123Library

CORE SURGERY JOURNAL

Volume 2, Issue 5

Contents

123Library

Editorial Committee

Darryl Ramoutar
ST4 Trauma and Orthopaedics

Conal Quah
ST4 Trauma and Orthopaedics

Andrew Titchener
ST3 Trauma and Orthopaedics

Vishal Patel
ST4 Trauma and Orthopaedics

Jeremy Rodrigues
BSSH Research Fellow

James Risley
Speciality Doctor Emergency Medicine

Speciality Coordinators

Gregory Shepherd
ST5 Paediatric Surgery

Kulbir Mann
ST3 General Surgery

Marcus Cumberbatch
ST2 Urology

Richard Jones
ST2 Anaesthetics and Critical Care

Gareth Lloyd
CT2 Otorhinolaryngology and Neck Surgery

Editor In Chief

D.P. Forward
Consultant Trauma and Orthopaedics.

Reviewers

TRAUMA & ORTHOPAEDIC SURGERY	
Mr. D.P. Forward	Queen's Medical Centre, Nottingham
Mr. J. Geoghegan	Queen's Medical Centre, Nottingham
Mr. A. Patel	Hinchingbrooke Hospital, Hinchingbrooke
Mr. T. Westbrook	Queen's Medical Centre, Nottingham
Mr. A. Tambe	Royal Derby Hospital, Derby
Mr. J. Hutchinson	Royal Derby Hospital, Derby
Mr. A. Stephen	Royal Derby Hospital, Derby
Mr. S. Auplish	Queen's Hospital, Romford
Mr. O. Sabri	Bristol Royal Infirmary, Bristol
Mr. J. Clamp (Spines)	Queens Medical Centre, Nottingham
Mr. R. Bommireddy (Spines)	Royal Derby Hospital, Derby
Mr. P. Kothari	King's Mill Hospital, Mansfield
Mr. M. Espag	Royal Derby Hospital, Derby
Mr. D. Clark	Royal Derby Hospital, Derby
CARDIOTHORACIC SURGERY	
Mr. A. Singh	Nottingham City Hospital, Nottingham
Mr. D. Jenkins	Papworth Hospital, Cambridge
Mr. M. Codispoti	Papworth Hospital, Cambridge
Mr. P. Catarino	Papworth Hospital, Cambridge
GENERAL SURGERY	
Mr. I. Hunter	Musgrove Park Hospital, Taunton
Mr. K. Rigg	Nottingham City Hospital, Nottingham
Prof. A. Acheson	Queen's Medical Centre, Nottingham
Mr. B. Braithwaite	Queen's Medical Centre, Nottingham
Mr. W. Tennant	Queen's Medical Centre, Nottingham
Mr. P. Driscoll	Queen Margaret Hospital, Dunfermline
Mr. M. Dube	King's Mill Hospital, Mansfield
Ms. L. Chagla	St Helens & Knowsley Hospital, Merseyside
Mr. D. Gomez	Queens Medical Centre, Nottingham
Mr. A.B. Hariskrishnan	Doncaster Royal Infirmary, Doncaster
Mr. M. Brett	Warrington NHS Foundation Trust, Warrington
OTORHINOLARYNGOLOGY & NECK SURGERY	
Mr. Olarinde	Chesterfield Royal Infirmary, Chesterfield
Mr. J. Sharp	Royal Derby Hospital, Derby
Prof. N. Jones	Queen's Medical Centre, Nottingham
Mr. A. Sama	Queen's Medical Centre, Nottingham
Mr. I. De	Royal Derby Hospital, Derby
Mr. D. Choa	Royal National Throat, Nose and Ear Hospital, London
Miss K. Midwinter	Chesterfield Royal Infirmary, Chesterfield
Mr. P. Andrews	Royal National Throat, Nose and Ear Hospital, London
PAEDIATRIC SURGERY	
Mr. S. Singh	Queen's Medical Centre, Nottingham
Mr. A. Williams	Queen's Medical Centre, Nottingham
Mr. M. Shenoy	Queen's Medical Centre, Nottingham
Mr. N. Patwardhan	Leicester Royal Infirmary, Leicester
Mr. B. Eradi	Leicester Royal Infirmary, Leicester
UROLOGY	
Mr. D. Shipstone	Chesterfield Hospital, Chesterfield
Mr. D. Bodiwala	King's Mill Hospital, Mansfield
Mr. H. Ratan	Royal Derby Hospital, Derby
Mr. V. Kumar	Doncaster Royal Infirmary, Doncaster
Mr. S. Pathak	Doncaster Royal Infirmary, Doncaster
Ms. S. Reid	Northern General Hospital, Sheffield
Mr. R. Inman	Royal Hallamshire Hospital, Sheffield
Mr. I. Eardley	Leeds Royal Infirmary, Leeds
Mr. J. Patterson	Royal Hallamshire Hospital, Sheffield
NEUROSURGERY	
Mr. D. Ramnarine	Frenchay Hospital, Bristol
Mr. L. Thorne	Royal Free Hospital, London
Mr. G. Dow	Queen's Medical Centre, Nottingham
Mr. A. Helmy	Addenbrookes Hospital, Cambridge
PLASTIC & RECONSTRUCTIVE SURGERY	
Mr. A. Mahajan	Bradford Royal Infirmary, Bradford
Mr. S. Al-Ghazal	Bradford Royal Infirmary, Bradford
Mr. T. Rasheed	Nottingham City Hospital, Nottingham
Mr. P. Russell	Royal Derby Hospital, Derby
Ms. A. Raurell	Nottingham City Hospital, Nottingham
Mr. P. Brooks	Nottingham City Hospital, Nottingham
Professor P. McArthur	Whiston Hospital, Merseyside
Mr. I. Mackie	Frenchay Hospital, Bristol
ALLIED SPECIALTIES	
Dr A. Kathirgamanathan	Consultant Anaesthetist , Kings Mill Hospital, Mansfield
Prof. S. Maxwell	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
Dr. Roger Bayston	Associate Professor and Reader in Surgical Infection, University of Nottingham
Dr. S. Ralph	Consultant Anaesthetist, Royal Derby Hospital, Derby
Mr. J. Tingle	Reader in Health Law, Director of the Centre for Health Law, Nottingham Law School, Nottingham

CORE SURGERY JOURNAL

Volume 2, Issue 5

Dear Prospective Authors

Thank you for considering the submission of an article to 'Core Surgery'. This is a new journal aiming 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.

Types of Article

Manuscripts are considered under the following sections:

1) Case based discussions
2) Practical procedures
3) Audit
4) Review articles
5) Course reviews
6) Research papers

Submission of Manuscript

Submissions will only be accepted via email and must be accompanied by a covering letter. Please submit your article to **coresurgery@123doc.com.** The covering letter must include a statement that all authors have contributed significantly and accept joint responsibility for the content of the article. In addition any financial or other conflict of interest must be declared.

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 numerals in brackets [eg. (1)], in the order in which they appear. 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.**

Copyright

Articles accepted for publication become copyright of *Core Surgery* and authors will be asked to sign a transfer of copyright form. In signing the transfer of copyright it is assumed that authors have gained permission to use any copyrighted or previously published material. This includes all images taken or copied from books, articles, websites etc. All authors must read and agree to the conditions in the copyright agreement form and either sign the form or agree that the corresponding author can sign on their behalf. The copyright form will be issued on acceptance of the article.

Format of Articles

Guidelines for the format of respective article types are as follows. All articles must contain an abstract of 150-250 words for indexing purposes and 3-5 keywords.

Case Based Discussions

Guidelines for the format of respective article types are as follows. All articles must contain an abstract of 150-250 words for indexing purposes and **3-5 keywords.**

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

Audit

Articles should be 1000-1500 words long and of high quality. Each article must contain an abstract. Completed audit cycles are strongly preferred as are audits which have led to guideline development.

CORE SURGERY JOURNAL

Volume 2, Issue 5

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.

Course Reviews

Should be a maximum of 1000 words and review a course which is either mandatory or desirable for core trainees and junior higher surgical trainees. An abstract is required summarising the article contents and salient conclusions.

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.

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. Examples of the requirements for question style can be found here: **http://www.intercollegiatemrcs.org.uk/old/pdf/samplequestions_MCQ.pdf**

Summary

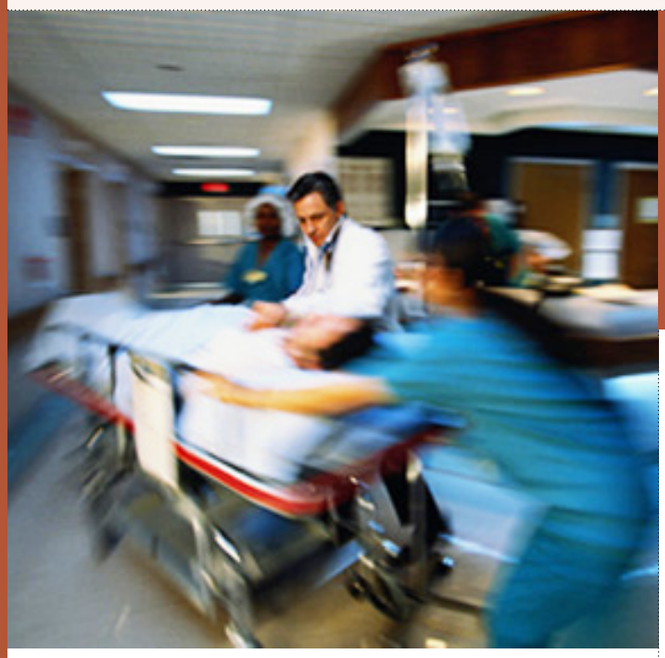
Articles considered for publication will be sent for review by our panel of consultants and junior surgical trainees. We wish you every success with your submission. Please contact the editorial team with any questions.

How To Order

Order online at: www.123library.org
Order by email: subscriptions@123doc.com
Order by phone: 0207 253 4363

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa



Abstarct

There were over nine million surgical operations in England in 2009/10, with roughly 50% being emergencies. Surgery in the emergency setting must be done promptly to save life, limb or functional capacity. This type of surgery has a higher mortality and morbidity. For this reason it is essential for surgeons to be able to manage these patients promptly and safely. This article introduces the surgical trainee to the differing aspects of pre-operative management and safety which are essential for the optimization of patients in preparation for emergency surgery.

Keywords: Consent, pre-operative, emergency surgery

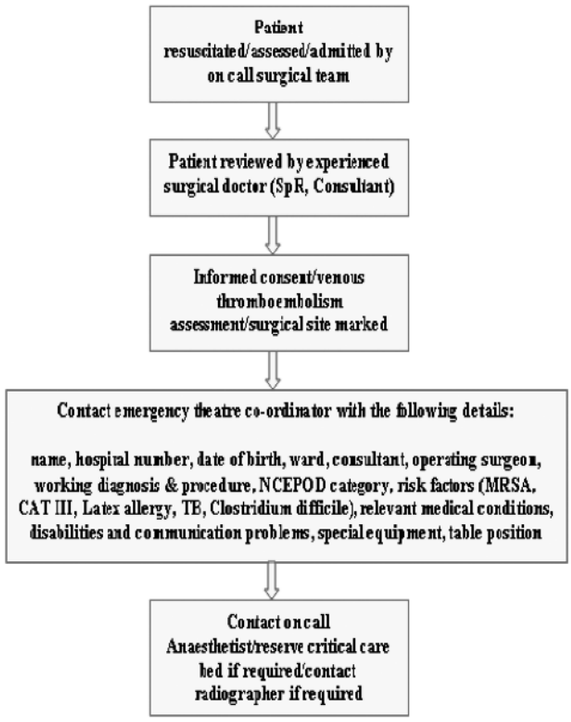
Case Vignette

You are the on-call senior house officer in a district general hospital at night. Your registrar has reviewed a 60 year old man who was admitted to the surgical assessment unit after being resuscitated in the emergency department. He presented with acute lower abdominal pain and vomiting with localised peritonism. A subsequent abdominal CT scan showed that this patient had acute appendicitis. He has a past medical history of type II diabetes, rheumatoid arthritis for which he takes regular steroids, and is on warfarin for atrial fibrillation. Your registrar has consented him for an appendicectomy but wants you to medically optimize and book him for emergency theatre for the following morning.

A trainee's guide to pre-operative care & surgical safety in emergency surgery
Back to Basics

How do you proceed?

Introduction



Flowchart of a typical emergency theatre booking process.

There were over nine million surgical operations in England alone between 2009/2010. Data on emergency surgical services in the UK is scarce and incomplete but it is estimated that it encompasses up to 50% of the workload of most surgical specialties. (1)

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa

Emergency surgical services encompass six main elements. These are:

- Operating on any emergencies regardless of the time of day.
- Operating on patients who require further intervention after undergoing planned or unplanned surgery.
- Providing good, ongoing clinical care to post operative patients including elective and emergency patient who have surgical complications.
- Providing advice and assessment of patients referred from other departments within the same hospital, other hospitals, and from the general practitioner.
- Providing effective, safe, early and continuous acute pain management.
- Providing good communication with patients, carers and supporters. (1)

Getting the patient to emergency theatre

Preparation for all emergency surgical patients is essentially about organisation and routine. Each hospital in the UK will have individual guidelines and protocols for emergency theatre booking.

The emergency theatres in many UK hospitals close between 23.00 and 08.00 with the exception of life or limb threatening conditions. A discussion with the on-call surgical consultant and anaesthetist needs to occur prior to the operating theatre being opened 'out of hours'.

In the infrequent occasion that two life or limb threatening emergencies arise simultaneously, a second operating theatre will need to be opened. This will ideally need to be done after consultant level involvement.

Preoperative fasting

Patients can suffer significant morbidity and mortality secondary to pulmonary aspiration of as little as 30 mls of gastric contents. Fasting aims to reduce the volume of gastric contents thus reducing the risk of aspiration. Other factors predisposing to aspiration include, obesity, pregnancy, inadequate anaesthesia, difficult airway, emergency surgery, full stomach and altered gastrointestinal motility.

The critically unwell surgical patient might not have the time required to adequately fast prior to surgery. For the patients that do, the American Society of Anaesthesiologists (ASA) in 1999 issued guidelines for preoperative fasting in elective patients. Similar guidelines are used by the Association of Anaesthetists of Great Britain and Ireland (AAGBI).

The minimal fasting period after consuming clear fluids (water, fruit juices without pulp, clear tea, and black coffee) in the surgical patient is over 2 hours. These fluids are emptied by the stomach in an exponential manner with a half-life of 20 minutes. This results in complete emptying by 2 hours. The minimal fasting period after consuming solids is 4 to 8 hours. The higher the fat or meat content, the longer the stomach takes to empty its contents. For example, light toast will be emptied by 4 hours, whereas meals containing meat will require at least 8 hours.

The minimal fasting period after consuming breast milk and cows milk is up to 4 hours and 5 hours respectively, This is because when mixed with gastric juices, milk congeals and is treated like a solid. (2)

Venous thromboembolism prophylaxis (VTE)

10% of all hospital deaths are due to pulmonary embolism. Patients that are high risk have a 40-80% chance of developing DVT and a 10% chance of PE without prophylaxis. (2) Each hospital has a rigid VTE protocol due to the risks stated above.

The different methods of prophylaxis are:

- Conservative (avoidance of prolonged immobility, avoidance of dehydration)

- Graduated compression stockings (reduces DVT but not PE. Enhances protection when combined with chemical thromboprophylaxis. Avoid in patients with severe arterial disease)

- Subcutaneous heparin (reduces fatal DVT and PE by two-thirds. Unfractionated heparin has been greatly replaced by low molecular weight heparin)

- Fondaparinux sodium (synthetic anticoagulant given subcutaneous once daily)

- Rivaroxaban and dabigatran (newer oral anticoagulants mostly licensed for elective orthopaedic procedures)

Preoperative optimization

In the current era, an increasing number of patients with significant co-morbidities present for anaesthesia and surgery. With an aging population and safer anaesthesia this trend is likely to continue to increase. Abnormalities in fluid balance, electrolytes, metabolism and coagulation are common in the emergency surgical patient. It is therefore increasingly important to identify these patients so that assessment and optimization can take place. In the emergency setting the time available for this is variable and limited as compared to that of elective procedures.

The following chapter will briefly describe the basic methods of optimization of patients with common background medical conditions. A full guide of pre-operative management of all organ systems is beyond the scope of the article therefore the focus is on a handful of conditions which have been 'hot topics' for the MRCS OSCE examination over the last few years.

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa

A trainee's guide to pre-operative care & surgical safety in emergency surgery
Back to Basics

Fluid optimization

The principle of fluid optimization in the emergency surgical patient is to return the body's physiology to as near normal as possible. The resuscitation fluid of choice is crystalloids (Normal saline or Hartmann's). (3, 4) If there is significant haemorrhage then these crystalloids will need replacing with blood products. In these circumstances, a hypotonic solution (eg 5% Dextrose) will not be sensible due to rapid intracellular shift of water. (4)

The volume of fluid depletion needs to be estimated in order to calculate the volume of fluid replacement required. This can be determined by:

- Haematocrit on admission if the level in the patient's healthy state is known.
- Patient's body weight on admission if weight known in healthy state (acute weight loss is mostly water).
- Disproportionate rise in urea as compared to serum creatinine.
- Clinical features (lax skin tone, dry mucous membranes) and altered physiological parameters (hypotension, tachycardia, oligouria). (3)

Fluid replacement needs to be tailored to the patient. In a previously fit patient (<60 years old with presumed good LV function) aggressive fluid boluses can be given (20 mls/kg if hypotensive, 10 mls/kg if normotensive).

A typical regimen might be 1,000 ml Hartmann's over 2 hours followed by 1,000 mls Hartmann's over 4 hours with regular clinical assessment of fluid balance. In a septic, severely dehydrated, or shocked patient, further 20 mls/kg fluid boluses may be required, and an urinary catheter should be inserted to ensure urine output of >0.5 mls/kg/hr. In an elderly patient or someone with impaired LV function, careful fluid resuscitation is required with regular hourly clinical assessments and a urine output of 0.5 mls/kg/hr might be acceptable. Fluid overload is a concern and it might become necessary to involve critical care teams early in order for invasive monitoring (eg central venous line, arterial line) to be inserted. A typical regime may be 1,000 ml Hartmann's over 4 hours followed by 500 mls Hartmann's over 3-4 hours with regular clinical assessments. (3-4)

Diabetes

If the patient does not require an immediate surgical procedure then pre-operative assessment of diabetics is of great benefit. They are prone to cardiovascular, renal, respiratory, gastrointestinal and infectious diseases.

The patient should be investigated with:

- serum glucose
- glycosylated haemoglobin (HbA1c). Reliable measure of recent glycaemic control. Normal range is 3.8 - 6.4%. If it is 7.5 - 10% then the patient is receiving suboptimal diabetic management and surgery should proceed with caution. If it is >10% then refer to the diabetic team for advice.

These patients should ideally be placed first on the operating list if no more urgent cases are booked. They should stop all long acting oral hypoglycaemics 24 hours prior to surgery.

Before deciding on the type of perioperative diabetic management required, you need to know whether the patient is type I or II diabetic and minor or major surgery is planned. Any surgery where the patient can be expected to eat within 4 hours (eg have lunch following morning surgery) is considered minor.

A typical regime would be:

- Type I diabetics undergoing major surgery will require an insulin sliding scale (See fig 1) and should withold all other diabetic medications.
- Type I diabetics undergoing minor surgery will need all diabetic medications omitting until their next meal with 2 hourly BM checks. In BM>14 mmol/L then will need sliding scale.
- Type II diabetics with a BM >14 mmol/L require an insulin sliding scale regardless of the type of surgery.
- Type II diabetics with a BM<14 mmol/L will need all diabetic medications omitting until their next meal with 2 hourly BM checks. If the BM rises to over 14 mmol/L or they are not expected to eat for 24 hours then will need sliding scale.

The main danger to diabetic patients peri-operatively is hypoglycaemia. If serum glucose <4 mmol/L then give 50 mls of 50% glucose iv and repeat blood sugar levels. Glucagon 1 mg (im or iv) or sugar via mouth or nasogastric tube are alternatives. (5)

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa

Blood glucose (mmol/L)	Insulin infusion rate (U/hr) - Human soluble 50U in 50mls NaCl 0.9%
0 - 3.9	0 (stop for 30 mins and review)
4 - 6.9	0.5
7 - 8.9	1
9 - 10.9	2
11 - 13.9	3
14 - 19.9	4
≥ 20	6 (contact doctor)

Figure 1: Standard Insulin sliding scale regime pre-operatively.

The rate can be increased or decreased in alternate regimes if the patient has persistent low sugar (4-6 mmol/L) or high sugar (>11 mmol/L) levels respectively.

If BM>14 mmol/L give 0.9% NaCl at required rate.

When BM<14 mmol/L change fluid to Glucose 10% (500mls) with K+ 20 mmol is required rate. If K+ > 5 mmol/L then Glucose 10% alone.

Pacemakers & Implantable cardioverter defibrillators (ICDs)

Heart problems are increasingly being managed by implantable pacemakers and implantable cardioverter defibrillators. Therefore more and more surgical patients present with an implantable device in situ.

Surgical diathermy can potentially give rise to:

- Electrical interference with the devices causing additional risk of malfunction
- Tissue heating caused by energy induced into heart lead systems.

For the above reasons, precautions need to be considered for both elective and emergency surgery.

Pre operative precautions include:

- If at all possible, avoidance of surgical diathermy altogether. If deemed essential, the use of bipolar diathermy should be first line. However, even bipolar diathermy has a risk of interference, therefore limit its use to short bursts, ensure the return electrode positioned as far away from device as possible, ensure cables are kept away from device and consider external/ transvenous pacing if diathermy is significantly affecting the implant.
- If a non-urgent procedure planned, information about the device (manufacturer, model number, serial number, implanting hospital, follow up hospital, date of implant, reason for implant) should be sought and the manufacturer and patient's cardiac follow up centre contacted if required
- An up to date pacemaker check (battery check if present) should be organised. In emergencies, this should be done immediately post-operatively. Clinical magnets may be used for patients with ICDs. This will inhibit shock delivery as long as the magnet is directly over device throughout the operation. Subsequent ventricular arrhythmias (VT/VF) will need external defibrillation. Magnets, do not guarantee asynchronous pacing if secured over pacemakers and vary between models. (6)

The patient on anticoagulation

When patients who need surgery are on anticoagulation medications, the risks and benefits of omitting or continuing them must be carefully considered. There are an estimated 500,000 patients in the UK using oral anticoagulants (warfarin, acenocoumarol, and phenindione). Due to the significant proportion of the population who are on warfarin, most hospitals have devised protocols in order to 'bridge' these patients on to heparin so that surgical procedures can be done safely.

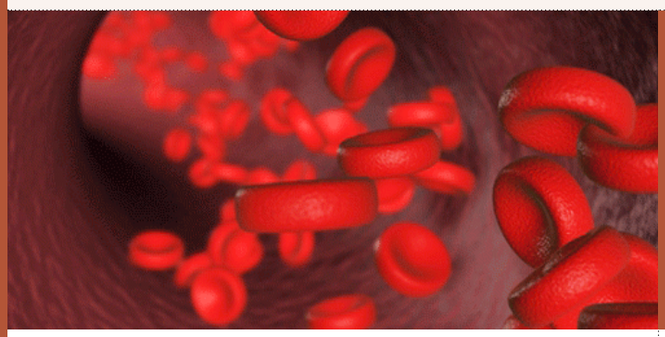
If the risk of procedure related bleeding is thought to outweigh the risk of thromboembolic events, then anticoagulants should be stopped and bridging anticoagulation considered.

Low molecular weight heparin (LMWH) has a 90-100% bioavailability and is given subcutaneously. It has by in large replaced unfractionated heparin because of its predictability and because it avoids the need for multiple serum clotting levels for monitoring.

Patients who do not require urgent surgery can be divided into standard and high thrombotic risk, if on warfarin in the community.

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa



A trainee's guide to pre-operative care & surgical safety in emergency surgery
Back to Basics

Reason for being on oral anticoagulation	Standard Risk	High Risk
Mechanical heart valve	Bileaflet aortic valve and no other risk factors for CVA	Recent CVA (within 6 months), any prosthetic mitral valve, caged ball or tilting disc aortic valve, bilateral prostetic aortic valve AND one or more of the following risk factor (chronic AF, LVF, >75 years old, HTN, diabetes, prior CVA)
Chronic AF	AF without prior CVA or rheumatic heart disease	AF with previous CVA or rheumatic valvular heart disease
Venous thromboembolism (VTE) or antiphospholipid syndrome	Previous VTE and now long term anticoagulant therapy	Recent episode of VTE (within 3 months), Recurrent VTE on oral anticoagulation, antiphospholipid syndrome with a history of venous or arterial thrombosis

Figure 2: Table of thrombotic risks for different medical conditions.

For patients who are standard risk, an example regime is given:

- Stop warfarin for 4 days pre-operatively.
- Admit the patient day before surgery and check INR.
- If INR > 1.5 then give 1 mg vitamin K and recheck INR on the morning of surgery. Start LMWH (eg 5000U Daltarparin once daily) if INR < 2
- Last dose of LMWH 12 hours before surgery.
- Post operatively, depending on type of operation, and post operative instructions you can commence LMWH 6-8 hours after procedure.
- Restart warfarin on day 1+ post op and continue LMWH until INR therapeutic.

For patients who are high risk, an example regime is given:

- Stop warfarin for 4 days pre-operatively.
- Admit patient 2 days before surgery and check INR.
- If INR > 1.5 then give 1mg vitamin K and recheck INR the day before surgery. Start LMWH (twice daily) if INR < 2.
- Last dose of LMWH 12 hours before procedure.
- Post operatively, give LMWH 6-8 hours after procedure if suitable
- Start warfarin day 1 post op.
- If INR not therapeutic by day 3 then give LMWH twice daily and discuss with haematologist. (7)

In emergency surgery, if the patient's INR >1.4 then the following steps should be considered:

- Vitamin K 10 mg by slow infusion, duration of action 12-24 hours.
- Fresh frozen plasma (FFP) – 10-15ml/kg, duration of action 6-12 hours.
- If patient bleeding – give FFP stat, if not then give over 1-2 hours.
- If life or limb threatening haemorrhage – urgent discussion with haematologist. Consider other concentrated clotting factor eg) prothrombin complex concentrates (Beriplex). (4)

The patients on steroids

Steroids are used by patients for varying medical conditions, including replacement therapy for adrenocortical insufficiency, and to suppress acute and chronic inflammatory and immunological responses.

Patients that are taking steroids and require surgery need careful planning because of the risk of an impaired stress response due to hypothalamic-pituitary-adrenal (HPA) suppression, or due to the risk of complications from their underlying disease.

Usual steroid dose	Type of surgery	Action
Prednisolone <10 mg/day	All	Assume normal HPA axis - no additional cover required
Prednisolone >10 mg/day	Minor eg) hernia	25 mg hydrocortisone iv at induction OR usual preoperative steroid
	Intermediate eg) nephrectomy	Usual preoperative steroid AND 25 mg hydrocotisone iv at induction and then 6 hourly for 24 hours
	Major eg) cardiac	Usual preoperative steroid AND 25 mg hydrocotisone iv at induction and then 6 hourly for 72 hours
High dose immunosupression	All	Should be on equivalent iv steroid dose until able to revert to oral intake eg) 60 mg prednisolone/24hrs = 240 mg hydrocortisone/24 hours
Previously taking steroids	< 3 months since steroids stopped	Treat as if the patient is still on steroids
	> 3 months since steroids stopped	No perioperative steroids required

Figure 3: The table below shows a typical perioperative steroid replacement therapy regime for patients.

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa

Prioritization of patient's for emergency surgery

National Confidential Enquiry into Patient Outcome and Death (NCEPOD) was first devised in association with the Royal College of Surgeons and of Anaesthetists and was established by 1990. NCEPOD has now expanded to include all specialties with a view of improving patient care. Based on this they devised a grading scale to determine a time scale of when the operation needs to be carried out so there is no comprise in the care of the patient.

