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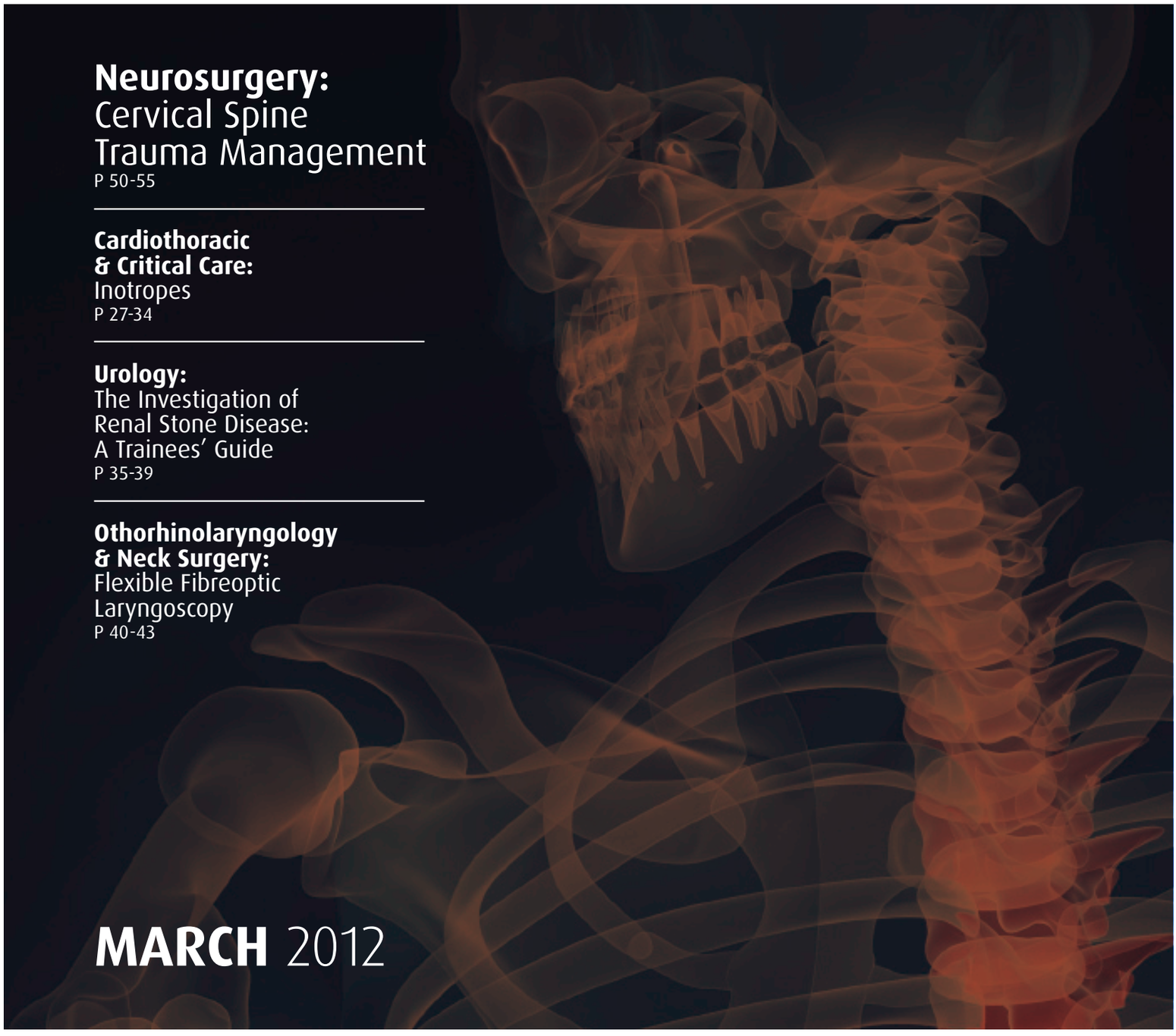
CORE SURGERY JOURNAL

Volume 2, Issue 2



MARCH 2012

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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 surgical trainees about relevant 'core' subject topics. Each issue will cover a topic from selected subspecialty fields: General Surgery, Trauma and Orthopaedic Surgery, Plastic and Reconstructive Surgery, Otorhinolaryngology and Neck Surgery, Neurosurgery, Urology, Paediatric Surgery, Cardiothoracic Surgery and Critical Care. 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. Authors are encouraged to submit articles on relevant topics to core surgical training.

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 **http://www3.imperial.ac.uk/library/subjectsandsupport/referencemanagement/vancouver/references.** References should be cited using superscript numerals 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.**

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Format of Articles

Guidelines for the format of respective article types are as follows:

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:

- 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

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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.

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 surgical trainees. We wish you every success with your submission. Please contact the editorial team with any questions.

THE POWER OF STATISTICS AND THE STATISTICS OF "POWER"; UNDERSTANDING THE BASICS OF MEDICAL STATISTICS

R Bolt

The Power of Statistics and the Statistics of "Power"; Understanding the Basics of Medical Statistics.
Back to Basics.

Abstract

This article discusses a number of the underlying statistical principles important to medical research. The aim is to introduce the reader to concepts of data classification, population parameters, sample statistics, measures of central tendency, measures of spread, confidence intervals, significance tests and their interpretation and sample size considerations. Although by no means an exhaustive text, the subjects covered should hopefully build on established knowledge and assist in both the critical analysis of published articles and in study design.

Data type	Sub-division	Features	Example
Qualitative (categorical)	Nominal	No sense of hierarchy between categories	Blue car, red car
	Ordinal	Categories have a hierarchy, but there is no scale to the hierarchy	Strongly agree/ agree/ disagree/ strongly disagree
Quantitative (numerical)	Interval	Data takes numerical form and has a scale Data can only take the form of specific values – e.g. integers	Number of goals scored in a football match
	Continuous	Data takes numerical form, has a scale, an absolute zero and can take the form of any value between two integers; recording is limited to the accuracy of the measuring instrument used	Length

Table 1: Types of Data

Introduction

Medical statistics may not seem the most enthralling of subjects to grace a clinician embarking on a career in research. However a core understanding is a prerequisite for a sound approach to both the planning, conduction and analysis of any study. This article aims to demystify common elements of medical statistics so as to help orientate those with a rudimentary knowledge of mathematics. Knowledge of basic mathematic principals shall therefore be assumed in this article, although the given references include a number of useful reviews where clarification is necessary.

Classifying Your Data

Although most readers will already know the properties of data that make it either "qualitative" or "quantitative" and the various sub-divisions therein, the correct classification of data remains the single most important consideration in how to appropriately handle results, and shall therefore be unashamedly revisited here. It is important to never lose sight of the true nature of your data – it is all too easy to incorrectly apply statistical tests to the properties of summary measures rather than to the empirical data you started with. For example, comparing the percentage of apples versus pears requires a test appropriate to qualitative data ("apples/pears"), and not quantitative ("percentage"). Table 1 summarises the main types of data a researcher may come across.(1)

Population Parameter or Sample Statistic?

Another concept that is central to the reporting and interpretation of statistical measures relates to whether we are referring to the whole population or a sample derived from that population. With the exception of census data, it is usually unfeasible to collect data from an entire population, and we therefore take what we hope will be a representative sample from it instead. A summary measure derived from sample data is referred to as a "sample statistic", and is an estimate of the true population statistic, which is referred to as the "population parameter". This is illustrated in Figure 1. Although we rarely have access to population parameters (in fact that is the reason why we have calculated the sample statistic in the first place), we can often provide measures of how accurate a sample statistic is likely to be.

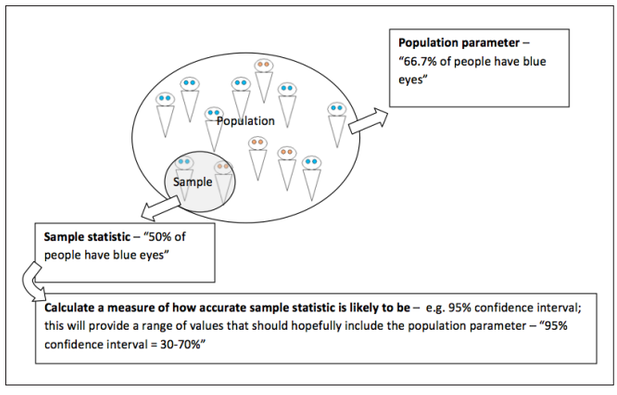

Figure 1: The Relationship Between Population Parameter and Sample Statistic

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Mean or Median?

Assuming your data is continuous, it is likely you will look to summarise your findings with a measure of central tendency (this is what we often refer to as an "average"; a value that the collected data tends to cluster around, or in other words our "best guess" of a true population average). This central measure is then commonly supplemented with a further measure of how much the collected data tends to vary from this central point ("measure of spread").

In a nutshell, the "average" that best represents numerical data will be reliant on whether the data is normally distributed or skewed. Mean is in general a useful gauge of "average", as it is contributed to by all data that has been collected. This works well when data is normally distributed. However, the mean is heavily affected if a number of extreme values lie to one side of the distribution, as is seen in skewed data. This tends to drag the mean towards these outliers and away from where the majority of data is clustering. For this very reason, median is regarded as a more useful measure wherever data is skewed. Median is less susceptible to outliers, as it is derived by arranging all measurements from lowest to highest and then picking the middle one in the list. It does not matter how extreme a few outliers are, as they do not directly contribute to the median's final value.(2) This is summarised in Figure 2.

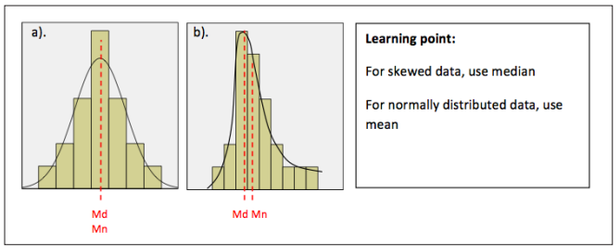

Figure 2: The Effects of Skewed Data on Mean and Median

a). Normally distributed data will have a coincidental mean (Mn) and median (Md)
b). Skewed data will not have a coincident mean and median. The mean deviates from the peak of the distribution more than the median due to outliers directly contributing to its value

Measure of Spread

The choice of a specific measure of central tendency will automatically infer that you should also be using a specific measure of spread. For the mean, standard deviation is used as a measure of spread, whereas for the median, interquartile range is generally used. This again relates to skewed data, whereby standard deviation does not account for the asymmetric shape of the distribution obtained. Interquartile range, in contrast, can have upper and lower quartiles which lie at varying distances from the median, helping to more accurately describe the asymmetry that has occurred (Figure 3).

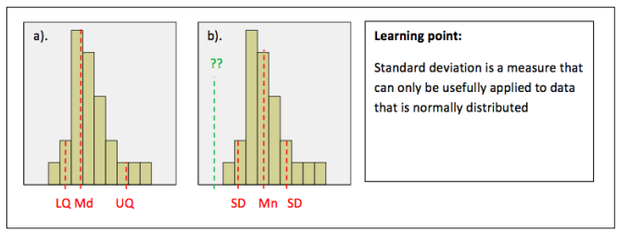

Figure 3: Interquartile Range (IQR) and Standard Deviation (SD) as Applied to a Skewed Distribution

a) Use of median (Md) and IQR to summarise skewed data. Note that the median is closer to the peak of the distribution, and that the lower quartile (LQ) is closer to the median than the upper quartile (UQ). This acts to describe the shape of the distribution.
b) Inappropriate use of mean (Mn) and SD to summarise skewed data. Note that compared to the median, the mean lies further from the peak of the distribution, and SD provides no reflection of the distribution's shape. Furthermore, 95% of normally distributed data should fall within 2 SDs either side of the mean. In the above case the point 2 SDs below the mean (green line) extends well beyond the lowest value recorded. In extreme cases of skew, even a single SD can lie outside the range in this manner.

