jan [cited 2014 Jul 14];187(1):227–31. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22100000
36. Marmar JL, Agarwal A, Prabakaran S, Agarwal R, Short RA, Benoff S, et al. Reassessing the value of varicocelectomy as a treatment for male subfertility with a new meta-analysis. Fertil Steril [Internet]. 2007 Sep [cited 2014 Jul 14];88(3):639–48. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17434508
37. Madgar I, Weissenberg R, Lunenfeld B, Karasik A, Goldwasser B. Controlled trial of high spermatic vein ligation for varicocele in infertile men. Fertil Steril [Internet]. 1995 Jan [cited 2014 Jul 14];63(1):120–4. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7805900
38. Dewire DM, Thomas AJ, Falk RM, Geisinger MA, Lammert GK. Clinical outcome and cost comparison of percutaneous embolization and surgical ligation of varicocele. J Androl [Internet]. [cited 2014 Jul 15];15 Suppl:38S–42S. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7721675
39. Miersch WD, Schoeneich G, Winter P, Buszello H. Laparoscopic varicocelectomy: indication, technique and surgical results. Br J Urol [Internet]. 1995 Nov [cited 2014 Jul 15];76(5):636–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8535687
40. Bassi R, Radice F, Bergami G, De Grazia F, Papa B. [Surgical treatment of varicocele. Our experience in the last 10 years]. Minerva Chir [Internet]. 1996 [cited 2014 Jul 15];51(7-8):533–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8975158
41. Al-Kandari AM, Shabaan H, Ibrahim HM, Elshebiny YH, Shokeir AA. Comparison of outcomes of different varicocelectomy techniques: open inguinal, laparoscopic, and subinguinal microscopic varicocelectomy: a randomized clinical trial. Urology [Internet]. Elsevier; 2007 Mar 3 [cited 2014 Jul 15];69(3):417–20. Available from: http://www.goldjournal.net/article/S0090429507001239/fulltext

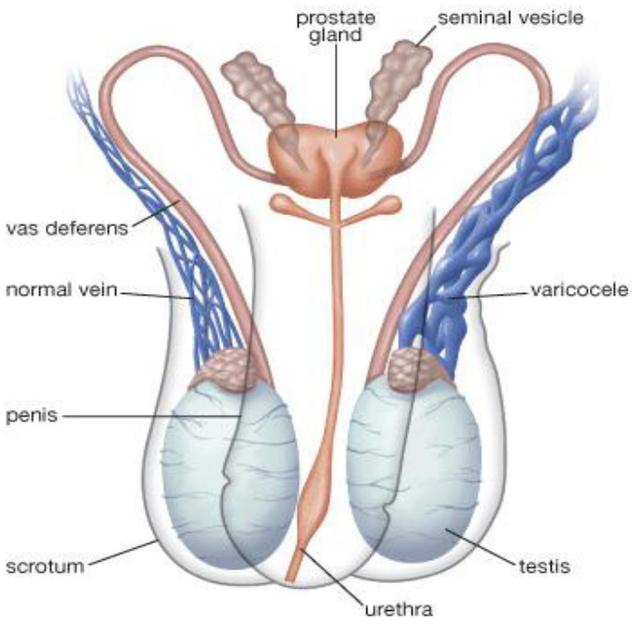
Disclaimers

Conflict Of Interest

The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

Financial Statement

The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.



Varicocele
Urology

Patient Consent statement:

All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights

When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

COURSE REVIEW: 98TH ANNUAL ANATOMY & HISTOPATHOLOGY OF THE HEAD, NECK & TEMPORAL BONE

S Okhovat

Abstract

The following is a review of the above course which was held on 13th-20th July 2013 at the Van Nuys Medical Science Building, Indianapolis, Indiana, USA. The course was organised by The Department of Otolaryngology-Head and Neck Surgery and the Division of Continuing Medical Education of the Indiana University School of Medicine.

Keywords: *training, head & neck, ENT, continuing professional development.*

Introduction

The Annual Anatomy and Histopathology of the Head, Neck and Temporal Bone course, has been offered continuously for 98 years and is the oldest running post-graduate course of any discipline in the US.

It is an 8 day intensive lecture-based as well as human cadaveric dissection course, covering all aspects of Otolaryngology and head and neck surgery with emphasis on applied anatomy.

Course Review: 98th Annual Anatomy & Histopathology Of The Head, Neck & Temporal Bone
Otorhinolaryngology & Neck Surgery

The course was delivered at the Van Nuys Medical Science building, associated with the Riley Hospital for Children at Indiana University Hospital, in the heart of the Medical district.

The faculty comprised predominantly of Otolaryngology, Rhinology, Head and Neck, Reconstructive and Facial Plastics surgeons from Indiana University School of Medicine Faculty, with guest faculty from prestigious institutes from around the US. In addition, a multidisciplinary team of anatomists, histopathologists and radiologists helped deliver the lectures.

The course was co-ordinated by very young and enthusiastic Head and Neck surgeons, Dr. Micheal Moore and Dr. Joseph Brigance, led by Professor of Otology Dr. Miyamoto.

Who Is It For?

With the exception of myself (CT1 surgery), all delegates were otolaryngology residents (equivalent of specialty registrar) at different stages in their career, coming from different parts of the US.

The course is aimed at surgical trainees in ENT and Plastic Surgery and provides a solid grounding in both the theoretical as well as applied anatomy of Otorhinolaryngology and Head and Neck surgery, and gives the opportunity to the delegates to perform surgical procedures in a controlled environment. The experience and expertise of the faculty meant that all participants including medical students with interest in ENT surgery could find the material relevant and applicable to their stage of training.

COURSE REVIEW: 98TH ANNUAL ANATOMY & HISTOPATHOLOGY OF THE HEAD, NECK & TEMPORAL BONE

S Okhovat

Why Did You Do It?

As a CT1 in Surgery, with limited ENT experience, I needed to broaden my knowledge base as well as practical surgical skills. My educational supervisor introduced me to this course, who himself had attended when he was at my stage in his training and found it to be extremely useful.

This course was unique in that it was an "all-in-one" comprehensive course, combining Head and Neck, Temporal Bone, Sinus Surgery, free flap reconstruction and facial plastics and more, in one intensive format. It was perfect for juniors and more seniors alike and provided an unparalleled exposure to all aspects of ENT surgery and helped build knowledge and confidence.

I also used this as a revision course for preparation for the DO-HNS exams and this dramatically improved my final performance.

As a junior trainee I found it an invaluable experience to meet ENT trainees in the US, share our experience of training in different systems, the challenges and pitfalls of each healthcare system (the American system vs. NHS) and broaden our perception of the practices and standards within a global ENT community.

What Is The Structure Of The Course?

The course is often advertised in March and usually runs during the second week of July (dates are variable and are announced in advance). It caters for a maximum of 32 delegates. The lectures were delivered in either the main lecture hall or in the anatomy dissection labs.

The dissections were in the anatomy labs. Temporal bone laboratory was used for micro-vascular course and temporal bone dissection.

There were roughly 2-3 candidates sharing a fresh frozen cadaver allowing for best hands on experience.

The course was divided into 3 sections, and there was the opportunity for attending particular days or the entire course.

Days 1-2 covered Head and Neck Free Flap Reconstruction Course; Days 3-6 focused on Head and Neck Anatomy and Histopathology and cadaveric dissections (including Sinus surgery course). Days 7-8 were dedicated to Otology and Temporal Bone dissection.

The course had an extremely professional yet friendly format with instructors constantly overseeing your performance, helping you through dissections, sharing their knowledge and always available to answer your questions.

Support was also available from commercial company reps who provided some of the equipment.

This course awards Fifty AMA PRA category 1 Continuing Medical Education points for attendance and participation in the entire course.

Outline Of The Course

	Lectures	Dissections
Day 1: *Head and Neck Reconstruction and Free Flap Course*	Welcome, introduction, distribution of the course material. All lectures delivered in the dissection room followed by cadaveric dissection.	• Pectoralis major flap • Radial forearm flap • Supraclavicular flap • Rectus abdominus flap • Antero-lateral thigh flap
Day2: *Head and Neck Reconstruction, Free Flap Course and Microvascular Techniques*	Further examples of free flaps and microvascular techniques	• Fibula free flap • Latissimus dorsi free flap • Scapula free flap • Microvascular techniques (hands on practice)
Day 3: *Facial Plastics*	Anatomy: superficial face, nose and scalp; surgical anatomy of the nose and Rhinoplasty; histopathology: benign and malignant skin lesions; basic facial trauma; local flap reconstruction.	• Temporalis fascia free flap • Rhinoplasty • Local flaps • Facial and mandible fracture management
Day 4: *Head & Neck Anatomy and Histopathology I*	Anatomy: Lateral Neck, neck dissection fundamentals, thyroid surgical anatomy and the RLN. Histopathology: Oral Cavity, Thyroid and Parathyroid glands.	• Neck Dissection • Thyroidectomy
Day 5: *Sinus Surgery*	Surgical anatomy of the sinuses, medical management of sinusitis, basic endoscopic sinus surgery, frontal approaches, complication of ESS, orbital surgery, endoscopic pituitary and skull base surgery.	• FESS • Spheno-ethmoidectomy • Frontal endoscopic sinusotomy ***Dinner Lecture:*** *Management of Recalcitrant CRS patient*
Day 6: *Head & Neck Anatomy and Histopathology II*	Anatomy: Parotid compartment, infratemporal fossa, and pterygopalatine fossa, CPA anatomy and sub-occipital approach. Histopathology: Salivary gland pathology, parotid surgery, surgery of the larynx.	• Parotidectomy • Excision of submandibular gland • Laryngectomy
Day 7-8: *Otology and Temporal Bone Dissection Course:*	Anatomy of the external, middle, and inner ear, skull base anatomy. Meniere's disease and vertigo, glomus tumours. Histopathology of the temporal bone (basic + advanced), cochlear implantation.	• Temporal bone dissection ***Course Reception:*** *President's room, on IU campus.*

COURSE REVIEW: 98TH ANNUAL ANATOMY & HISTOPATHOLOGY OF THE HEAD, NECK & TEMPORAL BONE

S Okhovat

Course Review: 98th Annual Anatomy & Histopathology Of The Head, Neck & Temporal Bone
Otorhinolaryngology & Neck Surgery

Highlights

- **Head and Neck Reconstruction course: raising flaps especially the pectoralis major flap.**

- **Facial Plastics day: taught by some of the leaders in the field (William H Beeson), practicing septoplasty, rhinoplasty, and local facial flaps under their guidance.**

- **Sinus surgery day: by far the most exciting. Excellent lectures, followed by practical dissection, supervised by and exceptionally gifted faculty (most notably Raj Sindwani from the Cleveland Clinic). Practiced basic sinus surgery skills and slightly more ambitious attempts at transphenoidal access! Learnt how to perform an endoscopic SPA ligation.**

- **Performing a superficial parotidectomy, skin to skin.**

- **Very welcoming approachable and knowledgeable young faculty of supervisors and instructors.**

- **Excellent opportunity to trainees from different parts of the world and share experiences.**

What Were The Facilities & How Much Does It Cost?