The NCEPOD Classification of patients:

- *Immediate* – life or limb saving; needs to be operated on within minutes, usually requires resuscitation at the same time (usually in the context of major haemorrhage) and less urgent cases have to make way for them.
- *Urgent* – acute deterioration with could mean a threat to the patient's life. Usually operations will take place within hours of presentation. This category usually includes the majority of the acute surgical take (eg – fractures, appendicectomy etc) and these patients have time to be resuscitated. Usually, they do not require surgery after midnight.
- *Expedited* – the operation is not needed to sustain life and will take place in next few days to weeks (typically malignancies). There is time to control and optimize most medical problems. This category of patients should be operated on during normal working hours.
- *Elective* – operation not needed urgently and therefore will be carried out at a time to suit both patient and hospital (8)

This classification system highlights that there is a window of opportunity for every case and a balance needs to be struck between the risk of delaying the operation against the risk of going ahead. For example:

- A patient with appendicitis who has been unwell and vomiting for a few days would benefit from a few hours delay to get fluid resuscitated with correction of electrolyte imbalances (hypokalaemia).
- A patient with peritonitis following a perforated peptic ulcer would only have 1-2 hours to be resuscitated and only partial correction of shock and acidosis may be possible before emergency laparotomy is essential.
- A patient with ruptured aortic aneurysm will need resuscitation in theatre. No delay should occur in order to correct shock and acidosis prior to surgery. (9)

When organising the order of the theatre list, once the NCEPOD classification has been established, other factors to consider, in order from first to last on theatre list, are:

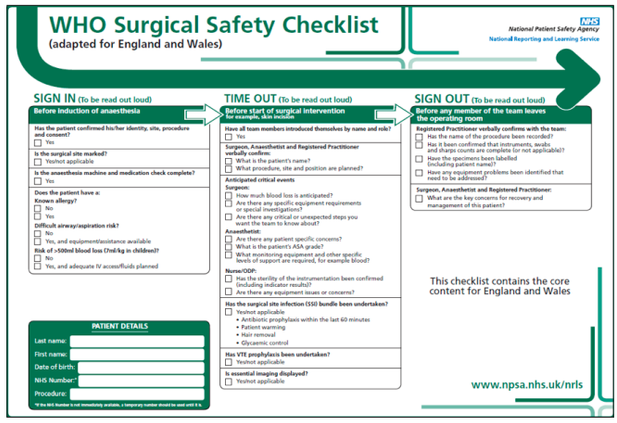
- Latex allergy patient should be first in morning to facilitate theatre preparation
- Paediatric patients
- Diabetic patients
- Day cases
- Local anaesthetic cases
- Dirty cases (infections, debridments, abscesses etc)

should ideally be last on the list.

Pre-operative safety in the operating theatre

234 million surgical procedures are performed world wide each year. Around 7 million patients suffer some form of harm. Out of these, around 50% of these harmful events are preventable. Factors that lead to these adverse outcomes are mostly human factor errors including failures in communication, leadership, team-working, decision-making and situational awareness. (2)

The World Health Organization established The Safe Surgery Saves Lives programme as part of the effort to reduce the number of surgical deaths across the globe. The aim of this programme was to address important issues in safety, including inadequate anaesthetic safety practices, poor communication among team members, and avoidable surgical infections. The National Patient Safety Agency (NPSA) adapted this to form a checklist for use in England and Wales. The checklist is shown below.



(10)

The principles of a team briefing are to introduce each team member and identify their role, identify patients and procedures planned, confirm the order of the list, identify specific equipment and any concerns relevant to the day ahead. This is done before the start of an operating list. The debrief is a structured discussion at the end of the list to allow the team to recognize good practice that should become routine, but also to identify factors that need to be improved. Lastly, it is an opportunity to thank the team members for the specific actions. The combination of the surgical check list with briefing and debriefing in operating theatre has resulted in a reduction in surgical complications and mortality. (2)

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa

A trainee's guide to pre-operative care & surgical safety in emergency surgery
Back to Basics

Questions

Multiple, all or none of the statements may be true.

1. A 68 year old man is admitted to the emergency department with a perforated peptic ulcer. He usually takes 40 mg of Prednisolone orally for COPD. Which perioperative steroid replacement therapy regime would be most appropriate for him:

a) No perioperative steroids required
b) 25 mg Hydrocortisone iv at induction with conversion to usual dose oral steroids immediately post operatively.
c) 25 mg Hydrocortisone iv at induction followed by 24 hourly iv replacement for 72 hours..
d) 25 mg Hydrocortisone iv at induction followed by 6 hourly iv replacement for 72 hours.
e) Continue with usual oral steroid perioperatively.

2. A 67 year old type II diabetic patient has been admitted to the ward the night before an urgent incarcerated inguinal hernia repair. His BM was 19 mmol/L. Which of the following management plans would be most appropriate for him:

a) Omit all diabetic medications overnight and during the procedure. Restart usual medications once eating.
b) Omit all diabetic medications and convert to an insulin sliding scale over night and during the procedure. Restart usual medication once eating.
c) Continue all diabetic medications until morning of surgery. Omit during surgery. Restart usual medications once eating.
d) Omit all diabetic medications and convert to an insulin sliding scale over night and during the procedure. Restart usual medication immediately post operatively.
e) Continue all diabetic medications until morning of surgery. Omit during surgery. Restart usual medications immediately post operatively.

3. A 72 year old gentlemen has been admitted into the resuscitation room in the emergency department with generalised peritonitis and shock. A portable CXR is identified free air under the diaphragm. He is on warfarin for chronic AF. His INR is 3.0. What would be the most appropriate management of his anticoagulation.

a) Omit warfarin and proceed to surgery urgently.
b) Omit warfarin, give 10mg Vitamin K and proceed to surgery urgently.
c) Omit warfarin, give 10-15mls/kg FFP and proceed to surgery urgently.
d) Omit warfarin, give 10mg Vitamin K and 10-15ml/kg FFP. Recheck INR in 6 hours and delay surgery until INR<1.4
e) Omit warfarin, give prothrombin complex concentrates and proceed to surgery urgently.

4. Which of the following questions are not part of the signing in process from the WHO surgical safety checklist.

a) Is the surgical site marked?
b) Does the patient have any known allergies?
c) Difficult airway/aspiration risk?
d) Has patient confirmed his/her identity, site, procedure and consent?
e) Is the anaesthesia machine and medication check complete

5. Which of the following statements about preoperative fasting are true:

a) The minimum fasting time after consuming clear fluids is 6 hours.
b) If a patient has consumed black tea then they need to be fasted for longer then a patient who has consumed water.
c) Consuming milk considerably prolongs gastric emptying when compared to black tea/coffee.
d) Foods with a higher fat content stay in the stomach for longer.
e) All patients that have consumed food need a maximum fasting of 5 hours.

A TRAINEE'S GUIDE TO PRE-OPERATIVE CARE & SURGICAL SAFETY IN EMERGENCY SURGERY

M Darrad, S Anandappa

Answers

Q1) d (please refer to 'the patient on steroids')

Q2) b (please refer to 'diabetes' for details). This patient needs close monitoring, omission of all his regular diabetic medications and conversion to an insulin sliding scale. If BM remains >11 then he will need an alternate sliding scale prescribing. He should only be restarted on his normal diabetic medications once he is eating due to the risk of hypoglycaemia.

Q3) e (please refer to 'patient on anticoagulation'), 'd' would be appropriate if the patient was not in shock with suspected bowel perforation. This patient has a life threatening emergency and therefore a delay of hours would not be suitable. Prothrombin complex concentrates can work within minutes and should be considered after discussion with the haematologists.

Q4) None of the answers. All of these questions are part of the WHO surgical safety sign in checklist.

Q5) c & d (please refer to 'preoperative fasting')

References

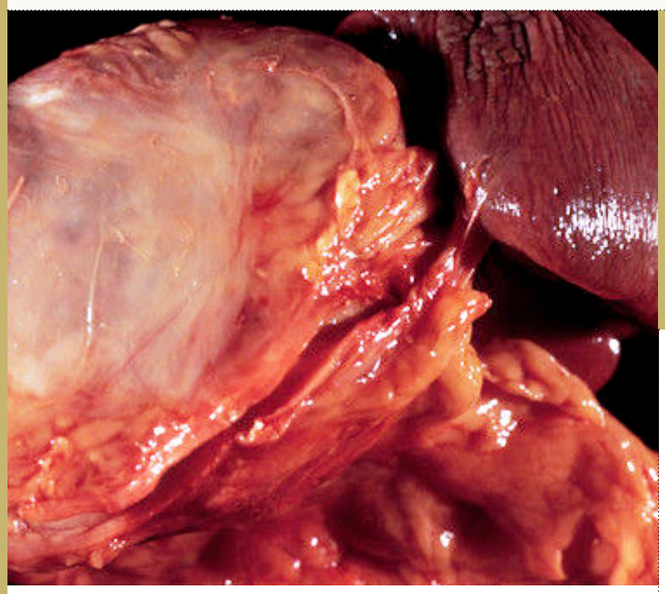
1. The Royal College of Surgeons of England (2011) Emergency Surgery. Standards for unscheduled surgical care. Available at w**ww.rcseng.ac.uk/publications/docs/emergency-surgery-standards-for-unscheduled-care/attachment_download/pdffile (Accessed on 1 July 2012)**
2. Allman K., Wilson I. (2011) Oxford Handbook of Anaesthesia (Third Edition). Oxford Medical Publications.
3. McLatchie G., Borley N., (2007) Oxford Handbook of Clinical Surgery (Third Edition). Oxford Medical Publications.
4. Callaghan C., Bradley J., (2008) Emergencies in Clinical Surgery. Oxford Medical Publications.
5. Sheffield Teaching Hospitals Clinical Guidelines (2011) Diabetes and Surgery: Guidelines and prescription chart for the management of blood glucose (BG) during Intravenous. Available at **http://nww.sth.nhs.uk/NHS/ClinicalGuidelines/ (Accessed on 1 July 2012)**
6. Medicines and Healthcare products Regulatory Agency (2006) Guidelines for the perioperative management of patients with implantable pacemakers or implantable cardioverter defibrillators, where the use of surgical diathermy/electrocautery is anticipatied. Available at **http://www.mhra.gov.uk/home/groups/dts-bi/documents/websiteresources/con2023451.pdf (Accessed on 1 July 2012)**
7. Sheffield Teaching Hospitals Clinical Guidelines (2012) Bridging anticoagulation: The peri-procedural management of patients on oral vitamin K antagonist. Available at **http://nww.sth.nhs.uk/NHS/ClinicalGuidelines/ (Accessed on 1 July 2012)**
8. National Confidential Enquiry into Patient Outcome and Death (2004) The NCEPOD Classification of Intervention. Available at **www.ncepod.org.uk/pdf/NCEPODClassification.pdf (Accessed on 1 July 2012)**
9. Hambly P., Sainsbury M (1996) Perioperative Management for House Surgeons. BIOS Scientific Publishers Limited.
10. World Health Organization (2009) Safe Surgery Saves Lives. Available at **http://www.who.int/patientsafety/safesurgery/en/ (Accessed on 1 July 2012)**

Corresponding author

M Darrad
CT2 Urolog,
Royal Hallamshire Hospital
Sheffield
Email: maitreydarrad@gmail.com

ACUTE PANCREATITIS

H Cui



Acute Pancreatitis
General Surgery

Abstract

Acute Pancreatitis remains a common surgical emergency. The traditional management techniques have been placed under close scrutiny and refinements and new measures have been suggested. The UK Working Party for Acute Pancreatitis published comprehensive guidelines in 2005 and these are currently undergoing a further revision. We review the basics of diagnosing and investigating acute pancreatitis and present a review of current management strategies.

Keywords: Pancreatitis, Gallstones, Alcohol

Clinical Vignette

A 40 year old man presented to the Emergency Department with two days of severe boring epigastric pain and several episodes of vomiting. He takes no regular medication, has no family history of pancreatitis and reports alcohol intake of '2-3 pints of lager' a day. On examination he had a temperature of 38°C, pulse rate is 111 beats per minute and had localised epigastric pain with no peritonitis. Blood investigations showed white cell count of 16 x 109/L, haematocrit 39%, serum amylase 1240 IU/L, serum aspartate transaminase (AST) 280 IU/L, albumin 40g/L and serum lactate dehydrogenase (LDH) 740 IU/L. Glucose, calcium, triglycerides, electrolytes and renal function were all normal.

He was admitted to the ward and abdominal ultrasound the next day showed no gallstones and a normal calibre common bile duct. Over the next five days he developed acute renal failure and was transferred to the High Dependency Unit for invasive monitoring. He had an abdominal CT scan, which showed evidence of extensive necrosis as shown in Fig. 1. CT guided percutaneous aspiration of the necrotic area was performed on day 8 for which Gram stain was negative and no organisms were cultured. The patient improved on supportive treatment and enteral feeding and was discharged home after three weeks hospital stay with advice to reduce alcohol intake.

Figure 1) Abdominal CT of patient with pancreatic necrosis as demonstrated by non-enhancing area (arrow). Arrowhead shows residual enhancing pancreatic tail.

Introduction

The incidence of acute pancreatitis is on the rise in the UK, especially so in Scotland and in the younger population, likely representing a rise in alcoholic pancreatitis. Hospital admission rates for acute pancreatitis have doubled over the past 30 years with no improvement in the 30% mortality rate for those with severe pancreatitis and multi-organ failure. (1) In the majority of patients, acute pancreatitis is mild and resolves without complications.

However in those that generate a Systemic Inflammatory Response Syndrome (SIRS), subsequent multi-organ failure and complications of pancreatic necrosis significantly increase morbidity and mortality. Although the initial management is mainly medical, definitive management of biliary pancreatitis and infected pancreatic necrosis nearly always require surgery.

ACUTE PANCREATITIS

H Cui

Aetiology and pathophysiology

The most common causes are gallstones (up to 50%) and alcohol (25%). Prolonged consumption of alcohol over 5-10 years usually precedes the first attack of pancreatitis. Alcohol causes toxic injury to the acinar cells, promotes synthesis of pancreatic enzymes and decreases the integrity of the intracellular membranes, which result in autodigestion of the gland. (2) Gallstones cause pancreatitis by the stone itself, or the surrounding oedema impacting or transiently obstructing the common bile duct (CBD) and pancreatic duct at the level of the ampulla of Vater. (3)

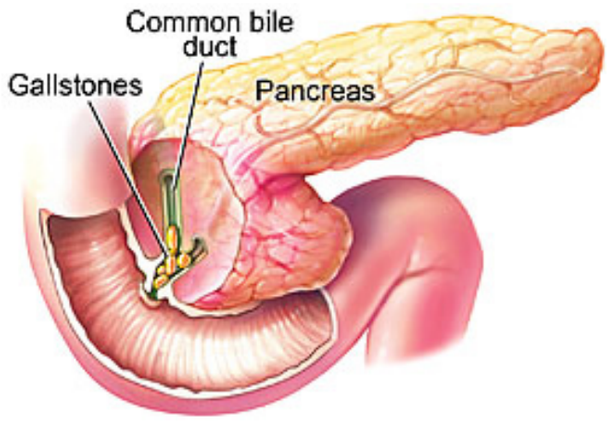
The next most common cause is idiopathic, although current UK guidelines recommend that no more than 20-25% of cases of acute pancreatitis should be labelled as idiopathic. (4) Other causes include trauma, surgery, mumps, other viruses e.g. EBV, CMV and increasingly HIV, autoimmune and inherited, hyperlipidaemia (hyperparathyroidism, hypothermia), ERCP and certain medications. Other controversial causes include pancreas divisum and sphincter of Oddi dysfunction.

Assessment

History taking and primary investigations should be targeted to finding the aetiology and predicting the severity of the attack of acute pancreatitis. These are crucial, as biliary pancreatitis requires early definitive management and the predicted severity of the disease guides level of care required and an increased likelihood of organ failure.

Presentation

Patients mostly present with severe epigastric pain that is dull and boring in nature ascending over several hours, often radiating to the back and relieved by leaning forwards. The pain may last for several days and persistence of pain is associated with local complications such as peripancreatic fluid collections and pancreatic necrosis. The abdomen may be peritonitic on palpation and there may be associated gastric ileus. Pancreatic inflammation can cause disruption of blood vessels, which leads to peripancreatic bleeding. If extensive bleeding in the retroperitoneal space occurs this may present as Grey Turner's sign or Cullen's sign, which is due to blood in the periumbilical tissues. Pancreatitis is a well known cause of SIRS and this can manifest with dysfunction of the major systems including respiratory (Adult Respiratory Distress Syndrome), cardiovascular (myocardial depression, vasodilatation), renal (acute tubular necrosis), gastrointestinal (liver failure, ascites) and haematological (thrombosis, Disseminated Intravascular Coagulation). Pyrexia can be due to the inflammatory response or acute cholangitis if there is biliary obstruction. (5)



Diagnosis

Diagnosis is usually confirmed with a rise in serum amylase and lipase level. The levels of these pancreatic enzymes released during an acute attack will peak at the onset of pain and decline over 3-4 days. Generally, amylase levels 3-4 times the normal range indicate pancreatitis but one has to consider several confounding factors. Firstly, as mentioned, amylase level on admission needs to be taken in consideration with length of time after onset of pain. Secondly, amylase is also raised in other conditions such as small bowel obstruction and ischaemia, visceral perforation, leaking aortic aneurysm and ectopic pregnancy; making its specificity for pancreatitis 88%. Lipase has a longer half life than amylase and is only released by the pancreas, therefore it is present for longer after the onset of pancreatitis and has higher sensitivity and specificity than amylase. (4) Where available, serum lipase is preferred to amylase.

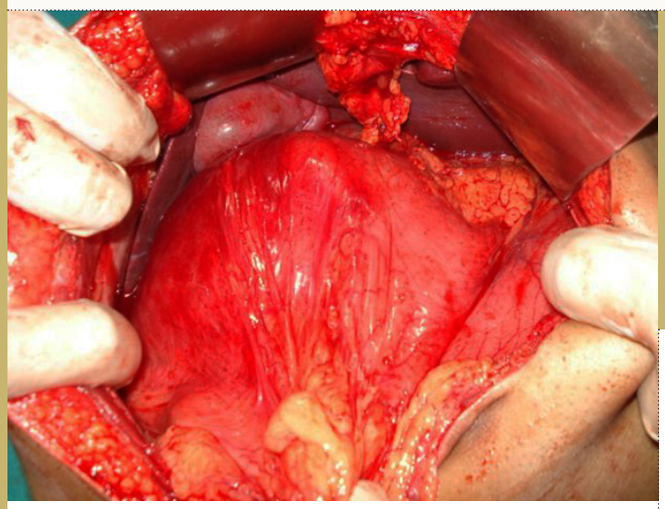
In order to elucidate the cause, initial investigation should be abdominal ultrasound. If the first ultrasound is negative or does not visualise the biliary structures then a second one should be performed. If there is still suspicion of gallstone disease causing recurrent pancreatitis then endoscopic ultrasound (EUS) or magnetic resonance cholangiopancreatography (MRCP) can be performed. EUS can help detect microlithiasis in recurrent cases of pancreatitis and MRCP clearly delineates the biliary tree to detect ductal stones and other abnormalities such as pancreas divisum. Further investigations, especially in cases of recurrent pancreatitis, should measure fasting lipid levels, fasting serum calcium, viral antibody titres and autoimmune markers. One should also consider the diagnosis of exacerbations of chronic pancreatitis and underlying pancreatic malignancy as a cause of recurrent pancreatitis. (4)

Predicting severity

Timely use of appropriate predictors of disease severity in acute pancreatitis forms an important part of the clinical decision making process. Patients can be grouped as severe or non-severe pancreatitis using an admission severity scoring system. After the initial 48 hours, slightly different predictors are used for scoring.

ACUTE PANCREATITIS

H Cui



The UK Working Party on Acute Pancreatitis guidelines found evidence to support the use of the following as indicators of severity in the first 24 hours: clinical impression of severity, obesity or APACHE (Acute Physiology and Chronic Health Evaluation) II >8. After 48 hours in hospital the following is recommended to predict severity: CRP (C Reactive Protein) >150 mg/L, Glasgow score ≥3 or persisting organ failure. (4) Use of the APACHE II score initially is recommended as both the Ranson and Glasgow score require 48 hours for full evaluation.

By 48 hours, the APACHE II score should be repeated, the CRP obtained, any ongoing organ failure noted and the Glasgow score calculated. (6) An APACHE II score that increases in the 48 hours is strongly suggestive of the development of severe pancreatitis whereas a score that decreases by day 2 strongly suggests mild pancreatitis. CRP levels peak at 36-72 hours after admission and so its measurement after 48 hours has been shown to correlate with the presence of necrosis with a sensitivity and specificity of >80%. (7) Patients with organ failure at admission that is corrected within 48 hours have a mortality approaching 0, whereas those with ongoing organ failure for more than 48 hours have a 36% mortality. (8)

CT in acute pancreatitis, scoring

Early CT is useful if the diagnosis is in doubt. However, using CT to stage extent of pancreatitis or pancreatic necrosis may be inaccurate within the first few days of admission and is unlikely to change management. Risk of exacerbating renal injury is possible with CT but there is currently no evidence to show that having a CT increases pancreatitis severity or mortality from pancreatitis. (9,10) Given that pancreatic necrosis is unlikely to be evident until at least day 4, the current recommendation is that CT (ideally with oral and intravenous contrast) is indicated in those patients with persisting organ failure, signs of sepsis or clinical deterioration 6-10 days after admission. (4) By this time, CT detection of pancreatic necrosis approaches 90%. Scoring of pancreatitis severity according to the Balthazar system gives further prognostic information (Fig. 2). (11) This also allows planning of radiological or surgical intervention based on the extent of pancreatic necrosis and whether the patient is showing signs of infected necrosis.

CT grade	Score
Normal pancreas	0
Oedematous pancreatitis	1
Oedema with mild extrapancreatic changes	2
Severe extrapancreatic changes including one fluid collection	3
Multiple or extensive extrapancreatic changes	4
Necrosis	
None	0
< One third	2
> One third, > one half	4
> Half	6

CT severity index = CT grade + necrosis score

Score	*Complications*	*Deaths*
0-3	8%	3%
4-6	35%	6%
7-10	92%	17%

Figure 2): CT severity index based on Balthazar scoring system. (4)

Initial management, use of prophylactic antibiotics and enteral nutrition

The aim of initial management is supportive treatment to arrest and resolve organ damage within the first 24 hours. Therefore patients should all initially be treated as aggressively as necessary to maintain adequate oxygenation (aiming for arterial saturations over 95%) and perfusion (fluid resuscitation to maintain urine output >0.5ml/kg body weight) until the severity level can be better gauged.

Importantly, prophylactic use of antibiotics in acute pancreatitis is not recommended as per NICE and UK Working Party on Acute Pancreatitis guidelines. (4,12) This is largely using evidence from the only double blind placebo controlled trail to date which shows no significant difference in mortality, infected necrosis and systemic complications. However, as can be expected, infectious complications such as sepsis and MODS were significantly lower in the prophylactic antibiotic group. (13) Current thinking proposes the use of antibiotics in those with extensive, or greater than 30%, necrosis on CT, as those with less than 30% necrosis rarely develop infected necrosis. (4)

ACUTE PANCREATITIS

H Cui

With regards to nutrition in pancreatitis, those with mild pancreatitis should be able to eat a normal diet and do not benefit from enteral feeding. In those with severe pancreatitis, nausea prevents adequate oral intake. The previously held belief that parenteral feeding was necessary in pancreatitis, as enteral feeding would exacerbate the disease has been mostly dispelled. Enteral feeding has been shown to be safer, cheaper, with less risk of septic complications and an improved clinical outcome compared to parenteral feeding. (14-16)

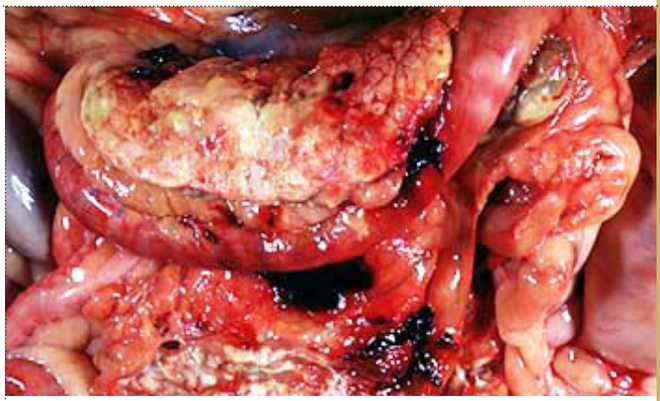
Management of gallstone pancreatitis

Endoscopic Retrograde Cholangiopancreatography (ERCP)

Early ERCP plays an important role in the management of gallstone pancreatitis. Clearly, those with an obstructed biliary system need to be decompressed to prevent complications of ascending cholangitis and multi-organ failure. For those who have severe pancreatitis and gallstones but no biliary obstruction, ERCP is also recommended based on evidence from three randomised controlled trials. (17) Therefore, patients with obstructive jaundice, cholangitis or a dilated common bile duct should all have an ERCP within 72 hours of admission. Furthermore it is recommended that all patients undergoing ERCP for severe gallstone pancreatitis with or without a finding of common bile duct stones have endoscopic sphincterotomy. (4) This is especially important in cases of cholangitis where a stent may be required to ensure drainage of the CBD is achieved.

Cholecystectomy

Definitive treatment for gallstone pancreatitis is required to prevent a recurrence of potentially life threatening pancreatitis. For mild pancreatitis, this is ideally in the form of a cholecystectomy performed within the same hospital admission, or at least for no longer than two weeks after discharge from hospital. (4) If these patients with mild pancreatitis have not warranted further imaging of their biliary tract in the form of an EUS, MRCP or ERCP, then operative cholangiogram should be performed at the time of cholecystectomy. If common bile duct stones are found intraoperatively, it is vital that these stones are cleared from the duct, either by bile duct exploration or post operative ERCP. (4) Patients with uncleared stones have very high rates of readmission for biliary pancreatitis. (18) Those unfit for a cholecystectomy can have an endoscopic sphincterotomy. In severe pancreatitis, the priority is to drain any biliary obstruction and allow organ dysfunction to resolve before considering cholecystectomy.



Pancreatic necrosis: radiological and surgical management

Sterile vs. Infected pancreatic necrosis

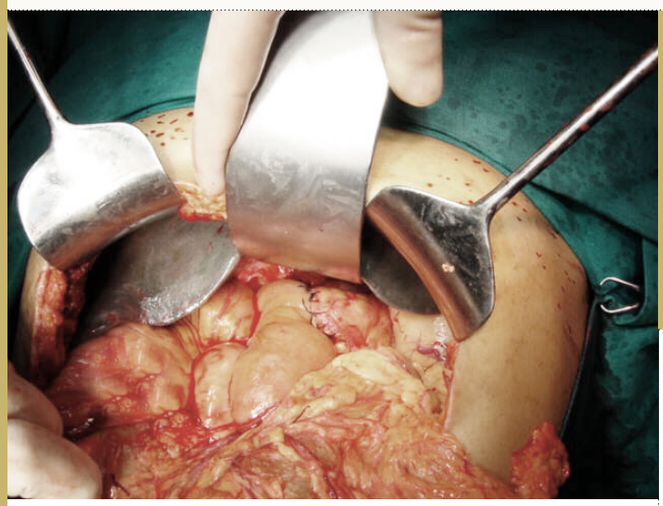
The significance of pancreatic and peripancreatic necrosis seen on CT largely depends on extent of necrosis, the clinical picture of the patient, and most importantly, whether the necrotic tissue is sterile or infected. Infected necrosis accounts for 80% of fatal outcomes in acute pancreatitis and therefore always requires radiological or surgical intervention, whereas sterile necrosis rarely necessitates surgical management. (19) As mentioned previously, patients with less than 30% necrosis of the pancreas rarely have infected necrosis and any infected necrosis will usually present itself after 7-14 days in hospital. If the patient has greater than 30% necrosis with unresolving symptoms, an aspirate of the necrotic area is required to send for bacterial culture. Similarly, if the patient has less than 30% necrosis but is clinically septic then radiologically guided Fine Needle Aspiration (FNA) is also indicated. (4) If there is no evidence of sepsis or infection on the FNA, non-operative management of sterile necrosis has always been preferred as pancreatic necrosectomy itself carries a 11% mortality overall. However recent evidence has shown in patients with persisting pain or inability to eat, necrosectomy can be beneficial and more than 20% of patients with a negative FNA will have infected necrosis at the time of operation. (20)

Radiological management

The standard management of infected necrosis has always been surgical necrosectomy. However, good outcomes with radiological drainage have also been found. In a systematic review of eleven retrospective studies including one randomised controlled trial, percutaneous drainage had a primary success rate of 55% (21). If radiological drainage is available, this should be attempted initially as it can delay need for early surgery, allowing time for the necrosis to demarcate (which is usually after two weeks from onset of pancreatitis). (22) The main difficulty lies in the fact that the necrotic tissue will likely be too solid to be amenable to drainage unless it has already liquefied into a pancreatic abscess.