Confidence Intervals

Confidence intervals are often used to describe how reliable a given sample statistic is in estimating a population parameter. One should always bear in mind that irrespective of where such confidence intervals lie, our best estimate of the true population parameter is always the sample statistic itself. The most common confidence interval (CI) to be quoted in medical research is the 95% CI. A simplistic way of viewing a 95% CI is that we are 95% certain that the true population parameter will be within the quoted range. This is technically incorrect, as the population parameter is a fixed number – it is the variability of the results of our experiment that introduces the uncertainty. Formal definitions of confidence intervals therefore involve describing the range of values that will include the population parameter 95% of the time we repeat the experiment. This subtle difference in the true definition is of philosophical importance rather than of any practical concern.(3)

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There is a very good reason why 95% CIs are usually quoted. Significance tests generally look for less than a 5% probability of results having occurred by chance should the null hypothesis be correct ("P < 0.05"). This is essentially saying that we are willing to accept that approximately 1 in every 20 results concluded to be statistically significant has in fact occurred by chance. 95% confidence intervals can be used in an analogous manner; if the results of a study show that two separate groups produce sample statistics with 95% confidence intervals that do not overlap, we have in doing so demonstrated that there is less than a 5% chance the groups are the same. We can therefore conclude that the groups are statistically different. This is illustrated in Figure 4a. Similarly, if we are looking to see whether a drug has any effect, demonstrating confidence intervals that are exclusive of an effect of zero is the same as saying that there is a statistically significant result (Figure 4b). A final point worth noting is that the wider the range of values covered by a confidence interval, the less precise is our estimate.(4)

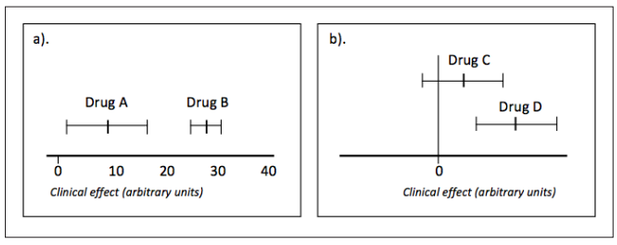

Figure 4; Practical Uses of the 95% CI

a) A statistically significant difference is demonstrated between 2 drugs. Assuming the vertical bar in bold represents the mean effect of drugs A & B, with horizontal lines representing the range of values contained within the 95% CIs for each drug, we can surmise that we are 95% confident that the drugs have a different level of effect.
b) Drug C has a 95% CI that includes zero. Although our best guess is that drug C has a weakly positive clinical effect (bold vertical bar is greater than zero), the results of the study suggest that the weak effect seen is not statistically significant. That is, we have little confidence that Drug C truly has any clinical effect. In contrast, Drug D has a 95% CI that does not include zero; we consider the observed effect of this drug to be statistically significant.

Calculating Confidence Intervals

Confidence intervals can be calculated for a range of sample statistics. A single example, perhaps the most useful, shall be illustrated here; the 95% CI of the mean. To derive this interval, it is important to have calculated the following two values:

(i) Sample mean
(ii) Standard error (derived from standard deviation)

It is relatively common knowledge that, in a normal distribution, 1.96 standard deviations either side of the mean will contain 95% of all data. In a similar manner, we can consider that 1.96 standard errors (SE) either side of the population mean will contain 95% of all estimates we make (all of which contain a small amount of *error*) of the true population parameter. Remember though, we are actually applying this process to a sample statistic rather than the population parameter, which contributes to the slight confusion with the definition of CIs discussed above.

Therefore;
95% CI upper limit = mean + 1.96 SE
95% CI lower limit = mean – 1.96 SE

Hypotheses and Hypothesis Testing

Hypothesis testing is fundamental to the underlying philosophy of science. To try and prove a theory (e.g. "the moon is made of cheese") by its advocates selectively drawing evidence to support that theory (e.g. "the moon is yellow, just like cheese") is a mark of pseudoscience. The adoption of a pseudoscientific "theory confirmation approach" adds nothing to the progress of true knowledge and fails to test a theory to see if it is really true. Science addresses this problem by adopting the assumption that a new theory is incorrect unless there is proof to the contrary (e.g. "the moon is not made of cheese". This forms the basis of the "null hypothesis" (H0); a "default" position that is devoid of bias or polarity. This approach naturally draws us to search for experiments that act to disprove the null hypothesis in order to demonstrate what we truly expect to be reality. Instead of adding to a body of dubious confirmatory evidence (e.g. "if you look carefully at the moon you can see what appear to be holes"), we will naturally search for "extreme" measures of experimentation that may revolutionise our current beliefs (e.g. assessment of the chemical composition of lunar samples to demonstrate presence of caseins).

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Disproving the null, H0 ("there are no caseins in lunar samples") will lead us to adopt an alternative hypothesis, H1 ("there are caseins in lunar samples") – which is now consistent with the theory we had set out to demonstrate ("the moon is made of cheese"). Please note that the moon is not made of cheese.

The null hypothesis commonly applied to medical research is that there is no beneficial effect of a specified therapy. In order for us to demonstrate the efficacy of a drug or surgical technique, we must therefore prove the contrary. This usually involves comparing the new treatment to a control group; H0 (the null) will be "there is no significant difference between treatment and control groups", and H1 (the alternative) will be that "a significant difference exists".

Significance Testing

The choice of which statistical test to use in analysing differences between two groups of data relies on three main things:

(i) The type of data (numerical, ordinal or nominal)
(ii) Whether the data is paired or unpaired
(iii) Whether the data, if numerical, follows a normal distribution

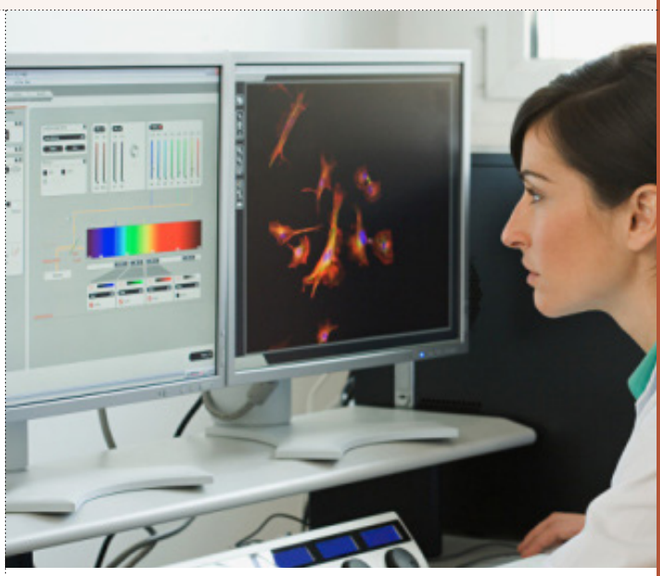
Table 2 summarises which tests are considered appropriate to each of these qualities(5):

Data Type	Distribution	Paired?	Test to Use
Numerical	Normally distributed	Paired	Paired T-test
		Independent	Independent T-test
	Not Normally distributed	Paired	Wilcoxon matched pairs test
		Independent	Mann-Whitney U-test
Ordinal	Not relevant	Paired	Wilcoxon matched pairs test
		Independent	Mann-Whitney U-test or Chi-squared
Nominal	Not relevant	Paired	McNemars if data is binary
		Independent	Chi-Squared

Table 2: Flow Chart for Choosing the Correct Statistical Test

All of the above statistical tests will ultimately return a "P-value". The P-value refers to the probability of the observed result or one more extreme occurring, *should H0 be correct*. The italicised part of this statement is important. If H0 was not correct, then in fact the probability of the observed result or more extreme would be much higher, as we would expect to find a significant difference.

It should be borne in mind that if we drew data twice from the same group and compared the two samples, there would likely be a small difference. For example, consider picking 5 children out of a classroom at random and measuring their height, then comparing the results to the height of another 5 children picked out of the same class at random. The important thing is that the difference seen is unlikely to be statistically significant when tested. What we are essentially saying with a statistical test is; "if the groups are in fact the same, what is the probability we would find the difference we have observed?" – if the answer is "high", then we can conclude that there is a high likelihood that the observed differences are due to the play of chance alone.



So, what is the relevance of P<0.05 in statistical tests?

In reality, there is no relevance of a P-value of 0.05. Just read that statement again – there is no relevance of the value 0.05. This value has been arbitrarily set as the threshold to which we accept or reject a hypothesis – no more, no less. This statement helps conceptualise what a P-value of 0.055 means. The dogmatic of us will consider this as "no significant difference", period. However, the reality is that a P-value of 0.055 reflects a probability very similar to 0.05; it has merely failed to reach the arbitrary threshold that has been set. Indeed, a P-value of 0.055 is more significant than 0.10, and in turn this is far more significant than 0.25.

It is therefore acceptable to regard P-values that fall slightly short of the agreed threshold of 0.05 as weakly significant. We still accept the null hypothesis as there is not enough evidence to reject it, but we may wish to remain open to the possibility of a difference existing. In general, a value of less than 0.10 is considered weakly significant, although to also use this value dogmatically is as flawed as being inflexible with the threshold of 0.05 in the first place. The pragmatic solution to managing a weakly significant result is to consider repeating the study with a larger sample. This will not only be more likely to return a statistically significant result if one truly exists, but will also return a more accurate estimate of what this difference really is.(6) The only caveat with the above approach is that *in extremis,* taking a large enough sample will almost guarantee returning a P-value that confirms a statistically significant difference between two groups, even if the groups are in reality very similar. However, in such circumstances the observed difference will be tiny, and another important factor then comes into play – what is a *clinically* significant difference? This can only be gauged in the context of what the study is investigating.

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Power & Sample Size Estimation

Sample size estimation is perhaps the most useful mathematical tool for predicting the resources that will need to be thrown at a study to make it statistically robust. The sample size estimate itself will tell you how many repeat measurements you will have to take, and may help you decide whether it is even feasible to collect the amount of data required to undertake the study at all. Sample size estimates take into account the degree of error we are willing to accept, described in terms of two probabilities, "α" and "1-ß".

We have already visited α in the above discussion of P-values; it is the probability of a "Type I error" – the chance of concluding the presence of a statistically significant difference when one does not really exist; our "P=0.05". ß is the converse of this – it is the probability of us not accepting H1 when a statistically significant difference really does exist ("Type II error"). 1-ß therefore represents the probability of us correctly accepting H1 when a statistically significant difference exists, and is also known as "power". ß is generally set at either 0.20 or 0.10 – this begs the question; why are we more willing to miss confirming a statistically significant result (ß=0.20) than we are to wrongly say there is a significant difference (α=0.05)? The answer to this lies in the action we take in response to accepting H1 – if a study wrongly found a drug to be significantly better than the current standard, we would all start using the new drug, which could be catastrophic. In contrast, if a study wrongly found a new drug to be of no benefit over our current standard, we would continue to use our current standard. Although we may have missed some additional benefit, at least there has not been a huge change in infrastructure to no avail.