The course was held in the Van Nuys Medical science Building and the temporal bone laboratory. Breakfast and lunch was provided with refreshments as well as a course dinner on two occasions.

The fees varied depending on which days you chose to attend. For the entire 8 days a discounted fee for residents in training was set at $1500 (approximately £895) which is incredible value for money.

Travel costs were not negligible. Flights from London to Indianapolis often go via Chicago and costs around £900.

Lots of accommodation options are available including campus accommodation. However I recommend staying somewhere close by, where you can walk to the venue. Cost of serviced apartments for 9 nights were approximately £450.

The total expenditure for this course is roughly £2500, (£600 study budget can be applied here making it roughly £1900) which may seem like a lot of money. However, when you consider that an average head and neck dissection course in the UK costs £700-800, Temporal bone course costs £500, Sinus surgery course costs £650, one realises that it is a very good value for money and offers an unparalleled experience.

Was It Worth It?

As a core surgical trainee gaining exposure and confidence in ENT surgery requires motivation and self-directed learning. The concepts of anatomy and histopathology can often be difficult to grasp and applied anatomy and surgical techniques are often hard to appreciate.

This course for me, de-mystified the field of ENT, and made the information accessible. It offered a unique opportunity to immerse myself in both theoretical and practical aspects of ENT surgery, and develop my surgical skills in a friendly and supportive setting. It provided the right balance between lectures and hands on dissection. No course covers such a diverse range of material in such an intense format.

COURSE REVIEW: 98TH ANNUAL ANATOMY & HISTOPATHOLOGY OF THE HEAD, NECK & TEMPORAL BONE

S Okhovat

It encouraged us to make mistakes in a controlled environment, and appreciate the challenges and pitfalls of surgery. The instructors would share their experiences, and helped us develop confidence and maturity as junior trainees. The course was filled with plenty of "Eureka" moments, when previously learnt concepts suddenly made sense.

It served as a fantastic revision tool for the DO-HNS exam, obviating the need for further courses. It will set you apart from other candidates.

It has also provides a unique understanding of sub-specialities within Otolaryngology and has helped me develop an interest in Head and Neck Surgery.

It has made me confident in my day-to-day practice and I strongly recommend this experience to all core trainees with an interest in ENT surgery.

Further Information

Indianapolis University CME website:
http://cme.medicine.iu.edu/event/98th-annual-anatomy-and-histopathology-of-the-head-neck-and-temp/.

Acknowledgement
Mr. Alisdair Mace for his support and guidance.

Correspondence Address

Saleh Okhovat MRCS, DO-HNS,
Core Surgical Trainee Year 2,
St Mary's Hospital, London
Email: saleh.okhovat@gmail.com

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Course Review: 98th Annual Anatomy & Histopathology Of The Head, Neck & Temporal Bone
Otorhinolaryngology & Neck Surgery

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

GASTROINTESTINAL DUPLICATIONS

K Sampat

Abstract

Gastrointestinal duplications are rare congenital anomalies that can present at any age, but tend to be diagnosed in the paediatric age group. They are described as cystic lesions with a two-layer smooth muscle wall and internal epithelium, which is either adjacent to or intrinsic with the normal intestine (1). Unlike other cystic lesions of the gut, duplications often have a gastrointestinal mucosal lining.

Cysts can occur anywhere from mouth to anus, and although they are often incidental findings, they may present with a variety of presentations including vomiting, bleeding, obstruction or perforation. Treatment usually involves surgical excision of the duplication, however resection of adjacent bowel is sometimes necessary.

Keywords: *Duplication cysts; alimentary cysts; gastric cyst; ileal cyst; paediatric, enteric cyst.*

Case Vignette

A 2 month old girl presented with persistent non bilious vomiting and a left upper quadrant mass. Antenatal history was unremarkable. An ultrasound scan showed a 5cm x 5cm cyst compressing the stomach. A provisional diagnosis of a duplication cyst was made. At laparotomy a large gastric cyst was found incorporated into the greater curvature. Due to the proximity to the pylorus and the size of the cyst, a decision was made for partial resection of the cyst and drainage with an internal cystogastrostomy and closure of the stomach. The postoperative course was uneventful and the child is asymptomatic at follow-up.

Introduction

The term 'duplication of the alimentary tract' was first coined by Ladd who described a lesion in which a cyst with both smooth muscle and epithelial lining arose from the alimentary tract. Various other terms such as enterocystomas, enterogenous cysts, ileum duplex, and giant diverticula have all been used to describe the same phenomenon.

Incidence

The true incidence of these anomalies is not known as some patients are asymptomatic and often go undiagnosed. The estimated prevalence is 1:4500 births, and equally prevalent between males and females. (2)

Embryology

There are many postulations for the formation of duplication cysts, although none are proven:

Abnormalities of recanalisation of the solid stage:
Bremer suggested that failure of vacuoles to form and coalesce during the recanalisation of the bowel in week 5 to 6 of embryogenesis leads to duplication formation. (3)

Split Notocord Theory:
Bentley proposed a theory where failure of separation of the gut endoderm and the neural tube ectoderm which would normally occur in week 4 leads to traction of the gut towards the vertebral bodies. This creates out-pouchings, which develop into tubular duplications; if these tubes detach then a duplication cyst occurs. This theory may explain the formation of neuroenteric cysts, as well as the associated spinal anomalies that can be seen with foregut duplications. (4)

Abortive Twinning Theory:
Case reports of total colonic duplication, or duplications associated with duplex ureters have supported the theory of abortive twinning hypothesis as a possible causative factor.(5)

GASTROINTESTINAL DUPLICATIONS

K Sampat

Remnants of embryological diverticula:
This theory suggests that small, usually transient diverticula found on the intestinal wall of embryo persist and give rise to the duplications. This theory could explain the higher incidence of ileal duplications, as this is where most diverticula occur. However duplications are classically noted to be paramesenteric while diverticula are usually found on the antimesenteric side. (6)

Environmental Factors:
Patients presenting with obstruction or perforation secondary to ileal or jejunal atresias have also been noted to have concurrent duplication cysts, suggesting a vascular accident or environmental factor, key to the formation of the duplication. (7)

Classification

Traditionally duplications have been classified by their macroscopic appearance; they are divided into the more common cystic lesions and the less frequent tubular structures. Cystic lesions may be completely separate from the adjacent bowel lumen or free in the peritoneal cavity with only a thin mesenteric stalk, whereas the tubular lesions may communicate with the lumen on one or both sides, or not at all (8).

Li et al proposed a classification system according to the vascular supply of a lesion from studying 80 patients over a 25 year period. They found that small bowel duplication either had a **parallel vascular** supply arising from a leaf of mesentery where the straight artery is separate to the straight artery of the bowel, or **an intramesenteric supply** as the cyst sits between two leaves of mesentery. The majority of small bowel lesions had a parallel vascular supply and so duplications of small intestines have relatively independent vascular supplies and could be resected without the adjacent bowel. (9)

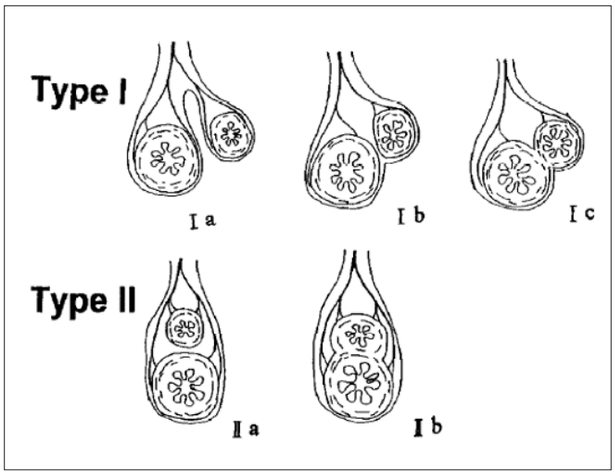


Figure 1: Classification of small intestinal duplication. Type 1 shows a duplication to one side of the mesentery with a straight arterial blood supply. In type 2 the arterial supply passes over both surfaces of the duplication, which is encased between two leaves of mesentery. (Taken from Li et al 1998).

Structure & Site

Duplications can present in a number of sites, may be single or multiple, and can vary in size. Spherical cysts can vary from 1cm to 10cm and some tubular cysts have been described as being up to 65cm. (8). They are lined with mucosa, which is either similar to the adjacent gastrointestinal (GI) tract or ectopic mucosa; more commonly this represents gastric mucosa or even pancreatic tissue but histological findings of ganglion cells or lymphoid aggregates have also been reported. (10) Some cases of duplication cysts with gastric mucosa have presented with perforation or bleeding similar to that of a peptic ulcer due to ectopic acid production.

Although most commonly described in the small intestine, duplications can occur anywhere in the gastrointestinal tract: (8)

Location		Incidence (%)
Oral and lingual		1
Oesophageal		19
Thoracoabdominal		5
Gastric		9
Duodenal		4
Jejunal		10
Ileal		35
Colon	Appendix	2
	Caecal	3
	Colonic	7
	Rectal	5

They can also occur further afield from the GI tract such as the mediastinum, retroperitoneum, liver (11), biliary tract or pancreas. (12). Cases of blind ending tubular duplications extending through the diaphragm into the thorax or mediastinum with a caudal attachment to the small intestine have been reported but are rare. Hindgut duplications have also been described as occurring with rectovaginal or rectoperineal fistulae in females, and rectourinary fistulae in males. (13) The location, size and type of the duplication determine the clinical presentation and surgical management.