ACUTE PANCREATITIS

H Cui



Surgical Management

Surgical options for failed percutaneous drainage include open necrosectomy and a number of minimally invasive necrosectomy techniques. Open necrosectomy via a laparotomy allows debridement and lavage of the necrotic tissue. The abdomen can then be packed and left open, or closed over drains with or without continuous peritoneal lavage, or planned re-laparotomies performed with repeated lavage. No case controlled trials exist to compare these methods. Evidence so far points to closure over drains or with continuous peritoneal lavage having lower morbidity than the other methods as repeat laparotomy is not required. (23)

Of the minimally invasive methods, the next step from percutaneous drainage could be a minimally invasive pancreatic necrosectomy along an established percutaneous drain tract using either visualization with endoscopy or use of soft tip catheters and fluoroscopy guidance. (24) Evacuation can also be performed endoscopically, similar to endoscopic pseudocyst drainage except the endoscope is inserted into the necrotic cavity itself via a cystostomy through the stomach. The only minimally invasive technique to have been approved by NICE is percutaneous retroperitoneal endoscopic necrosectomy. (25) This allows either a flexible or rigid endoscope to be inserted percutaneously via the posterolateral approach into the retroperitoneal space and the necrosis debrided using forceps, suction and lavage. Drains can then be placed and the procedure repeated if necessary. This recommendation is largely based on a randomised control trial of 88 patients by the Dutch Pancreatitis Study group which showed that retroperitoneal necrosectomy after failed drainage: the 'step up' approach, had a significantly lower rate of major complication or death than open necrosectomy. (26) There is no evidence to suggest that one method is superior or that minimally invasive techniques have better outcomes than open necrosectomy. What can be said is that these novel techniques all require careful patient selection and should only be performed in specialist centres. (21)

Acute Pancreatitis
General Surgery

Questions

1. Which of the following is not a cause of acute pancreatitis?

A. HIV
B. Microlithiasis
C. Pancreas divisum
D. Trauma
E. Type I Diabetes

2. The most common cause of early death (within 7 days) in patients with severe acute pancreatitis is:

A. Cardiac failure
B. Coagulopathy
C. Renal failure
D. Respiratory failure

3. Regarding initial management of acute pancreatitis which one of the following is true:

A. Abdominal ultrasound should be used to confirm the diagnosis.
B. A Glasgow score of more than 3 on admission necessitates admission to a critical care unit.
C. Lipase measurement is preferred for the diagnosis of acute pancreatitis.
D. Patients should be kept nil by mouth until the pain has resolved.
E. Prophylactic antibiotics should be given in patients with severe pancreatitis and pyrexia.

4. Which one of the following is not true in the recommended management of gallstone pancreatitis:

A. AST is a prognostic indicator
B. Cholecystectomy should be performed within the same admission if possible.
C. If initial ultrasound abdomen does not demonstrate the common bile duct, no further imaging is required.
D. Patients presenting with cholangitis should have an ERCP within 72 hours.
E. The cause of acute pancreatitis can still be biliary obstruction if no gallstones are demonstrated on abdominal ultrasound.

ACUTE PANCREATITIS

H Cui

5. Pancreatic necrosis:

A. Affecting less than 30% of the pancreas never requires FNA.
B. Can be radiologically scored using the APACHE II score.
C. Is a major cause of early death in pancreatitis.
D. Requires open necrosectomy.
E. Will not be apparent on CT until at least 4 days after onset of symptoms.

Answers

1. E: Type I diabetes is not one of the metabolic causes of pancreatitis, although pancreatitis can cause insulin dependent diabetes.

2. D: Respiratory failure due to acute lung injury caused by pancreatitis is the most common cause of early death, whereas the other organ failures cause death in the later phase.

3.C: Guidelines recommend use of lipase where available as it is more specific and has a longer half life compared with amylase.

4.C: A repeat ultrasound or MRCP should be performed if there is suspicion of gallstone pancreatitis if the calibre of the common bile duct cannot be seen on the initial ultrasound.

5.E: A CT before at least 4 days will underestimate the extent of any developing necrosis.

References

1. Goldacre M, Roberts S. Hospital admission for acute pancreatitis in an English population, 1963-98: database study of incidence and mortality. BMJ. 2004;328(7454):1466-9.
2. Hanck C, Whitcomb D. Alcoholic pancreatitis. Gastroenterol Clin North Am. 2004;33(4):751-65.
3. Frakes J. Biliary Pancreatitis: A Review: Emphasizing Appropriate Endoscopic Intervention. J Clin Gastroenterol. 1999;28(2):97-109.
4. UK guidelines for the management of acute pancreatitis. Gut. 2005;54(suppl 3):iii1-iii9
5. Kingsnorth A, O'Reilly D. Management of acute pancreatitis. BMJ. 2004;328(7446):968-9.
6. Blamey SL, Imrie CW, O'Neill J, Gilmour WH, Carter DC. Prognostic factors in acute pancreatitis. Gut. 1984 December 1, 1984;25(12):1340-6.
7. Weber CK, Adler G. From Acinar Cell Damage to Systemic Inflammatory Response: Current Concepts in Pancreatitis. Pancreatology. 2001;1(4):356-62.
8. Johnson CD, Abu-Hilal M. Persistent organ failure during the first week as a marker of fatal outcome in acute pancreatitis. Gut. 2004;53(9):1340-4.
9. Hwang T-L, Chang K-Y, Ho Y-P. Contrast-Enhanced Dynamic Computed Tomography Does Not Aggravate the Clinical Severity of Patients With Severe Acute Pancreatitis: Reevaluation of the Effect of Intravenous Contrast Medium on the Severity of Acute Pancreatitis. Arch Surg. 2000;135(3):287-90.
10. Uhl W, Roggo A, Kirschstein T, Anghelacopoulos SE, Gloor B, Müller CA, et al. Influence of Contrast-enhanced Computed Tomography on Course and Outcome in Patients with Acute Pancreatitis. Pancreas. 2002;24(2):191-7.
11. Balthazar EJ, Freeny PC, vanSonnenberg E. Imaging and intervention in acute pancreatitis. Radiology. 1994;193(2):297-306.
12. NICE. Alcohol-use disorders: diagnosis and clinical management of alcohol related physical complications. 2010(NICE clinical guideline 100).
13. Isenmann R, Rünzi M, Kron M, Kahl S, Kraus D, Jung N, et al. Prophylactic antibiotic treatment in patients with predicted severe acute pancreatitis: a placebo-controlled, double-blind trial. Gastroenterology. 2004;126(4):997-1004.
14. Windsor ACJ, Kanwar S, Li AGK, Barnes E, Guthrie JA, Spark JI, et al. Compared with parenteral nutrition, enteral feeding attenuates the acute phase response and improves disease severity in acute pancreatitis. Gut. 1998;42(3):431-5.
15. Gupta R, Patel K, Calder PC, Yaqoob P, Primrose JN, Johnson CD. A randomised clinical trial to assess the effect of total enteral and total parenteral nutritional support on metabolic, inflammatory and oxidative markers in patients with predicted severe acute pancreatitis (APACHE II > or =6). Pancreatology. 2003;3(5):406-13.
16. Powell JJ, Murchison JT, Fearon KCH, Ross JA, Siriwardena AK. Randomized controlled trial of the effect of early enteral nutrition on markers of the inflammatory response in predicted severe acute pancreatitis. Br J Surg. 2000;87(10):1375-81.
17. Behrns K, Ashley S, Hunter J, Carr-Locke D. Early ERCP for Gallstone Pancreatitis: For Whom and When? J Gastrointest Surg. 2008;12(4):629-33.
18. Sargen K, Kingsnorth AN. Management of gallstone pancreatitis: effects of deviation from clinical guidelines. JOP. 2001;2(5):317-22.
19. Werner J, Feuerbach S, Uhl W, Büchler M. Management of acute pancreatitis: from surgery to interventional intensive care. Gut. 2005;54(3):426-36.

ACUTE PANCREATITIS

H Cui

20. Fernández-del Castillo C. Open Pancreatic Necrosectomy: Indications in the Minimally Invasive Era. J GastrointestSurg. 2010;15(7):1089-91.
21. van Baal MC, van Santvoort HC, Bollen TL, Bakker OJ, Besselink MG, Gooszen HG. Systematic review of percutaneous catheter drainage as primary treatment for necrotizing pancreatitis. Br J Surg.98(1):18-27.
22. Schmidt C. Necrotizing Pancreatitis: Novel Minimally Invasive Strategies. Journal of Gastrointestinal Surgery. 2011;15(7):1086-8.
23. Werner, J, Hartwig, W, Hackert, T, et al. Surgery in the treatment of acute pancreatitis : Open pancreatic necrosectomy. Scand J Surg. 2005;94(2):5.
24. Bruennler T, Langgartner J, Lang S, Zorger N, Herold T, Salzberger B, et al. Percutaneous necrosectomy in patients with acute, necrotizing pancreatitis. Eur Radiol. 2008;18(8):1604-10.
25. NICE. Interventional procedure guidance 384: Percutaneous retroperitoneal endoscopic necrosectomy. 2011.
26. van Santvoort HC, Besselink MG, Bakker OJ, Hofker HS, Boermeester MA, Dejong CH, et al. A Step-up Approach or Open Necrosectomy for Necrotizing Pancreatitis. NEJM. 2010;362(16):1491-502

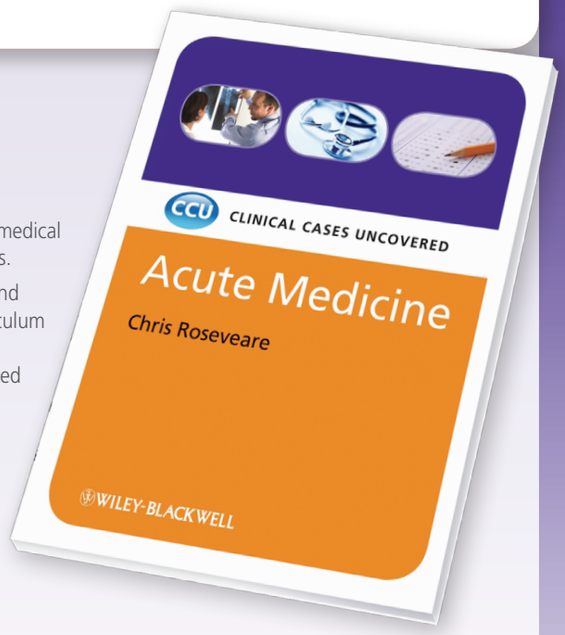
Corresponding Author

Helen Cui
Core Surgical Trainee,
Department of General Surgery,
Oxford Radcliffe Hospital NHS Trust,
Churchill Hospital, Old Road,
Oxford, OX3 7LJ
Email: helenw.cui@googlemail.com

Acute Medicine

CLINICAL CASES UNCOVERED

Chris Roseveare,
Southampton General Hospital



Acute Medicine is the central part of foundation and specialist general medical training and is one of the most rapidly expanding UK hospital specialties.

Acute Medicine: Clinical Cases Uncovered combines patient cases and outcomes, drawn from real-life experiences, with reference to the curriculum for Training in General (Acute) Medicine. It provides self-assessment MCQs, EMQs and SAQs to give Foundation Programme doctors and allied healthcare professionals the perfect preparation for life on the wards.

"Easy to read, excellent level of information and suitable to take on the wards for quick reference."
FINAL YEAR STUDENT, UNIVERSITY OF LIVERPOOL MEDICAL SCHOOL

"This is an excellent book! It illustrates key concepts in acute medicine through clearly laid out case studies that clinical students will commonly see while "on take" as part of their medical training... I would definitely use this book to study for my medical finals!"
4TH YEAR STUDENT, BRIGHTON AND SUSSEX UNIVERSITY

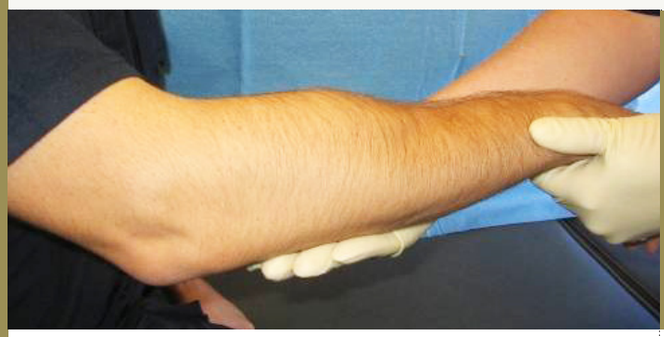
ISBN 9781405168830
FEBRUARY 2009 • Paperback • 256 pages

CONTENTS

WILEY-BLACKWELL

HOW TO REDUCE COLLES' FRACTURES: A STEP-BY-STEP GUIDE

F Shivji, T Coughlin, V Green



How to Reduce Colles' Fractures:
A Step-by-Step Guide
Trauma & Orthopaedic Surgery

Abstract

As the UK population continues to age, the frequency of fragility fractures is set to rise. It has been estimated that 71,000 people sustain distal forearm fractures each year in the UK. (1) The extra-articular distal radius fracture, first described by Abraham Colles in 1814, is one of the most common fractures managed by junior doctors. This article explains the diagnosis and management of Colles' fractures. Regional anaesthesia including Bier's and haematoma blocks is explained, and the application of a well moulded plaster using three point fixation is demonstrated. Hopefully this will prepare you to manage this injury, giving you the opportunity to improve your patients' outcomes and save many of them from needing surgical intervention.

Keywords: Colles' fracture, distal radius, Bier's block

Case

A 70 year-old lady trips over her rug and breaks her fall with her outstretched right hand. In the Emergency Department she complains of a painful right wrist. On examination, the wrist is found to be deformed and swollen. X-rays show a fracture of the distal radius (Figure 1).

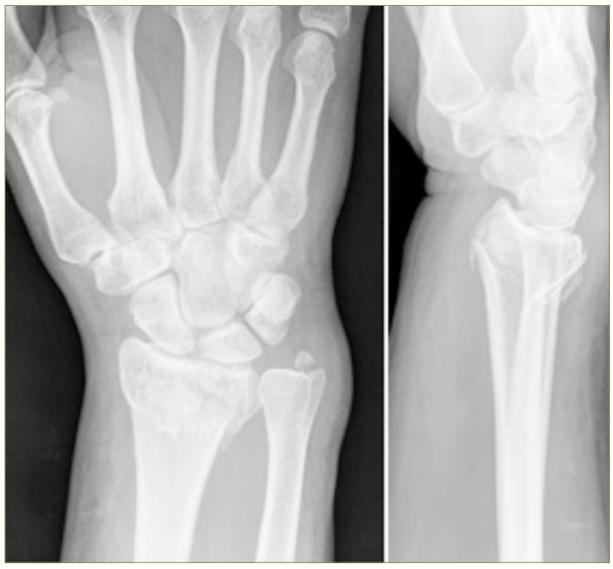


Figure 1: X-ray of Colles' Fracture with radial shortening, radial deviation, and dorsal angulation of the distal fragment.

History and Pathology

Fractures of the distal radius and ulna are common injuries with over 70,000 occurring each year in the UK. (1) The Colles' fracture, first described by Abraham Colles in 1814, is a fracture of the distal radius around 3 cm from the articular surface. (2) When it was described X-rays were not available and so this was the limit of the original description. It is now commonly also taken to have the following features:

1. Dorsal angulation

2. Radial deviation

3. Radial shortening

Colles' fractures are considered fragility fractures, which are defined by the World Health Organisation as, 'a fracture caused by an injury that would be insufficient to fracture a normal bone'. (3) They are more commonly seen in the elderly as a result of low energy trauma, such as a fall from standing height, as in the above case. The elderly are particularly affected due to the higher incidence of osteopenia and osteoporosis.

Indications for Reducing a Colles' Fracture

The common initial management of Colles' fractures is closed reduction and maintenance of reduction with a cast. This article describes the principles of reducing a Colles' fracture and using three-point fixation with a cast to maintain stability. Haematoma and Bier's block techniques are described as regional anaesthesia to allow fracture manipulation.

The International Distal Radius Fracture Study Group recommend reduction if certain criteria are met on x-ray, as shown in Table 1. (4) Reducing these fractures provides immediate and longer-term benefits. Firstly, reduction of the fracture reduces pain and swelling. Secondly, when successful reduction is obtained and maintained, these fractures can be treated conservatively avoiding the need for surgical intervention. (5)

HOW TO REDUCE COLLES' FRACTURES: A STEP-BY-STEP GUIDE

F Shivji, T Coughlin, V Green

Indications for Reduction
Dorsal tilt >10 degrees
Articular step-off >2mm
Radial shortening >5mm
Radial inclination <15 degrees

Table 1: Indications for reducing a Colles fracture (4)

Any patient who has sustained a Colles' fracture should also have a careful examination of their neurovascular status made which should be clearly documented in the notes. Median nerve and radial artery compression are rare but recognised complications, particularly if displacement is significant. If any neurovascular compromise is identified then prompt reduction is mandated.

Successful reduction of a Colles' fracture depends on good regional anaesthesia, a good reduction technique and a well-moulded cast with three point fixation.

Consent

Consent is required for any procedure performed on a patient. Written consent is not essential, but the authors recommend this as good practice. It is important when using a Bier's block, as cardiac arrhythmias could theoretically occur secondary to the intravascular local anaesthetic, should the tourniquet deflate prematurely.

As with any procedure, the patient should be informed of what steps the procedure entails, as well as its risks and benefits, as outlined in Table 2. There should be ample opportunity for the patient to ask questions before consenting to the procedure.

Benefits	Immediate Risks	Late Risks
Reduce pain	Pain during reduction	Compartment syndrome
Reduce swelling	Failure to improve position	Deformity/Mal-union
Reduce deformity	Neurovascular damage	Non-union
Anatomical fracture healing	Damage to tendons	Stiffness
	Anaesthetic risks	Arthritis
		Complex Regional Pain syndrome
		Carpal Tunnel Syndrome
		Tendon Rupture (Especially Extensor Pollicis Longus)

Table 2: Benefits & Risks of the Procedure

Patient Positioning

The patient should be positioned where they are most comfortable. A bed with the back rest set at 45 degrees is suitable. There should be ample space around the patient to allow for at least three people and a plaster trolley. This is not a procedure to perform in a cramped emergency department cubicle.

Regional Anaesthesia

The next step is to administer regional anaesthesia. Anaesthetic options include a haematoma block or a Bier's block. A haematoma block has the benefit of being quicker to administer and may have less potential complications than a Bier's block. However, studies have shown improved reduction and pain relief when using a Bier's block. (6, 7).

Haematoma Block

A haematoma block involves injection of local anaesthetic into the fracture haematoma. Aseptic technique is required when performing a haematoma block, as it technically converts a closed fracture into an open fracture by creating a communication between the fracture and the skin.

The equipment required for the haematoma block:

1. 10 ml 2% Lidocaine
2. 2 x green (21 Gauge) hypodermic needles
3. 10 ml syringe
4. 1 x Dressing Pack: consisting of sterile gauze, drape, gloves, forceps
5. Iodine-based skin prep (or equivalent)

Tip: Maximum dose of Lidocaine: 3 mg/kg.

HOW TO REDUCE COLLES' FRACTURES: A STEP-BY-STEP GUIDE

F Shivji, T Coughlin, V Green

How to Reduce Colles' Fractures:
A Step-by-Step Guide
Trauma & Orthopaedic Surgery

Technique:

1. The injection site should first be prepped with the chosen skin prep agent. It should be dressed with a non-adhesive dressing following injection.
2. Using the first green needle, draw up 10 ml 2% Lidocaine then discard the needle.
3. Attach the second needle to the syringe, and insert into the dorsum of the wrist over the fracture site. Walk the needle up the bone until it falls into the fracture site then aspirate until a flash of haematoma (dark blood) enters the syringe. At this point, the needle has reached the fracture haematoma and the Lidocaine can be infiltrated. It is best to try and infiltrate across the whole fracture site.
4. Once infiltrated, apply pressure with a sterile gauze to obtain haemostasis. Wait for five minutes before attempting reduction to allow the local anaesthetic to work.

Bier's Block

A Bier's block involves intravenous administration of local anaesthetic into the fractured arm in the presence of a tourniquet on the upper arm to prevent rapid systemic absorption.

The equipment required for the Bier's Block:

1. Double Tourniquet
2. 2 x cannulae
3. 40 ml 0.5% Prilocaine (preferred) or 0.5% Lidocaine
4. Saline flush

Technique:

1. Measure the patient's systolic blood pressure (SBP).
2. Insert two cannulae, one in dorsum of the hand on the fractured side and a large one (at least green) in the antecubital fossa of the unfractured side.
3. Attach a double tourniquet to the arm on the fractured side.
4. Inflate the tourniquet to 80mmHg above the patient's SBP and begin timing.
5. Inject 40 ml of 0.5% Prilocaine into the affected limb via the cannula. Warn the patient the limb may feel warm.
6. Remove the cannula from the affected limb and achieve haemostasis with digital pressure on sterile gauze.
7. Wait 5 minutes and test the anaesthesia with skin sensation.
8. The tourniquet must not be deflated until at least 15 minutes from the injection of local anaesthetic. The tourniquet should be deflated a maximum of 45 minutes from inflation.

Tip: Use a double tourniquet. If the patient feels uncomfortable, the proximal tourniquet can be inflated and distal tourniquet deflated, or vice versa.

Reduction Technique

Once good anaesthesia has been obtained then you can proceed to reduction. It is critical that everything you need is to hand before commencing. The procedure requires at least three people to be performed successfully. Two people are needed for the manipulation and a third to assist.

The equipment needed includes:

1. Stockinette pre cut to the length of the forearm
2. 2 x 2-4 inch width rolls of wool
3. 4 x 2-4 inch width plaster rolls
4. Bowl of warm water (20-25 degrees)

This photographic guide takes you through each step of one reduction technique. There are a number of different techniques and variations which are also acceptable and this is intended to give the authors preferred technique only. One notable variation is the use of finger traps to allow one person to perform the reduction and plastering rather than two. It is our experience that these devices are often not available, particularly in district general hospitals. This technique requires the minimum of equipment and should therefore be reproducible in all hospitals dealing with Colles' fractures.

1. Disimpact the fracture.

HOW TO REDUCE COLLES' FRACTURES: A STEP-BY-STEP GUIDE

F Shivji, T Coughlin, V Green

The lead clinician applies traction by holding the index and middle fingers in one hand, and the thumb base in another. An assistant applies counter traction by holding the distal humerus with the elbow in 90 degrees of flexion. Constant traction should be applied for at least 5 minutes. Most reduction attempts that fail do so because of inadequate traction.

2. Correct dorsal angulation.

While maintaining traction on the fingers with one hand use pressure from your thumb to manipulate the dorsally angulated distal radius volarly. If clinically satisfactory reduction is not achieved then return to step 1 and apply more traction.

3. Correct radial deviation.

When the wrist is deviated to the ulnar side of the forearm the reduction should be complete. However, this reduction must be held in place for the procedure to be successful.

Plaster Application

When applying a plaster the authors strongly advocate the use of a complete cast which is split once the plaster has set. It is very difficult to obtain good three point moulding with a backslab and reduction is likely to be lost when one is used. The plaster should begin an inch below the elbow crease and finish just proximal to the metacarpal-phalangeal joints (MCPJs) and the base of thumb. The elbow and finger joints should be free to move to prevent stiffness and swelling.

1. Apply Stockinette

Pull the pre-cut length of stockinette over the forearm with the thumb poking out through a pre-cut hole. It should have excess length both proximally and distally to allow it to be folded over during the plastering.

2. Apply the Wool

Start around the hand and make a small cut to allow for placement at the thumb base. Move proximally and stop below the elbow. The wool should be one layer thick as if it is too bulky it will prevent the plaster from gripping the fracture.

3. Apply the Plaster

The plaster should be applied around four to six layers thick with the thickest part around the fracture site. The plaster should not extend beyond the wool and should not touch the skin directly. While the plaster is soft and malleable three point fixation must be applied. Place one hand with the thenar eminence directly below the fracture site. Be careful not to put this hand too distal, a common mistake. Then use your other hand to push the plaster closely over the top of the radius sliding your hand from proximal to distal. This moulding must go both above and below the fracture site to give two points of compression. This gives the three points of fixation.

Whilst moulding the fracture care must also be paid that the wrist is in ulnar deviation. This will hold the distal radius out to length and prevent it from drifting back into radial deviation.

HOW TO REDUCE COLLES' FRACTURES: A STEP-BY-STEP GUIDE

F Shivji, T Coughlin, V Green

How to Reduce Colles' Fractures:
A Step-by-Step Guide
Trauma & Orthopaedic Surgery

4. Final Position

The moulded plaster should leave the final position of the wrist in 20-30 degrees of flexion and 15 degrees of ulnar deviation as shown in the pictures below.

5. Split the Plaster

Once the plaster has set and is no longer damp, it should be split to allow for any swelling which occurs after manipulation. This split should always be made on the volar aspect and must reach the wool throughout its whole length. Any bands of plaster which remain unsplit may cause complications if swelling occurs.

Summary

Distal radius fractures are common injuries. Due to an ageing population, the incidence of these fractures is set to increase. A Colles' fracture is a particular type of distal radius fracture with specific features, and it is essential that trainees understand what these features are and how they are treated. This article has provided a step-by-step guide showing how to reduce a Colles' fracture, from gaining consent to casting. It is hoped that this can be used by trainees in their clinical practice.

Questions

1. Which of the following is NOT features of a Colles' fracture?

a. Radial shortening
b. Dorsal angulation
c. Radial deviation
d. Fracture of the distal radius
e. Volar angulation

2. Which of the following is NOT an indication to reduce a Colles' fracture?

a. Dorsal tilt >10 degrees
b. Radial shortening >5 mm
c. Radial inclination <15 degrees
d. Ulnar styloid fracture
e. Articular step-off >2 mm

3. What is the maximum dose of Lidocaine that can be safely administered to an 80 kg woman?

a. 200 mg
b. 240 mg
c. 280 mg
d. 320 mg
e. 360 mg

4. A commonly used classification of distal radius fractures is:

a. The Schatzker classification
b. The Vancouver classification
c. The Frykman classification
d. The Neer classification
e. The Weber classification

HOW TO REDUCE COLLES' FRACTURES: A STEP-BY-STEP GUIDE

F Shivji, T Coughlin, V Green

5. The median nerve supplies which of the following structures?

a. Abductor pollicis brevis
b. Supinator
c. Extensor digitorum
d. Flexor carpi ulnaris
e. Biceps

Answers

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

Acknowledgements

The authors would like to thank Dr M Petrie and Dr C Taylor for their help in producing the photographs used.

Corresponding author

Dr Faiz Shivji,
CT1, Trauma and Orthopaedics, Queen's Medical Centre, Nottingham
Email: fshivji@nhs.net

References

1. O'Neill TW, Cooper C, Finn JD, Lunt M, Purdie D, Reid DM, et al. Incidence of distal forearm fracture in British men and women. UK Colles' Fracture Study Group. Osteoporos Int; 2001; 12(7): 555-8.
2. McRae, R. Pocketbook of Orthopaedics & Fractures. 2nd Ed, London: Churchill Livingstone Publishing; 2006.
3. World Health Organisation. Guidelines for preclinical evaluation and clinical trials in osteoporosis. [Online] Geneva, World Health Organisation: 1998. Available from: **whqlibdoc.who.int/publications/1998/9241545224_eng.pdf. [Accessed 17th February 2012]**
4. International Distal Radius Fracture Study Group: Indications for Reduction in Distal Radius Fractures. [Online] Available from **http://www.eradius.com/indications.htm [Accessed 17th February 2012]**
5. Neidenbach P, Audigé L, Wilhelmi-Mock M, Hanson B, De Boer P. The efficacy of closed reduction in displaced distal radius fractures. Injury [Online] 2010; 41(6): 592-8. Available from: http://www.sciencedirect.com/science/**article/pii/S0020138309005816 [Accessed 17th February 2012].**
6. Kendall J, Allen P, Younge P, Meek S, McCabe S. Haematoma block or Bier's block for Colles' fracture reduction in the accident and emergency department which is best? J Accid Emerg Med 1997; 14: 352-356.
7. Abbaszadegan H, Jonsson U. Regional anesthesia preferable for Colles' fracture. Controlled comparison with local anesthesia. Acta Orthop Scand 1990; 61(4): 348-349.

THE INITIAL MANAGEMENT OF LOWER LIMB OPEN FRACTURES: WHAT THE ON-CALL CORE TRAINEE NEEDS TO KNOW

RW Jordan, G Chahal

Abstract

Open fractures are typically high energy injuries. The Gustilo and Anderson classification can be used both for the communication of injury severity between health professionals and to predict the risk of subsequent infection. Efficient management improves outcome and the British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) in conjunction with the British Orthopaedic Association (BOA) published management guidelines in 2009; 'Standards for the management of open fractures of the lower limb.'

These guidelines advise patients should be managed in a specialist centre where a multidisciplinary team including plastic and pelvic surgeons are available. An ATLS approach should be applied in approaching all open fractures and great emphasis is placed on the systematic, careful and repeated examination of the affected limb. The guidelines cover wound management, neurovascular assessment, antibiotic and tetanus assessment, fracture splinting and timing of surgery. In this article we address each of these points and give the core surgical trainee the knowledge required to initially manage these patients.

Keywords: Open fracture, Compound fracture, Trauma, BAPRAS guidelines

Case Vignette

A 25 year old gentleman falls twenty feet from scaffolding and is brought to the emergency department with obvious deformity to both thighs. He has bilateral overlying soft tissue injuries with mud contaminating his wounds. The patient is assessed by the trauma team according to ATLS principles, undergoes clinical assessment and a trauma CT which fortunately reveal no other injuries. His femoral injuries are then addressed and the patient is given intravenous antibiotics, tetanus vaccine and immunoglobulin. The wounds are assessed; gross contamination is removed and pictures are taken before dressing with saline soaked gauze. The neurovascular status of both limbs are assessed and found to be intact, this is repeated after the legs are splinted. When the wounds have been dressed, antibiotics and tetanus administered and the patient stabilised the patient is sent for plain radiographs. The theatre staff and anaesthetist are informed as preparations are made for urgent debridement in view of the gross wound contamination.