Two of the most commonly used equations for sample size estimation are illustrated below. Both calculations rely on us having some estimate of certain values related to the property or measure we are investigating. This may be on first glance an easy thing to achieve, but unfortunately the reason for conducting most studies is that these values are not yet known. We therefore very often resort to using a combination of (i) values that we would be interested in for the research to be of clinical significance, and (ii) values from previous studies or pilot data.(7)

Sample size calculation for comparing 2 groups, continuous data

$$n = \frac{2\sigma^2 \left(Z_{\frac{1-\alpha}{2}} + Z_{1-\beta}\right)^2}{\delta^2}$$

Where:

n = number of measurements required per group
σ = standard deviation
δ = difference between the two groups
Z = Z-value for item written in subscript
α = Type I error
β = Type II error

As α and ß are predetermined (commonly 0.05 and 0.20, respectively), the Z-values in the equation will usually be the same. This allows the equation to be reduced to something far more manageable. For a significance level (α) of 0.05 and power (1-ß) of 80%:

$$n = \frac{16\sigma^2}{\delta^2}$$

For example, if we have a study looking at the effects of a drug on blood pressure, we may state that the minimum change in systolic blood pressure we would like to see for the drug to be considered as clinically effective is 10mmHg. We could then search the literature to see whether there was any data to provide us with an estimate of the standard deviation seen in blood pressures (we have to assume treatment and control groups would have the same standard deviations) – this may be, for example, 20 mmHg. The number required per group is therefore $(16 \times 20^2)/(10^2) = 64$; we would have to enrol 64 patients into a "treatment group", and a further 64 patients into a "control group".

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Sample size calculation for comparing 2 groups, proportions

Sometimes we become interested in binary measures. For example, people testing positive or negative to a disease. For this type of data, we can use the proportion of people in each group demonstrating the measure of interest so as to estimate sample size. Again, we are usually undertaking the study to actually find this figure out. We may therefore resort to describing the proportion we would be interested in for the test group to be considered clinically different to an already-known proportion occurring in the control group. Alternatively, we may do a pilot study beforehand to give an estimate.

For an α of 0.05 and power of 80%;

$$n = \frac{8[\pi_1 (1-\pi_1) + \pi_2(1-\pi_2)]}{\delta^2}$$

Again, the above equation is a reduction from a larger equation using Z-values. π1 denotes the proportion of data in Group 1 that is of the category of interest (e.g. proportion of people in a test group that return positive for a disease), and π2 denotes the proportion of data in Group 2 (e.g. the proportion of people in the control group that return positive for a disease). As with the equation for continuous data, δ represents the difference between these two proportions (i.e. π1 – π2). (8)

Conclusion

It is essential that a medical researcher is able to apply statistically robust methodology throughout the course of any study, be it laboratory-based or clinical trial. A sound approach incorporates a clear understanding of the type of data that is being handled (quantitative or qualitative), estimation of the sample size needed to ensure the study is suitably powered, and is followed by appropriate data interpretation, analysis and use of summary measures.

Questions

1. What type of data is presence or absence of disease, and which statistical test would be appropriate to comparing the prevalence of osteoarthritis in obese versus non-obese patients over the age of 65?

a) Continuous, T-test for independent samples
b) Continuous, Paired T-test
c) Ordinal, Mann-Whitney U-test
d) Nominal, McNemars test
e) Binary, Chi-Square test

2. Which of the following is the most appropriate summary measure for how long cancer patients survive post-surgery?

a) Mean survival time
b) Median survival time
c) Modal survival time
d) Significance level of a paired T-test
e) Significance level of an independent samples T-test

3. 1.96 standard errors either side of a sample mean includes

a) 90% of all data collected
b) 95% of all data collected
c) The population mean 95% of the time the experiment is repeated
d) The mean, median and mode
e) 95% of all data within the population

4. Two drugs used in the management of hypertension are compared in a single study. The authors perform an appropriate statistical test, which shows that there is a significant difference between the two drugs. They also calculate the mean effect size for each drug, along with 95% confidence intervals. What can we already deduce about the research?

a) Only one of the drugs will have a confidence interval that includes zero
b) The confidence intervals will not overlap
c) The confidence intervals will always overlap
d) Both of the drugs could still potentially have a confidence interval that includes zero
e) The research confirms only the more effective drug should now be prescribed

5. The sample size required for a suitably powered study of children being born prematurely in Indian versus Caucasian families is influenced by:

a) The magnitude of the Standard Deviation
b) The difference in mean gestational age at birth
c) The estimated proportion of premature births in Caucasians
d) The accuracy of how we measure gestational age
e) Whether we have access to enough data

THE POWER OF STATISTICS AND THE STATISTICS OF "POWER"; UNDERSTANDING THE BASICS OF MEDICAL STATISTICS

R Bolt

Answers

1. e)

Presence or absence of disease is a sub-type of nominal data referred to as "Binary". Binary data can only take 2 possible forms, such as "yes" or "no", or in the case of computing "1" or "0". As disease must be either present or absent from every case studied, the data is binary. The study also involves independent samples – the amount of disease in obese patients is independent of the amount of disease found in the non-obese group; this explains why answer d) is incorrect; McNemars test is appropriate to paired data.

2. b)

Cancer survival is skewed data. One would hope only a few patients would be expected to die within a short period post-op, whereas a number of patients will survive their cancer and live for many years. This hopefully illustrates the anticipated shape of the distribution of survival time – it is positively skewed. Median is a suitable average for summarising skewed data, and therefore is appropriate here. Note that the answers d) & e) are incorrect for a number of reasons. First and foremost, we are referring to a descriptive study. There is only a single group and significance testing is therefore impossible. Secondly, the skewed distribution precludes the use of the tests suggested.

3. c)

1.96 standard errors either side of the sample mean is the range of values that comprise the 95% confidence interval of the mean. This is far less than the amount of data covered by 1.96 standard deviations. As discussed in the article, the 95% confidence interval of the mean will include the population mean 95% of the time the experiment is repeated. As a footnote, the reason for d) being incorrect is that the mode is defined as the measurement that has occurred most frequently. This has potential to be outside the range that comprises the confidence interval of the mean, and may even be an outlier in exceptional circumstances.

4. b)

This scenario is illustrated in Figure 4a. The significance test tells us that there is less than a 5% chance of the data having occurred by chance if the null hypothesis is true. This is also the case if 95% CIs do not overlap; hence b) is the answer. It is impossible for both drugs to have confidence intervals that include zero, based on the fact that we have already established the confidence intervals do not overlap – d) is therefore incorrect. Both drugs could still be effective, and so a) is not necessarily correct. The answer e) would require far more information. We would need to know cost-efficacy, whether the drugs can be co-prescribed and the side-effects profile of each drug to name just a few.

5. c)

The description of the study infers that we are looking at proportions for the binary outcome measure of premature versus term births. Considerations relating to continuous data are therefore not appropriate, excluding possible answers a), b) and d). Although answer e) is an important factor in whether we consider a study feasible, it will not influence the sample size required for a suitably powered study – it will just tell us whether this size is achievable.

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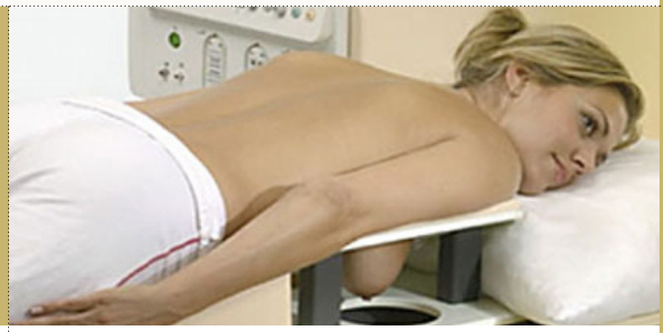
TRIPLE ASSESSMENT IN BREAST CLINIC

Z Barber and T Dobbs



Triple assessment in breast clinic. General Surgery.

Clinical vignette

A 65-year old non-smoker is referred by her General Practitioner to Breast clinic with a 1cm centimetre lump in her left breast. She noticed it whilst showering and is not sure how long it has been there for. She has not found any lumps elsewhere. She denies any pain, skin changes, nipple changes or discharge associated with the lump. She is post-menopausal, has 2 children, the first of whom she had aged 27, both of whom she breastfed. She has not used HRT but took the oral contraceptive pill for a period of 10 years. She is otherwise fit and well, taking no medications. She has no family or personal history of breast or ovarian disease.

She undergoes triple assessment. You are able to palpate a lump and she has no other clinical signs of breast or axillary disease. Mammography demonstrates a mass and suspicious area of calcification in the upper outer quadrant of the left breast. Her axilla ultrasound was normal and an ultrasound-guided core biopsy of the lesion shows it to be an invasive ductal carcinoma. She subsequently undergoes wide local excision of the carcinoma with concurrent sentinel node biopsy, which is negative. The histology comes back as T1N0M0 ER/PR positive, HER2 –ve. She is treated with post-operative radiotherapy and hormone therapy.

Introduction

Breast cancer affected more than 47,000 women in the UK in 2010 (1) and is the most commonly-diagnosed cancer in women in the UK, accounting for 31% of female cancers diagnosed each year.(2) Multidisciplinary Triple Diagnostic Method, or Triple Assessment, refers to the diagnostic assessment of patients presenting with breast symptoms using history and clinical examination, imaging and tissue sampling. All three should be carried out at the same clinic attendance.(2) The results of Triple Assessment should then be discussed at a multidisciplinary team (MDT) meeting, with each element being considered to ensure the correct diagnosis. If there is discordance between the separate elements of Triple Assessment, further investigation, including repeat biopsy, should be considered.

This article describes each of the three elements of Triple Assessment of patients presenting with breast symptoms and the evidence behind them.

Clinical assessment

History

History-taking in women presenting to the breast clinic concerns three main areas: the symptoms and lump itself, risk factors for breast cancer and patient concerns.

Risk factors for breast cancer may be hormonal or genetic, and other independent risk factors have been identified.

Hormonal risk factors were first characterized in 1982, comparing 1,185 women with breast cancer to 3,227 controls.(3) Young age at first birth is protective, whilst having a late age at first birth is associated with a higher risk of breast cancer than nulliparity. Increasing parity reduces risk independently of age at first birth. Early menarche and late menopause also increase risk. This is thought to be due to increased oestrogen exposure and, since, there has been extensive discussion relating oral contraceptive pill (OCP) and hormone replacement therapy (HRT) use with breast cancer.

A meta-analysis of 54 studies relating OCP use with breast cancer showed a slightly increased risk in recent or current OCP users (RR 1.07-1.24) versus women who have never used the OCP.(4) The evidence regarding HRT use is equivocal, with most data coming from observational studies.(5) However, a recent review, looking at the single large-scale randomized controlled trial into HRT use and breast cancer shows an increased incidence of breast cancer with prolonged use of combined oestrogen and progesterone HRT.(6)

Several genetic mutations have been identified as causing breast cancer(7,8) including BRCA-1 and BRCA-2. Both are single-gene mutations responsible for inherited breast cancer in pre-menopausal women. Testing is available for each in high-risk women, either at diagnosis of breast cancer in pre-menopausal women, or in those with a known family history of BRCA-positive disease. However, many familial breast cancers have not been linked to a single gene and research continues to identify further genes involved in familial breast cancer with the hope of being able to offer genetic testing to quantify breast cancer risk in the future.