Clinical Presentation

Most patients present before the age of 2 years, (10) but presentation during adulthood has been described. (14) Often patients may be completely asymptomatic or have nonspecific symptoms, which can pose a diagnostic dilemma. The symptoms vary depending on the age of the patient, the location, the type of mucosal lining and the size of the duplication. (Table 1).

GASTROINTESTINAL DUPLICATIONS

K Sampat

Pressure effect from the mass can cause obstruction, perforation and also biliary or venal caval obstruction. In cases of duodenal duplication where obstructive jaundice is present, ERCP can be helpful in diagnosis. In those lesions with gastric mucosa, patients may have haematemesis, melaena, or haematochezia.

Small bowel duplications predominantly present with pain and vomiting due to gradual bowel obstruction; however cases of the cyst lesion acting as a lead point in intussusception have been described. (15). One third of infants have been described as having associated anomalies; foregut duplications are most commonly associated with spinal malformations such as thoracic and cervical hemivertebrae, and idiopathic scoliosis, whereas hindgut duplications are seen more frequently with gastrointestinal anomalies. (8)

Imaging

The three diagnostic criteria for duplication cysts include the presence of an intimate attachment to the GI tract, a layer of smooth muscle in the wall, and an epithelial lining resembling some part of the GI tract. (1) Ultrasonography is the most commonly used study. The inner echogenic mucosal layer and the outer hypoechoic muscle layer creates the double wall or "muscular rim" sign on ultrasound, which has been suggested to be characteristic of duplication cysts. (16) Prenatal ultrasonography can be used to identify cystic lesions; however the specificity remains user-dependent (17, 18).

CT and MRI scans are helpful in determining the size and extent of the mass. They can also help reveal other duplications elsewhere in the alimentary tract. MRI may be necessary if neurologic symptoms of spinal cord compression exist as a result of the cyst.

Location	*Commonly presenting symptoms*	*Differential Diagnosis*
Oesophageal	Asymptomatic neck mass. Upper airway obstruction. Dysphagia. Chest pain. Haemoptysis	Branchial cleft cyst. Cystic hygroma. Intramural tumour. Hiatal hernia. Diaphragmatic hernia
Gastric	Non-bilious vomiting. GI bleeding. Perforation. Fistula to spleen or lung. Palpable abdominal mass	Pyloric stenosis in an infant. Pancreatic cyst. Intramural tumours
Duodenal	Vomiting. GI bleeding. Palpable mass. Obstructive jaundice. Pancreatitis	Intramural tumour. Choledochal cyst. Pancreatic cyst. Pancreatic pseudocyst. Pancreatic tumour
Small bowel	Bowel obstruction. Melaena. Abdominal mass. Perforation. Volvulus, Intussusception	All causes of neonatal bowel obstruction. Mesenteric or omental cysts
Colonic	Vomiting. Abdominal pain. Abdominal mass. Urinary retention. Volvulus. Perforation	Intramural tumours
Rectal	Asymptomatic mass. Constipation. Rectal bleeding. Rectal prolapse. Tenesmus. Perianal fistula	Anterior meningocele. Sacrococcygeal teratoma. Pilonidal cyst

Technetium 99m Pertechnetate Scinitigraphy scanning may be used to detect bleeding from heterotopic gastric mucosa especially in oesophageal, duodenal and tubular small bowel duplications. Contrast studies can show intramural or extramural compressional defects, and can be used for any part of the alimentary tract, but do rely on the lesion being large enough to cause an obstructive effect. Laparoscopy can be used in all cases where other investigations are inconclusive.

Management

The desired outcome of treatment is the prevention of complications that can occur in the short – and long – term from the lesions. Bower et al examined 78 GI duplications in 64 patients; the most common indications for surgery included intestinal obstruction, GI bleeding or a mediastinal or abdominal mass causing pressure symptoms. The mortality of surgery was reported at 20%. (19) Rarely carcinomas arising in duplication cysts have been reported. These occur predominately in small bowel and include carcinoid tumors, squamous cell carcinomas, and common adenocarcinomas, and so surgical removal of incidentally diagnosed cysts is also advocated. (20)

GASTROINTESTINAL DUPLICATIONS

K Sampat

Despite of the increasing accuracy of prenatal ultrasonography, the antenatal diagnosis of a gastrointestinal duplication still represents a diagnostic challenge. Differential diagnosis for cystic lesions include includes urinary and gastrointestinal tract defects, choledochal and hepatic cysts underneath the liver, splenic and mesenteric cysts, meconium cysts, fetal cystic neuroblastoma, mesoblastic nephroma and ovarian cysts in females. (21) Prenatal diagnosis does however allow for timely planning of postnatal management in order to establish the diagnosis and to screen for associated malformations. In some specialist centers thoracoamniotic shunting in thoracic duplications is performed in utero to allow normal pulmonary development. (22)

There are three main factors to consider prior to excision: firstly the degree of common vasculature between the duplication and the native bowel, secondly the close proximity to structures such as the biliary tract and thirdly the presence of any gastric mucosa. Lesions containing gastric mucosa that have been internally drained, have been shown to re-present with gastrointestinal hemorrhage and so complete excisions are advised. (23) Most cystic lesions can be dissected free from the surrounding tissues, but the surgical approach and the degree of resection depends entirely on the location and type of duplication:

Oesophagus

Oesophageal duplications are commonly found protruding posteriorly into the mediastinum and although the majority of oesophageal duplications are adjacent to the oesophagus, cysts within the pleural space have also been described. (8) As these lesions often contain heterotopic mucosa that may perforate or bleed, therefore complete excision is recommended. A supraclavicular approach is best for high oesophageal lesions, with thoracoscopic excision used in isolated lesions, where the expertise is available.

Gastric

If these lesions are not in communication with the stomach, then excision is advised. However more adherent lesions may require a partial gastrectomy. Cases have been reported when internal drainage has been performed in such lesions. (24)

Duodenum

These lesions tend to occur in the first and second part of the duodenum and so there is often close proximity to the biliary or pancreatic ducts. Preoperative endoscopic ultrasound and cytology can help differentiate from a malignancy or a pancreatic cyst. CT scanning can delineate the extent of the cyst and the presence of heterotopic tissue on Technetium scanning can help guide management. Postoperatively it is wise to perform cholangiography to ascertain any damage to the bilary tree. In those where the blood supply to the ducts and duplication are intimately related, marsupialisation of the cyst or internal drainage via a cystojejunal roux-en-y anastomosis, or a cystoduodenal anastomosis have been described. (25)

Small bowel

Cystic lesions in the small bowel can be shelled out, and may occasionally require a small segmental resection with end-to-end anastomosis.

Colon

These duplications may be closely related to the bladder or the vagina, and so careful consideration of these organs is required. The isolated colonic lesions can be excised in total with a colocolostomy. However long tubular lesions are often not completely resectable without risking small bowel syndrome; in these cases, the blind distal end is joined to the distal colon to allow drainage. In addition heterotopic gastric mucosa is rarely seen in colonic mucosa and so internal drainage of these lesions is effective when resection is not possible. (26)

Rectum

These lesions are not in communication with the rectum in the majority of cases. A posterior sagittal approach allows good exposure and does not interfere with the rectal lumen. (27)

Prognosis and Outcome

The outcome of surgical management of gastrointestinal duplications is favorable. Other congenital comorbidities affect the overall prognosis.

Multiple Choice Questions

1. The prevalence of gastrointestinal duplications are approximately:

a. 1 in 2000

b. 1 in 4000

c. 1 in 8000

d. 1 in 10000

2. Gastrointestinal duplications most commonly occur in:

a. Oesophagus

b. Stomach

c. Small bowel

d. Colon

GASTROINTESTINAL DUPLICATIONS

K Sampat

3. Heterotopic tissue occurs most commonly in cysts within the:

a. Oesophagus

b. Colon

c. Rectum

d. Retroperitoneum

4. First line investigation of cystic structures is

a. Ultrasonography

b. CT scan

c. Contrast studies

d. Laparoscopy

5. The ideal management of cysts is

a. Marsupialisation of cysts

b. Complete excision of cyst preserving surrounding structures

c. Complete excision of cysts and wide local excision of surrounding structures

d. Radiological guided drainage of the cyst

Answers

1. b

2. c

3. a

4. a

5. b

Correspondence Address

Miss Keerthika Sampat,
Core Surgical Trainee, Central Manchester Foundation Trust,
Email: keerthika.sampat@doctors.org.uk