The initial management of lower limb open fractures: what the on-call core trainee needs to know
Plastic & Reconstructive Surgery

Introduction

Open fractures typically result from high energy mechanisms and can be associated with multiple other injuries. Although efficient management of these fractures improves outcome, the patient is initially assessed and treated according Advanced Trauma Life Support (ATLS) principles. Following this, the performance of a secondary and tertiary survey has been shown to avoid missing other injuries (1, 2) and has now become an essential part of assessing the trauma patient.

The availability of a simple and reproducible classification facilitates communication between health professionals and ensures the transfer of appropriate patients to specialist centres. Despite poor interobserver reliability (3, 4) and the final grading only being confirmed in the operating theatre the Gustilo and Anderson classification is most commonly used by clinicians (see Table 1). (5) The grade of fracture is linked to the amount of soft tissue injury and has been shown to be related to infection rates; Type I 1.4%, Type II 3.6%, Type III 22.7%. (6) Patients in the most severe grade (Type IIIC) have a reported amputation rate as high as 50%. (7, 8) Many alternative systems have been proposed; for example the 'mangled extremity severity score' was developed to aid identification of patients who would benefit from primary amputation. (9)

Grade	Skin wound	Soft tissue damage	Fracture pattern
I	Less than 1cm	Minimal	Simple – either transverse or oblique
II	Between 1 and 10cm	Minimal to moderate soft tissue damage, with minimal contamination	Simple – either transverse or oblique
III	Greater than 10cm	Significant damage with significant contamination	Complex with presence of comminution and periosteal stripping
IIIA		Not requiring flap coverage	
IIIB		Requires flap coverage	
IIIC		Vascular injury or severe contamination (agricultural, marine or sewage)	

Table 1 – The Gustilo and Anderson Classification of Open Fractures (5)

THE INITIAL MANAGEMENT OF LOWER LIMB OPEN FRACTURES: WHAT THE ON-CALL CORE TRAINEE NEEDS TO KNOW

RW Jordan, G Chahal

Clinical guidelines

'Standards for the management of open fractures of the lower limb' was developed jointly by the British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) and the British Orthopaedic Association (BOA) and was published in 2009. (10) These guidelines clearly define the standards that should be reached in the management of lower limb open fractures. They start by recommending that patients with open fractures should be managed at a specialist centre where a multidisciplinary team inclusive of pelvic and plastic surgeons is available. There is evidence that the management of patients in these centres improve results (11, 12) and the guidelines suggest these centres should be organised on a regional basis. The requirements of a specialist centre are given in Table 2 and injury patterns that should prompt referral to these centres are given in Table 3. (10)

Requirements
Trauma and orthopaedic expertise
Plastics surgeons with expertise in microsurgery
Dedicated theatre sessions
Microbiologists with expertise in management of open fractures

Table 2 – Characteristics of a specialist centre according to the BAPRAS guidelines (10)

Fracture pattern	Soft tissue injury pattern
Fibula fracture at same level	Skin loss
Segmental tibial fracture	Degloving
Fracture with bone loss	Muscle loss during debridement
	Vascular injury

Table 3 - Characteristics of open fractures that should prompt referral to a specialist centre (10)

Initial Assessment and Management

An ATLS approach should always be employed at initial assessment, an AMPLE history obtained (see Table 4) and any external haemorrhage should be addressed by direct pressure with the use of a tourniquet reserved for extreme circumstances. Once the patient is stabilised or the limb is identified as an isolated injury the patient should be provided with adequate analgesia and the limb assessed. In the BAPRAS guidelines, great emphasis is placed on the systematic, careful and repeated examination of the affected limb. They also recommend that open fractures in children should be assessed in a similar manner to adult cases. (10)

A	Allergy
M	Medications
P	Past medical history
L	Last meal
E	Event – what happened?

Table 4 – Initial AMPLE history should be taken as per ATLS recommendations

The wound should be inspected for size, site and any evidence of contamination. A photograph of the wound should be taken and any gross contamination removed. The emergency department is not the correct environment for debridement or exploration. Obtaining swab cultures of the traumatic wounds are not routinely performed in the emergency department as studies have shown that any late infections are secondary to different organisms than cultured from initial swabs. (13, 14) The wound is dressed with moist saline soaked gauze, adding an antiseptic is not recommended. This dressing should then be left in place until the patient is in the operating room and the earlier photograph used to aid communication with colleagues of the soft tissue injury. The importance of degloving injuries if present is often underestimated and the viability of the degloved tissues can be difficult to assess. At clinical inspection various colouration of the skin are seen, the presence of blanching may represent the pooling of blood under the degloved tissue, where as the absence of blanching results from the thrombosis of intra and subdermal veins.

Accurate examination of the neurovascular status of the limb is imperative and after any intervention (e.g. splinting or manipulation) should be repeated. The vascular status of the limb should be assessed by both the capillary refill time (CRT) and distal pulses (dorsalis pedis and posterior tibial). The CRT can be misleading as pooling of blood in the foot (e.g. after a degloving injury) may give a brisk return of colour and for this reason pulse palpation is always recommended. If pulses are not palpable then a Doppler ultrasound should be performed, if this fails to confirm their presence then either urgent realignment of the limb or vascular referral should be obtained. Devascularised limbs are a surgical emergency and the aim should be to restore circulation within 6 hours as this avoids irreversible muscular ischaemia. (15)

The clinician should be able to predict the level of arterial injury from the fracture pattern and a delay for a preoperative angiography should be avoided. (16) Both motor and sensory function of the nerves should be assessed; the deep peroneal nerve is tested by ankle dorsiflexion and the presence of sensation in the first web space, the superficial peroneal nerve by sensation to the remainder of the dorsum of the foot and the tibial nerve by ankle plantarflexion and sensation to the sole of the foot.

THE INITIAL MANAGEMENT OF LOWER LIMB OPEN FRACTURES: WHAT THE ON-CALL CORE TRAINEE NEEDS TO KNOW

RW Jordan, G Chahal

The initial management of lower limb open fractures: what the on-call core trainee needs to know
Plastic & Reconstructive Surgery

If the limb has an obvious deformity then realignment of the limb should be attempted with subsequent immobilisation and application of splintage (e.g. Plaster of Paris or skin traction). Following application a further neurovascular assessment should be made and radiographs of the limb obtained. When requested plain radiographs, these should include two views of the fracture site and views of the joint above and below.

Antibiotics and Tetanus

Literature has shown that the use of antibiotics in the setting of open fractures is beneficial (6, 17) and authors recommend antibiotic prophylaxis should be given as early as possible. (5, 18) The BAPRAS guidelines recommend that all patients should be given antibiotics within 3 hours of their injury. (10) The choice of antibiotics depends both on local guidelines and the mechanism of injury; for example anaerobes may exist in ischaemic or farm injuries (18, 19) and evidence that aminoglycosides should be used in high grades of injury. (7) The BAPRAS guidance on antibiotics selection for various stages of open fracture management is given in Table 5. Historically antibiotics would be continued for 7 to 10 days after injury, (5) current literature recommends they should be continued until 24 to 72 hours after wound closure (18, 20) and BAPRAS guidelines suggest they should be continued until wound closure or for 72 hours whichever is sooner. (10)

If the patient's condition allows then tetanus immunisation history should be obtained, if unavailable then management should be performed on a worst case scenario (i.e. no immunisation history). Management is dependent both on the timing of their last booster and the mechanism of their injury and is illustrated in Table 6.

Setting	Antibiotics
Emergency department	Augmentin 1.2g or Cefuroxime 1.5g TDS (Clindamycin 600mg QDS if penicillin allergic)
First debridement	Augmentin 1.2g or Cefuroxime 1.5g TDS (Clindamycin 600mg QDS if penicillin allergic) **AND** Gentamicin (1.5mg/kg)
Definitive skeletal stabilisation or soft tissue coverage	Augmentin 1.2g or Cefuroxime 1.5g TDS (Clindamycin 600mg QDS if penicillin allergic) **AND** Gentamicin (1.5mg/kg) **AND** Vancomycin 1g or teicoplanin 800mg

Table 5 – BAPRAS guidance on selection of antibiotics in management of open fractures (10)

Timing since last booster	Treatment
< 5 years with full immunisation history	No tetanus needed
> 5 years with clean wound	Tetanus vaccine
> 5 years and wound prone to tetanus	Tetanus vaccine Human tetanus immunoglobulin
> 10 years	Tetanus vaccine Human tetanus immunoglobulin

Table 6 – Assessing and management of Tetanus status (10)

Timing of surgery

Traditionally a six hour window was advised for surgical intervention in open fracture cases (5), however recent literature suggests this is not necessary and that the first surgical intervention should be performed at the earliest opportunity when experienced surgeons are available. (11, 21-23) This is reflected in the BAPRAS recommendations that first debridement should occur during daytime hours by senior plastic and orthopaedic surgeons within 24 hours of the injury. (10)

When applied in clinical practice this should avoid the need for initial debridement during the middle of the night, which should be reserved for cases with an urgent indication for surgical intervention. In these cases the patient should ideally be in theatre within six hours and these indications include; gross contamination (marine, agricultural or sewage injuries), devascularised limb and multiply injured patients.

Compartment syndrome

Compartment syndrome is a surgical emergency and results from raised pressure within an osteofascial compartment that leads to local tissue hypoxia with resultant irreversible muscle and nerve damage. The surgical trainee needs to recognise the condition early and escalate concerns to seniors so that urgent decompression with surgical fasciotomies can be performed. The trainees should be aware that the condition is progressive and may not be present on initial assessment, highlighting the importance of repeated examination. The only important clinical sign is that of pain which is out of proportion to injury, fails to improve with analgesia and is aggravated by passive muscle stretch.

THE INITIAL MANAGEMENT OF LOWER LIMB OPEN FRACTURES: WHAT THE ON-CALL CORE TRAINEE NEEDS TO KNOW

RW Jordan, G Chahal

Traditional teaching of the "5 P's," pain, pallor, paralysis, pulselessness and parasthesia, should not be relied upon for diagnosis and are late signs of the condition and if present may signify irreversible damage. Diagnosing compartment syndrome is complicated in children, unconsciousness patients and if a regional nerve block has been administered. In these cases the diagnosis should always be kept in mind and if concerned either the compartment pressures can be measured or prophylactic fasciotomies should be performed. When measuring compartment pressures, a difference of less than 30mmHg between the diastolic pressure and the compartment pressure has been suggested as an indicator of compartment syndrome, (24) however some authors dispute the reliability of these measurements. (25, 26) Despite the availability of these techniques, the trainee should remember that if reasonable clinical doubt exists then fasciotomies should be performed.

Conclusion

The management of open fractures can form part of the complex treatment of polytrauma patients or can be isolated injuries. BAPRAS and BOA have jointly produced clear guidance for the management of these injuries which are summarised in Table 7. (10) The core surgical trainee should be able to efficiently instigate the initial assessment and management of these patients, being aware of the indications for urgent surgical intervention and escalating these cases to their seniors early.

Intervention	Standard
Early transfer to specialist unit	Complex open fractures
	For first surgical intervention
Management of wound	Minimal handling
	Remove only gross contamination
	Photograph
	Dress
	Saline soaked gauze/impermeable film
Neurovascular status	Repeated examination
Vascular injury	Immediate surgery within 3-4 hours, max warm ischaemia time is 6 hours
Antibiotics	Within 3 hours of injury
Tetanus	History obtained and correct treatment administered
Splint limb	Include ankle and knee for tibial fractures
Compartment syndrome	Immediate decompression
Contaminated wound (marine, agricultural or sewage matter)	Immediate surgery
Children	Assessed and managed as per adults

Table 7 – Summary of BAPRAS standards (10)

Questions

1. In which of the following scenarios would the patient not be classified at having a type III fracture according to the Gustilo Classification?

a) A complex open femoral shaft fracture with comminution and periosteal stripping.
b) A midshaft tibial fracture with an 11 cm wound not requiring flap coverage.
c) A distal femoral fracture with a 2 cm overlying wound that occurred in a farmyard.
d) A transverse midshaft tibial fracture with 4 cm wound anteriorly.
e) A distal tibial fracture with a clean 4 cm anterior wound with a cold and pale foot with no pulses obtained using a Doppler probe.

2. Regarding the vascular status of the injured limb, the following statements are all true EXCEPT:

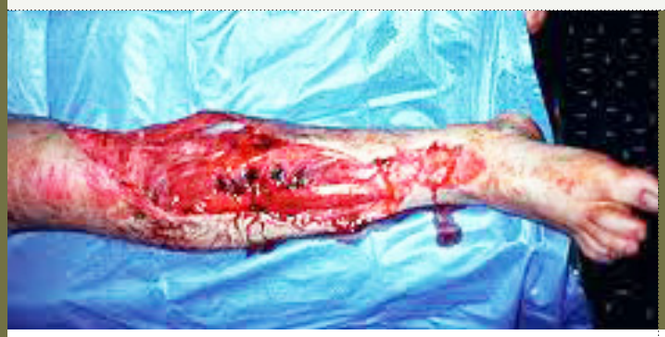
a) Accurate examination of the vascular status of the limb is imperative and should be repeated after splinting or manipulation.
b) The vascular status of the limb should be assessed by both the capillary refill time (CRT) and distal pulses.
c) A CRT of 2 seconds excludes a vascular injury.
d) If pulses are not palpable then a Doppler ultrasound should be performed.
e) Devascularised limbs are a surgical emergency and the aim should be to restore circulation within 6 hours to avoid irreversible muscular ischaemia.

3. Regarding the administration of antibiotics in open fracture cases, the following are true EXCEPT:

a) Evidence exists that early administration of antibiotics has a beneficial effect on outcome.
b) Local guidelines should be consulted when prescribing antibiotics.
c) The mechanism of injury has no bearing on antibiotics selection.
d) Antibiotic prophylaxis should be given within three hours.
e) BAPRAS guidelines recommend antibiotics should be continued until wound closure or for 72 hours whichever is sooner.

THE INITIAL MANAGEMENT OF LOWER LIMB OPEN FRACTURES: WHAT THE ON-CALL CORE TRAINEE NEEDS TO KNOW

RW Jordan, G Chahal



The initial management of lower limb open fractures: what the on-call core trainee needs to know
Plastic & Reconstructive Surgery

4. A 38 year old gentleman suffers a fracture to his left distal tibia associated with 3 cm medial wound when his ankle 'goes over' in a cattle field. He was up to date with his immunisations when he left school but has not required a booster since. Which of the following should be administered:

a) Tetanus vaccine alone should be administered.
b) No tetanus treatment is required.
c) Human tetanus immunoglobulin alone should be administered.
d) Both the tetanus vaccine and the human tetanus immunoglobulin should be administered.
e) Treatments should be postponed until the history can be confirmed with his GP.

5. According to the BAPRAS guidelines, in which of the following scenarios would urgent surgery (< 6 hours) NOT be indicated.

a) A 48 year old gentleman suffering an open ankle fracture with 2cm medial wound whilst scuba diving.
b) An 89 year old gentleman suffered a midshaft tibial fracture when hit by a car at low speed. On assessment the leg was neurovascularly intact with a 12cm wound located on the medial side.
c) A 65 year old female sustained an open fracture dislocation of her left ankle after a fall down 10 stairs. In the emergency department the ankle is relocated but the foot remains pale and distal pulses cannot be located using the Doppler probe.
d) 28 year old gentleman involved in a high speed road traffic collision suffering multiple injuries; unstable cervical injury, lung contusions, rib fracture, liver laceration, right humeral fracture, right femoral shaft fracture, and open right tibial shaft fracture. The right leg is found to be neurovascularly intact and a clean 2 cm wound is found over the anterior surface of the fracture site.
e) A 45 year old lady suffered an isolated open midshaft tibial fracture when hit by a car at 45 mph. On assessment the wound is 2 cm, the limb is neurovascularly intact but over the first two hours after admission her pain becomes uncontrollable. On further assessment she is in agony, the leg is swollen and tense despite removal of all dressings but she remains neurovascularly intact.

Answers

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

References

1. Buduhan G, McRitchie DI. Missed injuries in patients with multiple trauma. J Trauma 2000; 49:600-605.
2. Janjua KJ, Sugrue M, Deane SA. Prospective evaluation of early missed injuries and the role of tertiary trauma survey. J Trauma 1998; 44:1000-1006.
3. Brumback RJ, Jones AL. Interobserver agreement in the classification of open fractures of the tibia: the results of a survey of two hundred and forty-five orthopaedic surgeons. J Bone Joint Surg Am 1994; 76:1162-1166.
4. Horn BD, Rettig ME. Interobserver reliability in the Gustilo and Anderson classification of open fractures. J Orthop Trauma 1993; 7:357-360.
5. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long ones: retrospective and prospective analyses. J Bone Joint Surg Am 1976; 58:453-458.
6. Patzakis MJ, Wilkins J. Factors influencing infection rate in open fracture wounds. Clin Orthop Relat Res 1989; 243:36-40.
7. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. J Trauma 1984; 24:742-746.
8. Gustilo RB, Gruninger RP, Davis T. Classification of type III (severe) open fractures relative to treatment and results. Orthopedics 1987; 10:1781-1788.
9. Johansen K, Daines M, Howey T, Helfet D, Hansen ST Jr. Objective criteria accurately predict amputation following lower extremity trauma. J Trauma 1990; 3:568-572.
10. British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS). Standards for the management of open fracture of the lower limb. BAPRAS, 2009. Available at: http://www.bapras.org.uk/downloaddoc.asp?id=379 (Accessed 5/07/12)
11. Naique SB, Pearse M, Nanchahal J. Management of severe open tibial fractures: The need for combined orthopaedic and plastic surgical treatment in specialist centres. J Bone Joint Surg Br 2006; 88:351-357.
12. Gopal S, Majurnda S, Batchelor A, Knight S, Boer PD, Smith R. Fix and flap. The radical orthopaedic and plastic treatment of severe open fractures of the tibia. J Bone Joint Surg Br 2000; 82:959-66.
13. Sanders R, Swiontkowski MF, Nunely JA II, Spiegel P. The management of fractures with soft-tissue disruptions. Instr Course Lect 1994; 43:559-570.
14. Valenziano CP, Chattar-Cora D, O'Neill A, Hubli EH, Cudjoe EA. Efficacy of primary wound cultures in long bone open extremity fractures: are they of any value? Arch Orthop Trauma Surg 2002; 122:259-261.

THE INITIAL MANAGEMENT OF LOWER LIMB OPEN FRACTURES: WHAT THE ON-CALL CORE TRAINEE NEEDS TO KNOW

RW Jordan, G Chahal

15. Lange RH, Bach AW, Hansen ST Jr, Johansen KH. Open tibial fractures with associated vascular injuries: Prognosis for limb salvage. J Trauma 1985; 25:203-208.
16. Glass GE, Pearse MF, Nanchahal J. Improving lower limb salvage following fractures with vascular injury: A systematic review and new management algorithm. J Plast Reconstr Aesthet Surg 2009; 62:571-9.
17. Gosselin RA, Roberts I, Gillespie WJ. Antibiotics for preventing infection in open limb fractures. Cochrane Database Syst Rev 2004; (1):CD003764.
18. Gustilo RB. Use of antimicrobials in the management of open fractures. Arch Surg 1979; 114:805-808.
19. Robinson D, On E, Hadas N, Halperin N, Hofman S, Boldur I. Microbiologic flora contaminating open fractures: its significance in the choice of primary antibiotic agents and the likelihood of deep wound infection. J Orthop Trauma 1989; 3:283-286.
20. Dellinger EP, Caplan ES, Weaver LD, Droppert BM, Hoyt N, Brumback R, Burgess A, Poka A, Bernirschke SK, Lennard ES, Lou MA. Duration of preventive antibiotic administration for open extremity fractures. Arch Surg 1988; 123:333-339.
21. Khatod M, Botte MJ, Hoyt DB, Meyer RS, Smith JM, Akeson WH. Outcomes in open tibia fractures: relationship between delay in treatment and infection. J Trauma 2003; 55:949-954.
22. Harley BJ, Beaupre LA, Jones CA, Dulai SK, Weber DW. The effect of time to definitive treatment on the rate of non-union and infection in open fractures. J Orthop Trauma 2002; 16:484-490.
23. Spencer J, Smith A, Woods D. The effect of time delay on infection in open long-bone fractures: a 5 year prospective audit from a district general hospital. Ann R Coll Surg Engl 2004; 86:108-112.
24. McQueen MM, Court-Brown CM. Compartment monitoring in tibial fractures. The pressure threshold for decompression. J Bone Joint Surg Br 1996; 78:99-104.
25. Tiwari A, Haq AI, Myint F, Hamilton G. Acute compartment syndromes. Br J Surg 2002; 89:397-412.
26.Janzing HM, Broos PL. Routine monitoring of compartment pressure in patients with tibial fractures: Beware of overtreatment! Injury 2001; 32:415-421.

Corresponding author

Mr RW Jordan
University Hospital Coventry & Warwickshire,
Clifford Bridge Road, Coventry CV2 2 DX
Email: Robert.jordan@doctors.org.uk

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani

Abstract

The recognition and management of hypovolaemia in the surgical patient is especially important to try and prevent progression to hypovolaemic shock and an increase in morbidity and mortality. It is a common presentation in surgery and one that the surgical trainee should be able to competently treat.

In this article we discuss the presentation and management of hypovolaemia in the surgical patient, as well as the physiological changes that occur with acute blood loss. This article should provide a framework for the prompt recognition and management of the hypovolaemic patient on the surgical wards.

Keywords: hypovolaemia, resuscitation, starlings curve, blood loss, fluid replacement

Case vignette

You are the core trainee covering the surgical wards. You're informed of a 72-year-old man who underwent a total cystectomy for bladder carcinoma earlier in the day. On examination, he has a distended abdomen that is diffusely tender. He is apyrexial with a heart rate of 115 beats per minute (bpm) and has a blood pressure (BP) 110/70 mm/Hg. What is the most likely diagnosis? How will you manage this patient? When will you call for senior support?

Introduction

The definition of shock is the abnormality of the circulatory system that results in inadequate organ perfusion and eventually organ death if not promptly identified and treated. (1) It is therefore imperative to recognise the signs and symptoms of shock early and initiate treatment.

There are 4 subgroups of shock (table 1). They can occur individually or in combination. In this article we will focus on hypovolaemic shock.

The management of the hypovolaemic post-operative surgical patient
Cardiothoracic & Critical Care

Type of shock	Aetiology	Signs
Hypovolaemic shock	Reduction in: - Circulatory volume (Haemorrhage) - Plasma loss (Pancreatitis) - Extracellular fluid loss (Diabetic Ketoacidosis)	Tachycardia Hypotension Cold peripheries Confusion
Cardiogenc shock	Secondary to pump failure: - Myocardial infarction - Aortic dissection - Valvular dysfunction	Heart rate variable (May be raised or depressed) Hypotension Cold peripheries Confusion
Obstructive shock	Circulatory obstruction from: - Pulmonary embolus - Cardiac Tamponade - Tension Pneumothorax - Constrictive Pericarditis	Tachycardia Hypotension Cold peripheries Muffled heart sounds
Distributive shock	- Sepsis (Vasodilation and capillary damage causing misdistribution of fluid) - Anaphylaxis (Allergen induced vasodilation) - Neurogenic (Traumatic spinal cord lesion above the level of T6 interrupting the sympathetic nervous system)	Tachycardia Hypotension Warm peripheries Strong bounding pulse in early sepsis

Table 1. The sub-classification of shock

Normal distribution of body water

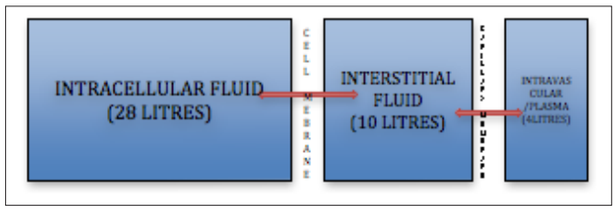


Figure A. Distribution of fluid in a 70 Kg man

Water makes up approximately 50-60% of total body weight. A man weighing 70kg is made up of around 42 L of water. This is further divided into: -

- Intracellular fluid (inside cells) – two thirds (28 L)
- Extracellular fluid (outside the cells) – One third (14 L)

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani

Of the extracellular fluid (14 Litres): -

- 75% is made up of interstitial fluid (10 L)
- 25% is made up of plasma/intravascular fluid (4 L)

The three compartments are divided by semipermeable membranes and fluid can move freely between them. Figure A illustrates the different compartments of fluids.

Cardiac Physiology

An overview of basic cardiac physiology is essential in understanding why the body reacts the way it does when shocked.

Cardiac output is the volume of blood pumped by the heart per minute. It is calculated by: -

Heart Rate (HR) x Stroke Volume (SV)

The Stroke volume is the amount of blood pumped by the heart with each contraction and is determined by three factors.

- Preload – This is the volume of blood returning to the heart (venous return)
- Myocardial contractility – The force at which the heart contracts
- Afterload – The resistance the heart has to overcome to enable blood flow (essentially systemic vascular resistance)

Frank Starling stated that the SV of the heart increases in response to an increase in the volume of blood filling the heart, i.e. the heart behaves like a rubber band, the more it is stretched – the harder it contracts. This is true to a certain point – after which the pump fails (the rubber band snaps).

Figure B demonstrates what a small increase in preload (From A-B) can do to the SV in a heart with good ventricular function (a'-b'). When compared with a heart with poor ventricular function the same volume expansion causes far less increase in SV (a-b).

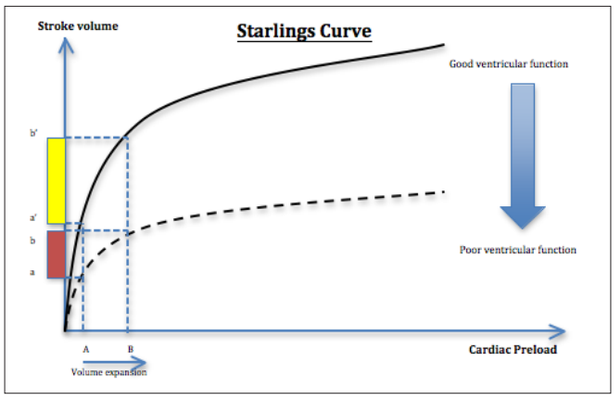


Figure B. Frank Starlings Curve

The Mean Arterial Pressure (MAP) is the average pressure throughout a cardiac cycle. It is equal to diastolic pressure + 1/3(systolic –diastolic pressure).

MAP is also: -

Cardiac output (CO) x Systemic vascular resistance (SVR) + Central Venous Pressure (CVP)

CVP is usually small and omitted from the above equation

Therefore: -

MAP = CO x SVR

or

MAP = HR x SV x SVR

In sepsis, there is an early drop in SVR (due to peripheral vasodilatation) that causes a decrease in MAP. In acute blood loss, there is a profound decrease in circulating volume, decreasing SV, which in turn causes a fall in MAP.

Neurohumoral response to hypovolaemia

When hypovolaemic, the body will compensate to maintain cardiac output and tissue perfusion. It does this through various hormonal mediated responses.

Initial beta-sympathetic response causes tachycardia, which is one of the earliest responses to maintain cardiac output. The release of catecholamines increases peripheral vascular resistance and this causes peripheral vasoconstriction. Vasoconstriction of cutaneous and visceral circulation preserves blood flow to the kidneys, heart and brain. This is turn will result in a raised diastolic BP and reduction in pulse pressure (difference between systolic and diastolic BP). Other hormones such as histamine, bradykinin, ß endorphins, prostaglandins and vasopressin have a significant effect on the microcirculation, vascular permeability and water regulation (i.e. feeling thirsty). (1)

Presentation

When presented with an acutely unwell patient, after airway and ventilation have been ensured, the doctor must establish if the patient is in shock.

As discussed above, an understanding of the neurohumoral response to hypovolaemia is important:

- Is the patient drowsy?
- Does the patient feel thirsty?
- Do they have cool peripheries, what is their capillary refill time?
- Do they have pale conjunctiva, reduced skin turgor and dry mucous membranes?
- What is the trend of their vital signs?

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani

The management of the hypovolaemic post-operative surgical patient
Cardiothoracic & Critical Care

Trends of vital signs are more useful than isolated values. A BP of 120/80 and a pulse of 90 may seem perfectly acceptable. However, in a hypertensive patient that has a normal BP of 165/95 and a pulse of 50, the above values are far more concerning.

Deterioration in patients may be detected through early warning scores that assess basic clinical parameters. These systems are recommended by the National Institute of Health and Clinical Excellence (NICE) to aid rapid detection of deteriorating patients. (5) A drop in systolic BP is a late indicator of haemodynamic compromise as hypotension correlates to failure of compensatory mechanisms with potential for imminent circulatory collapse. (6) Figure C illustrates the pattern of vital signs that might be reported.