Independent risk factors for breast cancer include smoking, increased alcohol intake, and obesity, Incidence is also higher in Jews and the more affluent.(3)

TRIPLE ASSESSMENT IN BREAST CLINIC

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Triple assessment in breast clinic. General Surgery.

Hormonal	*Non-Hormonal*
Early menarche/late menopause	Age
Nulliparity	Obesity
Not breastfeeding	Alcohol
Oral contraceptive pill use	Family history of breast cancer
	Affluence
	Jewish background

Table 1: risk factors for breast cancer

Clinical Examination

Clinical examination by a health professional involves examination of both breasts and nipples, axillae and supraclavicular fossae. Abnormalities should be compared with the contralateral side. Any lump should be characterized according to site, size, surface, consistency, tethering (to overlying skin or underlying pectoralis major muscle), and associated skin or nipple changes. The importance of triple assessment is that clinical examination is considered in combination with imaging and tissue sampling. Reassuring clinical examination is not a reason to reassure and discharge a patient without imaging and/or tissue sampling.

In 2008, a Cochrane review of the evidence for self-examination and clinical examination in the detection of breast cancer reviewed two large-scale trials with conflicting results.(9) Population-based studies from Russia and Shanghai involving a total of 388,535 women were analysed. The Russian study showed greater detection of breast cancers in the self-examination group versus a no-intervention control group, which was not reproduced in the Shanghai study. Neither trial showed a difference in breast cancer mortality and both studies showed an increase in biopsies and detection of benign breast disease in the self-examination group. It has therefore since been recommended that women are 'breast aware', i.e. aware of breast changes, rather than regularly self-examine.

Imaging

Imaging of the breast plays an important role as part of the triple assessment of a breast lump. It is also used as part of the national screening programme for breast cancer. The two most commonly used imaging modalities when assessing a breast lump are mammograph and ultrasound, however magnetic resonsance imaging (MRI) has specific clinical indications.

Screening

The UK operates a national breast cancer screening programme that invites all women over the age of 50 years to have a mammographic assessment of the breast every 3 years. This programme is currently being extended to include all women between the ages of 47 and 73 years old, the aim of completion being 2016.(10) A study published in 2010 looking at the Swedish Two-County trial and the UK Breast Screening Programme showed that between 2 and 2.5 lives are saved for every overdiagnosed case and therefore mammographic screening for breast cancer does more good than harm.(11)

Figure 1
A patient undergoing mammography.

TRIPLE ASSESSMENT IN BREAST CLINIC

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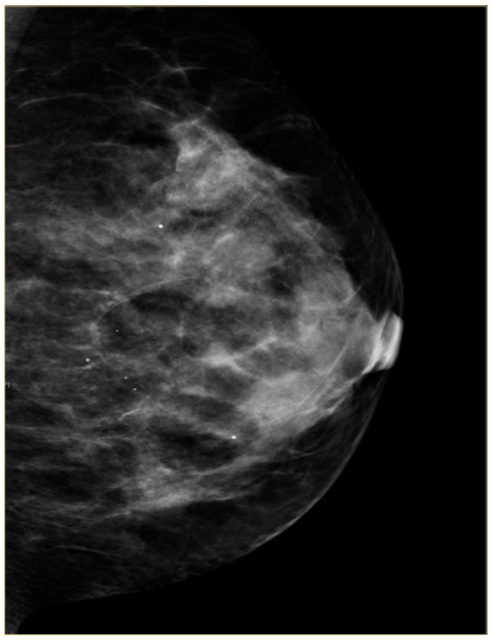

Figure 2
A mammogram displaying microcaicification involved within a maligant tesion.

Mammography uses low energy x-ray to image the breast tissue. It has been the mainstay of breast imaging for many years and is currently the first line imaging modality for patients over the age of 35 years as well as being used in the national screening program.

In order to obtain the best quality pictures possible the breast is compressed between two parallel plates in order to even out the thickness of the breast tissue and prevent motion blur by holding the breast still. Two views are taken, a craniocaudal and mediolateral oblique.

Standardised reporting of mammography and ultrasound is according to the National Breast Screening System (NBSS) in the UK, and the American College of Radiology's Breast Imaging Reporting and Data System (BiRADS) in the US and some parts of Europe.(12) NBSS is a five-point scale (from 1-5) (table 1). Interestingly, in M3/U3 lesions, the BiRADS recommendation is radiological follow-up every 6 months for 1-2 years, rather than further investigation in the form of tissue sampling, which is recommended by NBSS and NBCC (the Australian National Breast Cancer Centre).

M1	U1	Normal/no significant imaging abnormality
M2	U2	Benign imaging findings
M3	U3	Indeterminate/probably benign findings
M4	U4	Findings suspsicious of malignancy
M5	U5	Findings highly suspicious of malignancy

Table 2: NBSS imaging classification. M=Mammography; U=Ultrasound.

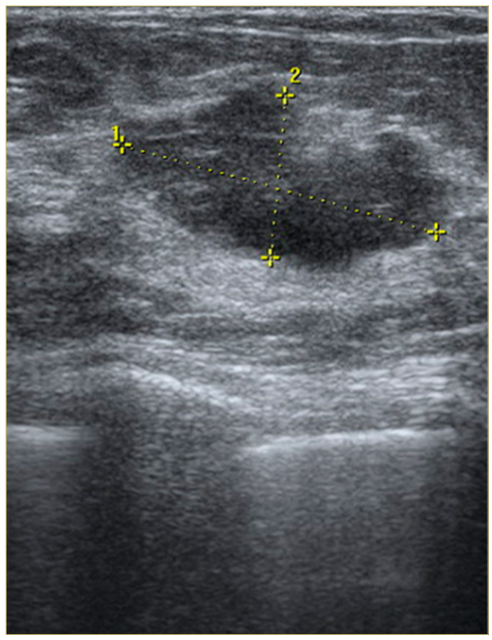

Figure 3
A breast ultrasound showing a potentially maligant lession.

Ultrasound is currently the imaging modality of choice when assessing a breast lump in women less than 35 years of age. This is because the young breast is much denser in nature and as such mammography provides less reliable results. It has now become part of routine screening to perform an ultrasound of the axilla.

A recent advancement in the use of ultrasound has come in the form or automated whole-breast ultrasound (AWBU). This technique is being evaluated as a method of allowing ultrasound to be more easily used as a screening tool. It has been shown to be both specific and sensitive and due to its operator independence and ability to image the whole breast could prove to be a very useful screening tool.(13)

TRIPLE ASSESSMENT IN BREAST CLINIC

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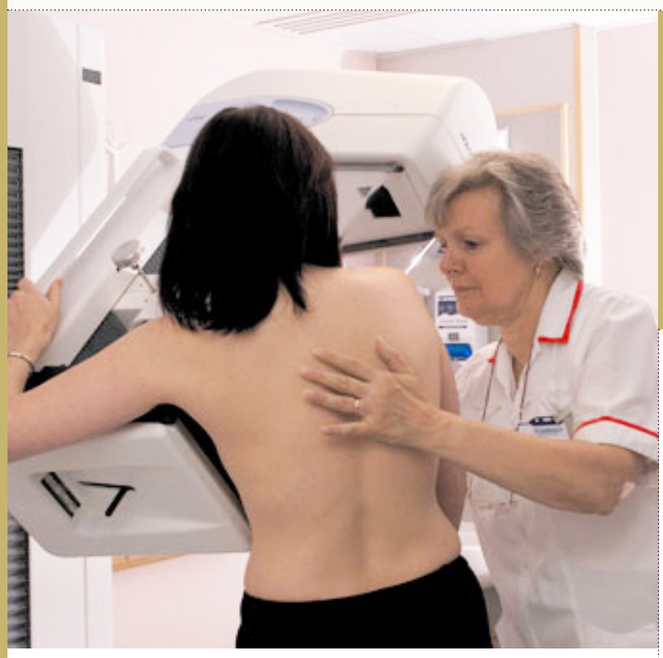

MRI

Magnetic resonance imaging (MRI) produces images of the body by using a magnetic field to align protons in the water molecules contained within tissues. When the magnetic field is released these protons return to their original state and release energy of varying degrees which can then be measured and used to construct a picture.

While MRI does not have a mainstream use in all women who are undergoing breast screening or investigation of a breast lump, it does have some specific indications:

- Screening of women who have a high risk of breast cancer, such as those who are BRCA positive. MRI screening can begin at a much younger age than with normal screening programmes.
- For the evaluation of multifocal disease, and contralateral disease especially in lobular carcinoma.
- Evaluation of recurrence around the site of a previous wide-local excision or axilla. MRI makes it easier to determine whether changes seen on mammogram are due to surgical scarring or recurrence of disease.

Gadolinium-based contrast enhanced MRI scans have been shown to have a high sensitivity for detecting breast cancer in high-risk asymptomatic and symptomatic women.(14)

A study carried out in 22 centres in the UK that looked at 649 women who were considered to be high risk for developing breast cancer (>25% lifetime risk) showed MRI to have a sensitivity and specificity of 77% and 81% respectively when compared to mammography of 40% and 93%.(15)

Triple assessment in breast clinic.
General Surgery.

There are, however, disadvantages with MRI that prevents its widespread use in breast disease, namely cost and investigation time and therefore it is used only in certain cases and not as a screening tool.

Tissue diagnosis

Accurate tissue diagnosis of a breast lump is vital in preoperative planning and directs therapy. Fine needle aspiration and core biopsy are the two mainstream techniques adopted to obtain a sample. Either can be under ultrasound or mammographic guidance or, more recently, under MRI guidance. Both have advantages and disadvantages, summarized in table 1.(16,17,18)

A key drawback with both techniques is that they might not sample the lesion, giving a falsely reassuring result of normal breast tissue. It should be remembered that if a lump is palpable and visible with imaging, it is not normal breast tissue and therefore any cytology or histology suggesting this should be viewed with suspicion and a repeat sample taken. This further emphasises the importance of Triple Assessment to ensure accurate, sensitive and specific evaluation of any breast lump.

Fine needle aspiration	
Advantages	*Disadvantages*
Quick	Higher inadequate sample rate
Less painful	Cannot assess invasion vs *in-situ* disease
Widely available	Low accuracy in papillary lesions
Requires minimal training	Interpretation depends on pathologist
Fewer complications	
Core biopsy	
Advantages	*Disadvantages*
Lower inadequate/suspicious results	Requires training/experience
Allows additional testing (e.g. HER-2)	More painful, requires local anaesthetic
Confirms invasion	Cannot predict invasion in *in-situ* disease
	Requires specialist equipment
	Not suitable for difficult/superficial sites

Table 3: fine needle aspiration vs core biopsy in breast lumps

TRIPLE ASSESSMENT IN BREAST CLINIC

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Summary

Triple Assessment of breast lumps refers to clinical (history and examination), radiological (mammography or ultrasound or both) and tissue (fine needle or core biopsy) investigation of breast lumps in secondary care. NICE recommendations are that each element is performed during the same clinic visit. The evidence underlying each element has been discussed along with advantages and disadvantages of each.