References

1. Macpherson RI. Gastrointestinal tract duplications: clinical, pathologic, etiologic, and radiologic considerations. Radiographics. 1993;13:1063–1080.
2. Schalamon J, Schleef J, Hollwarth ME. Experience with gastrointestinal duplications in childhood. Langenbeck's Arch Surg 2000; 385:402-405.
3. Bremer JL. Diverticula and duplications of the intestinal tract. Arch Patholog 1952; 38:132-140.
4. Bentley JFR, Smith JR. Developmental posterior enteric remnants and spinal malformations. Arch Dis Child 1960; 35: 76-86.
5. Edwards H Congenital diverticular f the intestine: with report of a case exhibiting heterotopia Br J Surg 1929; 17:7-21.
6. Lewis FT, Thyng FW. Regular occurrence of intestinal diverticula in embryology of pig, rabbit and man. Am J Anat 1908; 7:505-519.
7. Favera BE, Franciosi RA, Akers DR. Enteric duplications: thirty seven cases. A vascular theory of pathogenesis. Am J Dis Child 1971; 13: 1063-1080.
8. Gross RE, Holcomb GW Duplications of the alimentary tract. Paediatrics 1951 9, 449 – 68.
9. Li L, Zhang JZ. Vascular classification for small intestinal duplications: experience with 80 cases. J Pediatr Surg 1998 Aug; 33(8): 1243-5.
10. Ildstad ST, Tollerud DJ. Duplications of the alimentary tract 1988 Ann Surg 208, 184-9.
11. Seidman JD, Yale-Loehr AJ Alimentary duplication presenting as a hepatic cyst in a neonate. Am J Surg Pathol 1991; 15: 647-648.
12. Akers DR, Favara BE, Duplications of the alimentary tract: report on three unusual cases associated with bile and pancreatic ducts. Surgery 1972, 71: 817-823.
13. Ravitch MM. Hind gut duplication, doubling of colon and genital urinary tracts. Ann Surg 1953; 137:588-601.
14. Hocking M, Young DG. Duplications of the alimentary tract. Br K Surg 1981; 68:92-96.
15. Bing-Lu Li, Xin Huang. Ileal duplication mimicking intestinal intussceptions: A congenital condition rarely reported in adults. World J Gastroenterology 2013 October 14; 19(38): 6500-6504.
16. Cheng G et al. Sonographic pitfalls in the diagnosis of enteric duplication cysts. Gastrointestinal imaging, Feb 2005, Vol 184, Number 2.
17. VanDam LJ, DeGroot CJ. Intrauterine demonstration of bowel duplication by ultrasound 1984 Gynaecol. Reprod. Biol 18 229 – 32.
18. Dyon JF, Sabatier E, Prenatal diagnostic imaging of abdominal cysts Pediatric. Becur 45 857 – 68
19. Bower RJ, Seiber WK, Kiesewetter WB. Alimentary tract duplications in children. Ann Surg 188(5):669-74.
20. Orr MM, Edwards AJ. Neoplastic change in duplication of the alimentary tract. Br J Surgery. 1975; 62:269.
21. Duncan BW, Adzick NS, Eraklis A. Retroperitoneal alimentary tract duplications detected in utero. J Pediatr Surg 27: 1231±1233.
22. Ferro MM, Milner R, Voto L, et al. Intrathoracic alimentary tract duplication cysts treated in utero by thoracoamniotic shunting. Fetal Diagn Ther 1998;13:343–347.
23. Wrenn EL, Tubular duplication of the small intestine. Surgery 1962; 52: 494-498.
24. Lewis PL, Holder I Duplication of the stomach: report of a case and review of the English literature. Arch Surg 1961; 82:634-640.
25. Merrot T, Anastasescu R Duodenal duplication: clinical characteristics, embryological hypothesis, historlogical findings, Treatment. Eur J Pediatric Surg 2006; 16:18-23.
26. Holcomb GW, Gheissari A, O'Neill JA Jr, Shorter NA, Bishop HC (1989) Surgical management of alimentary tract duplications. Ann Surg 209(2):167–174.
27. La Quaglia MP, Feins N. Rectal duplication. J Pediatric Surg 190; 25:980-984.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

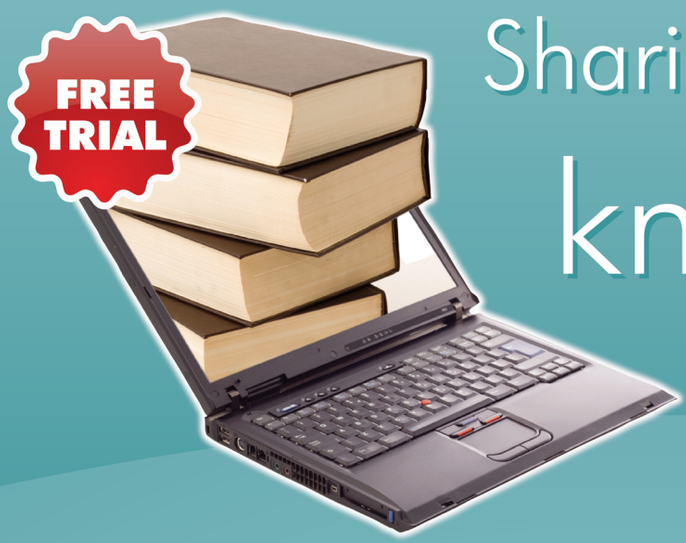
Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

123Library

www.123Library.org



Sharing **more** knowledge



Contact us on
0207 253 4363
or email
sales@123library.org
for a
FREE TRIAL

What is 123Library?

123Library is a fast growing and innovative eBook and **digital content provider for libraries** in the field of healthcare.

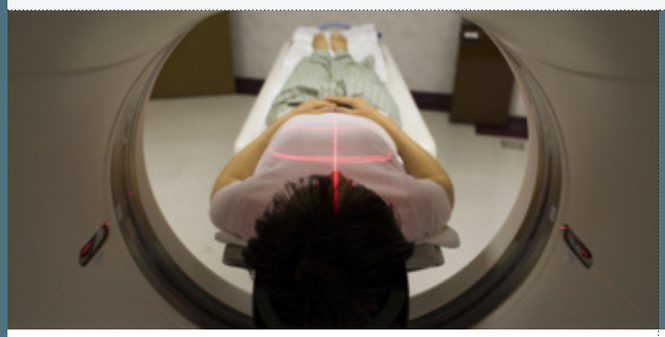
What are the benefits for your library?

1. FULL FLEXIBILITY ✔
2. KNOWLEDGE ✔
3. CUSTOMER CARE ✔
4. NO HASSLES ✔
5. FULL SECURITY ✔
6. GET FEEDBACK ✔
7. SUPPORT ✔
8. EASE OF USE ✔
9. SAVING MONEY ✔

Benefit today, visit **www.123Library.org**

CRANIAL IMAGING: THE BASICS OF CRANIAL CT

V Bagga



Cranial Imaging: The Basics Of Cranial CT
Neurosurgery

Abstract

Since its development in the early 1970's, Computed Tomography (CT) has become an invaluable radiological investigation in neurosurgery. Its widespread availability, speed of imaging and relative low cost allows immediate imaging and assessment of intracranial pathology, particularly haemorrhage, mass lesions and CSF flow disorders.

This article will discuss the principles of computed tomography and explain how to recognise the common traumatic cranial pathologies seen in the emergency department and in particular those that require neurosurgical intervention.

Keywords:
Cranial CT, brain masses, intracranial haemmorrhage, CSF, skull fractures.

Basic Principles Of Computed Tomography

CT images are acquired with an X-ray source which rotates 360 degrees around the patient, and a X-ray detector which is positioned 180 degrees from the X-ray device. The X-rays are attenuated by various amounts as they pass through the different substrates of the body and therefore different levels of X-rays are detected.

For example, the attenuation capacity of bone is high compared to that of air, which is negligible. The subsequent levels of X-rays detected for a given body area will therefore differ and it is this that forms the basic principle of CT imaging. The attenuated X-rays are detected, computerised and a highly sensitive grey-scale axial image is subsequently generated which displays objects of different densities reflecting the changes in attenuation [1].

Sagittal, coronal and oblique imaging planes can be reconstructed from the generated axial image. It is important to note that cranial CTs are taken at an angle parallel to the base of the skull to decrease irradiation of the orbits [2,3].

CT density is quantified using Hounsfield units (HU), named after Sir Godfrey Hounsfield, one of the pioneers of the CT scan. Using these units, a linear scale of density can be derived. Water is given the value of 0 HU and substrates with increased attenuation compared to water are given a positive HU value and appear hyperdense (e.g bone is given the value +1000) [4].

Those substrates that attenuate less than water with given negative HU values and appear hypodense (e.g. air has a value of -1000 HU). Given the different density characteristics of different tissues, features on CT images are described as being hyper, hypo or isodense when compared to the density of water.

Normal Cranial Anatomy On CT

Recognising the normal anatomical structures when interpreting cranial CT images is vital so that any abnormalities are identified, and like any other investigation, this requires a systematic approach. Some clinicians who are inexperienced in cranial CT interpretation find it useful to use mnemonics to ensure a structured approach to reading cranial CT images [5,6], whereas others may initially focus on a particular region of the brain based on the presenting symptoms and clinical history.

Whatever the method, it is important to recognise the normal structure of the brain parenchyma, analyse the skull architecture and carefully assess the ventricular system for hydrocephalus. This consists of the lateral ventricles, 3rd ventricle, cerebral aqueduct and the 4th ventricle and represents the site of cerebrospinal fluid (CSF) production and flow. The skull should be viewed in the bone window and should be assessed throughout the slices as fractures may indicate potentially significant head trauma.

One effective way of achieving this is working from the top, looking at the skull, falx cerebri - a midline structure between the two hemispheres and the sulcal/gyri pattern of the two hemispheres which should be symmetrical. Unilateral effacement of the sucli indicates increased pressure in the ipsilateral hemisphere (e.g. secondary to a mass lesion).

CRANIAL IMAGING: THE BASICS OF CRANIAL CT

V Bagga

Bilateral sulcal effacement may be present and represents widespread raised intracranial pressure. Descending through the axial images, the frontal and parietal lobes should be identified followed by two hypodense cavities, one on either side of the midline which represent the lateral ventricles. Within these ventricles, hyperdense areas may be visible illustrating calcified choroid plexus.

Moving through, the smaller, medially positioned slit-like third ventricle arises and the important structures of the basal ganglia and the internal capsule can be identified laterally. The occipital and temporal lobes will become apparent and an important structure to identify at this point is the uncus.

This is an area of the mesial temporal lobe located at the anterior margin of the parahippocampal gyrus [1]. This is of significance in temporal lobe or middle cranial fossa lesions which may cause descending, transtentorial displacement, also known as uncal herniation. Continuing, the brainstem and cerebellum where another fluid-filled cavity - the forth ventricle is located, can be assessed before finally ending at the foramen magnum.

By using this approach and comparing each hemisphere, any asymmetry in bone, brain parenchyma or ventricular size can be recognised and abnormalities identified. Identifying the falx throughout will also help identify the midline and therefore assess for any deviation or midline shift. Any increase in ventricular size (which may only be identified by comparing with older images Fig. 1A), or evidence of periventricular lucency indicates hydrocephalus. Occasionally, this can be identified by assessing for the presence of the temporal horns of the lateral ventricles which are only seen in the context of hydrocephalus or atrophy (Fig 1B).

Traumatic Cranial Abnormalities:

Skull Fractures

Given the hyperdensity of bone, depressed and comminuted skull fractures are relatively easy to identify. On the other hand, small, linear fractures are often difficult to see and distinguish from cranial suture lines. However, associated soft tissue injury and asymmetrical skull features will favour this diagnosis. The presence of skull fractures should alert the clinician to the possibility of underlying brain injury, and this should be thoroughly assessed. Depending on the severity of the insult, there may be evidence of subarachnoid and/or intraparenchymal blood and contusions. In addition, there may be associated hypodense areas which represent intracranial air. Evidence of fluid in the sinuses may indicate a basal skull fracture.