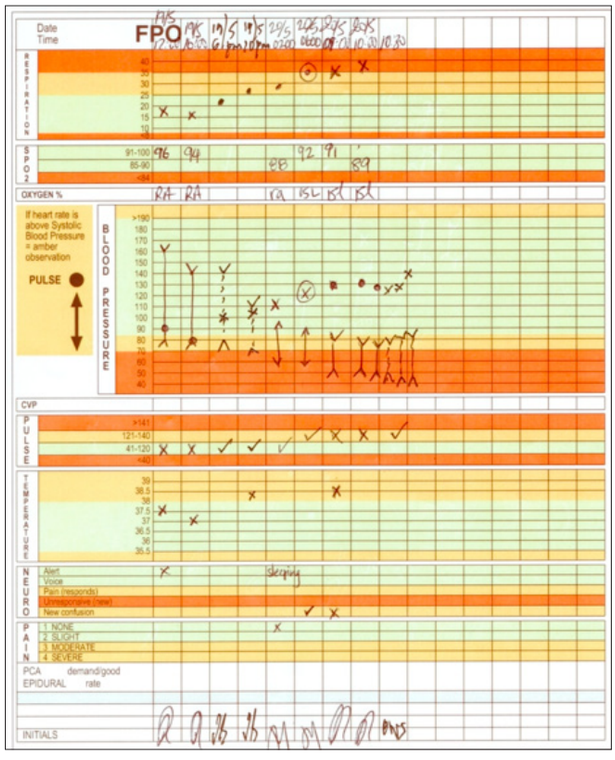


Figure C: Example of the Portsmouth Sign.

Assessment

An ABCDE approach should be adopted. A rapid primary survey should be conducted to allow simultaneous identification and resuscitation of immediately life-threatening abnormalities. Once the patient is stable, this should be followed by a more in depth secondary survey. In a trauma patient, early identification and definitive management of a bleeding source is vital. Places of significant blood loss include chest, pelvis, retroperitonium and long bones. (1) These therefore have to be promptly assessed and treated to ensure haemodynamic stability.

In haemorrhagic shock, 'the degree of blood loss may be estimated using physiological parameters as demonstrated in table 2. Using this grading system, Grade 1 would be considered a non-shock state that can be corrected via oral supplementation whereas Grade 4 would require urgent volume replacement (including blood products) to prevent deterioration and death. (7)

	Grade 1	Grade 2	Grade 3	Grade 4
Blood loss (ml)	<750	750-1500	1500-2000	>2000
Blood loss (%)	<15	15-30	30-40	>40
Pulse (bpm)	<100	>100	>120	>140
Blood pressure	Normal	Decreased	Decreased	Decreased
Pulse Pressure (mmHg)	Normal or increased	Decreased	Decreased	Decreased
Respiratory rate (rpm)	14-20	20-30	30-40	>35
Urine output (mL/hr)	>30	20-30	5-10	Negligible
CNS symptoms	Normal	Anxious	Confused	Lethargic

CNS= Central nervous system

Table 2: Classification of acute blood loss (1).

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani

If a diagnosis of hypovolaemia is suspected, a fluid bolus can be given with subsequent reassessment of clinical parameters to assess response. (8, 9) Passive leg raising has been shown to be a useful bedside tool in the assessment of hypovolaemia and prediction of fluid responsiveness by acting to increase venous return (cardiac preload). (10, 11).

Initial management

Following initial history and examination, signs will guide to the likely subtype of shock. After ensuring the airway is not compromised and administering high flow oxygen to maximise oxygen delivery, the primary aim when managing a shocked patient is to halt on-going bleeding, or other underlying mechanism, and restore tissue perfusion and oxygen delivery. The most effective way to do this is by the insertion of 2 large bore (16 G or larger) intravenous cannulae and rapid infusion of warmed intravenous fluid. Poiseuille's law states that the rate of flow is proportional to the fourth power of the radius of the cannulae and inversely related to its length. Therefore short, wide intravenous cannulas are preferred for the administration of large volumes of fluid. (1)

Fluid challenge

There is a clear difference between a fluid challenge and an increase in maintenance fluids.

An increase in maintenance fluids:

This is an increase in the rate of fluid administration and does not expand the intravascular volume.

A fluid challenge:

This describes the period in which the patient's intravascular volume is expanded. A bolus of fluid is given over a short period of time. The patients' response is then carefully evaluated.

When giving a fluid challenge, it is important to establish: (12)

1. The type of fluid to give (e.g. crystalloid or colloid)

2. The rate of fluid infusion (e.g. 500 – 1000 ml in 30 minutes)

3. The end point (e.g., a heart rate of less than 100 bpm and a MAP of greater than 65 mmHg)

4. The safety limits (e.g. the development of pulmonary oedema)

1. Type of fluid: Crystalloid or Colloid?

Debate is on going as to which fluid type provides the most efficacious restoration of haemodynamic stability. This debate is based upon the argument that fluids with higher osmolarities promote fluid retention within the intravascular compartment by reducing fluid shift and extravasation, allowing the use of smaller volumes to prevent pulmonary and cerebral oedema and electrolyte disturbance. (13)

Table 3 demonstrates the composition of a number of available fluids. Despite the large number of trials conducted, there is still no clear evidence to illustrate whether crystalloid (isotonic or hypertonic) or colloid solutions have better outcomes. (14-16)

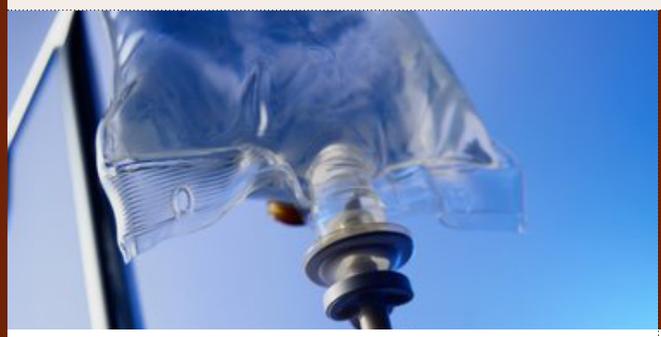
		Components (mmol/L)					
	Glucose(g/L)	Na^+	Cl^-	K^+	Ca^{2+}	Lactate	Osmolarity (mOsM/L)
0.45% Normal Saline	-	77	77	-	-	-	154
5% Dextrose	50	-	-	-	-	-	278
0.9% Normal Saline	-	154	154	-	-	-	308
Ringer's Lactate	-	130	109	4	3	28	273
Hartman's Solution	-	131	111	5	2	29	275
7.5% Normal Saline	-	1283	1283	-	-	-	2567
5% Albumin	-	150	150	-	-	-	300
HES 6% 130/0.4	-	154	154	-	-	-	308
Gelatine 4%	-	145	145	-	-	-	290
Dextrose 4% Saline 0.18%	40	30	30	-	-	-	283

HES= Hydroxyethyl starch

Table 3: Fluid compositions (8,13).

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani



The management of the hypovolaemic post-operative surgical patient
Cardiothoracic & Critical Care

Understanding how each fluid is distributed within the body (see figure A) may determine choice of fluid administered in a given clinical situation.

Crystalloids: -

Examples include

- 0.9% normal saline
- Hartmann's

They are water-based solutions containing small solutes. Crystalloids pass freely across the capillary membrane and therefore redistribute within 1 to 4 hours.

When normal saline is administered as a fluid bolus, it is redistributed across the extracellular (interstitial and intravascular) compartments. Remembering that the intravascular content only accounts for approximately 25% of the extracellular compartment, we can calculate for every 1,000 ml of normal saline given, 250 ml will remain in the intravascular space. Excess fluid in the interstitial space can lead to oedema.

5% dextrose is not given in shock to expand intravascular volume. This is because cells rapidly take up the glucose, leaving just pure water. Approximately 10% remains in the intravascular space (100 ml for every 1 L given).

The main disadvantage of crystalloid is that large amounts are needed to account for fluid lost. The redistributed crystalloid can cause peripheral oedema and pulmonary oedema.

Colloids:

These are water based solutions that contain large solute molecules such as starches or albumin that do not easily diffuse out of blood vessels with intact capillary integrity. Colloids exert an oncotic pressure that draws water into the intravascular compartment, further expanding intravascular volume.

Colloids redistribute across compartments much slower than crystalloids so the volume that is initially infused will almost entirely stay in the intravascular compartment. The main disadvantages of colloids are that they are more expensive and there is a risk of anaphylaxis. (12)

The decision between a crystalloid and colloid is a clinical one. The fluid of choice depends on what has been lost. For example, for a hypotensive patient with a bowel obstruction and is vomiting, the patient is likely to be depleted in salt and water, which has lead to hypovolaemic shock. In this situation it would be fair to resuscitate the patient with a crystalloid. In contrast, in the above case study, where hypovolaemic shock is likely to be secondary to a postoperative bleed, normal circulatory volume should be replaced by blood.

Hypotonic solutions, such as 0.45% saline and 5% dextrose should not be used in the acute fluid resuscitation setting. This is because of their poor retention within the vascular space and risk of significant hyponatraemia. (8) 5% dextrose is classified as hypotonic due to rapid hepatic metabolism of glucose resulting in a very short period of osmotic activity.

In patients with significant blood loss (Grade 3 or 4), replacement with blood products will be required to maintain oxygen delivery to replace lost red cell volumes.

2. The rate of infusion of fluids

Fluid challenge is given at a rate of 500 to 1000 ml of crystalloid solution or 300 to 500ml of colloid solution over 15 – 30 minutes. (12) Again, the rate has to be a clinical decision. For example: a septic patient with a systolic BP of 95 mmHg will need fluid at a different rate to a patient that is having active haematemasis with no recordable blood pressure.

3. The end point

When offering any fluid therapy, a designated end-point should be decided upon to allow goal-directed treatment. In shocked patients the target will relate to restoration of tissue perfusion and oxygenation. This may be achieved by obtaining a MAP of >65 mmHg. (12) However, there is some evidence to prove that a lower systolic BP may be appropriate in bleeding patients as an elevated pressure may promote continued bleeding through dilutional coagulopathy, but enhanced pressure might be deleterious to thrombus formation and even dislodge a clot that is already present. (9)

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani

Isolated values are of limited clinical utility in the monitoring and on going assessment of the critically ill patient. Recording of haemodynamic parameters and vital signs allows assessment of trends and is a far more valuable tool in assessing the overall patient status and response to treatment. Normalisation of these parameters would be classified as an appropriate response. It is important to consider the pre-operative status of all patients when assessing post-operative observations as it would not be appropriate to expect the same BP for an elderly frail female, and a middle-aged hypertensive male. The value of following trends highlights the need for continual reassessment and modification of treatment to meet the on going needs of the patient.

4. Safety limits

Although there is no limit on how much fluid to give a hypovolaemic patient, it is important to reassess the patient after and during every fluid challenge. This will minimise the well-documented increase in morbidity and mortality associated with excess fluids. (17) In particular, patients with underlying cardiac history are more likely to develop complications such as peripheral oedema and pulmonary oedema so the lower volume of recommended fluid should be administered to these patients when giving fluid challenges. (12)

When to escalate

It is important to recognise the effect of treatment and know when to escalate.

See table 4 for action that should be taken after the first fluid challenge. If vital signs fail to improve after repeated boluses of 20ml/kg of crystalloid or 5 to 10 ml/kg of colloid (12, 18) the patient should be assessed by the High Dependency Unit for further support. This also applies if the patient shows signs of pulmonary oedema.

Vital Signs	Action
Normalise	Monitor for stability
Transiently improvement/ stay the same	Further fluid challenge and reassess
Deteriorate	Seek advise from high dependency department

Table 4: Vital signs and escalation.

The role of the High Dependency Unit (HDU)

If a patient is transferred to HDU, invasive monitoring of BP and central venous pressure can occur. To understanding the effect of inotropes and vasopressors, it is important to consider the equation:

MAP = CO x HR x SVR

If MAP is < 65mmHg despite adequate fluid resuscitation, either SVR or CO can be increased by vasopressors or inotropes respectively, to increase MAP.

Conclusions

Shock is a significant post-operative complication with high morbidity and mortality. Understanding the neurohumoral response to hypovolaemia is important in recognising patients that may be shocked. A decrease in systolic BP is suggestive of significant hypovolaemia and is a late indicator of shock. In trauma patients, it is the clinician's responsibility to identify any potential source of bleeding and initiate treatment. Remembering that there is a trade off in maintaining adequate BP to perfuse vital organs but not too high as to dislodge a potential clot formation and cause further bleeding through dilutional coagulopathy.

Hypotonic solutions (i.e. 5% Dextrose) should not be used in acute fluid resuscitation setting.

In patients that fail to respond to fluid challenges, early involvement of the critical care team is important for invasive monitoring and further treatment.

Questions

1. You have been called to assess a 72-year-old patient who has become confused over the last 2 hours. He has had profuse diarrhoea for 48 hours. On examination he is apyrexial with a weak peripheral pulses of 115 bpm, blood pressure of 90/40 mmHg. What is the most likely diagnosis?

A. Septic shock.
B. Anaphylaxis
C. Hypovolaemic shock.
D. Cardiogenic shock.

2. In the above patient, what would be the best first choice of fluid resuscitation?

A. 5% dextrose
B. 0.9% Normal Saline
C. Hartmann's solution
D. Gelofusin

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani

3. At what rate should this fluid be administered?

A. Over 4 hours
B. Over 2 hours
C. Over 1 hour
D. Over 20 minutes

4. At the end of the fluid challenge, the patient's blood pressure drops to 75/61 mmHg. Oxygen saturations fall from 96% to 72% (on air). He has become acutely tachypnoeac. What should your next step of management be:

A. Give a fluid challenge, as the patient is still hypotensive.
B. Start inotropic support
C. Contact the on call anaesthetist that is covering the High Dependency unit
D. Sit up, high flow oxygen and stop intravenous fluid

5. A 34-year-old man has sustained numerous injuries after a violent assault. In the emergency department his pulse is 135 beats per minute with a systolic blood pressure of 60mmHg. He has a respiratory rate of 32 breaths per minute. He is fully alert but clearly confused. From his signs and symptoms, how much blood is likely to have been lost?

A. <750 ml
B. 750 - 1,500 ml
C. 1,500 - 2,000 ml
D. >2,000 ml

Answers

Question 1

A - Incorrect. Although this patient could have septic shock, the clinical picture would be of that of a warm clammy patient with a strong bounding pulse. It is important to note that in late sepsis, a patient may become peripherally shut down.
B - Incorrect
C - Correct. This patient has become confused due to poor cerebral perfusion secondary to hypovolaemia (caused by his diarrhoea)
D - Incorrect.

Question 2

A - Incorrect. 5% dextrose should not be used in acute fluid resuscitation. The glucose is taken up by cells and metabolised essentially leaving water. For every 100ml of fluid that need replacing, 1 Litre of dextrose needs to be administered.
B - Incorrect. Even though this is a perfectly acceptable fluid to use. It is more likely to cause hyperchloraemic acidosis than Hartmann's solution.
C - Correct. This is the most physiologically balanced crystalloid above. The hypotension is likely secondary to the loss of salts. Replacing these salts will in turn correct the hypotension. Further fluid administration should be guided by urea and electrolyte measurements.
D - Incorrect. Again, this is a perfectly acceptable fluid (colloid) to use in acute resuscitation. There are better alternatives in this scenario.

Question 3

A - Incorrect
B - Incorrect
C - Incorrect
D - Correct. A fluid challenge needs to administer over a maximum of 30 minutes so accurate assessment of the patients' response can be made. Ideally it would be given over 2 minutes VIA a three-way tap, however in elderly patients, extra caution has to be taken. They are at higher risk of developing pulmonary oedema.

THE MANAGEMENT OF THE HYPOVOLAEMIC POST-OPERATIVE SURGICAL PATIENT

A E Thorpe, H Rehmani

Question 4

A - Incorrect. This patient is showing signs of pulmonary oedema.
B - Incorrect. Although this may eventually occur, it has to be done in a controlled setting with central monitoring, i.e. High Dependency Unit.
C - Incorrect. Although this needs to be done urgently, the patient's hypoxia has to be corrected to the best of your capabilities.
D - Correct. The patient should be fully reassessed in the ABCDE way to find a cause for his acute deterioration. High flow oxygen needs to be administered as part of assessing A (airway).

Question 5

A - Incorrect
B - Incorrect
C - Correct
D - Incorrect. See table 2.

References

1. American College of Surgeons Committee on Trauma (2008). Advanced trauma life support program for doctors, 8th edn. American College of Surgeons, Chicago .
2. Findlay GP, et al. Knowing the risk: A review of the peri-operative care of surgical patients. National Confidential Enquiry into Patient outcome and Death. 2011.
3. Scottish Audit of Surgical Mortality. Annual Report 2010. Scottish audit of Surgical Mortality. 2010.
4. Association of Anaesthetists of Great Britain and Ireland. Blood transfusion and the anaesthetist: Management of massive haemorrhage. Anaesthesia. 2010;65:1153-1161.
5. National Institute for Health and Clinical Excellence. Clinical Guideline 50. Acutely ill patients in hospital: Recognition of and response to acute illness in adults in hospital. London: NICE; 2007.
6. Antonelli M et al. Haemodynamic monitoring in shock and implications for management: International Consensus Conference, Paris, France 27-28 April 2006. Intensive Care Med. 2007; 33(4): 575-590.
7. Guillermo G, Reines H, Wulf-Gutierrez M. Clinical Review: Haemorrhagic Shock. Critical Care. 2004; 8(5):373-381.
8. Powell-Tuck J, et al. British Consensus Guidelines on Intravenous fluid therapy for Adult Surgical Patient. The Intensive Care Society. 2008
9. Holley A, et al. Part one: Goal-directed resuscitation- which goals? Haemodynamic targets. Emergency Medicine Australasia. 2012; 24(1): 14-22
10. Maizel J, et al. Diagnosis of central hypovolaemia by using passive leg raising. Intensive Care Med. 2007; 33(7):1133-1138.

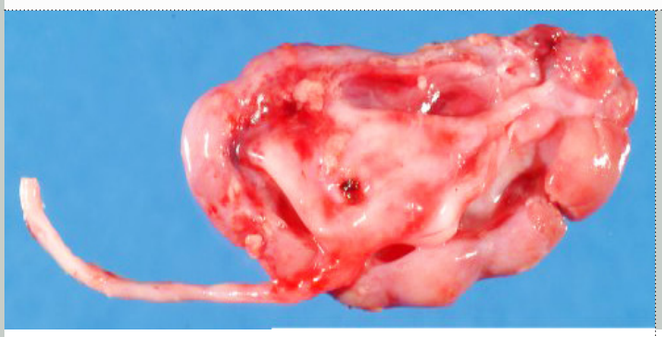
11. Monnet X, Teboul JL. Passive leg raising. Intensive Care Med. 2008; 34(4): 659-663.
12. Dellinger RP, Carlet JM, Masur H, Gerlach H, Calandra T, Cohen J, et al. Surviving Sepsis Campaign guidelines for management of severe sepsis and septic shock. Intensive care Med 2004;30(4):536-555.
13. Moranville M, Mieure K, Santanya E. Evaluation and management of shock states: Hypovolaemic, Distributive, and Cardiogenic Shock. Journal of Pharmacy Practice. 2011; 24(1); 44-60.
14. Roberts I, et al. Human Albumin solution for resuscitation and volume expansion in critically ill patients. Cochrane Database Syst Rev. 2011; Issue 11. Art. No.: CD001208. DOI: 10.1002/14651858.CD001208.pub4.
15. Bunn F, et al. Hypertonic versus near isotonic crystalloids for fluid resuscitation in critically ill patients. Cochrane Database Syst Rev. 2008; Issue 3. Art. No.: CD002045. DOI: 10.1002/14651858.CD002045.pub2.
16. Perel P, Roberts I. Colloids versus crystalloids for fluid resuscitation in critically ill patients. Cochrane Database Syst Rev. 2011; Issue 3. Art. No.: CD000567. DOI: 10.1002/14651858.CD000567.pub4.
17. Marik P, Monnet X, Teboul J. Haemodynamic parameters to guide fluid therapy. Annals of Intensive Care. 2011; 1;1.
18. American Thoracis Society. Evidence- based colloid use in the critically ill: American Thoracic Society Consensus Statement. Am J Respir Crit Care Med 2004;170(11):1247-59

Corresponding author

Hassan Rehmani
Northern General Hospital
Herries Road
Sheffield
South Yorkshire
S5 7AU
Email: H.Rehmani@doctors.org.uk

PELVIURETERIC JUNCTION OBSTRUCTION

C Spearman, R Mackinnon



Pelviureteric Junction Obstruction
Urology

Abstract

Pelviueteric junction obstruction is an increasingly recognised condition involving a blockage between the renal pelvis and proximal ureter. In the majority of cases the cause is unknown, but a congenital element is suspected. MAG-3 or DTPA scans are the investigation modalities of choice, with some evidence suggesting that MAG-3 may be a better first line. Management varies depending on the patient's age and presentation, however currently the gold standard treatment in adults is laparoscopic dismembered pyloplasty. Other management options are also considered and these may have an impact in the future treatment of this condition.

Keywords: Renal pelvis, ureter, pyloplasty.

Definition

Pelviueteric junction obstruction (PUJO) describes a blockage between the renal pelvis and the proximal ureter. (1) It is increasingly being diagnosed antenatally due to the introduction routine antenatal ultrasound scanning, although can present later in both adults and children with complications or as an incidental finding. (2) PUJO is believed to be the most common congenital pathology of the urinary tract. (3)

Causes

The cause of PUJO is unknown although the majority are attributed to a congenital malformation of the pelviueteric junction (PUJ). (3) Other causes recognised include renal calculi, malignancy and scar tissue formation within the ureter. (2) Congenital PUJO can be either intrinsic or extrinsic, with intrinsic being more prevalent. (4) Intrinsic PUJO is due to a narrowing of the lumen, usually caused by a section of aperistaltic tissue within the ureter. Extrinsic PUJO, in comparison, is caused by external pressure narrowing the lumen, with a crossing vessel supplying the lower renal pole commonly implicated. (2)

Anatomy: the renal pelvis, PUJ and the ureter (5)

Within each kidney there are usually fourteen minor calyces, although this is open to variation. These are arranged in pairs resulting in seven ventral and seven dorsal calyces. The collecting tubules of the renal nephrons drain into these. Each calyx will fuse with others around it resulting in the formation of two or three major calyces. The major calyces each drain into an infundibulum. In most cases there are two infundibula formed, one from the upper pole and the other from the lower, however a third may be present as a normal variant draining calyces from the central section of the kidney. The infundibula fuse to form the renal pelvis. (5)

The renal pelvis tapers and joins the ureter. There is vast variation in the positioning of the PUJ. In the majority of cases it is found to be in line with the lower pole of the kidney but has been described as far up as to lie completely within the renal sinus (the area of the kidney within which the calyces of the renal pelvis lie). (5)

The ureters are 25-30 cm long muscular peristaltic tubes. The average diameter is 3 mm but there is a narrowing at the PUJ and the pelvic brim. Each ureter runs anteriorly to psoas major, slightly medially. As it enters the pelvic cavity it moves laterally and then curves back medially as it enters the bladder, at or around the level of the ischial spines. (5)

The blood supply to the kidneys is via the renal artery. This branches directly from the aorta. Accessory vessels supplying the inferior pole of the kidney cross the ureter anteriorly. This may have a role in extrinsic PUJO. (5)

Case Discussion

An 18 years old male presented to the accident and emergency department with severe left loin pain. He describes the pain as coming on last night while he was out with friends celebrating his birthday. It was the first time he had drunk large amounts of alcohol. On examination he complains of tenderness over the right renal angle. No palpable mass is found.

In adults PUJO often presents as recurrent flank pain, worse after diuretic event such as drinking alcohol. (2) This is known as Dietel's crisis. (6) PUJO can also present either primarily or incidentally post renal calculi, renal infection or malignancy. In other cases it can present asymptomatically as an incidental finding during investigations for other unrelated symptoms. (2)

PELVIURETERIC JUNCTION OBSTRUCTION

C Spearman, R Mackinnon

A diuretic renogram should be conducted in any patient with suspected PUJO to check the functioning of the kidneys. MAG-3 or DTPA can be used although some evidence suggests that MAG-3 may be a better first line. (7) Based on the degree of damage the best treatment approach can be decided.

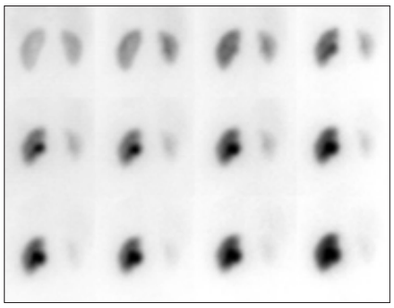


Figure 1: MAG-3 diuretic image showing obstruction of the left side.
(image reproduced with the kind permission of J. Antony Parker MD PhD (8))

History of Surgery in PUJO

JC Anderson and W Hynes first published a paper in 1979 describing their novel techniques for treatment of PUJO. (9) It was this technique that would become the gold standard for treatment of this condition. It is now known as Anderson-Hynes pyleloplasty or dismembered pyeloplasty. (10)

This technique has become so well used due to its versatility. It not only removes the stricture directly but can be adapted whatever the cause of the obstruction. It has however been found to be ineffective in cases where a long ureteral stricture is present. (10)

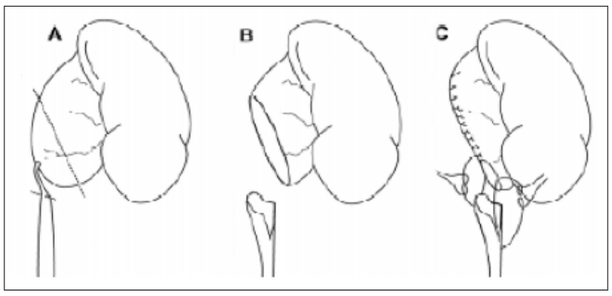


Figure 2: Anderson-Hynes Pyeloplasty.
(Image kindly reproduced with permission from International Braz J Urol (10))

Other historical operations include Foley Y-V plasty and Scardino-Prince Verticle Flap, however these were both superseded by dismembered pyloplasty due to its ease, better versatility and higher success rate. (10)

Management

Surgical management of PUJO is indicated in symptomatic cases to relieve pain, or to protect renal function (or prevent further decline) in an asymptomatic population, as well as to reduce the rate of complications such as infection, calculi and renal loss. (2) Currently there is no definitive management agreement between centres. A commonly employed strategy is to advise treatment in asymptomatic patients only when there has been an appreciable decline in function, or initial renography suggests function less than 40% of overall at outset.

Laparoscopic dismembered pyeloplasty is now considered the gold standard of first line treatment as it has a high success rate, similar to that of open pyeloplasty, with a shorter hospital stay and a better cosmetic outcome. (3) A number of techniques can be used; however, a laparoscopic approach to dismembered pyeloplasty is common as it is the only procedure that can be used universally, whatever the cause of the obstruction. Many centres are unable to conduct this procedure, due to the high level of training required. It is also associated with longer operating times than the open approach. For this reason endopyelotomy is used at some centres. (10)

Endopyelotomy can be either antegrade or retrograde. Antegrade endopyelotomy is more invasive but tends to have a higher success rate, although not as high as that of pyeloplasty. With the patient prone, a guide wire is inserted through the abdominal wall, into the kidney usually through an upper calyx, across the PUJ where it is then passed down into the bladder. The cutting instrument of choice is then passed over the wire; a cold-cut knife was historically most commonly used, but now balloon dilation or laser incision of the PUJ are favoured. Formal percutaneous access using balloon dilators and sheaths may be required to access the PUJ. Once the procedure is finished a stent and a nephrostomy tube should be inserted for 48 hours. (10)

In comparison retrograde endopyelotomy does not require an incision. Two dilatation techniques are employed; simple balloon dilation or AcuciseTM cutting balloon. The failure rate of simple balloon dilation is high, for this reason it is less popular. AcuciseTM requires careful positioning of the cutting wire, which overlies a balloon, across the PUJ. As the balloon is inflated the wire will cut the surrounding tissue so releasing the stricture. It does however have a high risk of bleeding associated. For this reason retrograde endopyelotomy is less popular than antegrade endopylotomy. (3, 10) Retrograde endopyelotomy is not recommended by the current NICE guidelines due to the low success rate and a high bleeding risk. (11,12) Retrograde laser incision using Holmium laser ureteroscopically is also feasible but has a similarly high recurrence rate.