Questions

1. A 50 year old woman was seen in the breast clinic with a painful lump following trauma one week ago and has returned for her results. The lump is still there. Imaging and FNA suggest that it is a resolving haematoma. What is the most appropriate next step in management?

a) Reassure and discharge to GP
b) Repeat imaging today
c) Repeat FNA today
d) Review in clinic in 4-6 weeks with triple assessment
e) Repeat triple assessment today

2. Which of these is NOT a benefit of FNA (fine needle aspiration) over core biopsy?

a) It is quicker
b) It is cheaper
c) It is less painful
d) It requires minimal training
e) It enables detailed histology

3. Which of the following genetic mutations is NOT associated with breast cancer?

a) MENIN on chromosome 11
b) BRCA 1
c) BRCA 2
d) FAP on 5q21
e) BRCA A

Answers

1. d)
This patient has a persisting lump, which may be a resolving haematoma, but which needs a clear plan for follow-up with repeat triple assessment.

2. e)
Fine needle aspiration allows cytological analysis but not histological analysis.

3. e)

BRCA A is not a genetic mutation

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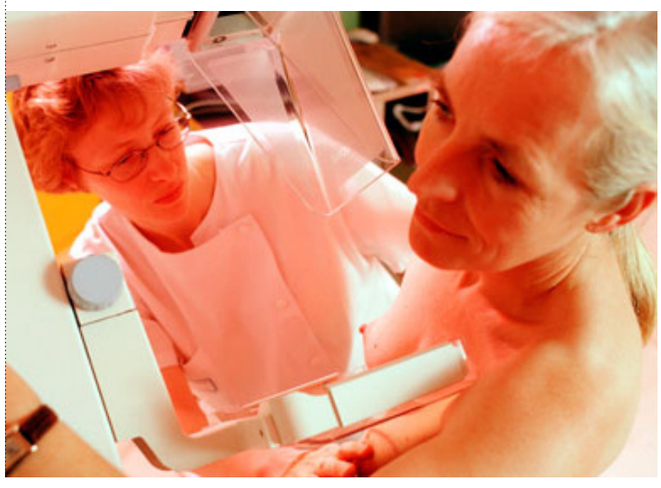
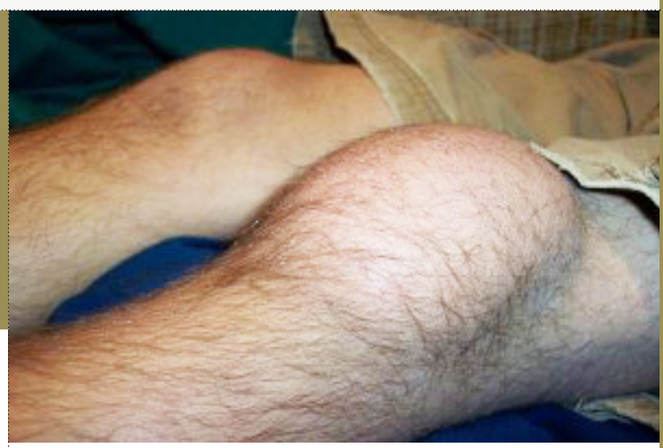


SEPTIC ARTHRITIS IN THE KNEE

P Kodumuri

Septic Arthritis in the Knee.
Trauma & Orthopaedic Surgery.



Introduction

Septic Arthritis or infectious arthritis is a condition with severe complications and a high mortality rate (10-16%) (5,14) even with the use of antibiotics. It is inflammation of a joint secondary to infection due to pathogenic inoculation of microbes (usually bacteria) or to haematogenous spread.

The incidence in Europe and the USA is reported to be upto 7.8 per 100,000 (1,2,3). Patients with prosthetic joints have a higher incidence rate (1 – 2%) depending on the type of the joint. (21) Early diagnosis and immediate treatment should be started as delay can lead to rapid and irreversible damage to articular surface. (17)

This article deals with a medical overview of this condition including diagnostic workup and management options available based on the best clinical practice with a focus on the septic arthritis in the knee as this is the most commonly affected joint. (4,5)

Presentation

The typical presentation is a red, hot and swollen joint with decreased range of movements. The onset can be acute or gradual (in prosthetic joints and Tuberculosis infections) with worsening and constant pain. In the knee, patient complains of being unable to weight bear. The patient may have systemic features of infection such as pyrexia and tachycardia. However, absence of pyrexia does not rule out septic arthritis. (10) It is important to establish any significant background history as there are several associated risk factors with Infectious arthritis such as previous joint disorders like Rheumatoid or Osteoarthritis, Diabetes, IV drug abuse, prosthetic joints, cutaneous ulcers and intra-articular corticosteroid injection.(3,6,7,8)

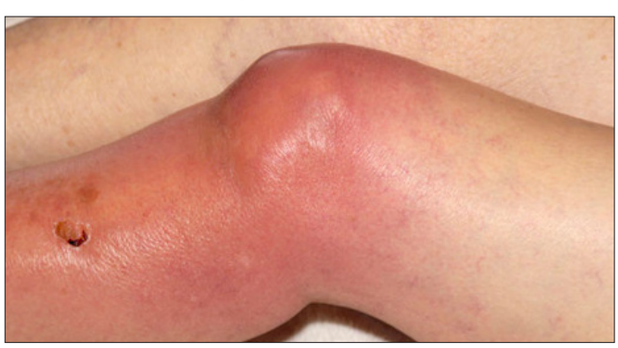


Fig 1

Investigations

The role of clinical suspicion in diagnosis of septic arthritis cannot be overemphasized. Systematic review performed by CJ Matthews et al found that no investigation is more reliable than clinical diagnosis of an experienced doctor.9 The next reliable test is analysis (gram stain) of synovial fluid aspirated from the knee. In prosthetic joints, the aspiration is performed under sterile conditions (in operating theatre) to minimize a risk of introducing infection during aspiration. Other inflammatory indicators such as CRP, ESR, and White cell count are important. However, their accuracy is variable.(25)

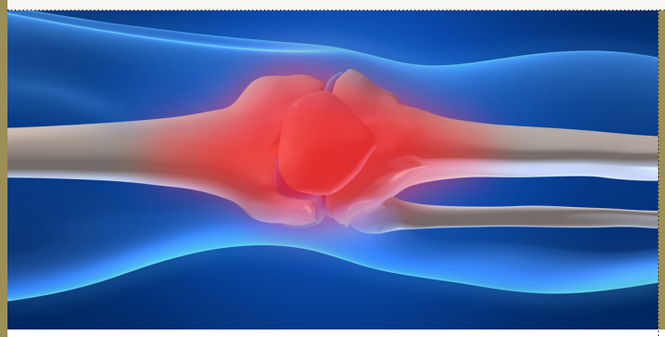
Elevated WBC (more than 10,000/uL) has a reported sensitivity of 90% and specificity of 36%. Elevated ESR (more than 30 mm/hr) has a reported sensitivity of 95% and specificity of 29%. Elevated CRP (more than 100 mg/L) has a sensitivity of 77% and specificity of 53%.(18) They also serve as good prognostic indicators of treatment if performed serially. In children a combination of positive Gram staining, elevated CRP, ESR, pyrexia and inability to weight bear have been reported to have a positive predictive value of 98%.(19) Blood cultures should be taken. A plain radiograph of the knee joint (AP and lateral) helps to assess any underlying joint pathology and is recommended as a baseline test. MRI scan is useful to investigate osteomyelitis in cases refractory to standard treatment.(10)

Technique of fluid aspiration (Arthrocentesis)

This procedure needs to be carried out under aseptic precautions. Warfarin is not a contraindication for joint aspiration.(10) With the patient either supine or sitting up, the knee is prepared with antiseptic and draped adequately. A towel can be placed under the knee to facilitate patient comfort and slight flexion which helps with aspiration. A long white needle along with 30-50 mL syringe is used for arthrocentesis. 2 mLs of local anaesthetic can be used to infiltrate the skin, but is not always required. Palpating the border of the patella, the needle is inserted either medially or laterally aiming for the joint space between the under surface of the patella and the distal end of the femur. Fluid is then aspirated as much as possible as this often helps with pain. The synovial fluid thus aspirated is sent off for urgent Gram's staining, microscopy and culture. Synovial White cell count is found to lack sensitivity in ruling out septic arthritis.(24)

SEPTIC ARTHRITIS IN THE KNEE

P Kodumuri



Septic Arthritis in the Knee.
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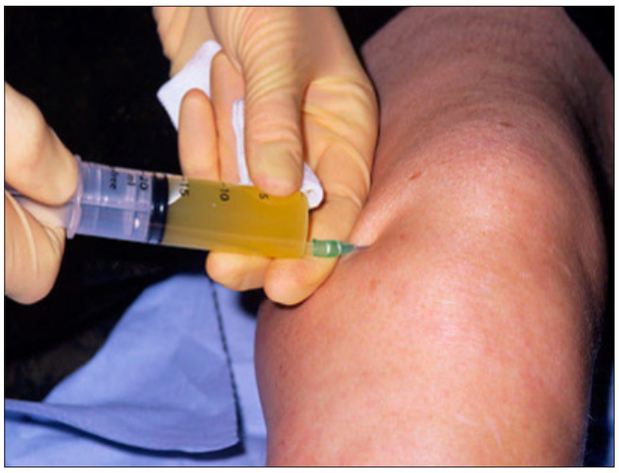

Fig 2

Fig 3

Differential Diagnosis

Condition	Distinguishing Feature
Osteoarthritis	Often has background history of chronic knee pain and stiffness
Rheumatoid Arthritis	Other joints involved (symmetrical distribution)
Gout	History, urate crystals on synovial fluid analysis
Pseudogout	Calcium pyrophosphate crystals in synovial fluid
Haemarthrosis	Trauma, frank blood on aspiration, bleeding diathesis in history
Cellulitis	No fluid or straw coloured fluid from joint aspiration
Bursitis	Localised swelling, joint movements normal, none or straw coloured fluid from aspiration

Management

After synovial fluid aspiration, the patient should be started on empirical antibiotics depending on the hospital protocol until the culture and sensitivity results are available. There are guidelines in place regarding the empirical antibiotics issued by the BSR, BOA, BSHR, BSAC and RCGP if in doubt.(10) Previously, Gonococcal arthritis was most commonly reported.(11,12) More recent studies in Europe have shown Staphylococci and streptococci to be commonly involved (91%).(9,13,18)

The current evidence behind medical versus surgical management of patients with septic arthritis in native joints suggests that patients who do not respond to repeated aspirations and Intravenous antibiotics under physicians should be referred to Orthopaedic team for surgical intervention.(15,16) However, the strength of studies supporting this hypothesis is weak. A systemically unwell patient is more likely to have a surgical intervention to decrease the infected load. Best practice involves orthopaedicians, rheumatologists and physicians and an early consultation from all three is often necessary. The length of the course of Intravenous antibiotics may vary ranging from 4-6 weeks depending on the nature of the microbe.10 Microbiologist advice should be sought.

Arthroscopic lavage is shown to have an effective role in surgical debridement of knee joint.(20) Repeated surgical debridement may be necessary in a small group of patients who do not respond to a single arthroscopic lavage.

SEPTIC ARTHRITIS IN THE KNEE

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If the patient has a prosthetic joint, urgent surgical debridement usually by arthroscopic lavage is performed. The pathogens are more resistant to antibiotics as they are enclosed in biofilms.(21) Periprosthetic synovial tissue is highly valuable in isolating the pathogens and cultures have low sensitivity. (22) In case of early onset of infection (i.e within 2-6 weeks from the surgery), arthroscopic or open washout with an exchange of polyethylene liner is performed. Upto 9 litres of Normal Saline is used for arthroscopic lavage.