Patients should be assessed for the clinical signs of base of skull fracture, including CSF rhinorrhoea and otorrhoea, haemotympanum, tympanic membrane laceration and delayed periorbital and post-auricular ecchymosis. The patients will then require vaccinations to minimize the chances of meningitis and perhaps an ENT opinion if there is concern about disruption of the hearing apparatus.

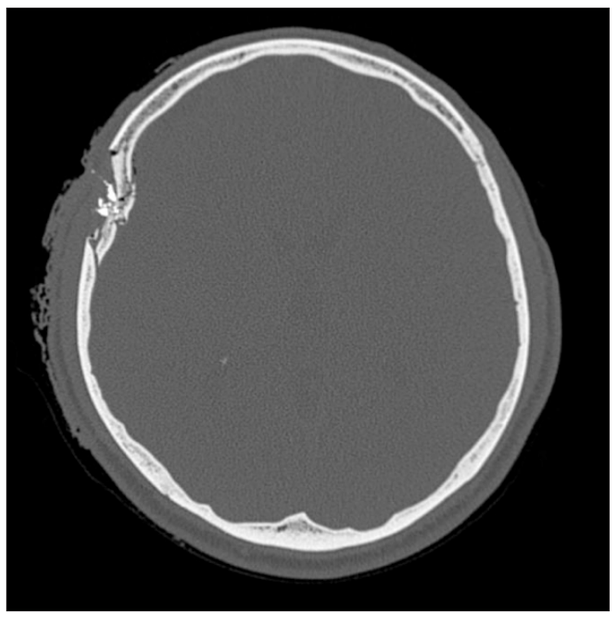


Figure 1: Axial CT Bone window demonstrating a right frontal depressed skull fracture.

Cranial Haemorrhage

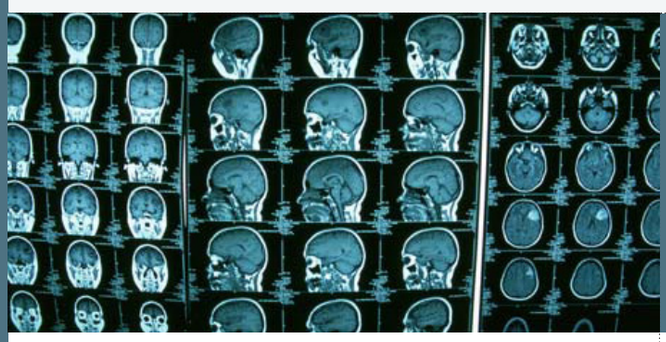
The appearance of blood on the cranial CT image can vary in location and appear hyperdense, isodense or hypodense depending whether is it acute (<72 hours), subacute (72 hours to 2 week) or chronic (> 2 weeks) respectively. The difference in appearance is related to the attenuation coefficient of haemoglobulin which highly attenuates X-Ray radiation. However, over time, haemoglobin molecules degenerate and therefore attenuate less, appearing increasingly hypodense [5].

Extradural Haematoma

Extradural haematomas (EDH) appear as a biconvex, hyperdense abnormalities on the CT image. As its name indicates the lesion is located between the dura and the skull. The spread of blood is limited to where the dura attaches to the suture lines of the skull and the resultant collection of blood pushes the dura inwards, giving the characteristic biconvex appearance (Fig 2). This condition is primarily related to significant head trauma, subsequent skull fracture and rupture of arterial vessels such as the middle meningeal artery and its branches [3,5-7]. There may be adjacent soft tissue swelling and associated hyperdense regions within the brain parenchyma which represent contusional injury. This condition requires an urgent neurosurgical referral and normally requires immediate surgical evacuation.

CRANIAL IMAGING: THE BASICS OF CRANIAL CT

V Bagga



Cranial Imaging:
The Basics Of Cranial CT
Neurosurgery

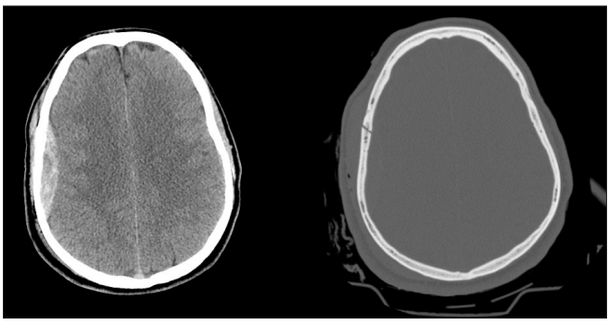


Figure 2: Extradural Haematoma. Biconvex high attenuation in the right parietal region (A). There is an associated skull fracture (B). The features are in keeping with an acute extradural haematoma.

Acute Subdural Haematoma

Acute subdural haematomas (ASDH) appear as hyperdense, crescentic lesions (Fig x). The location of the bleed is between the dura mater and arachnoid layer and unlike extradural haematomas, the collection is not limited by dural attachments and so it spreads along the convexity of the cerebral hemisphere [5]. These appearances are a consequence of significant head trauma and the resultant shearing of the bridging subdural veins. Unfortunately, the underlying brain sustains significant injury and neurological outcome can be poor. This condition, like extradural haematomas requires urgent neurosurgical intervention.

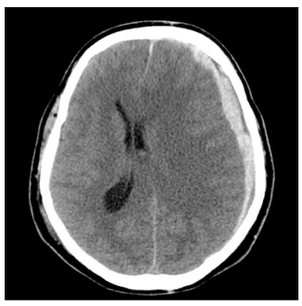


Figure 3: There is moderate sized left sided acute subdural haematoma extending from the temporal region all the way to the vertex with a maximum depth of 11mm within left frontal convexity. There is significant associated midline shift of 12mm secondary to subfalcine herniation resulting in partial effacement of left lateral ventricle and early dilatation of right lateral ventricle. Generalised oedema within left cerebral hemisphere.

Chronic Subdural Haematoma

Chronic subdural haematomas (CSDH) appear as hypodense, crescentic collections (Fig 4). The haematoma location is identical to that of ASDHs, however the aetiology follows a more benign course. They often occur in the elderly because the brain is relatively atrophic resulting in the subdural veins becoming stretched and more fragile, and occur after a trivial head injury (which the patient may not even remember until asked on admission!) and/or in patients who are anticoagulated resulting in slow, venous bleeding. Patients may present with persistent headache, seizures or neurological deficit prompting a CT Head. Some of these patients can be managed conservatively, however others may benefit from burr hole evacuation.

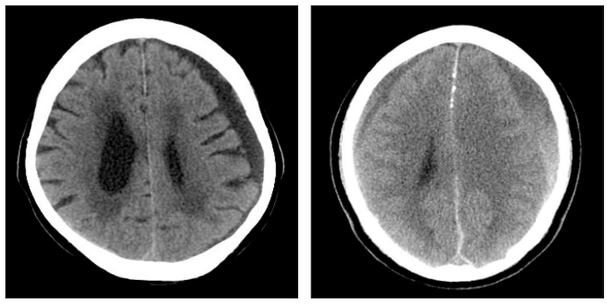


Figure 4: Axial CT scan demonstrates a left sided chronic subdural haematoma, note the sulcal gyral pattern is maintained, not suggestive of significant mass effect. Fig b demonstrates bilateral chronic subdural haematomas, greater in size on the left. These collections are sub-acute, hence the mixed density and are exerting more pressure as indicated by the loss of sulcal-gyral pattern

Subarachnoid Haemorrhage

Subarachnoid haemorrhage (SAH) describes a condition where blood is present in the subarachnoid space (which is normally filled with CSF). The CT images will therefore show acute blood (hyperdense) with the distribution of blood being variable depending and on the cause. If traumatic in nature, blood may be distributed within the sulci close to the injury site, however if extensive injury has occurred, the blood maybe widespread throughout the subarachnoid space. It is important to differentiate between traumatic and non-traumatic SAH.

CRANIAL IMAGING: THE BASICS OF CRANIAL CT

V Bagga

If non-traumatic and secondary to a vascular abnormality such as an aneurysm or arteriovenous malformations, blood may be seen in the suprasellar cisterns, sylvian fissures or ventricular system (depending on the location of the abnormality, Fig x). The distribution of blood may indicate the underlying pathology but patients inevitably require vascular imaging for a definitive diagnosis. Depending on the neurological status of the patient and the type and location of abnormality, patients may require endovascular or surgical intervention.

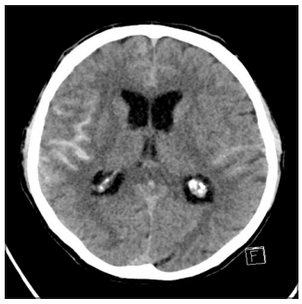


Figure 5: Subarachnoid Haemorrhage. Non-contrast CT brain shows high attenuation material in keeping with blood within the sulci of the right perisylvian region. Less dense blood in the parafalcine sulci and left sylvian fissure. Features are consistent with a SAH.

Contusions

Cerebral contusions can occur after head injury and appear as hyperdense areas on the CT image and may or may not be associated with surrounding oedema which appears hypodense. Since contusional injury is related to the rapid deceleration, injury is often seen in areas of the brain which are situated close to bony prominences, e.g. frontal, temporal poles and occipital lobes [5] (Fig 6). It is important to understand that as well as these lesions being localised to the site of trauma, they are also often seen as contrecoup injuries, i.e. located opposite to the site of impact. This is classically seen in patients who have sustained injury to the occiput (either by a fall or direct blow) and have resultant frontal contusional injuries. Importantly, cerebral contusions can rapidly enlarge, causing mass effect, midline shift and a rapid increase in intracerebral pressure. Therefore, patients with these types of injuries require close observation in case neurosurgical intervention is required.

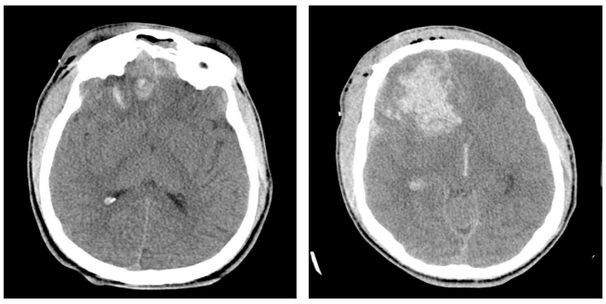


Figure 6: Frontal contusion involving the anterior skull base, these patients need close observation as the contusions can evolve and expand over a matter of days resulting in a deterioration in clinical status.