Nephrostomy is sometimes required prior to pyeloplasty to drain infection and increase or protect the function of the kidney. (13)

Ureterocalycostomy is not commonly used but has an important role. It is recognised as a treatment option post failed pyeloplasty. It also has a role as the primary procedure of choice in patients with abnormal anatomical kidney conditions such as a horseshoe kidney. (10)

PELVIURETERIC JUNCTION OBSTRUCTION

C Spearman, R Mackinnon

Pelviureteric Junction Obstruction
Urology

As a last resort nephrectomy can be conducted when the affected kidney has little or no salvageable function and there is good function in the remaining kidney. (13,14)

Paediatric PUJO

A 32 year old woman had a routine antenatal ultrasound scan at 20 weeks gestation. A dilated renal pelvis was noted on the foetus' left hand side. No other abnormalities where noted. (15)

A definitive diagnosis of PUJO cannot be made while the foetus is still in utero. (16) However, providing the bladder is filling and emptying appropriately and the ureters are not dilated, an apparent diagnosis of PUJO can be made. It is important to council the parents explaining that although the degree to which the child will be affected is unknown until after birth, treatment options are good and it should not affect the child's long term health or development, although they may require an operation after birth. For the remainder of the pregnancy it is necessary to monitor the condition with regular ultrasounds. The frequency of these varies dependent on the degree of the hydronephrosis. (17)

Figure 3: A dilated renal pelvis (15).

Immediately after birth, on day one, a renal ultrasound should be performed to check if dilation is still present. If renal pelvic dilatation persists a micturating cystogram can be performed to rule out vesicoureteric reflux. Any reflux detected at this point would indicate that the initial diagnosis of PUJO was incorrect and vesicoureteric reflux is more likely. Providing no reflux is found a MAG-3 radioisotope study should be conducted to check the functioning of the affected kidney. (16) Surgery is indicated in children with a significant impairment in renal function (15-40%), infection due to the obstruction, loin pain or a large palpable mass. (4)

The treatment of choice in these children is open Anderson-Hynes pyeloplasty. An open technique is preferred in infants due to the additional difficulty of the laparoscopic procedure. This results in a higher complication rate than in adults, thus removing the benefit. In children with poor renal function or infection, nephrostomy can be used to improve the renal function prior to pyeloplasty. Although it is used primarily to improve the results of pyeloplasty, in some cases it can negate the need for the second operation at all. (13)

In children where the hydronephrosis resolves after birth with no compromise to renal function a watch and wait policy is often enforced. The main difficulty is knowing how long to follow the patient up for complications and the degree of renal function that may be permanently lost should complications occur. (18)

Future

Currently there is no standardised treatment for PUJO. This is to do with difficulties in developing the skill set required for laparoscopic pyeloplasty at non-specialist centres. It is hoped that the implementation of robotic-assisted pyeloplasty will improve this. In preliminary trials it has been found that the robot-assisted technique is comparable to that of laparoscopic pyeloplasty in theatre time, length of stay, complication rate and recovery time. It is believed that this technique will be easier for new trainees to learn therefore enabling the "gold standard" procedure to be carried out more widely. An obvious current limitation is the high initial outlay on the equipment required. It is not known if this will be more cost effective in the long term or if the current methods will be more financially viable. (1)

PELVIURETERIC JUNCTION OBSTRUCTION

C Spearman, R Mackinnon

Another problematic area is how long to follow up asymptomatic patients. It has been noted in children that inadequate follow up can cause permanent, irreversible renal damage should complications occur, but the length of follow up to avoid this is unknown. (18) A similar question is also faced within the adult population. It has been recognised for a number of years that short term conservative management is safe within the adult population but long follow up times are being implemented to ensure no patients are missed should their renal function start to deteriorate asymptomatically. (2) More recently in a study of 50 patients, the largest study to date, it was recommended that if at two years post diagnosis, the patient was still asymptomatic with no deterioration in renal function it was safe to discharge with access to the urological team for urgent review should the patient become symptomatic in the future. (19)

In conclusion, currently there is no universal treatment strategy for patients presenting with PUJO. It is important to take into account the patients age, the degree obstruction and damage it is causing as well as local guidelines when deciding on treatment options. Nonetheless, many treatment options are available and the outlook for these patients is good. In the future, with the assistance of new technology and further research, the how and when to treat will hopefully become clearer.

Questions

1. In the usual anatomical variant how many minor calyces are there?
a. Twelve
b. Thirteen
c. Fourteen
d. Fifteen

2. What do the renal nephrons drain into?
a. Minor calyces
b. Major calyces
c. Infindibulum
d. Renal pelvis

3. What is the most common cause of extrinsic pelviueteric junction obstruction?
a. Anteriorly crossing renal vessels
b. Posteriorly crossing renal vessels
c. Anteriorly crossing accessory vessels
d. Posteriorly crossing accessory vessels.

4. What is the current ""gold standard treatment of pelviueteric junction obstruction in adults?
a. Anterograde endopyelotomy
b. Reterograde endopyelotomy
c. Open Pyeloplasty
d. Laproscopic Pyeloplasty

5. What is the current "gold standard" treatment of pelviueteric junction obstruction in children?
a. Anterograde endopyelotomy
b. Reterograde endopyelotomy
c. Open Pyeloplasty
d. Laproscopic Pyeloplasty

Answers

1. C **2. A** **3. C** **4. D** **5. C**

References

1. Uberoi J et al. Minimally invasive surgical management of pelvic-ureteric junction obstruction: update on the current status of robotic-assisted pyeloplasty. BJU International. 2009;104:1722-1729.
2. Gulur D et al. How successful is the conservative management of pelvi-ureteric junction obstruction in adults. BJU International. 2008;103:1414-1416.
3. Eden CG. Treatment options for pelvi-ureteric junction obstruction: implications for practice and training. Br J Urol. 1997;80:365-372.
4. Mughal SA, Soomro S. Pelvi-ureteric junction obstruction in children. Journal of Surgery Pakistan International. 2008;13:163-166.
5. Standing S (ed). Grey's Anatomy, The Anatomical Basis of Clinical Practice. Thirty-ninth edition. Edinburgh: Elsevier Churchill Livingstone: 2005.
6. Mergener K et al. Dietl's Crisis: a syndrome of episodic abdominal pain of urological origin that may present to a gastroenterologist. Am J Gastroenterol. 1997:92(12); 2289-2291.
7. Ritchie G et al. Comparison of differential renal function using technetium-99m mercaptoacetyltriglycine (MAG-3) and technetium-99m dimercaptosuccinic acid (DMSA) renography in a paediatric population. Paediatric Radiology. 2008;38:857-862.
8. MAG-3 Laxis diuresis renogram. http://www.med.harvard.edu/JPNM/TF96_97/Nov26/WriteUp.html (accessed on 10.5.2012)
9. Anderson JC, Hynes W. Retrocaval ureter: a case diagnosed preoperatively and treated successfully by a plastic operation. Br J Urol. 1949;21:209-214.
10. Kausik S. Segura JW. Surgical management of urereropelvic junction obstruction in adults. International Braz J Urol. 2003;29:3-10.
11. National Institute of Clinical Excellence Guidance on Electrocautery cutting balloon treatment for pelviureteric junction obstruction (interventional procedures consultation). (Accessed from: http://www.nice.org.uk/guidance/index.jsp?action=article&o=45282 on 3 October 2011.)
12. National Institute of Clinical Excellence Guidance on Endopyelotomy for pelviureteric junction obstruction (interventional procedures consultation). (Accessed from: http://www.nice.org.uk/guidance/index.jsp?action=article&o=45276 on 3 October 2011.)
13. Barnacle AM et al. Paediatric Interventional Uroradiology. Cardiovascular Interventional Radiology. 2011;34:227-240.
14. Williams NS et al (ed.) Bailey and Love's Short Practice of Surgery. Twenty fifth edition. London: Hodder Arnold: 2008.
15. Abrams P, Feneley RCL, Gillatt DA, Gingell JC, Frank JD, Hinchliffe A. Case Presentations in Urology (Case Presentation Series - I. Title II. Series). Oxford: Reed Elsevier: 1993.
16. Duncan KA. Antenatal renal pelvic dilatation the long-term outlook. Clinical Radiology. 2007;62:134-139.
17. Pates JA, Dashe JS. Prenatal diagnosis and management of hydronephrosis. Early Human Development. 2006;82:3-8.
18. Subramaniam R et al. Antenatally detected pelvi-ureteric junction obstruction: concerns about conservative management. BJU International. 1999;84:335-338.
19. Malki M et al. Conservative Management of Pelvi-ureteric Junction Obstruction (PUJO): Is it appropriate and if so what length of-follow up is needed? BJU International. 2012 (DOI: 10.1111/j.1464-410X.2011.10779.x)

Corresponding author

Dr. Rory Mackinnon
Foundation Year 2 trainee
Northern General Hospital, Sheffield
Email: rory.mackinnon@nhs.net

SURGICAL APPROACH TO THE MIDDLE EAR & MASTOID

G Lloyd, C Huins

Abstract

This article introduces the core surgical trainee to the common surgical approaches employed in otological surgery. Basic anatomy, pre-operative work up, theatre set-up and post-operative considerations accompany a step-by-step guide to permeatal, endaural, postaural and combined approaches to the middle ear and mastoid.

Keywords: mastoid, otologic surgery, middle ear

Introduction

Otologic surgery is a technically challenging sub-specialty. Core trainees in otolaryngology regularly care for patients undergoing a range of routine and advanced ear surgery, however there is often limited opportunity for hands on experience in theatre.

Typically there is a single operating surgeon (consultant or senior trainee) and the junior trainee may be restricted to observing proceedings on a monitor. With a basic understanding of relevant anatomy and the common approaches to the ear this article aims to equip the core trainee with the knowledge and confidence required to take on a more active role in otologic surgery.

Surgery requiring access to the external ear canal
1. Excision of canal osteomas and exostoses
2. Meatoplasty
3. Myringotomy (+/- ventilation tube insertion)
Surgery requiring access to the middle ear
1. Exploratory tympanotomy
2. Tympanoplasty (5 types; type I = 'myringoplasty') – includes ossiculoplasty (such as stapedectomy and other middle ear implants)
3. Rarer procedures including glomus tympanicum tumour excision or tympanic neurectomy (transect Jacobson's nerve to decrease parotid salivary flow)
Surgery requiring access to the mastoid
1. Cortical mastoidectomy
a. Emergency treatment of complications of acute mastoiditis
b. Elective treatment of chronic otitis media, often as part of a 'Combined Approach Tympanoplasty'
2. Mastoidectomy for removal of cholesteatoma
3. Repair to the facial nerve in the temporal bone
4. Radical excision of malignant temporal bone neoplasms
Surgery requiring access to inner ear (often via a cortical mastoidectomy)
1. Cochlear implantation
2. Labyrinthectomy (membraneous or osseous)
3. Endolymphatic sac surgery (for Menière's disease)
Surgery requiring access to lateral skull base
1. Excision of vestibular schwannoma (acoustic neuroma)
2. Vestibular nerve section (for intractable vertigo)

Table 1: Indications for otologic surgery.

Anatomy for the approach to the ear

The external ear comprises of the pinna, composed of elastic cartilage, and the lobule, devoid of cartilage and composed of fibrous tissue and fat, covered in skin. The pinna is thrown to into folds to create the helix, antihelix and concha (Figure 1).

SURGICAL APPROACH TO THE MIDDLE EAR & MASTOID

G Lloyd, C Huins

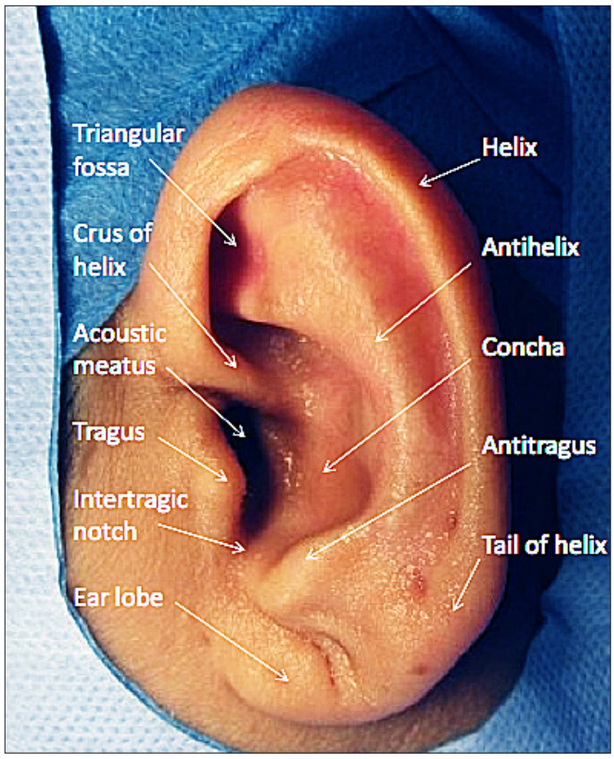


Figure 1. The outer ear.

The cartilage extends medially to form the cartilaginous lateral third of the external ear canal (EAC), lined with hair-bearing skin and containing ceruminous and sebaceous glands which produce cerumen (ear wax). The medial two-thirds is bony and lined with thin skin that is adherent to the underlying bone and continuous with the external layer of the tympanic membrane (TM). The TM forms a thin, semitransparent membrane angled antero-inferiorly separating the meatus from the tympanic cavity of the middle ear. The pars tensa forms the inferior portion and is comprised of three layers - squamous epithelium externally, middle ear mucosa internally and has a fibrous layer in between. It is thickened around its border to produce an annulus that sits in a groove in the temporal bone. The pars flaccida is considerably thicker but lacks the fibrous component. Lateral epithelial migration prevents build up of debris and wax within the ear (i.e. the ear is physiologically self-cleaning).

Detailed anatomy of the four parts of the temporal bone (tympanic, squamous, petromastoid and styloid) is beyond the scope of this article however key structures to note are:

- *Facial nerve (CN VII)* – exiting the internal acoustic meatus anteromedially into the middle ear cavity, the facial nerve angles posteriorly at the first genu to begin its horizontal course medially through the middle ear, generally encased in its bony canal. At its second genu near the tip of the short process of the incus, it angles inferiorly and exits the skull through the stylomastoid foramen to supply the muscles of facial expression.

- *Chorda tympani* – following the same course as CN VII, it separates posteroinferiorly and follows its curving anterosuperior course across the medial surface of the TM, passing between the long process of the Incus and handle of malleus. It can often be identified with simple otoscopy and supplies taste to the anterior two-thirds of the tongue – important to include as a potential complication on the consent form.

- *Ossicles* – Identifiable with otoscopy, the handle of the malleus, particularly the lateral process (angled anterolaterally), is adherent to the medial surface of the TM. Its head articulates with the body of incus, neither usually visible superiorly in the 'attic' of the middle ear. The long process of incus is often visible on otoscopy and its articulation with the most medial ossicle, the stapes, completes the ossicular chain.

Preoperative work up

All patients require a recent pure tone audiogram (PTA) before undergoing any of the procedures listed in Table 1. This, together with a thorough history, forms the basis of a provisional diagnosis and repeat measurement post-operatively allows qualitative assessment of hearing improvement.

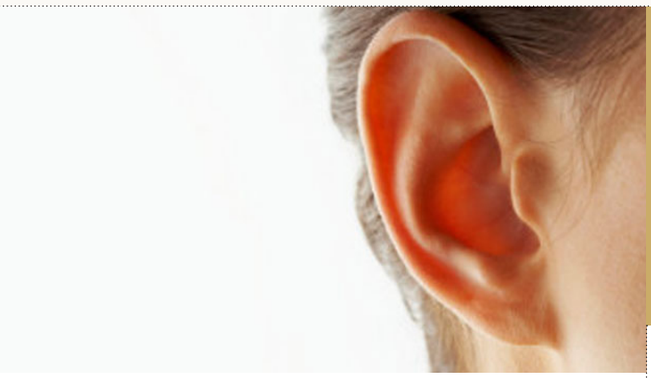
Elective procedures should be carried out in clean dry ears therefore any active infection must receive adequate medical treatment prior to surgery.
Pre-operative imaging is not necessary in all cases but can aid diagnosis and surgical planning if used appropriately. Computed tomography (CT) is an established pre-operative imaging modality and diffusion weighted MRI has become increasingly recognised in the work up of revision cholesteatoma surgery. (1) All relevant images and investigations must be available to the surgeon in theatre.

Informed consent is essential and it is preferable to quote local rates of success, failure and complication rather than relying on figures quoted in the medical literature if possible. Specific otological complications include but are not limited to: hearing loss, tinnitus, dizziness, damage to the chorda tympani nerve and damage to the facial nerve. General complications relating to anaesthesia, bleeding, haematoma, infection and scarring must also be discussed.

If images or video are to be recorded then this needs to be stated explicitly on the consent form and the purpose explained to the patient. Finally, always mark the side intended for surgery as part of the WHO Surgical Safety Checklist. (2)

SURGICAL APPROACH TO THE MIDDLE EAR & MASTOID

G Lloyd, C Huins



Which ear?

With the exception of grommet insertion, elective surgery is rarely carried out on both ears at the same time. Therefore it can be a challenge deciding which ear to operate on first. Generally, the side that is worst affected – poorest hearing or recurrent infections and hence the most to gain – is operated on first, leaving the better ear untouched and thus avoiding the remote risk of complete hearing loss or other complications to both ears.

Theatre set up

The operating microscope must be set up with the hinge of the horizontal arm pointing away from the surgeon to permit easy adjustment during the case (Figure 2). The appropriate focal length for ear cases is always 250 mm. This differs to microlaryngoscopy, which typically requires a focal length of 400 mm. Interpupillary distance is of course operator dependent. Initially select a moderate magnification to allow general assessment of the ear canal before focussing on the deeper structures. If a stack system is available, this should be connected to allow the theatre team to see what the operating surgeon is doing and to enable digital documentation of the procedure if required.

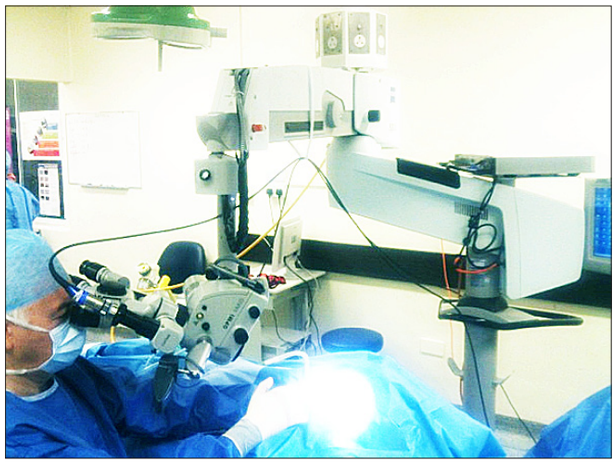


Figure 2. Microscope set-up in theatre.

Patient preparation

The patient is positioned supine with the head turned slightly away from the surgeon so that the operated ear is uppermost. The reverse Trendelenburg position (feet down) may help to achieve a bloodless operating field. The surgeon should aim to move around the patient to gain the best view rather than continuous intraoperative turning of the patient's head.

If a post aural incision is to be made it may be necessary to remove hair using clippers in theatres. Most surgeons prefer an aqueous solution to prepare the skin such as Savlon and avoid preparations containing chlorhexidine as these may risk ototoxicity. (3) Excessive hair in the EAC may need to be trimmed with micro-scissors if it obscures the view to the TM in spite of using an adequate aural speculum. Cerumen and epithelial debris should be cleared with microsuction.

Anaesthesia

In the UK there is a tendency towards general anaesthesia for ear surgery. However, it is possible to undertake many ear procedures under local anaesthetic with sedation. This depends on the procedure, the suitability of the patient, the preference of the surgeon and the expertise of the anaesthetist. Even when general anaesthesia is employed it is common practice to use a combination of injected and topical local anaesthetic agents during the procedure. The soft tissue around the pinna and EAC may be infiltrated with a 2% lignocaine/1:80,000 adrenaline mixture (Lignospan®) using a dental syringe. Intraoperatively, cotton wool balls soaked in 1:1,000 adrenaline can be applied directly onto the middle ear mucosa to control bleeding.

Permeatal approach

This approach is suitable for most clean middle ear surgery, such as tympanoplasty and stapedectomy. It assumes that the EAC is sufficiently wide to negate the need for an external incision. It is important to use the largest aural speculum that can be accommodated by the EAC to optimise access. (Figure 3).

SURGICAL APPROACH TO THE MIDDLE EAR & MASTOID

G Lloyd, C Huins

Figure 3. Selection of different sized aural speculae.

After clearing any cerumen and epithelial debris, slowly infiltrate the skin of the posterior EAC with 1-2 ml of the 2% lignocaine/1:80,000 adrenaline solution. With the bevel pointing downwards, insert the needle at the junction of the cartilaginous and bony canal, indicated by the medial extent of the canal wall hairs. A slow smooth wave of blanched skin should appear rather than an obstructing bleb.

Using a Rosen knife curette (commonly referred to as the "spud knife"), make a transverse incision parallel and 5mm lateral to the fibrocartilagenous annulus. This should run across the posterior canal from 12 o'clock to 6 o'clock and extend down to the bone. With a Plester "D" flap knife, make a longitudinal incision from the superior and inferior limits of the transverse incision and progress medially, stopping at least 2mm from the annulus, thus creating a two-limbed incision (Figure 4).

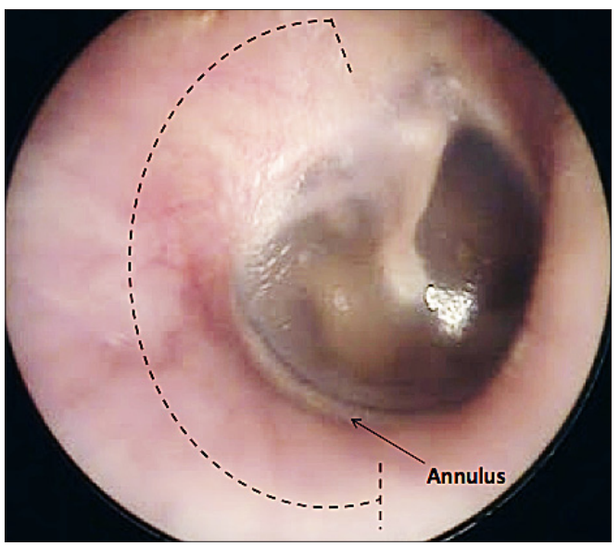


Figure 4. Incision lines for creating posterior tympanomeatal flap.

Raise the tympanomeatal flap starting with the relatively thick skin at the superior aspect. A cotton wool ball impregnated with 1:1,000 adrenaline will aid haemostasis, protect the flap from the suction tip and can be used for blunt dissection as the flap progresses medially and inferiorly. It is key to ensure dissection remains down to the bone especially at the tympanomastoid suture where tethering is common and can result in tearing.

When the annulus is reached it is elevated from its groove and the middle ear mucosa is then breached to enter the tympanic cavity. Care needs to be taken to identify and preserve the chorda tympani nerve running transversely between the long process of the incus and the handle of the malleus. Reflecting the tympanomeatal flap anteriorly now gives access to the middle ear structures (Figure 5).

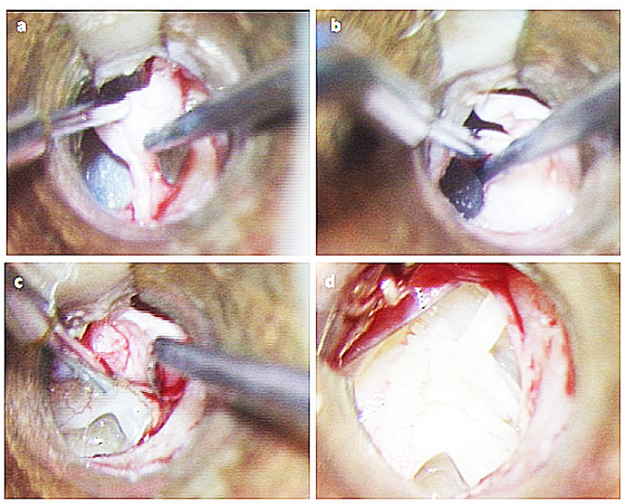


Figure 5. Creation of posterior tympanomeatal flap by raising the annulus out of its groove (a&b). Reflecting the flap anteriorly to expose middle ear structures (c) and allow access to incudo-stapedial joint (d).

SURGICAL APPROACH TO THE MIDDLE EAR & MASTOID

G Lloyd, C Huins

Endaural approach

This approach utilises the deficiency of cartilage between tragus and helix, widening access to the external ear canal. Lignocaine with adrenaline should be infiltrated to the EAC as described in the permeatal approach with further infiltration to the skin between the tragus and the helix and along any intended incision line anterior to the helix. (Figure 6)

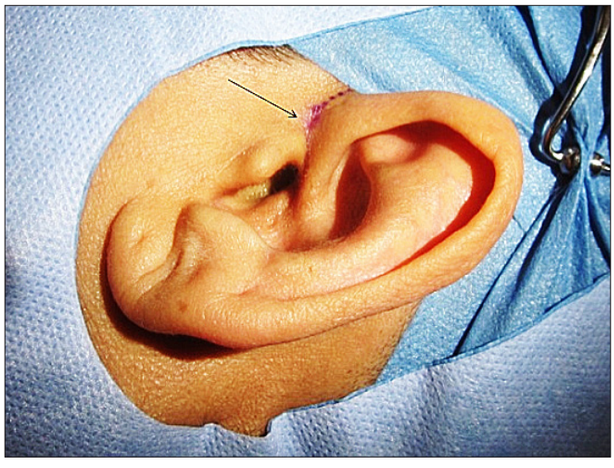


Figure 6. Incision line marked for an endaural approach.

With the assistance of a Lempert's bivalve endaural speculum use a size 15 blade to make an incision running from the superolateral part of the bony external canal, ensuring that it extends down to the bone. Bring the incision laterally to pass between tragus and helix. To harvest temporalis fascia, extend the incision superiorly in front of the helix. Alternatively, expose the tragal cartilage and perichondrium to provide graft materials for middle ear reconstruction. It is possible to extend the incision superiorly and reflect the pinna inferiorly to allow access to the mastoid air cell-system.

The skin within the superolateral EAC may now be elevated and reflected using a small self-retaining retractor. This optimises access to the deeper canal allowing a posterior tympanomeatal flap to be fashioned as described previously.

Postaural approach

This approach provides excellent access for mastoid surgery. With the auricle retracted anteriorly, a curved or upside down 'hockey stick' shaped incision is made behind the pinna approximately 5 mm behind the postauricular crease (Figure 7). The curved superior extension facilitates access to the epitympanum and zygomatic cells. Be aware that in children the facial nerve is relatively unprotected as it leaves the stylomastoid foramen due to an underdeveloped mastoid process and therefore it is advisable to place the incision further posteriorly and superiorly to avoid facial nerve trauma.

Figure 7. Incision line marked for a postauricular approach.

Dissect superiorly until the temporalis fascia has been identified and follow this inferiorly to expose the periosteum over the mastoid process. Proceed anteriorly to find the cartilaginous EAC and reflect the auricle anteroinferiorly. (Figures 7a&b)

SURGICAL APPROACH TO THE MIDDLE EAR & MASTOID

G Lloyd, C Huins

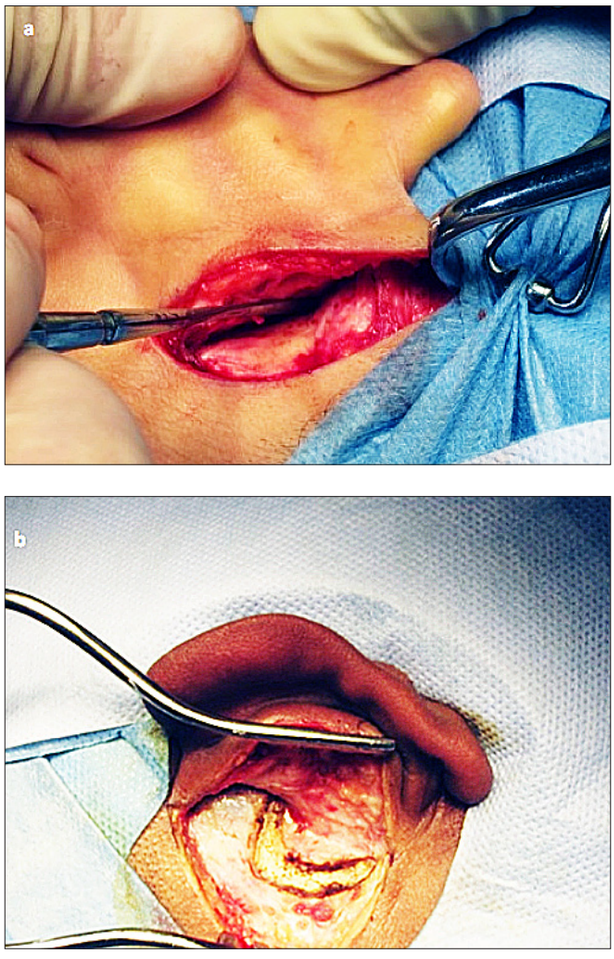


Figure 7. Dissection down to the temporalis fascia (a) and exposure of the periosteum over the mastoid process (b).

If mastoidectomy is being undertaken the periosteum is incised and elevated to allow mastoid or antral drilling. Cutting drills and diamond burrs are used to drill out the mastoid until the sigmoid sinus, dura, facial nerve and chorda tympani have been identified.

For other procedures the next stages will be surgery-specific. If a temporalis fascia graft is required this may be harvested superiorly but it is advisable to retain a band of fascia inferiorly to allow adequate closure.