The delayed presentation (more than 6 weeks) can be less striking and a constant pain in the knee may be the only positive finding. At least three periprosthetic samples are analysed for infection. Once infection is established, a revision of the arthroplasty is performed usually in a two stage procedure. The first stage involves excision arthroplasty, debridement and insertion of antibiotic impregnated spacer to align the limb. The use of such spacers has shown better cure rate from infection.(23) Second stage involving implantation of new prosthesis is performed once the infection has resolved.

Complications and Prognosis

As outlined at the beginning septic arthritis can be a devastating condition causing rapid, irreversible joint damage in upto 50% of patients.(10) It has serious implications resulting in the poor quality of living for the patients. Early intervention and complete antibiotic therapy would give them the best chance of survival. Septic arthritis should be at the foremost differential diagnosis of a clinician when assessing a patient with a painful swollen and stiff knee unless proved otherwise.

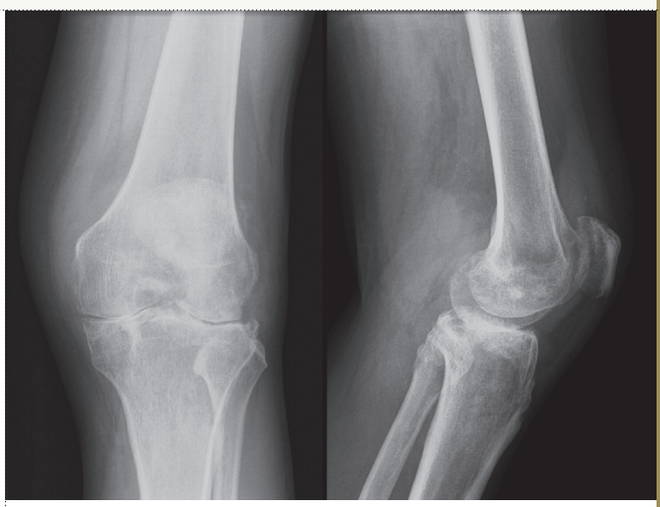
Questions

1. What is the most reliable diagnostic indicator in a patient presenting with a probable septic arthritis in the Emergency Department?

a) Pyrexia
b) Elevated WCC
c) Elevated CRP above 20
d) Clinical suspicion
e) Elevated ESR above 40

2. A GP refers a 65 year old with a swollen painful knee for the past 24 hours with sudden onset. She also complains of feeling hot and sweaty. She has a background of Type 2 Diabetes on Metformin. She also takes Warfarin for PE. Her temperature is 38.3°C, pulse rate is 90 per minute. GP reports she has a globally tender knee with decreased range of movements. Which of the following statements is false?

a) She needs to have INR checked before a joint aspiration can be performed.
b) Advise GP to commence her on broad spectrum antibiotics.
c) Full history and examination to assess any other focus of infection need to be performed.
d) a) and b)
e) b) and c)



3. Which one of the following is not a strong associated risk factor of septic arthritis?

a) Osteoarthritis
b) Prosthetic joint
c) Alcoholism
d) Occupation
e) Cutaneous ulcers

4. A 77 year old patient is brought to ED with 2 week history of a painful swollen right knee. The GP has started him on oral dose of Flucloxacillin under suspicion of cellulitis. He has had a right total knee replacement one month ago. He is apyrexial. On examination of the knee, he has a tense swollen knee which is tender all over and recent decrease in range of movements. Intraoperative fluid aspiration was positive for infection. Choose the single most appropriate option of treatment.

a) Broad spectrum antibiotics
b) Arthroscopic lavage
c) Open debridement with exchange of polyethylene liner
d) Revision of the arthroplasty (Single stage revision)
e) Two stage revision

5. Which of the following is the most common causative organism for septic arthritis in the UK?

a) Staphylococcus aureus
b) Streptococcus
c) Neisseria gonorrhoeae
d) Mycobacterium tuberculosis
e) Haemophilus influenza

SEPTIC ARTHRITIS IN THE KNEE

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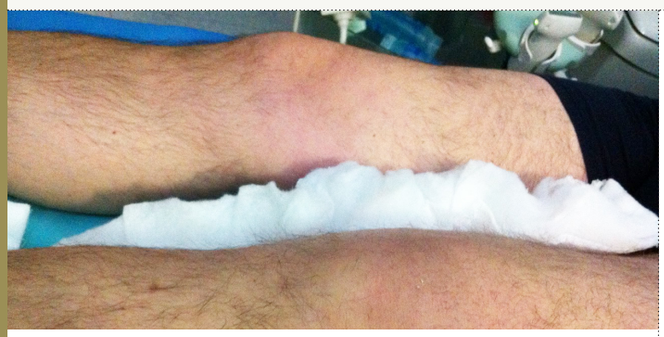

Answers

1. e) According to the systematic review performed by CJ Matthews et al in 2006 (Ref 9), clinical suspicion by an experienced doctor is the most reliable indicator in diagnosing septic arthritis in the acute setting

2. d) This patient needs to have urgent fluid aspiration with Gram staining and then broad spectrum antibiotics. Thorough systemic examination to exclude any other focus of infection must be performed viz. urinary tract symptoms, chest infection or a new onset heart murmur.

3. d)

4. d) Since this patient falls in the early presentation of infected prosthesis, he would benefit from open debridement and exchange of the liner. Revision arthroplasty is needed in the delayed presentation.

5. a)

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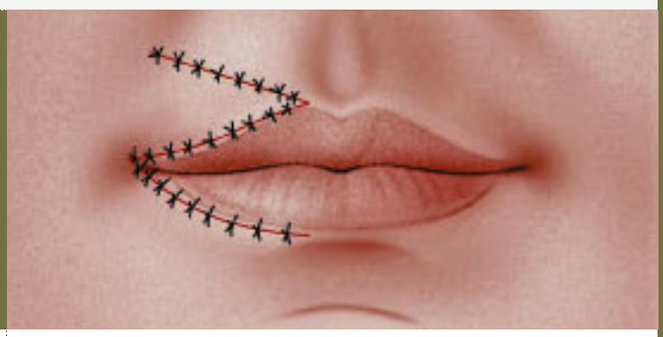
AN INTRODUCTION TO LOCAL FLAPS

D Nikkhah



An Introduction to Local Flaps.
Plastic & Reconstructive Surgery.

Abstract

In this review article we discuss the use of local flaps to cover soft tissue defects. We describe the fundamental types of local flaps with simple stepwise diagrams.

Case Example

A 69-year-old gentleman presented with a large Basal Cell Carcinoma (BCC) over his right temple. Unfortunately this lesion was not amenable to primary closure. He had a history of BCC, for which he had had numerous operations under local anaesthesia. He had no significant history.

A rhomboid flap was designed to close the defect. The BCC was excised and sent to histopathology for analysis. The procedure was performed under local anaesthetic. The rhomboid local flap closed the defect elegantly. He was reviewed 6 weeks later, the wound had healed and the scar was barely noticeable.

Introduction

Skin flaps are transplants of skin and subcutaneous tissue, which are moved from their normal position in order to make good an integumental defect. (1). A flap is a unit of tissue that maintains its own blood supply while being transferred from the donor site to a recipient site. A graft on the other hand has to attain its own blood supply.

Local flaps have the advantage of having the same colour and texture of the skin excised from the defect. Also functionally flaps are much better than grafts because little or no scar contracture occurs.(2) We can classify local flaps more simply by describing their method of movement. We will start by explaining the Z-plasty, which in essence is two transposition flaps. We will discuss the principles of rotation flaps, transposition flaps, advancement flaps in different settings in plastic surgery.

Three simple steps represent each technique here, from the initial marking of the flap, the raising of the flap to covering the defect and closure of the donor site.

Z-Plasty

In Z-plasty two triangular flaps are reversed. This technique has wide applications in plastic surgery; from scar division in burn contracture to Dupuytren's surgery in the hand. The 60-degree angle Z-plasty gives a theoretical gain in length of 75 %. If the angle of the Z-plasty is increased to 75 degrees, this theoretical gain in length is 100%. However the 60 degree Z-plasty confers least tension laterally whilst adequately lengthening the central limb(3) (Fig 1).

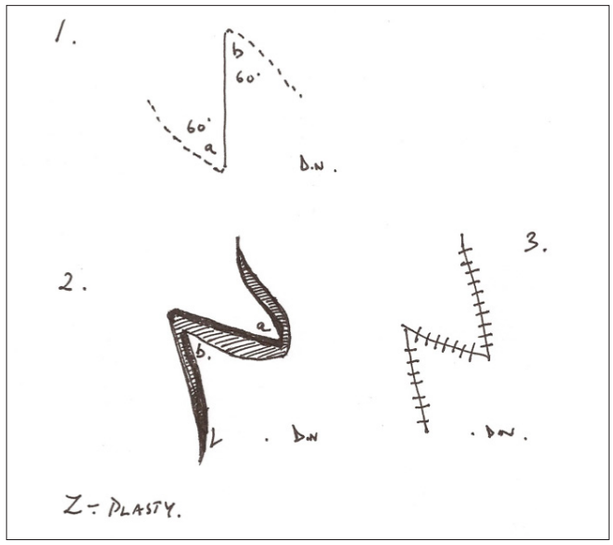


Figure 1: Z-plasty

Rotation Flaps

These are classically semicircular local flaps rotated around a pivot point and into the triangular defect in question (Fig 2). Depending on the amount of rotation, the donor site can either be closed primarily or by utilising a split thickness skin graft (SSG). Application for this local flap can be anywhere from the scalp to the back. If the surgeon feels rotation is not sufficient, he can facilitate rotation by performing a 'back-cut'; an incision made toward the centre of the circle.

AN INTRODUCTION TO LOCAL FLAPS

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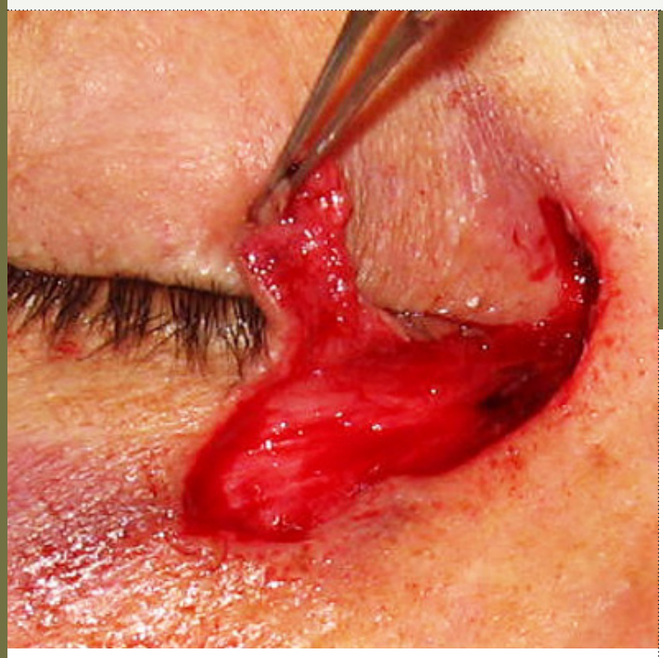