In addition to the traumatic pathologies described above, a systematic approach to cranial CT interpretation will allow the identification of the majority of abnormalities. Non-traumatic lesions include:

Non-traumatic Intraparenchymal Haematomas

Non-traumatic intraparenchymal haematomas are primarily secondary to hypertension which characteristically results in basal ganglia or posterior fossa haematomas. If occurring in the elderly patient and peripherally located, the underlying pathology is more like to be amyloid angiopathy. Other causes of intraparenchymal bleeds include bleeding into tumours or rupture of aneurysms/AVM.

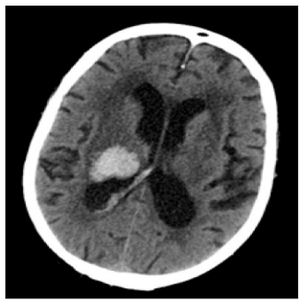


Figure 7: Haemorrhagic infarct in the right thalamus. The location is typical of a hypertensive haemorrhage in this patient with extensive small vessel cerebrovascular disease.

Hydrocephalus

Hydrocephalus is an accumulation of CSF within the ventricular system (lateral ventricles, 3rd ventricle cerebral aqueduct and 4th ventricle). It is caused by either an obstructive (non-communicating) or non-obstructive (communicating) lesion, resulting in ventriculomegaly. In obstructive hydrocephalus, the ventricular size downstream from the obstructive lesion will remain the same whereas the ventricular size above the level of the lesion will increase.

For example, a colloid cyst obstructing the foramen of Munroe (outflow path of CSF from the lateral ventricles) will result in bilateral lateral ventricle enlargement with normal ventricular anatomy downstream.

In some instances of hydrocephalus, the ventricular size may appear normal, however the presence of the temporal horns of the lateral ventricles (which are not normally visible) is an early sign (fig x). The causes of obstructive hydrocephalus can include congenital abnormalities (e.g aqueductal stenosis) and external compression or internal occlusion of the ventricular system by tumours or haematomas. In non-obstructive hydrocephalus, the ventricular system communicates freely, however there is often a abnormality with CSF absorption at the arachnoid villi. Causative factors include infections (e.g. meningitis) or occlusion of the absorption channels by substances such as blood products (as seen in some cases of SAH).

CRANIAL IMAGING: THE BASICS OF CRANIAL CT

V Bagga

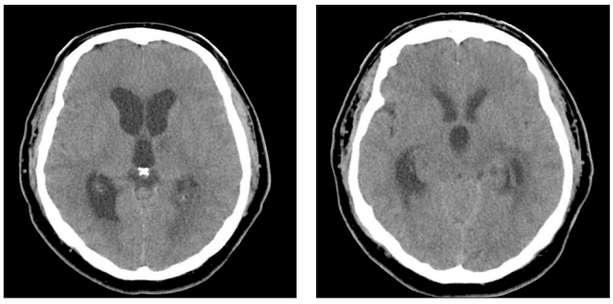


Figure 8: On the left the lateral and third ventricles are enlarged, on the right the temporal horns are bilaterally dilated.

Cranial Lesions

Tumours

A comprehensive discussion on brain tumours is outside the scope of this article. Common appearances of tumours will be described with the primary aim of helping to recognise an abnormality rather then diagnose the underlying pathology. If one is systematic in the approach to cranial CT interpretation, the majority of tumours can be identified on a non-contrast CT image. However, contrast CT imaging is often useful in defining tumours [7].

Depending on the type of tumour, they can vary from being well-circumscribed to highly irregular, hypodense to hyperdense and homogenous to inhomogonous in appearance (Fig 9). For example, highly circumscribed, homogenously hyperdense lesions originating from the dura are likely to represent meningiomas, whereas irregular, mixed density lesions may represent glioblastomas. Lesions are often surrounded by a hypodensity which signifies surrounding vasogenic oedema secondary to distruption of the blood-brain barrier. Again the amount of oedema varies but metastases characteristically have a disproportionate amount compared to lesion size [4].

Cranial Imaging:
The Basics Of Cranial CT
Neurosurgery

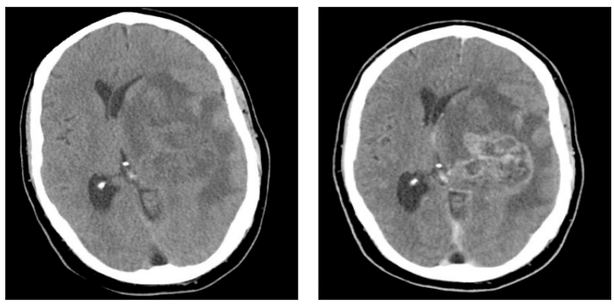


Figure 9: Pre and post contrast imaging in a patient with progressive dysphasia over several weeks. On unenhanced imaging there is diffuse low attenuation throughout the left cerebral white matter with evidence of mass effect. Post contrast a large well defined heterogenous enhancing lesion is demonstrated. Imaging appearances are typical for a glioblastoma multiforma.

Abscesses

Intracranial abscesses are characteristically described as ring-enhancing lesions because they appear as homogenous, hypo/isodense lesions with a surrounding enhancement on contrast CT imaging (fig 10). Patients often have associated systemic upset, such as pyrexia, rigors etc and raised infective/inflammatory markers on the blood profile. As well as requiring surgical aspiration and IV antibiotic treatment, patients require a full dental examination by experienced personnel and an echocardiogram to find the source of infection.

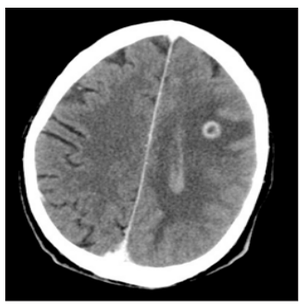


Figure 10:. Small ring enhancing lesion in the left frontal lobe suggestive of an abscess. Note the extensive vasogenic oedema in the surrounding parenchyma. The left lateral ventricle is also enhancing suggestive of ventriculitis.

CRANIAL IMAGING: THE BASICS OF CRANIAL CT

V Bagga

Ischaemic Infarcts

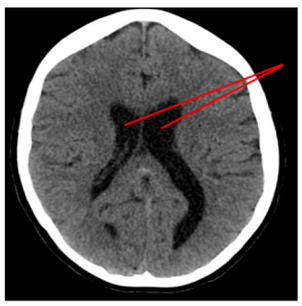
Patients with ischaemic infarcts will have CT images showing normal appearances in the acute phase. Early findings will show a loss of grey-white matter differentiation due to the movement of water into the infarcted cells [5]. After 12-24 hours, an area of hypodensity will appear in the given territory of the infarct. The reason why CT imaging is performed in the acute setting is to assess for other causative cerebral lesions and to rule out haemorrhagic cerebral events.

MCQS

1. Acute blood appears as what on the CT image?:

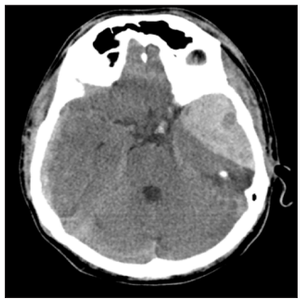
a) Hypointense
b) Hyperintense
c) Hyperdense
d) Isodense
e) Unable to see acute bleed on CT

2. What structure is labelled in the following CT image?



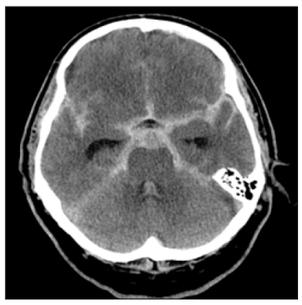
a) Lateral Ventricles
b) 3rd Ventricle
c) Suprasellar cistern
d) Hypothalamus

3. What is shown on the Cranial CT image?



a) Subarachnoid Haemorrhage
b) Acute subdural Haematoma
c) Extradural Haematoma
d) Meningioma
e) Cerebral Abscess

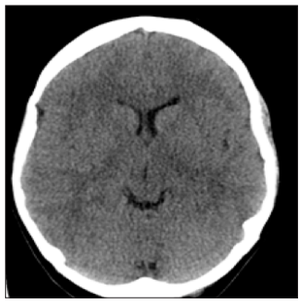
4. What investigation is most appropriate in a patient presenting with the following scan?



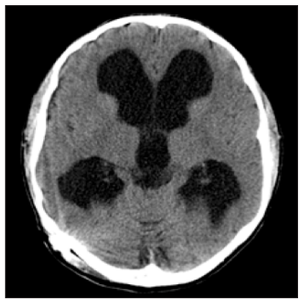
a) MRI
b) Repeat CT head
c) Cerebral Angiography
d) No further investigations are required as diagnosis is obvious

5. Which one of the following images shows hydrocephalus?

a)



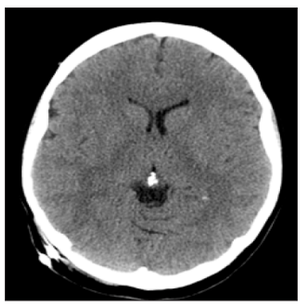
b)



CRANIAL IMAGING: THE BASICS OF CRANIAL CT

V Bagga

c)



MCQ Answers

1. B
2. A
3. C
4. C
5. B

Corresponding Address

Mr Veejay Bagga
Dept of Neurosurgery
Royal Hallamshire Hospital, Sheffield, UK
Email: veejay.bagga@sth.nhs.uk

References

1. Tozer Fink KR, Levitt MR, Fink JR. Principles of modern Neuroimaging. In: Ellenbogen RG, Abdulrauf SI, Sekhar LN. Principles of Neurological Surgery. 3rd Edition. Elsevier Health Sciences; 2012. p53-76.

2. Sutton D, Kendall B, Stevens J. Intracranial Lesions (1). In: Textbook of Radiology and Imaging. 6th Edition. Volume 2. Edinburgh, Scotland: Churchill Livingstone, 1998. p1581 - 1618.