Combined approach

A combined approach tympanoplasty (CAT) is commonly undertaken in the treatment of cholesteatoma. Quite simply this combines the postaural and permeatal approaches to achieve access to the mastoid air cells, epi-, meso- and hypotympanum without taking down the posterior bony wall of the EAC. This is known as 'canal wall up' surgery and precludes the creation of an open mastoid cavity which is formed in 'canal wall down' mastoidectomy. Further details specific to mastoidectomy and cholesteatoma surgery are beyond the scope of this article but will be covered in a future issue.

Closure and dressings

Packing of the middle ear to support any reconstruction is routinely performed using absorbable gelatine sponge (Gelfoam®) The EAC requires packing in virtually all instances. This serves to hold the tympanomeatal flap in position as it is not routinely sutured when replaced to its original position. It also aids haemostasis and antisepsis. Packing material varies with the individual preference of the operating surgeon. In the authors' own practice strips of silastic sheeting are placed over the TM followed by ribbon gauze impregnated with bismuth, iodoform and paraffin paste (BIPP) (Figure 8). Post-auricular incisions are closed in two layers (temporalis fascia and skin) with sutures. Drains are rarely indicated, however a pressure bandage may be employed in the case of external incisions to prevent post operative haematoma formation.

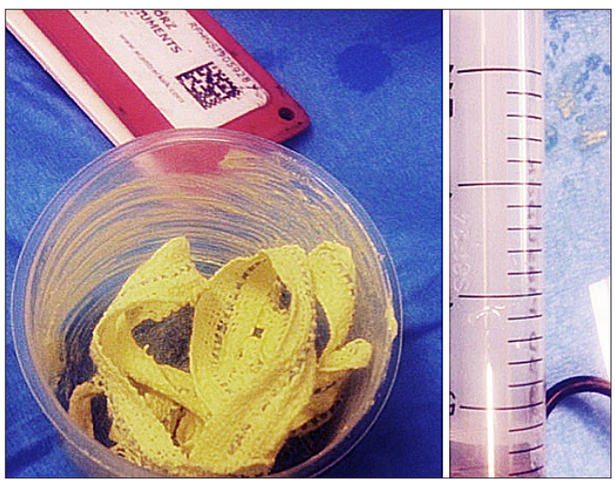
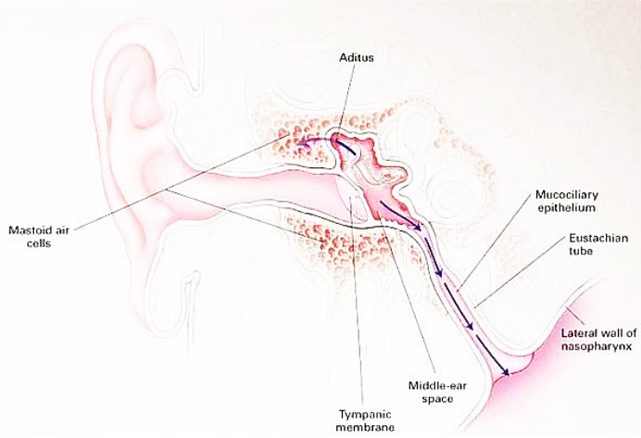


Figure 8. Ribbon gauze soaked in BIPP and made into "roly-polies" for ear dressing.

SURGICAL APPROACH TO THE MIDDLE EAR & MASTOID

G Lloyd, C Huins



Post operative management

Facial nerve function should be documented and a sensorineural hearing assessment with Weber's test should be performed before discharge. Pressure bandaging is removed 24 hours post operatively, non-absorbable sutures at 7-10 days and the EAC packing at 1-2 weeks. At follow up it is essential to obtain a masked bone-conduction audiogram and identify any potential complications as described during the consent procedure.

Suggested further development

- Temporal Bone Course (national/international)
- Foundations of Otologic Surgery Course (UCL Ear Institute, London)

Questions

1. Which focal length in the objective piece of the microscope is most commonly used for ear surgery?

a. 100 mm
b. 200 mm
c. 250 mm
d. 400 mm
e. 450 mm

2. The auricle is formed from which of the following?

a. 1st pharyngeal arch
b. 2nd pharyngeal arch
c. Ectoderm
d. Six Hillocks of His
e. All of the above

3. Where is the nucleus of the facial nerve situated?

a. Medulla
b. Pons
c. Superior colliculus
d. Inferior colliculus
e. None of the above

4. What nerve(s) supply sensory innervation to the outer ear?

a. Greater auricular nerve
b. Lesser petrosal nerve
c. Vagus nerve
d. Jacobson's nerve
e. Lesser occipital nerve

5. If 5 mls of 2% lignocaine is injected, what dose has been administered?

a. 2.5mg
b. 10mg
c. 25mg
d. 50mg
e. 100mg

Answers

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

References

1. Jindal M, Riskalla A, Jiang D, Connor S, O'Connor AF. A systematic review of diffusion-weighted magnetic resonance imaging in the assessment of postoperative cholesteatoma. Otol Neurotol. 2011 Oct;32(8):1243-9.
2. World Health Organisation surgical safety checklist and implementation manual. **http://www.who.int/patientsafety/safesurgery/ss_checklist/en/**
3. Lai P, Coulson C, Pothier DD, Rutka J. Chlorhexidine ototoxicity in ear surgery, part 1: review of the literature. J Otolaryngol Head Neck Surg. 2011 Dec;40(6):437-40.

Corresponding author

Gareth Lloyd,
CT2, Royal National Throat Nose and Ear Hospital,
330 Gray's Inn Road, London. Email: gareth.lloyd@nhs.net

OESOPHAGEAL ATRESIA & TRACHEO-OESOPHAGEAL FISTULA

S Sharif

Oesophageal Atresia & Tracheo-oesophageal Fistula
Paediatric Surgery

Abstract

This review article explores the presentation and management of oesophageal atresia and tracheo-oesophageal fistula. A dynamic narrative discussion using a clinical case demonstrates the important steps in pre- and post-operative management as well as acute post-operative complications which are relevant to patients of all ages.

Oesophageal atresia (OA) denotes a congenitally interrupted oesophagus. This may be associated with one or more fistulae between the trachea and the abnormally formed oesophagus. The incidence is 1 in 3,000 with a slight male preponderance. The aetiology is unknown but is likely to be multi-factorial. There are no known human teratogens. OA that occurs in families has been reported; when a sibling is affected the risk of recurrence is 2%.

Keywords: Oesophageal atresia, Fistula, Tracheo-oesophageal.

Embryology

The embryological basis of OA is still under debate. The traditional idea that the foregut is divided into the trachea and oesophagus by lateral invaginations is appealing but is unfortunately not supported by modern human embryology studies. At the beginning of the fourth week of gestation a ventral evagination of the floor of the post-pharyngeal foregut produces a respiratory primordium from which a fixed cephalad point of tracheo-oesophageal separation is produced. Following this there is a period of rapid growth and the trachea becomes separated from the dorsally placed oesophagus. (1) It has also been suggested that OA without fistula may be a result of ischemic events.

Classification

Many variants of OA have been described. The original classification by Vogt has been revised by Gross (2) and this revised classification is the one most often cited (Figure 1).

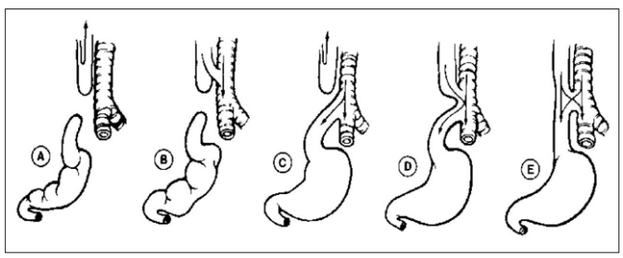


Figure 1: Classification of Oesophageal Atresia.

Type A - Pure OA (10%)

Type B - OA with proximal trachea-oesophageal fistula (<1%)

Type C - OA with distal trachea-oesophageal fistula (85%)

Type D - OA with both proximal and distal trachea-oesophageal fistulae (<1%)

Type E - H-Type fistula = Tracheo-oesophageal fistula without oesophageal atresia (4%)

Even given this accepted classification it is best practice to also give a narrative description of the findings to be certain that there is no ambiguity. Given this variation in abnormalities it is easy to understand how the condition may present differently both antenatally and postnatally. In a large number of infants the antenatal findings will be normal or very non-specific. A foetus with pure OA will not be able to swallow amniotic fluid and the antenatal scan findings may show polyhydramnios. (3) In a foetus with OA and some form of fistula some amniotic fluid may pass into the gut via the trachea therefore there may be no abnormal antenatal scan findings.

Clinical Presentation

The clinical presentation, investigation, surgery and management of complications will be discussed and illustrated by using the clinical case of Baby B.

The Case of Baby B

Baby girl B was the first child of her parents. All antenatal scans were normal and the pregnancy was uneventful. Her mother had a spontaneous onset of labour at 37 weeks gestation. There were no concerns at the delivery and Baby B had good apgar scores of 8, 9 and 10 at 1, 5 and 10 minutes. On attempting breast-feeding she had a lot of oral mucous secretions and then appeared slightly floppy. On bottle feeding the milk returned via her nostrils. An orogastric tube was passed and a chest X-ray confirmed the diagnosis (Figure 2). She had no other obvious physical abnormalities.

OESOPHAGEAL ATRESIA & TRACHEO-OESOPHAGEAL FISTULA

S Sharif

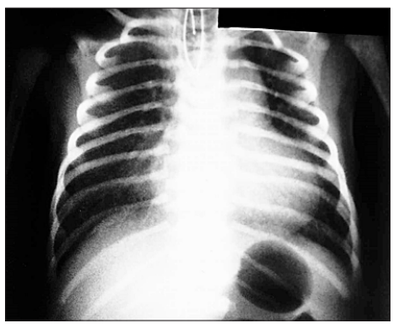


Figure 2: Initial X-ray from the referring hospital showing the coiled position of the orogastric tube in the upper oesophageal pouch.

As the primary abnormality in OA is a discontinuity in the oesophagus the main symptoms present very early in life as the infant is unable to swallow. There are excessive oral secretions which will mainly comprise of the infant's saliva. In addition any attempt at feeding will result in milk returning via the mouth or nostrils and an episode of choking.

Overflow from an obstructed upper oesophageal pouch may cause aspiration. Additionally, if a proximal tracheo-oesophageal fistula is present then fluid will flow directly into the trachea-bronchial tree causing further respiratory complications. In order to diagnose the condition an orogastric tube is passed and this is generally found coiled in the upper pouch as the tube is very flexible.

A Replogle tube, which is much stiffer than an orogastric tube, is passed and this is usually not able to go beyond 8-10cm. An X-ray confirms the position of the tip, i.e. the base of the obstructed upper pouch; this is usually between T2 and T4. The replogle tube is placed on continuous suction in order to remove saliva and to reduce the risk of aspiration (Figure 3). It is important to assess for any gas shadow below the diaphragm as the presence of gas will indicate a tracheo-oesophageal fistula. A thorough clinical examination of the infant will also reveal possible associated anomalies.

Figure 3: Replogle tube (the fenestrated appearance enables it to distinguished easily from other tubes) in-situ with the tip almost to T5 indicating a longer proximal oesophageal pouch. Note the abundance of air in the bowel which indicates the presence of a tracheo-oesophageal fistula.

Associations (4)

- **VACTERL association is a combination of anomalies including Vertebral, Anorectal, Cardiac, Tracheo-oesophageal, Renal and Limb (radial) abnormalities.**
- **Other bowel atresias: duodenal and ano-rectal**
- **Cardiac anomalies: Most commonly ventricular septal defects and tetralogy of Fallot.**
- **Genetic defects: Trisomy 18 or 21 (20% of cases)**
- **CHARGE association includes Coloboma, Heart defects, Atresia choanae, Retarded growth, Genital hypoplasia and Ear deformities.**

Pre-Operative Management

Once a diagnosis is established the infant must be transferred to a specialist paediatric surgery centre for further investigation and management. A replogle tube must be placed as soon as the diagnosis is made to ensure the infant does not aspirate. The ventilatory support requirement must be assessed by a neonatologist and if required the infant must be intubated and ventilated. In the presence of a distal trachea-oesophageal fistula there is a real risk of gastric distension and perforation secondary to leak of respiratory gases and this must be monitored closely. (5)

OESOPHAGEAL ATRESIA & TRACHEO-OESOPHAGEAL FISTULA

S Sharif

All infants should have an echocardiogram before surgery. This will demonstrate any associated cardiac structural abnormality. It will also determine the position of the aorta. In 2.5% of cases there is a right-sided aortic arch. (6) Other associated abnormalities may be detected by careful inspection of plain X-rays for vertebral and skeletal problems as well as a renal ultrasound. Further imaging of the spine is only carried out where indicated and not as part of routine investigation. In a few select cases surgery will not be appropriate. These include infants with trisomy 18 and those with Potter's syndrome owing to high fatality rate within the first year of life. In such cases a discussion between the parents, surgeon and neonatologist would be more appropriate in the first instance. In predicting outcome at the initial presentation two important factors have been highlighted: those with a birth weight (bwt) less then 1.5kg and the presence of major cardiac disease. (7) Three prognostic groups have been proposed:

Group I:	*bwt > 1.5kg, no cardiac anomalies*	*98%*	*predicted survival*
Group II:	*bwt < 1.5kg OR cardiac anomalies*	*60%*	*predicted survival*
Group III:	*bwt < 1.5kg AND cardiac anomalies*	*20%*	*predicted survival*

The Case of Baby B

Baby B underwent a planned ligation of tracheo-oesophageal fistula and primary repair of oesophageal atresia under general anaesthetic on day 2 of life. The approach was via a right-sided postero-lateral thoracotomy through the 5th intercostal space and the dissection was extrapleural. The first step involved identifying and ligating the azygos vein. Next the tracheo-oesophageal fistula was divided and over sewn. The upper oesophageal pouch is mobilized and the two oesophageal ends approximated. A trans-anastomotic feeding tube (TAT) was placed and the oesophageal anastomosis completed with an interrupted single-layer monofilament suture. There was no evidence of any air leak from the pleura so a chest drain was not required. Baby B was paralyzed and ventilated for 2 days post-operatively.

Surgery

Surgery may be sub-categorized into three broad areas:

1. *Emergency*
2. *Primary/Definitive*
3. *Delayed/Staged*

Surgery for OA is generally not viewed as emergency surgery. The exception to this is an infant requiring a high level of ventilatory support (8) due to gas leak via the fistula into the stomach. Over distension of the stomach may lead to gastric perforation and resultant pneumoperitoneum which further compromises respiratory function. In such cases, an emergency ligation of the tracheo-oesophageal fistula is undertaken as a standalone procedure and further definitive surgery is completed 7-10 days later.

The vast majority of infants with OA do have an associated distal fistula and undergo early definitive surgery as per the case of Baby B. The extrapleural approach is favoured as this protects the pleural space if there is a leak from the oesophageal anastomotic site. If a transpleural approach is taken then a chest drain is placed; with the extrapleural approach some surgeons may choose to insert a chest drain if there is any doubt regarding a possible air leak.

The management of long-gap atresia is staged or delayed. (9) A Long gap atresia is defined as a gap of three or more vertebral bodies or 5 or more cm. The most notable finding is a gasless abdomen as there is no connection between either the oesophagus or trachea and the stomach. An initial open gastrostomy and delayed primary anastomosis is one option. Other techniques are available in order to allow an early thoracotomy to reduce the gap and to then perform a second stage thoracotomy for anastomosis.

In those with very little oesophageal length a cervical oesophagostomy and gastrostomy are performed with a view to an oesophageal replacement later. As with most specialities in surgery there is a role for minimally invasive surgery. It is possible to undertake a thoracoscopic repair of OA. The hazards in a very small fragile neonate are still being quantified. There is a high risk of having periods of severe acidosis owing to the small chest volume and difficulty with maintaining adequate ventilation while providing a good thoracoscopic view. In order to achieve a thoracoscopic repair an experienced paediatric anaesthetist is a vital part of the team.

Post-operative Management

Post-operatively most infants are paralyzed and ventilated for 48 hours. However, if there is a wide gap between the two oesophageal ends or there is tension at the repair site then the infant is paralyzed and ventilated for 5 days to ensure the anastomosis site will heal well. Feeds may be commenced via the TAT on post-operative day 2 onwards dependent on the infant's clinical condition. If there is any doubt surrounding the integrity of the anastomosis a water-soluble contrast is undertaken, generally this is on post-operative day 5-7, and it ensures the anastomosis is watertight before oral feeding. Regular suctioning and monitoring will indicate when the infant is able to swallow her own saliva. When the infant is able to swallow her saliva then oral feeding may be slowly introduced. It is important to remember that although the structural integrity of the oesophagus is established with surgery the concomitant functional component will still be present. Oesophageal dysmotility will be present to some degree in most children with OA.

The Case of Baby B

By day 4 post surgery Baby B was making good progress and had been successfully extubated. However, in the early hours of the morning Baby B developed marked respiratory distress. A chest X-ray demonstrated the problem clearly: a large right-sided tension pneumothorax (Figure 4). This was treated promptly with a chest drain with excellent clinical effect (Figure 5).

OESOPHAGEAL ATRESIA & TRACHEO-OESOPHAGEAL FISTULA

S Sharif

Figure 4: Large right pneumothorax. Note the position of the TAT.

Figure 5: A needle thoracocentesis was performed immediately after the X-ray shown in Figure 4. A right sided chest drain was then sited with an underwater seal with good effect.

Complications

Complications may be categorized into early and late. The most important complication to be aware of in the early post-operative period is an anastomotic leak (10%). This may result in air, saliva or feed leaking into the chest cavity. (10) Prompt diagnosis and treatment is imperative in the vulnerable neonate. Other early complications include oesophageal stricture (15-30%) and recurrent trachea-oesophageal fistula (5-10%).

The Case of Baby B

After the insertion of the chest drain Baby B had a stormy 72 hours in which she required 2 further chest drains due to drain blockage and displacement. The third chest drain showed an output of straw and white coloured fluid. Further investigations included a water-soluble contrast study to define the problem (Figure 6). She had maximal medical supportive treatment including ventilatory support, total parenteral nutrition, intravenous antibiotics and analgesia. She responded well to these measures and a week later all drains had been removed and she was slowly recommenced on TAT feeds and subsequently transferred back to her local neonatal unit.

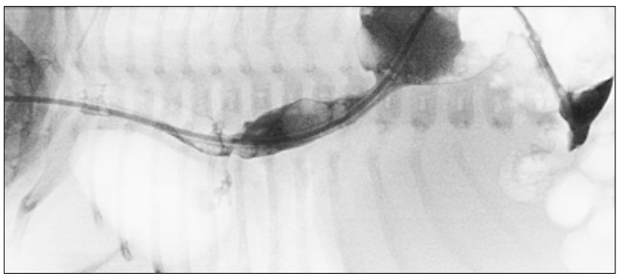


Figure 6: Water-soluble contrast study performed via the TAT showing leak of contrast from the anastomotic site into the right hemi-thorax. Also note the right-sided pneumothorax.

If the infant is clinically stable then a conservative approach to an anastomotic leak may be sufficient and further delayed contrast imaging will demonstrate when it is safe to commence oral feeding. However, if there is a large early leak the surgeon may elect to re-operate in order to restore oesophageal continuity or create a diversion with a cervical oesophagostomy. Having an anastomotic leak increases the risk of developing a stricture later. Other factors implicated in stricture formation (11) include a tight anastomosis under tension and gastro-oesophageal reflux. (12) The vast majority of OA patients are commenced on anti-reflux medications early.

The Case of Baby B

Baby B was readmitted for further assessment at 3 months of age. She had been making good progress with bottle feeding and had gained weight well. She continued on her anti-reflux medication. However, recently she had taken longer to complete her feeds and appeared to regurgitate more milk back as well. A further contrast study was taken (Figure 7). Following this she had a general anaesthetic for upper GI endoscopy and dilatation of her anastomotic stricture. She did well post-operatively.

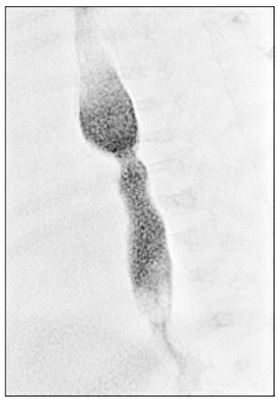


Figure 7: Water-soluble contrast study demonstrating the site of the anastomotic stricture.

Anastomotic strictures often require repeated dilatations until the infant is asymptomatic. Other long-term complications to consider include gastro-oesophageal reflux, tracheomalacia, oesophageal dysmotility (13) and dysphagia. Infants who undergo surgery are followed-up long term and these concerns are sought and addressed if they arise.

Questions

1. A neonate has been transferred to your unit with a confirmed diagnosis of oesophageal atresia. A plain film demonstrates a gasless abdomen. Which type of variant is associated with this finding?

a. Type B
b. Type C
c. Type D
d. Type E
e. None of the above

OESOPHAGEAL ATRESIA & TRACHEO-OESOPHAGEAL FISTULA

S Sharif

2. A 2 hour-old newborn has excessive oral secretions and an episode of choking when feeding associated with cyanosis. The antenatal scans show that the pregnancy was complicated by polyhydramnios. Which test is most useful in this very young infant to confirm the diagnosis?
a. CT of the chest
b. flexible bronchoscopy to identify a fistula
c. endotracheal intubation
d. orogastric tube and chest X-ray
e. water-soluble contrast swallow

3. An infant with the oesophageal atresia has been diagnosed with the CHARGE association. Which of the following abnormalities will not be present?
a. choanal atresia
b. retarded development
c. ear deformity
d. radial abnormality
e. genital hypoplasia

4. A neonate has undergone surgery for OA with a proximal fistula. Post-operatively the chest drain has a minimal amount of clear fluid. Which single test would be most useful in identifying the source of the fluid?
a. Sodium
b. Culture and sensitivity
c. Protein
d. Amylase
e. WCC count

5. An infant presents to the Accident and Emergency department with an episode of collapse and cyanosis 18 months after surgery for OA. After in-patient observation and further similar episodes an aortopexy was performed with a good result. What was the cause?
a. anastomotic stricture
b. severe gastro-oesophageal reflux
c. tracheomalacia
d. structural cardiac anomaly
e. anastomotic leak

Answers

1. e. Pure OA without a fistula occurs in 10% of cases and is known as Type A in the Gross classification.

2. d. The mainstay of diagnosis is the inability to advance an orogastric tube past 8-10cm. A chest x-ray would confirm that the tip is coiled in the upper oesophageal pouch. In difficult diagnostic cases a minimal amount (1-2 ml) of water soluble contrast may be injected into the orogastric tube under supervision in order to demonstrate the blind-ended upper pouch. A large volume should never be administered and all infants with suspected OA should be placed nil by mouth as the risk of aspiration and associated morbidity is very high.

3. The clue is in the name! d. CHARGE association = Coloboma, heart defects, atresia choanae, retarded growth and development, genital hypoplasia and ear deformity.

4. d. If there is a leak from the oesophageal anastomosis this will leak salivary fluid. Amylase is secreted by the salivary glands into saliva this will be reflected in the high amylase count in the chest drain fluid.

5. c. The initial manifestations of OA are due to the structural abnormality of the oesophagus which is addressed through surgery. There is an associated functional abnormality which presents with dysmotility and possibly dysphagia in the oesophagus. A similar structural and functional abnormality also occurs in the trachea it is termed tracheomalacia. It occurs in 10% of OA patients and approximately 50 % will go on to have surgery. In tracheomalacia there is an area of weakened soft cartilaginous tracheal rings which can collapse during expiration causing the classic 'TOF-cough'. This also has the potential to lead to life-threatening episodes of apnoea

References

1. Merei J, Hasthorpe S, Framer P, et al: Relationship between esophageal atresia and tracheoesophageal fistula and vertebral anomalies in mammalian embryos. J Pediatr Surg 1998;33:58-63.
2. Gross RE: The Surgery of Infancy and Childhood. Philadelphia, W B Saunders, 1953 as cited in Ashcraft K, Holcomb III GW, Murphy JP: Pediatric Surgery, Philadelphia, Elsevier Saunders, 2005.
3. Stringer MD, McKenna KM, Goldstein RB, et al: Prenatal diagnosis of esophageal atresia. J Pediatr Surg 1995;30:1258-1263.
4. Ein SH, Shandling D, Esson D, et al: Esophageal atresia with distal tracheoesophageal fistula: Associated anomalies and prognosis in the 1980s. J Pediatr Surg 1989;24:1055-1059.
5. Maoate K, Myers NA, Beasley SW: Gastric perforation in infants with oesophageal atresia and distal tracheo-oesophageal fistula. Pediatr Surg Int 1999;15:24-27.
6. Babu R, Pierro A Spitz L, et al: The management of esophageal atresia in neonates with right-sided aortic arch. J Pediatr Surg 2000;35:56-58.
7. Spitz L, Kiely EM, Morecroft JA, Drake DP. Oesophageal atresia: at risk groups for the 1990s. J Pediatr Surg 1994;29:723-75.
8. Malone PS, Kiely EM, Brain AJ, et al: Tracheo-esophageal fistula and pre-operative mechanical ventilation: A dangerous combination. Aust NZ J Surg 1990;60:525-527.
9. Hagberg S, Rubenson A, Sillen U, et al: Management of long-gap esophagus: Experience of end-to-end anastomosis under maximal tension. Prog Pediatr Surg 1986;19:88-92.
10. Chittmittrapap S, Spitz L, Kiely EM, et al: Anastomotic leakage following surgery for esophageal atresia. J Pediatr Surg 1992;27:29-32.
11. Chittmittrapap S, Spitz L, Kiely EM, et al: Anastomotic stricture following repair of esophageal atresia. J Pediatr Surg 1990;25:508-511.
12. Guo W, Fonkalsrud EW, Swaniker F, et al: Relationship of esophageal anastomotic tension to the development of gastro-esophageal reflux. J Pediatr Surg 1997;32:1337-1340.
13. Chetcuti P, Phelan PD: Gastrointestinal morbidity and growth after repair of oesophageal atresia and tracheo-oesophageal fistula. Arch Dis Child 1993;68:163-166.

Corresponding author

Miss Shazia Sharif
Specialty Registrar Paediatric Surgery, The Royal London Hospital.
Email: shaziapsharif@yahoo.co.uk

LUMBAR DRAIN INSERTION

M L Josefsson

Abstract

Lumbar drain insertion is a common neurosurgical procedure that allows controlled drainage of cerebrospinal fluid. This paper explains the method of lumbar drain insertion in a step-wise approach, as well as discussing its indications, contra-indications and common complications.

Keywords:
lumbar drain, lumbar subarachnoid space, CSF leak, intracranial pressure

History and pathology

Insertion of a lumbar drain into the lumbar subarachnoid space was first described by Vourch et al in 1963 and has since become a common neurosurgical procedure that allows controlled drainage of cerebrospinal fluid (CSF). (1) Diverting the drainage is indicated in patients with fistula formation following dural and arachnoid lacerations to reduce the pressure at the site of the CSF leak. A CSF fistula is most commonly caused by blunt trauma, but may also occur following craniotomy. It is associated with an increased risk of infection and revision surgery. (2)

Indications

1. To reduce CSF pressure on a site of CSF fistula/leak, ie. following posterior fossa, transsphenoidal or spinal surgery. In spinal surgery the lumbar drain will divert CSF away from the dural tear and thus the wound allowing wound healing following which the drain is removed.

2. To reduce intracranial pressure in cases of communicating hydrocephalus ie. normal pressure hydrocephalus assessment; hydrocephalus following subarachnoid haemorrhage (SAH).

3. To reduce or dilute CSF inflammatory component load ie. SAH, communicating hydrocephalus from post-operative infection.

4. To reduce CSF pressure in an attempt to increase spinal cord perfusion.

Contraindications

Definitive contraindications include:
1. Cutaneous infection at the site of incision.
2. Unequal pressures between the supratentorial and infratentorial compartments. (4)

Relative contraindications include:
1. Evidence of increased intracranial pressure.
2. New focal neurological findings on examination
3. Coagulopathy. (4)

Caution should be taken in patients with a history of sciatica or other unexplained neurological symptoms, and prior spinal surgery.

Gaining informed consent/ explaining procedure to patient

A signed consent form should be obtained following procedure, benefits, risks, complications and alternative options have been explained. The patient should be informed that the purpose of the procedure is a temporary way to drain CSF in order to relieve the pressure at the site of a CSF leak and to assist its healing. Complications to be aware of include the drain becoming blocked or dislodged, symptoms following over drainage of CSF, and the risk of infections.

LUMBAR DRAIN INSERTION

M L Josefsson

Equipment required

The following equipment is required; spinal epidural catheter kit that includes a Touhy needle and the drainage system (16 or 18 guage), sterile dressing pack, plain lidocaine 1% or 2%, betadine or chlorhexidine solution, CSF manometer (in case opening pressures need documented), adhesive dressings or drain fixation devices, Universal sample pots, and sterile gloves.