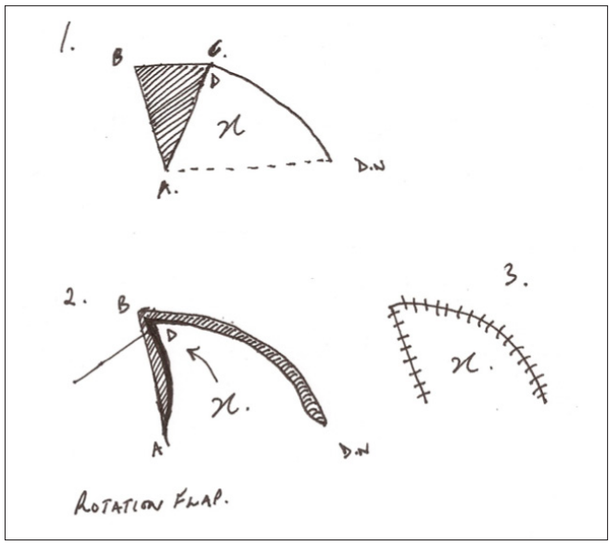

Figure 2: Rotation flap

Transposition Flaps

These local flaps are simply transposed laterally about a pivot point into an immediately adjacent defect (Fig 3). The donor site can be closed primarily, or can be replaced by a secondary flap. These flaps share the same characteristics of movement as the rotation flaps.(2) The maximum possible transposition of the flap is 90 degrees from its original position.(2)

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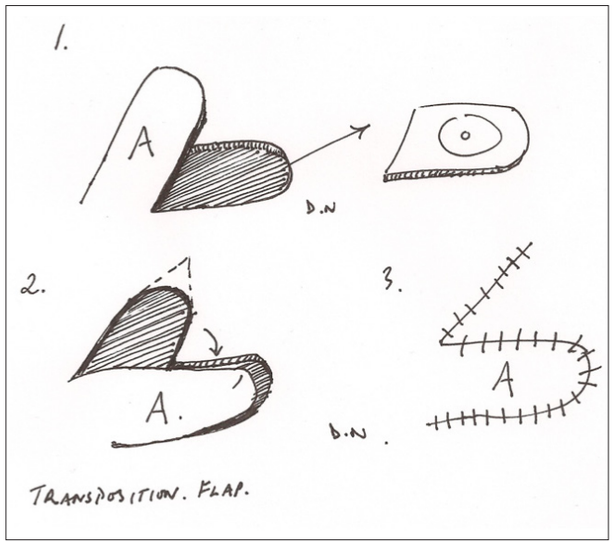

Figure 3: Transposition flap

Another transposition flap of importance is the Rhomboid or Limberg flap. Limberg described its use to fill a rhomboid-shaped defect, where all angles must be 60 or 120 degrees (Fig 4). In designing this flap, a line is drawn bisecting the 120-degree angle of the rhomboid. From the end of this line another line is drawn 60 degrees parallel to the side of the rhomboid defect. The surgeon should then check skin availability by pinching the skin to see if the donor site will close primarily. Four potential flaps can be designed for each rhomboid.

AN INTRODUCTION TO LOCAL FLAPS

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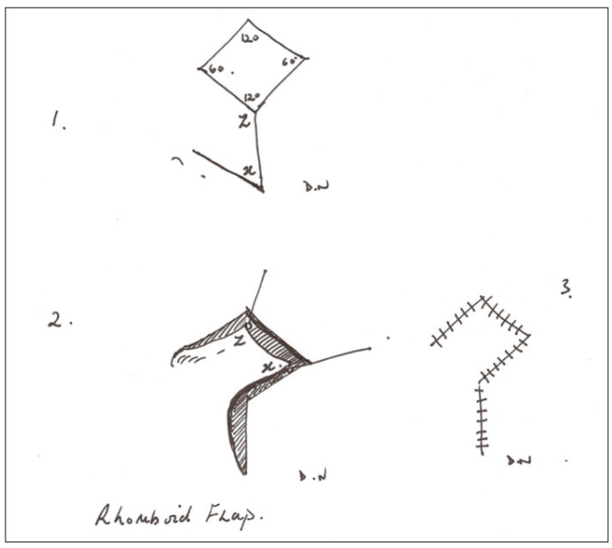

Figure 4: Rhomboid flap

However Quaba et al. (4) described a variation of this flap. In essence the 'square peg into a round hole'. In their modified design the positioning of the flap into the defect is not predetermined, this allows for more flexibility and better distribution of tension (Fig 5).

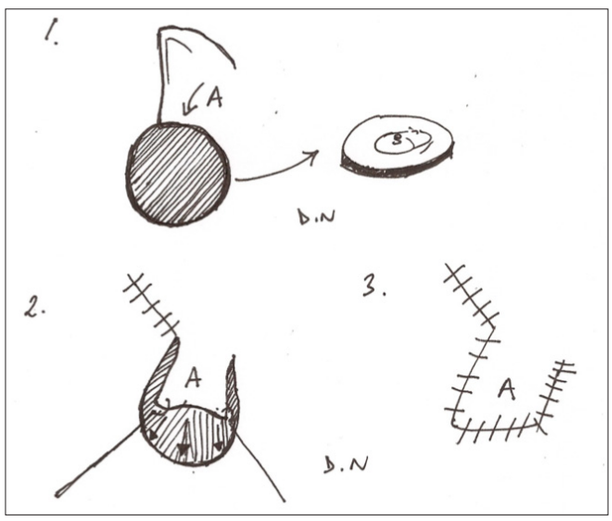

Figure 5: Square peg modified Rhomboid flap

Advancement flaps

In Advancement flaps, skin is slid directly forward into the defect. Examples of this are the V-Y advancement flap (Fig 6) In the V-Y flap, the skin is lifted as a V, slid forward, with closure of the posterior defect. The resultant suture line is Y shaped. The rectangular advancement flap (Fig 7) can also be used for coverage of square defects.

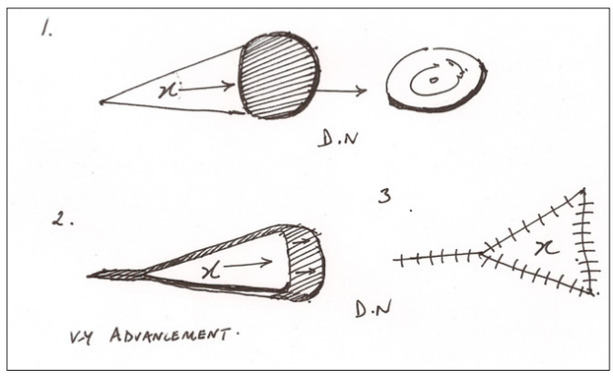

Figure 6: V-Y advancement flap

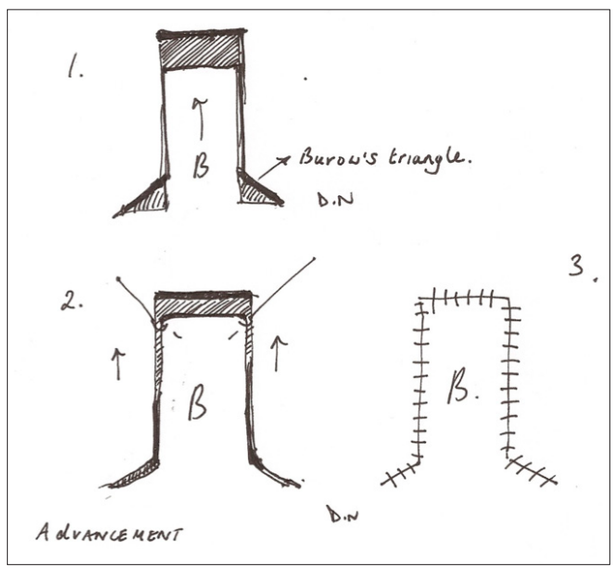

Figure 7: Rectangular Advancement flap

AN INTRODUCTION TO LOCAL FLAPS

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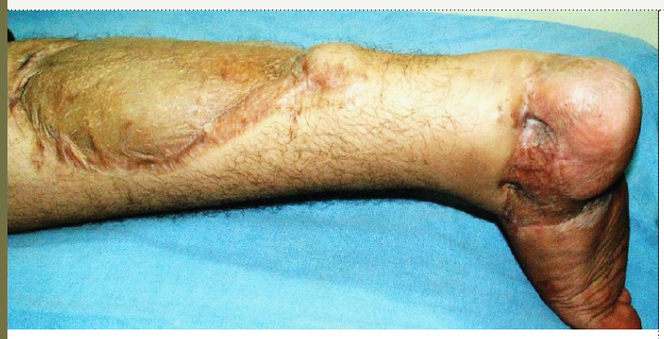

Complications of local flaps

An important complication of scenarios in which local flaps are being performed is recurrence of a tumour that has been excised (resulting in the defect that the flap is closing). The prime concern of the surgeon should be complete excision of the tumour (or adequate debridement of other wounds, such as traumatic ones), and then the best method of local reconstruction should be planned. With this proviso, local recurrence is rare.

Flap loss almost always results from a technical error.(2) The surgeon may accidently damage the pedicle intraoperatively whilst raising the flap. A haematoma can also interrupt the blood supply to the flap resulting in skin necrosis. Therefore haemostasis should be meticulous and in those with a bleeding diasthesis a small suction drain should be used. Suturing the flap under too much tension can result in flap compromise.

Summary

Local flaps are of great use to close defects in a variety of situations. Adequate excision or debridement of the defect is of primary importance; closure is a secondary concern.(2) Great care must be taken to plan these flaps accurately. This takes practice and experience. The local flaps described in this review are basic fundamental flaps. There a many further techniques, which are beyond the scope of this introductory teaching article.

Questions

1. A 60 degree Z-plasty would lengthen a scar by:

a) 75 percent
b) 70 percent
c) 100 percent
d) 125 percent
e) 50 percent

2. How many flaps can be designed in a 'Rhomboid flap'

a) 4
b) 5
c) 3
d) 2
e) 1

3. A 72 year old man had large BCC excised and a local flap covered the defect. 5 days later he developed a collection of blood under the flap which was drained by releasing several stitches. Which one these factors is most likely to cause flap failure in his case?

a) Postoperative Haematoma
b) Damaged to pedicle
c) Small flap design to cover large defect
d) Suturing under too much tension
e) Poor Flap Design

4. Which one of these is NOT an advantage of a local flap?

a) Local flaps have similar skin texture for the site defect
b) Local flaps are associated with less scar contracture
c) Donor sites can often be closed directly
d) They are associated with a lower risk of cancer recurrence
e) They are not associated with a significant pigment mismatch unlike skin grafts.

5. Where should incision lines be placed for local flaps and donor areas be placed?

a) Lines of minimal relaxed tension
b) Lines of maximal relieved tension
c) Lines of stress tension
d) Lines of maximal relaxed tension
e) At right angles to the lines of minimal tension

Answers

1. a **2. a** **3. a** **4. d** **5. a**

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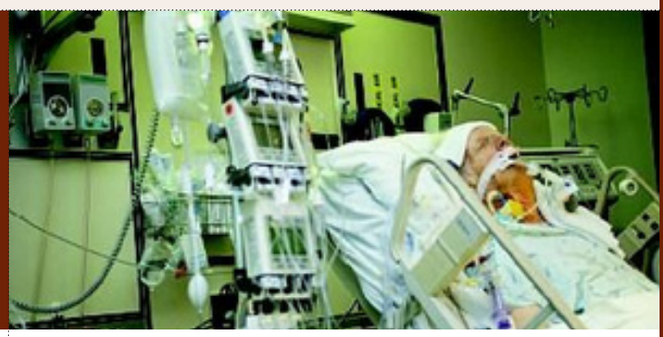
INOTROPES

R Dickson-Lowe



Inotropes.
Cardiothoracic & Critical Care.