3. Tie MLH. Basic CT head for Intensivists: Critical Care and Resuscitation. 2001;3:35-44.

4. Greenberg MS. Handbook of Neurosurgery. 7th Edition. Thieme Publishers. 2010 p122-128.

5. Perron AD. How to read a Head CT scan. In: James G, Adams MD. Emergency Medicine. 1st Edition. Elsevier; 2008 p753-764.

6. Amrish Mehta. Head. In: ABC of Emergency Radiology. Chan O. 2nd Edition. Blackwell Publishing. London. p83-93.

7. Liebenberg WA, Johnson RD. Neurosurgery for Basic Surgical Trainees. Hippocrates Books. London. 2004.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

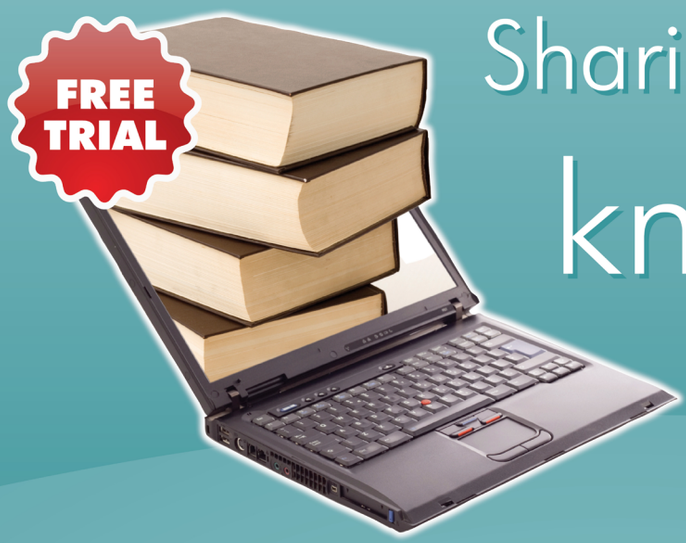
Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

123Library

www.123Library.org



Sharing **more** knowledge



Contact us on
0207 253 4363
or email
sales@123library.org
for a
FREE TRIAL

What is 123Library?

123Library is a fast growing and innovative eBook and **digital content provider for libraries** in the field of healthcare.

What are the benefits for your library?

1. FULL FLEXIBILITY ✔
2. KNOWLEDGE ✔
3. CUSTOMER CARE ✔
4. NO HASSLES ✔
5. FULL SECURITY ✔
6. GET FEEDBACK ✔
7. SUPPORT ✔
8. EASE OF USE ✔
9. SAVING MONEY ✔

Benefit today, visit **www.123Library.org**

THE MENTAL CAPACITY ACT (2005) & HOW IT APPLIES TO SURGEONS

N Britchford

The Mental Capacity Act (2005) & How It Applies To Surgeons
Current Training Issues

Abstract

The Mental Capacity Act 2005 (MCA) provides a statutory framework, for adults who lack capacity to make decisions for themselves. Its sets out who can take decisions, in which situations and how they should go about this. The framework is supported by a code of practice which has statutory force. This means that people using the act have a legal duty to have regard for the code, when they are working with people who lack capacity to make decisions for themselves.

Surgeons will work with people who lack capacity in three possible ways covered by the MCA. The most frequent being in their professional capacity, the second being in paid for acts (legal reports) and the third being carrying out research.

This article sets out to summarize the core principles underpinning the MCA, and how it may apply to surgeons, particularly in training.

Keywords: *Mental Capacity, Surgery, Consent.*

Introduction

The main area where surgeons encounter issues around mental capacity is in seeking informed consent for surgical procedures; either in an acute situation or in an outpatient setting. They will also encounter issues in providing post-operative care for many patients, who at the time lack the mental capacity to make decisions for themselves.

Some populations may have a permanent impairment that impairs their capacity to make a complex decision, such as giving consent for surgery e.g. those with severe learning disability or a significant degree of dementia. There are many others who may temporarily lack capacity due to an acute presentation, causing an impairment or disturbance in the functioning of the mind or brain.

The UK has a rapidly ageing population, with the over 65 population being over 11 million: an increase of 17% since 2003 (1). Cognitive impairments become increasingly common with age, and there are an estimated 800,000 people in the UK who have dementia (2). The single commonest acute presentation in this population is a fractured neck of femur (3).

It is important that the treating surgeon understands and follows the principles behind the MCA, so that they consider mental capacity when consenting patients, and that they act in the best of interest of patients who lack capacity to consent.

There are a number of studies suggesting that surgeons tend to overestimate peoples capacity to consent for surgery, however the overall incidence of incapacity may in fact be small (4,5,6).

Background

The Mental Capacity Act 2005 came into effect on the 7th of April 2005. Prior to this point the law commission had been commissioned to look at the existing legal framework around mental capacity and decision-making. The Lord Chancellor stated in 1997:

'As it currently stands, the law affords little protection either to mentally incapacitated adults, or to those who care for them. The law is confusing and fragmented. Many carers in particular are expected to make decisions on behalf of incapacitated adults without a clear idea as to the legal authority for those decisions' (7).

THE MENTAL CAPACITY ACT (2005) & HOW IT APPLIES TO SURGEONS

N Britchford

The Mental Capacity Act 2005

The act is intended to be enabling and supportive of people who lack capacity, not restricting or controlling of their lives (8).

The five key principles are:

1. A person must be assumed to have capacity, unless it is established that they lack capacity.

2. A person is not to be treated as unable to make a decision, unless all practicable steps to help him to do so have been taken without success.

3. A person is not to be treated as unable to make a decision, merely because he makes an unwise decision.

4. An act done, or decision made, under this Act for or on behalf of a person who lacks capacity must be done, or made, in his best interests.

5. Before the act is done, or the decision is made, regard must be had to whether the purpose for which it is needed, can be as effectively achieved in a way that is less restrictive of the person's rights and freedom of action.

Mental Capacity applies to an individuals ability to make a specific decision, at the time it needs to be made.

A person's capacity must not be judged on the basis of age, appearance, condition or an aspect of their behaviour.

It is important to take all possible steps to try and help people make a decision for themselves. This can include delaying treatment if appropriate, if there is a likelihood that a person may regain capacity to make the decision in the future (such as intoxicated or acutely confused people).

Capacity is assessed as a two-stage test:

1. Does the person have an impairment of the mind affecting the way it works? (this can be temporary or permanent).

2. If so, does the impairment mean that person is unable to make the specific decision at that time? e.g. Consent to procedure.

Assessing ability to make a decision:

1. Does the person have a general understanding of the decision they need to make and why they need to make it?

2. Does the person have a general understanding of the likely consequences of making, or not making the decision?

3. Is the person able to understand, retain, use and weigh up the information related to the decision?

4. Can the person communicate their decision? (by any means including signs)

It is clear that the clinical decision is not dependent on presence or lack of mental capacity, but is made according to the principles set out by the GMC in Good Medical Practice 2013. When a person is deemed not to have capacity to make a decision, then the clinician as the likely decision maker has to follow a number of steps to ensure that a best interest decision is then made in accordance with the act.

Every effort must be made to enable a person who lacks capacity to take part in making the decision. The person's past and present wishes and feelings should be taken into account. The view of other people who are close to the person lacking capacity including family, carers and any Deputy or Attorney. If there is no one independent to speak about best interest, then in the case of serious medical treatment the person will qualify to be supported by an Independent Mental Capacity Advocate (IMCA).

The code of practice sets out what happens to people who will require emergency treatment to save their life or prevent serious harm. In these cases it will nearly always be appropriate in their best interest to provide treatment without delay. The only exception being if the decision maker is aware of an advanced decision to refuse treatment. Note, even if a Lasting Power of Attorney has been granted, the Attorney generally can not make decisions to refuse or accept treatment on behalf of the donor, unless the Attorney has been made to include personal welfare as part of the written power and then it often excludes decisions about life saving treatment unless specifically stated.

THE MENTAL CAPACITY ACT (2005) & HOW IT APPLIES TO SURGEONS

N Britchford

The Mental Capacity Act (2005) & How It Applies To Surgeons

Current Training Issues

Court Of Protection

Complex cases can be referred to the court of protection particularly where there is dispute, or where the surgery proposed can cause irreversible effects. Cases can also be referred if there is serious doubt about the validity of an advance decision.

Conclusion

The MCA and supporting code of practice provide a framework for supporting and enabling people who are incapacitated, to have provision for their best interests to be met. This allows appropriate treatment to be provided within a legal framework, for those who cannot provide informed consent.

The anxieties traditionally faced by clinicians when working with people who are unable to make decisions, should be lessened by adherence to the principles of the MCA. This reduces the chance of being threatened by legal proceedings in relation to decision-making, as long as the guiding principles of the MCA are followed.

Key Definitions

Advance decision

A decision to refuse treatment made in advance by a person who has capacity to do so.

Attorney

Someone appointed under either a Lasting Power of Attorney (LPA) or an Enduring Power of Attorney (EPA), who has the legal right to make decisions within the scope of their authority on behalf of the person (the donor) who made the Power of Attorney.

Decision maker

The person who actually makes the decision for a person who lacks capacity, it is their responsibility to decide what is in the persons best interest.

Deputy

Someone appointed by the Court of Protection with ongoing legal authority as prescribed by the Court to make decisions on behalf of a person who lacks capacity to make particular decisions as set out in Section 16 (2) of the Act.

Independent Mental Capacity Advocate

Someone who provides support and representation for a person who lacks capacity, Capacity Advocate (IMCA) where the person has no one else to support them. Must be involved in serious medical treatment decisions.

MCQs

1. People with dementia lack mental capacity(True or False).

1. It depends upon the degree of dementia
2. It depends on the type of dementia
3. It depends on the type of decision
4. Can only be proved if backed up by other testing e.g. MMSE
5. If they have an understanding about the decision, they understand the consequences, they are able to retain the information and they can communicate the decision

2. The following people can be involved in making decisions for people who lack capacity (True or false)

1. The nearest relative
2. A neighbour who has known the patient for 30 years
3. An IMCA
4. A professional carer
5. The treating surgeon

3. In a life threatening situation where urgent treatment is required (True or false)

1. The MCA does not count
2. An advance decision can be overridden
3. A relative can refuse treatment for a person who lacks capacity
4. The Court of Protection should decide
5. The best interest of the patient should be the overriding principle

THE MENTAL CAPACITY ACT (2005) & HOW IT APPLIES TO SURGEONS

N Britchford

4. A decision maker can be (True or false)

1. The surgeon providing the treatment
2. The next of kin
3. The deputy holding lasting power of attorney
4. The court of protection
5. Any person involved in the care

5. When someone has been assessed as lacking capacity they cannot make decisions (True or false)

1. Only if assessed for a specific decision at the time necessary to make the decision.
2. This affects all future decisions
3. Mental capacity can fluctuate
4. They can make some decisions and not others
5. They can make unwise capacitated decisions

Answers

1. FFFFF

A persons capacity must not be judged simply on the basis of their condition. A person's capacity must be assessed specifically in terms of their capacity to make a particular decision at the time it needs to be made.