Draping/sterile field preparation

The procedure may be done in the theatre post-operatively or at the bedside. Reducing the risk of infection is crucial as this may cause significant morbidity and mortality, hence adhering to a strict aseptic technique throughout is imperative.

Patient positioning and relevant anaesthetic points

The positioning is similar to that for a lumbar puncture; the patient may be positioned in the lateral decubitus postion with the chin flexed and their knees curled up towards the chest. The back should be positioned close to the edge of the bed. The next steps are as follows:

1. Identify the land marks and mark the puncture site. As the spinal cord ends at the level of L1-L2, aim for the L4-5 vertebral space which can be identified in a perpendicular line between the iliac crests. L3-4 may also be used.

2. Use sterile gloves and prepare the equipment.

3. Use antiseptic skin preparation to clean the pre-marked site and adjacent skin.

4. Drape the patient and recheck the landmarks.

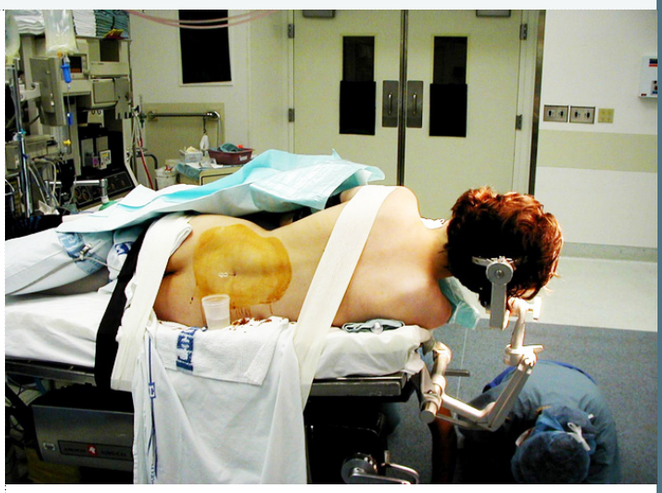
5. Administer local anaesthetic to the skin and subcutaneous tissue with a 22-25 gauge needle.

6. Insert the 14 gauge Touhy needle with the bevel facing up. Advance it slowly in the direction towards the umbilicus with a 20 degree angulation on a horizontal axis. Stop and reposition the needle if the patient complains of nerve root pain. A 'give' may be felt when piercing the ligamentum flavum and a further 'give' once the needle is past the dura mater. Remove the stylet frequently to check for CSF flow. If no CSF can be obtained, withdraw the needle to the subcutaneous tissue, change its angle slightly and continue.

7.Once CSF flow is established, rotate the needle 90 degrees counter-clockwise to allow the passage of the drain into the subarachnoid space.

8. Drain 1-2 ml of CSF into the test tubes to send to the lab for routine microbiology, glucose, protein and cytology as indicated.

9. Thread the epidural catheter through the Touhy needle into the canal for at least 10-15 cm beyond the tip of the needle.



10. Withdraw the Touhy needle with the catheter until the needle tip is seen just outside the skin, and then remove the needle over the catheter. This manoeuvre often prevents the bevelled tip of the needle damaging the catheter when not under direct vision.

11. Attach the catheter to the epidural drainage system and ensure drain patency.

12. Secure the catheter with two suture ties to the skin and attach it to the external drainage system. Cover the incision site with a transparent adhesive dressing.

13. Nurse the patient with the head of the bed at a 30 degree angle with the drip chamber at the patient's shoulder level.

14. Usually the drip chamber is set to drain 10-20 ml of CSF per hour, or to maintain a desired level of spinal CSF pressure.

Documentation of procedure

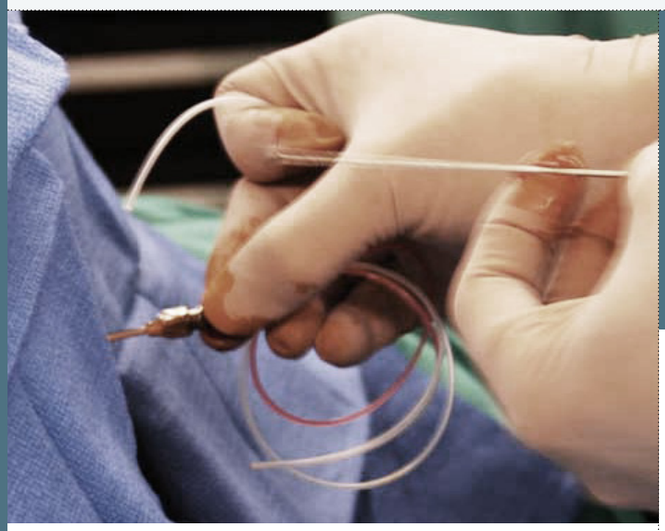
Pre-procedure examination findings and the indication for the lumbar drain should be clearly documented and the consent form filed in the patient's notes. The procedure and its complications should be document as well as instructions to the nursing staff.

Recording of complications and management of such

Infection is as already mentioned, a common and serious complication with rates up to 4.2% reported in the literature. (5, 6) It is thus important to monitor for infection with regular CSF sampling and routine bloods. The risks of infection can be reduced by ensuring strict aseptic technique whenever handling the drainage system and when obtaining CSF samples. Infections are treated with antibiotics as per microbiology advice, and usually removal of the lumbar drain.

LUMBAR DRAIN INSERTION

M L Josefsson



Another common complication is that the drain becomes blocked or dislodged, which sometimes can be solved with gentle manipulation of the catheter but more often means that the drain has to be removed and a new one re-inserted. The lumbar drain should never be flushed. Other complications include over drainage of CSF, which may occur if the drip chamber is incorrectly set or if the patient stands up without first clamping the drain.

It is important that the nursing staff are educated in managing a lumbar drain. (7) Over drainage of CSF may cause low pressure headache which is managed with analgesia and bed rest. A more serious but rare complication of low intracerebral pressure is pneumocephalus which can happen in the presence of a CSF leak when air is drawn into the skull through a negative pressure gradient. (7) In very rare occasions this may develop into a tension pneumocephalus and ultimately brainstem herniation.

Retained parts of the catheter post removal have been reported, and it is important to ensure that the drain is intact when removed. (6) A CSF leak may occur following drain removal which in most cases can be solved with a suture to close the puncture site, but a blood patch may be considered if symptoms persist.

Questions

1. Which of the answers below is a definitive contra-indication to lumbar drain insertion?

A. New focal neurological findings on examination
B. Coagulopathy
C. Unequal pressures between the supratentorial and infratentorial compartments
D. Evidence of increased intracranial pressure
E. History of sciatica

Lumbar drain insertion
Neurosurgery

2. Which of the answers below is not an indication for lumbar drain insertion?

A. Hydrocephalus following SAH
B. Normal pressure hydrocephalus assessment
C. CSF leak following posterior fossa surgery
D. CSF sampling
E. Communicating hydrocephalus from post-operative infection

3. Which of the answers below is incorrect regarding lumbar drain insertion?

A. Insert the drain at the L4-5 vertebral space.
B. Use a 14 gauge Touhy needle.
C. Once CSF flow is established, rotate the needle 90 degrees counter clockwise.
D. Thread the catheter through the Touhy needle into the canal for 20 cm beyond the tip of the needle.
E. Withdrawing the Touhy needle with the catheter until the needle tip is seen just outside the skin, and then removing the needle over the catheter helps to prevent the catheter being damaged by the tip of the needle.

4. Which of the answers below is correct regarding the management of patients with a lumbar drain in situ?

A. The incision site of the lumbar drain should be covered with a gauze dressing.
B. Strict aseptic technique should be adhered to whenever handling the drainage system and when obtaining CSF samples.
C. The patient should be nursed flat.
D. Regular CSF and routine blood sampling are not required unless the patient becomes septic.
E. If a drain becomes blocked it is acceptable to flush it with normal saline.

5. Which of the answers below is not correct regarding post-procedure complications?

A. Infection is a common and serious complication.
B. Pneumocephalus is a rare but serious complication of over drainage of CSF.
C. Low pressure headache is managed with analgesia and bed rest.
D. The drain becoming blocked or dislodged is a common complication.
E. CSF leak following drain removal is always managed with a blood patch.

LUMBAR DRAIN INSERTION

M L Josefsson

Answers

1. C **2. D** **3. D** **4. B** **5. E**

References

1. Vourch G. Continuous CSF drainage by indwelling spinal catheter. Br J Anaesth 1963; 35: 118-20.
2. Trotter MI, Morgan DW, Continuous lumbar drainage. Ann R Coll Surg Engl 2002; 84:64-65.
3. Walchenbach R, Geiger E, Thomeer RT, Vanneste JA. The value of temporary external lumbar CSF drainage in predicting the outcome of shunting on normal pressure hydrocephalus. J Neurol Neurosurg Psychiatry. Apr 2002;72(4):503-6.
4. Farhat HI, Elhammady MS, Levi AD, Aziz-Sultan MA. Cervical subarachnoid catheter placement for continuous cerebrospinal fluid drainage: a safe and efficacious alternative to the classic lumbar cistern drain. Neurosurgery. Mar 2011;68(1 Suppl Operative):52-6; discussion 56.
5. Coplin WM, Avellino AM, Kim DK, Winn HR, Grady MS. Bacterial meningitis associated with lumbar drains: a retrospective cohort study. J Neurol Neurosurg Psychiatry. Oct 1999;67(4):468-73.
6. Governale LS, Fein N, Logsdon J, Black PM. Techniques and complications of external lumbar drainage for normal pressure hydrocephalus. Neurosurgery. Oct 2008;63(4 Suppl 2):379-84; discussion 384.
7. Luciano T. BasauriLT, Concha-Julio E, Selman JM, Cubillos P, Rufs J. Cerebrospinal fluid spinal lumbar drainage: indications, technical tips, and pitfalls. Crit Rev Neurosurg (1999) 9: 21–27

Corresponding author

Mette L Josefsson
Foundation Year 2 Doctor,
Department of Intensive Care
Papworth Hospital
Cambridge University Hospitals

Email: m.josefsson@doctors.org.uk

COURSE REVIEW: EDINBURGH SURGICAL SCIENCES QUALIFICATION (ESSQ)

J Rodrigues

Course review: Edinburgh Surgical Sciences Qualification (ESSQ)
Career Focus

What is it?

It is a distance-learning part-time qualification run jointly by The University of Edinburgh and The Royal College of Surgeons of Edinburgh.

How does it work?

It involves a three year distance learning programme delivered via a dedicated website.

Successful completion of year one results in the award of a Postgraduate Certificate in Surgical Sciences. Completion of year two upgrades this to a Postgraduate Diploma, and completion of year three results in the award of an MSc in Surgical Sciences from The University of Edinburgh.

Who is it for?

ESSQ is only open to doctors who have not yet completed their MRCS, and usually who have graduated from medical school less than five years earlier. It is ideal for all junior doctors, UK and abroad, who wish to gain additional guided study towards MRCS and in particular for those who aim to pursue a career involving academia.

What areas are covered?

Years one and two cover the MRCS syllabus, and so help to prepare you to sit the exams. This is achieved through case-based learning and web-based discussion boards. Year three involves a research project of the student's choice, supervised locally where they are working. This allows students to focus on the specialty or area that interests them.

Are there exams?

There are written exams at the end of years one and two. These are held in Edinburgh for UK and Ireland students, and at other venues overseas.Assessment in the third year takes the form of research-relevant submissions, such as a scientific meeting style e-poster and a report similar to a scientific paper.

What was it like to do?

I found the first two years genuinely interesting without being too much of a commitment. I must point out that I graduated in 2010, having started in the first year the course was run in 2007, and the course has evolved since then. My third year project has actually changed my career plans, and has led to my current appointment and research.

How much does it cost?

Fees are £8,450 (June 2012) and are the same for both UK and international students. Fees are spread over the three years, and they may be able to be further divided into instalments across the course of each year. Scholarships may be available: check the programme website.

Is it worth it?

I think so. It facilitates the development of an academic career. It has directly contributed to my current work towards a further higher degree.

Additionally, obtaining an MSc may help with gaining entry to competitive higher training programmes in its own right. The opportunity to do this without taking time out potentially streamlines progression. I also found that studying whilst working, and thus earning, made financial sense.

This particular degree programme combines helpful preparation for MRCS with the opportunity to produce work of relevance to the specialty you aim to pursue. It is tailor-made for junior surgical trainees and works well. Also, data published on the ESSQ website demonstrates that ESSQ students fare better in the MRCS than other candidates.

Where is there more information about it?

Website: **www.essq.rcsed.ac.uk**

Author

Jeremy Rodrigues
British Society for Surgery of the Hand Research Fellow,
University of Nottingham; Plastic Surgery StR; ESSQ MSc Graduate
Email: j.n.rodrigues@doctors.org.uk

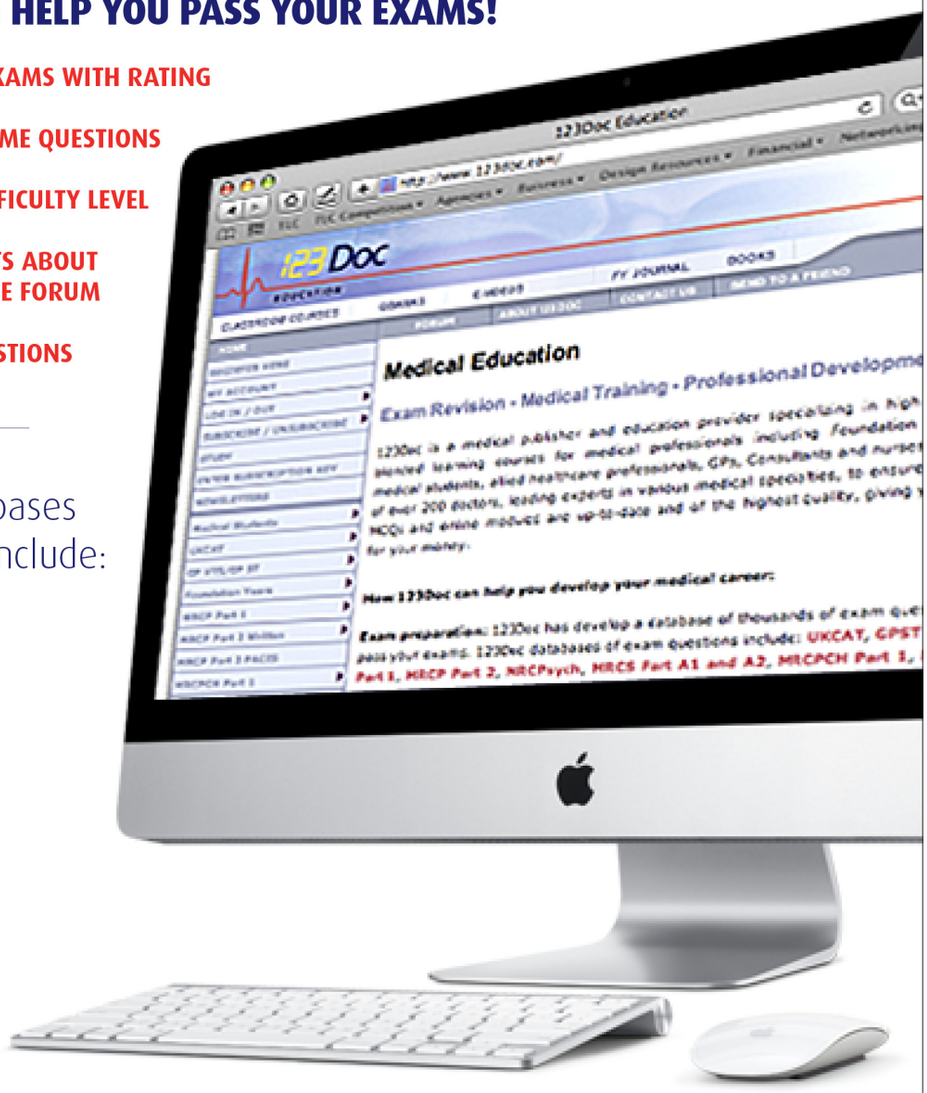
Declaration of Interests

Since graduating from ESSQ, the author has become an e-tutor of the University of Edinburgh, contributing to the teaching of the ESSQ programme. For this he receives a fixed annual stipend from The University of Edinburgh.

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:

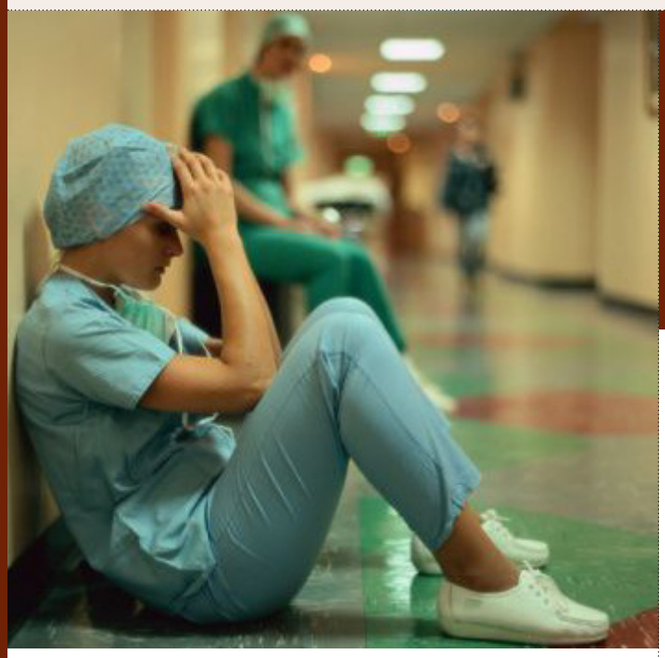
- ✓ **UKCAT**
- ✓ **GPST / GPVTS**
- ✓ **MRCP Part 1**
- ✓ **MRCP Part 2**
- ✓ **MRC Psych**
- ✓ **MRCS Part A1 and A2**
- ✓ **MRCPCH Part 1**
- ✓ **MRCPCH Part 2**
- ✓ **FRCA Primary**
- ✓ **Primary FRCR**
- ✓ **PLAB Part 1**
- ✓ **Medical Student**
- ✓ **MRCOG**

123Doc.com

ONLINE COURSES

NEGLIGENCE AND THE MEDICAL PROFESSION

J Risley



Abstract

Negligence is a term familiar to all healthcare professionals; however it is not one which is necessarily particularly well understood. It is the aim of this article to outline the basic concepts and principles underlying negligence and how that relates to the medical profession. The key cases of Bolam and Bolitho will be considered, and the standard of care and concept of 'reasonableness' will be discussed.

Key words: Negligence, Duty of Care, Standard of care, Bolam Test.

Introduction

Negligence is a term that is familiar to all doctors, indeed all healthcare professionals, however it is one that is not necessarily particularly well understood. Based on the author's experience, the medico-legal aspects and implications of negligence, along with its application to medical practice, are not covered to any great depth at either undergraduate or postgraduate level. It is the aim of this article to provide an introduction to the subject, and explain the underlying principles behind negligence as it relates to the medical profession.

Negligence is classed as a Tort, and as such forms part of the Common Law. Defining 'tort' is not simple, though can be best thought of as a 'civil wrong'; assault, battery and nuisance are other examples of tort law. The common law is the branch of law which is otherwise thought of as being 'judge made'; there is no statutory basis laid down by parliament to govern this area. It has developed on a case-by-case basis over more than 100 years, developing principles in each case which are applied and modified over time. As such, certain aspects may not be entirely clear-cut and will be open to interpretation.

For hospital doctors working in the NHS, it is relatively uncommon for an individual doctor to be pursued in an action under the tort of negligence. This is due to the principle of Vicarious Liability; this basically states that an employer is responsible for the actions of their employee. Thus an action is usually taken against the Trust for which the doctor works as opposed to the individual doctor. (1)

This has many advantages for the claimant, principally that the Trust is in a better financial position from which an award of damages can be made. In this instance most cases will be settled out of court, since it may be cheaper to do so rather than go to trial in court. If this situation arises following the action of a doctor, it does not necessarily mean that they are guilty of being negligent, merely that given all the circumstances it may be more cost effective for the Trust to reach a financial settlement out of court.

Whether or not a case is settled or goes to court, the actions of the individuals involved will be assessed to determine whether fault lies, and if so with whom. In order to establish negligence it is for the claimant (the person bringing the action) to establish that the following are present:

1. That the defendant owed the claimant a duty of care

2. That there was a breach of this duty of care

3. That there was a causal relationship between the breach of care by the defendant and the harm caused to the claimant, known as causation.

Whether a duty of care is owed, if so to what standard, and whether there was a failure to meet this standard, are more relevant to the medical professional and so will be considered in more detail below. Other aspects such as causation, and defences such as consent (volenti non fit injuria), illegality (ex turpi causa non oritur action) and contributory negligence, although important are outside the scope of this article.

NEGLIGENCE AND THE MEDICAL PROFESSION

J Risley

Does a doctor owe a duty of care?

There are a number of principles that have developed in order to establish whether or not a duty of care is owed, however in certain situations it has been recognised that a duty of care is automatically owed in law, for instance between one road user and another. The doctor-patient relationship is one such example where a duty of care is owed simply by the fact that you are the patient's doctor. (2)

What standard of care is owed?

In order to assess whether there has been a breach of this duty of care, the standard of care that is required by law must be established. This has historically been guided by the principle of 'reasonableness', with a famous example being the judgement of Alderson B in Blyth v Birmingham Waterworks Co:

'Negligence is the omission to do something which a reasonable man, guided upon those considerations which ordinarily regulate the conduct of human affairs, would do, or doing something which a prudent and reasonable man would not do'.

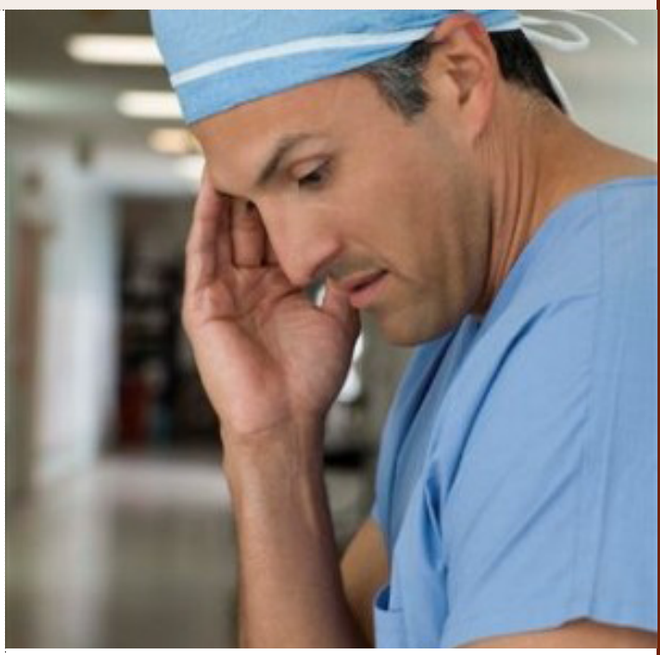
The reasonable person has been described as the 'man on the Clapham omnibus' or the 'man in the street'. Thus the reasonable person is 'average', not perfect, and therefore the court will apply an objective test when analysing the defendant's behaviour. (2)

However, in situations where the defendant professes or has a particular skill, the situation is slightly different. The standard of care applied to professionals is that of the reasonable person with the same skill or expertise, and is decided by applying the 'Bolam test'.

Two important principles arose from the case of Bolam v Friern Hospital Management Committee. In this case the claimant underwent a course of electro-convulsant therapy as a treatment for depression. The doctor failed to provide the claimant with any muscle relaxants or physical restraints and the resulting seizures led to the claimant dislocating both hips and fracturing his pelvis. The court thus had to decide whether it was negligent not to provide relaxants or restraints. The following principles were established:

1. When the defendant purports to have a special skill, his conduct is judged according to the standard of a reasonable person having the skill the defendant claims to possess. It is not judged by the standard of the reasonable lay person.

2. The law will not regard a professional defendant as having fallen below the required standard of care if it is shown that the defendant's conduct is regarded as proper by one responsible body of professional opinion.



Thus the law will not judge a surgeon performing an operation by the standard of a reasonable lay person performing that operation, but by the standard of a 'reasonable surgeon'. It was confirmed in Wilsher v Essex Area Health Authority that the standard of care expected of a professional is to be determined by considering the nature of the 'post' which they occupy and the tasks which it involves, which is to be distinguished from their 'rank' or 'status'. In this case the plaintiff was a premature baby who developed retrolental fibroplasia leaving him almost totally blind. The patient suffered hypoxia as a result of a catheter being placed in a vein as opposed to an artery, which a doctor had negligently failed to notice.

Thus if a junior doctor were filling a 'post' involving the performance of tasks usually undertaken by a senior doctor, the junior would be judged by exactly the same standards as the senior doctor. Mustill L.J held:

'To my mind, it would be a false step to subordinate the legitimate expectation of the patient that he will receive from each person concerned with his care a degree of skill appropriate to the task which he undertakes, to an understandable wish to minimise the psychological and financial pressures on hard-pressed young doctors'

The apparent harshness of this rule was mitigated slightly by the assertion in the same case that where an inexperienced doctor is called upon to perform a task in which he or she lacks expertise, it is sufficient for the doctor to discharge the duty of care to the patient if they seek and act on the advice of a more senior colleague. (2)

NEGLIGENCE AND THE MEDICAL PROFESSION

J Risley

The role of common practice and professional opinion

The second element of the Bolam test has proved controversial, in that a professional will escape liability if his conduct accords with one view of responsible common practice. In Bolam, the expert evidence demonstrated a marked difference of opinion as to the correct procedure for administering ECT with regards to the use of muscle relaxants and restraints. It was held that according to the law, a doctor will not be liable in negligence if 'he has acted in accordance with a practice accepted as proper by a responsible body of medical men skilled in that particular art', and that a professional person would not be liable 'merely because there is a body of opinion which would take a contrary view'.

This view has been controversial, since it effectively allows professions to self-regulate. If the conduct required of a doctor is to be determined, not by a judge, but by evidence of what some other doctors would do, then it can be argued that doctors are not truly answerable to their patients through the courts, because they are allowed to set their own standards of care. (2)

Thus a judge is not permitted to substitute his views for the defendants' expert witnesses, as held by Lord Scarman in Maynard v West Midlands Health Authority:

'a judge's 'preference' for one body of distinguished professional opinion to another also professionally distinguished is not sufficient to establish negligence in a practioner'

However the fact that the defendant has conformed with common practice cannot in itself be conclusive evidence that they have met the standard of care, since the common practice itself may be negligent. (2)

It has thus been held that there are situations in which a court is entitled to reject the professional opinions of the defendant's experts, as outlined in Bolitho v City and Hackney Health Authority. In this case, a two year old presented in respiratory distress, leading to a cardiac arrest and brain damage. One of the questions for the court was whether the child should have been intubated. Five of the expert witnesses for the claimant stated that in the circumstances a competent doctor should have intubated the child, however three expert witnesses for the defendant stated that intubation would not have been appropriate.

Although the judge, having listened to the experts views, as a lay person felt persuaded that intubation would have been the right course of action, he felt bound to hold that the defendant escaped liability because the failure to intubate was endorsed by one responsible party; to hold otherwise would have been to substitute his own views for the defendants expert witnesses, contrary to the Bolam test.

The House of Lords held the judge's approach as correct, however it also made it clear that in some circumstances a judge would be entitled to reject the opinions of professional experts if he felt that their opinion had no logical basis and was unable to withstand logical analysis. Therefore a doctor cannot escape liability for their conduct unless that conduct has a rational justification. (2)

Summary

It was the aim of this article to give a brief outline of the law of negligence as it relates to the medical profession. When making difficult clinical decisions, a doctor's mind will be concerned with making a safe and responsible decision, and so this article has focused more on the standard of care required by a medical professional to his patients, and how that relates to principle of negligence. More in-depth analysis can be found in the texts and cases in the references.

References

1. Law and Medical Ethics, J.k.Mason , G.T.Laurie Seventh Edition, Oxford University Press
2. Tort, Paul Giliker, Silas Beckwith Fourth Edition, Sweet & Maxwell

Corresponding Author

James William Risley, BMedSci(Hons), BMBS MRCS(Eng), DO-HNS
Speciality Doctor in Emergency Medicine,
Queens Medical Centre, Nottingham.
Email: jamesrisley1@gmail.com

123Library

www.123Library.org

Sharing **more** knowledge



What is 123Library?

FREE TRIAL from 123Library.org

123Library is a fast-growing and innovative eBook and **digital content provider** in the field of health-care.

What are the benefits for your 123Library.org?

1. Over 2,000 eBooks ✔
2. Access from any PC ✔
3. Collections available ✔
4. Pick and choose ✔
5. Secured ✔
6. Customer care ✔
7. Save money ✔
8. Available 24/7 ✔
9. Easy to use ✔

Benefit today, visit www.123Library.org

Volume 2, Issue 5

How We Can Help You Succeed?

To find out how 123Library 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

2012 Past Issues

2011 Past Issues

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