2. TTTTT

The decision maker has a duty to consult other people close to or interested in the welfare of a person lacking capacity this includes personal as well as professional parties.

3. FFFFT

The MCA includes a specific section on urgent treatment, an advance decision may include details about urgent care. The court of protection is very unlikely to be involved if the case is urgent.

4. TTTFT

The decision maker is just that and will be potentially anyone making a decision on behalf of someone lacking capacity. In a surgical case it will be the surgeon.

5. TFTTT

Mental Capacity is always decisions and time dependant, it often fluctuates and even when someone has been assessed as lacking capacity for one decision they may be able to make capacitated decisions for something else, these can be unwise

Correspondence Address

Dr N Britchford,
Former Consultant In The Psychiatry Of Learning Disability,
Queens Medical Centre, Derby Road, Nottingham, NG7 2UH.
Email: nicholas.britchford@nhs.net

References

1. Large P. Population Estimates for UK, England and Wales, Scotland and Northern Ireland, Mid 2013, Office for National Statistics 2014.
2. Alzheimer Society Report 2012.
3. An Age Old Problem: A review of the care received by elderly patients undergoing surgery: A report by the National Confidential Enquiry into Patient Outcome and Death 2010, London.
4. Kerrigan S,Dengu F, Erridge S, Grant R, Whittle SR; Recognition of mental incapacity when consenting patients with intracranial tumours for surgery:how well are we doing?,British Journal of Neurosurgery, February 2012, 26/1 (28-31).
5. Terranova C, Cardin F, Pietra LD, Zen M, Brottocao A, Millitello C Ethical and medico-legal implications of capacity of patients in geriatric surgery. Medicine, Science and the law, 07 2013, 53/3 (166-171).
6. Karlawisch J, Cary M, Moelter ST, Siderowf A, Sullo E, Xie S, Weintraub D; Cognitive impairment and PD patients' capacity to consent to research., Neurology, 08 2013, 81/9 (801-807).
7. The Lord Chancellor, Lord Irvine of Lairg, Statement to the House of Lords,London 1997.
8. Department of Constitutional Affairs,Mental Health Act Code of Practice 2007,TSO, London.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

TAKING TIME TO CARE: A DOCTOR'S EXPERIENCE OF THE OTHER SIDE OF HEALTHCARE

O Taiwo

Abstract

The job of a health care assistant and a nurse is one that most of us as doctors have not come to fully appreciate. Prior to my registration as a medical doctor in the UK I had the opportunity to work as a care worker at a care residential home in North London. Through this opportunity I was able to appreciate the patience and dedication of most of our care workers, health care assistants and nurses. This article is a reflection of that experience.

Keywords: *healthcare, nursing, allied healthcare, care worker.*

In 2006, just after passing my PLAB part 2 exam I started a part-time job as a care worker in a residential home. My usual morning ritual was to wake up at 5.30am, get ready, while drinking the proverbial cup of coffee to kick start the brain and catch the 5.55am bus to get to the residential home by 7am. I usually met my colleague Ken on this bus.

Taking Time To Care: A Doctor's Experience Of The Other Side Of Healthcare
Career Focus

Our job usually involved getting an 87 yr old man (Mr R) washed, cleaned and out of bed ready for the breakfast we prepared for him.

Mr R was not mobile and required hoisting out of bed. He was incontinent of urine and wore pads.

In the morning we would give him a bed wash; he usually washed his own face (I believe now that this was probably the last piece of independence that he clung on to). The application of the hoist harness was a difficult and cumbersome task; everyday some part of me wondered if it would snap when we were lowering Mr R onto the commode.

Once we had successfully navigated the hoist manoeuvre, Mr R would be wheeled to the toilet. While he was "moving his bowels " my colleague and I had split jobs, one was either changing /making Mr R's bed whilst the other made Mr R breakfast- Two rounds of toast with butter and a cup of tea. After Mr R had finished, he would call out to us, at this point it is fair to say, we both took turns in wiping Mr R's back passage (a grim reality of care work, which I think most of the public fail to appreciate).

The truth is, you get used to it after the first, second or third time. Victor Frankl, in his book "Man's search for meaning", described the breadth of tasks human beings can adapt to, when put in challenging situations. Ironically however I found that the most challenging task after a while was making Mr R's cup of tea! "Tea and milk no sugar please" he would say... I didn't ever seem to be able to deliver to required standard.

TAKING TIME TO CARE: A DOCTOR'S EXPERIENCE OF THE OTHER SIDE OF HEALTHCARE

O Taiwo

Imagine going to work at 5.30am and the thought on my mind was how to get this man's cup of tea right. After a number of attempts Mr R finally accepted my level of competence in tea making (having resigned himself to the fact that it would have to do).

This description of a two hour morning care job is only a fraction of what is done. Working long shifts, especially nights, is also very tasking, involving regular patient turns, changing pads moving residents and dealing with aggressive and agitated residents. I learnt there how important bedside manner was, particularly whilst working with vulnerable adults .

Reflecting back, I believe my year as a care worker brought a paradigm shift in me. It has made me a more compassionate person, I have also been able to work better with nurses and healthcare assistants because I am more able to appreciate the sheer stress and amount of work that they put daily in to the NHS.

It is now compulsory that pre-nursing all staff spend a year as a HCA following the catastrophic Mid Staffordshire review. I believe this political driven agenda is well justified from my experience as patient compassion and basic care is fundamental to the humanitarian side of the healthcare industry. It can be easy to be bogged down to bureaucracy, targets and discharge summaries. Furthermore, I put it to the reader should medical students spend a block attachment working alongside a HCA?

Correspondence Address

O Taiwo
Trust SHO Trauma & Orthopedics,
Kettering General Hospital,
Email: dioscuri2@doctors.org.uk

References

1. Tekian A, Harris I. Preparing health professions education leaders worldwide: A description of masters-level programs. Med Teach. 2012; 34: 52-58.

Disclaimers

Conflict Of Interest
The Core Surgery Journal requires that authors disclose any potential conflict of interest that they may have. This is clearly stated in the Journal's published "Guidelines for Authors" **(https://www.123library.org/misc/CSJ_Guidelines_For_Authors.pdf).** The Journal follows the Guidelines against Conflict of Interest published in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals **(http://www.icmje.org/urm_full.pdf).**

Financial Statement
The authors of this article have not been paid. The Core Surgery Journal is financed by subscriptions and advertising. The Journal does not receive money from any other sources. The decision to accept or refuse this article for publication was free from financial considerations and was solely the responsibility of the Editorial Panel and Editor-in-Chief.

Patient Consent statement:
All pictures and investigations shown in this article are shown with the patients' consent. We require Authors to maintain patients' anonymity and to obtain consent to report investigations and pictures involving human subjects when anonymity may be compromised. The Journal follows the Guidelines of the Uniform Requirements for Manuscripts **(http://www.icmje.org/urm_full.pdf).** The Core Surgery Journal requires in its Guidelines for Authors a statement from Authors that "the subject gave informed consent".

Animal & Human Rights
When reporting experiments on human subjects, the Core Surgery Journal requires authors to indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Volume 4, Issue 5

How We Can Help You Succeed?

To find out how 123 Library can help you dramatically increase your medical knowledge, register your interest on our website.

123Doc Education
72 Harley Street
London
W1G 7HG

Tel: +44 (0) 207 253 4363
Web: www.123library.org
Email: info@123doc.com

ISSN

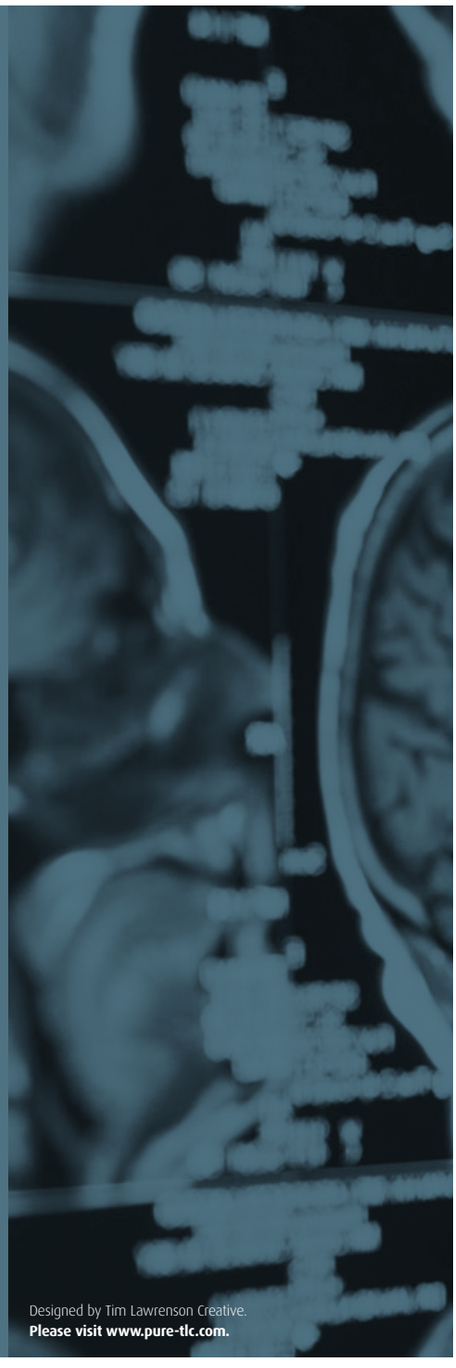
2054-6009

2014 Past Issues

2013 Past Issues

2012 Past Issues

2011 Past Issues



Designed by Tim Lawrenson Creative.
Please visit www.pure-tlc.com.