Abstract

This review article covers principles of cardiovascular support and the role of inotropic agents in the optimal management of the peri-operative or critically ill patient. It includes an overview on different inotropes, how they can be classified and how they mediate an intracellular effect. A clinical vignette, regarding a surgical patient requiring early intervention and critical care input is also included with multiple choice questions to conclude.

Principles of cardiovascular support

Cardiovascular support involves optimizing oxygen delivery to vital organs. These organs need to be perfused by oxygenated blood. Perfusion is dependent on the pressure gradient across the organ and hence arterial blood pressure. The oxygenation of blood requires an effective lung unit and adequate perfusion of the lungs. Both are dependent on the ability to generate an adequate cardiac output and can be manipulated with fluid management and drugs. To support a failing cardiovascular system, follow the VIP principles: Ventilate, Infuse and Pump.(1)

Ventilate – *using the ABC rule of resuscitation, improving oxygenation and gas exchange, reducing oxygen demand to respiratory muscles and correcting acidaemia via CO_2 correction.*

Infuse - *ensure adequate filling prior to vasoactive support (following Starling's Law) with fluid challenges using invasive monitoring.*

Pump – *restoration of perfusion pressure and optimizing cardiac output.(1)*

Equations underlying the principles of cardiovascular support

Shock is a potentially life-threatening condition, which must be corrected. It is "circulatory insufficiency with inadequate oxygen delivery resulting in hypoperfusion and tissue hypoxia". Two equations are fundamental to understanding shock:(2)

Equation 1: Blood pressure (BP) = Cardiac Output (CO) x Systemic Vascular Resistance (SVR)

This equation states that to maintain an adequate perfusion pressure (BP), an adequate flow of blood (CO) and adequate vascular tone (SVR) are needed. Think of water flowing through a pipe. The pressure in the pipe can be increased in one of two ways:

(a) Increasing the flow of water through the pipe (increasing the CO)
(b) Maintaining the same flow but increasing the resistance to flow by decreasing the pipe diameter (increasing the SVR through vasoconstriction)(2)

Thus, hypotension, with resultant hypoperfusion, can be caused by either low CO (cardiogenic shock, outflow obstruction, hypovolaemic shock) or a low SVR (neurogenic shock or septic shock) or both (septic shock).(1, 2)

For low cardiac output states we must also remember that:
CO = Stroke Volume (SV) x Heart Rate (HR)

Heart rate is easy to measure, stroke volume is not. However, we can consider the variables that determine stroke volume:

1. Pre-load: Increasing end-diastolic volume by filling the heart will lead to an increase in stroke volume.

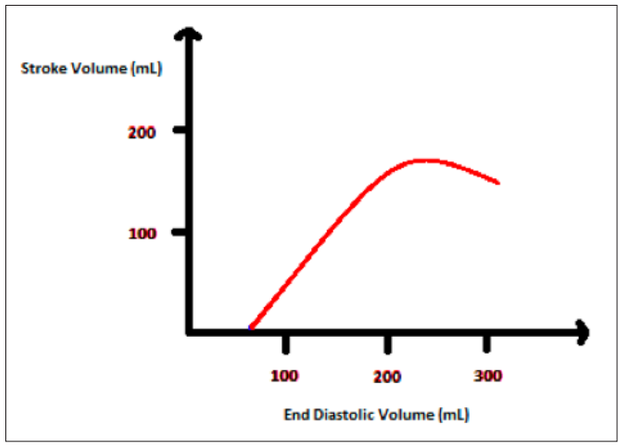
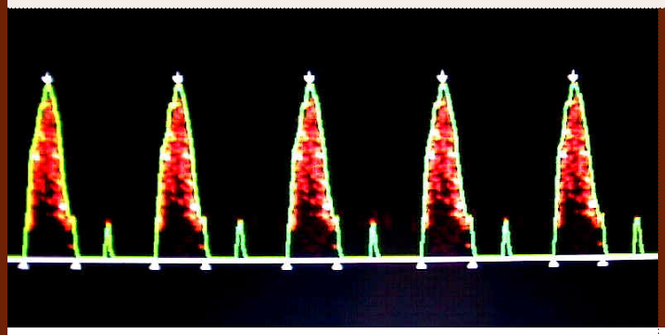


Figure 1. The Starling Curve (2)

INOTROPES

R Dickson-Lowe



Inotropes.
Cardiothoracic & Critical Care.

In the critically ill patient, low preload from hypovolaemia is the most common cause of low SV (and subsequent low CO) and reduced perfusion. Fluid resuscitation is thus the mainstay of correcting this. The hypovolaemic patient will attempt to maintain CO and perfusion by becoming tachycardic. The Starling curve shows, however, that it is possible to over stretch the heart. This is why reducing preload and/or afterload with vasodilators or diuretics in a patient with heart failure improves myocardial function.(1,2)

2. Contractility: Increase in contractility can be achieved by administration of an inotrope. The effect of an inotrope on the Starling curve is demonstrated below:

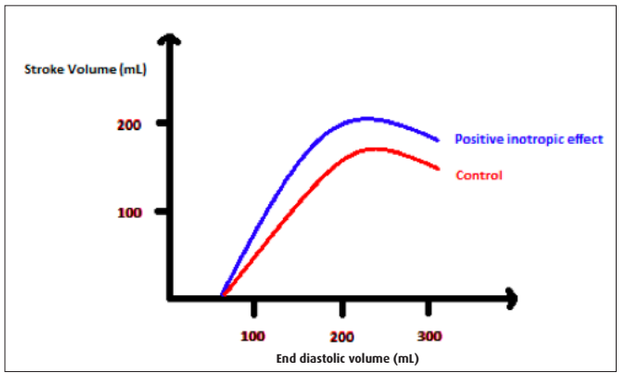


Figure 2. The Starling curve. Effect of inotropes on contractility and stroke volume.(2)

We can see that an inotrope generates a greater SV for a given preload. It is important to remember that an inotrope is more effective with an adequately filled heart.

3. Afterload: A high SVR will tend to reduce CO. However, it must also be remembered that perfusion pressure (BP) is not the only important factor in ensuring adequate oxygen delivery. In order to understand why an 'adequate' BP is not always reassuring we must look at the following equation:

Oxygen delivery (DO_2) = blood flow (CO) x oxygen content of blood

Equation 2. DO_2 = CO x ([Hb x arterial oxygen saturation x constant] + a small amount dissolved in plasma)

The equation shows that oxygen delivery is dependent on blood flow not pressure. Using Equation 1, a normal BP could be generated by an extremely high SVR and very low CO. Then using Equation 2, although 'perfusion pressure' was adequate a low CO would result in a very low oxygen delivery and tissue hypoxia.(2)

Mean arterial blood pressure (MAP) is a term, frequently used in critical care medicine, and is used to describe an average blood pressure defined as the average pressure during a single cardiac cycle. MAP = (CO x SVR) + central venous pressure (CVP). It is similar to Equation 1, except that CVP is not included, which can often be neglected due its small value. MAP is considered to be the perfusion pressure seen by organs in the body, hence its importance. It is believed that a MAP >60mmHg will adequately perfuse body organs, below this level, ischaemia may occur.(3)

How do we classify drugs that aid cardiac output?

The cardiac drugs (usually infused in µg/kg/min) are classified as:

Inotropes - *increase the force of ventricular contraction*

Chronotropes - *increase heart rate*

Lusiotropes - *enhance myocardial relaxation*

Dromotropes - *affects conduction velocity at the AV node, and subsequently heart rate*

Bathmotropes - *modify the degree of excitability of heart muscle*

Vasopressors - *constrict blood vessels*

Vasodilators - *dilate blood vessels (arterial, venous or both)*

These drugs act upon receptors called adrenergic receptors (adrenoceptors) and dopaminergic (DA) receptors.(1,3,4)

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How do adrenoceptors and dopaminergic receptors work?

A hormone affects its target tissues by first forming a hormone-receptor complex, which alters the function of the receptor itself, and the activated receptor initiates the hormonal effects. Many hormones activate receptors that indirectly regulate the activity of target proteins (e.g. enzymes or ion channels) by coupling with groups of cell membrane proteins called heterotrimeric GTP-binding proteins (G proteins). All G protein-coupled receptors have seven transmembrane segments that loop in and out of the cell membrane (see Figure 3). Some parts of the receptor that protrude into the cell cytoplasm are coupled to G proteins that include three (i.e. trimeric) parts – the α, β and γ subunits. When the ligand (hormone) binds to the extracellular part of the receptor, a conformational change occurs in the receptor that activates the G proteins and induces intracellular signals that either (1) open or close cell membrane ion channels or (2) change the activity of an enzyme in the cytoplasm of the cell.(4)

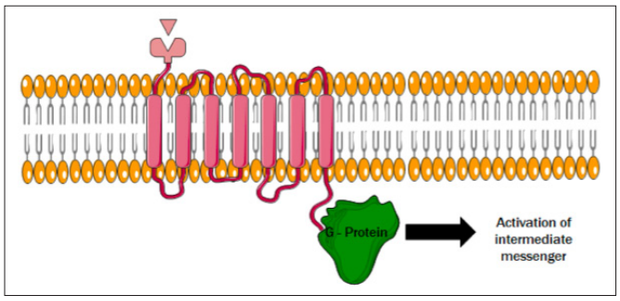

Figure 3. Action of G protein-coupled receptor

The trimeric G proteins are named for their ability to bind guanosine nucleotides. In their inactive state, the α, β and γ subunits of G proteins form a complex that binds guanosine diphosphate (GDP) on the α subunit. When the receptor is activated, it undergoes a conformational change that causes the GDP-bound trimeric G protein to associate with the cytoplasmic part of the receptor and to exchange GDP for guanosine triphosphate (GTP). Displacement of GDP by GTP causes the α subunit to dissociate from the trimeric complex and to associate with other intracellular signaling proteins; these proteins, in turn, alter the activity of ion channels or intracellular enzymes such as adenyl cyclase or phospholipase C, which alters cell function.(4)

The signaling event is terminated when the hormone is removed and the α subunit inactivates itself by converting its bound GTP to GDP; then the α subunit once again combines with the β and γ subunits to form an inactive, membrane-bound trimeric G protein. Some hormones are bound to inhibitory G proteins (denoted Gi proteins) whereas others are coupled to stimulatory G proteins (denoted Gs and Gq proteins). Thus depending on the coupling of a hormone receptor to an inhibitory or stimulatory G protein, a hormone can either increase or decrease the activity of intracellular enzymes.(1,4)

Adrenoceptors and dopaminergic receptors are both G protein-coupled receptors that are targets for catecholamines, especially adrenaline and noradrenaline. Dopaminergic receptors are the targets for dopamine and synthetic dopamine derivatives. Many cells possess these receptors, and binding an agonist will generally cause a sympathetic (or sympathomimetic) response (e.g. the fight or flight response).(5,6)

Adrenoceptors consist of two main groups, α and β, with several subtypes:

- α-adrenoceptors have the subtypes α1 and α2.

- α1 is coupled with Gq proteins, which activate phospholipase C (PLC) cleaving phosphatidylinositol 4,5-triphosphonate (PIP3), in turn causing a rise of inositol triphosphate (IP3) and diacylglycerol (DAG) resulting in increased intracellular Ca2+ which results in smooth muscle contraction. α1 are located in vascular smooth muscle and mediate vasoconstriction and increase in MAP. (4,6)

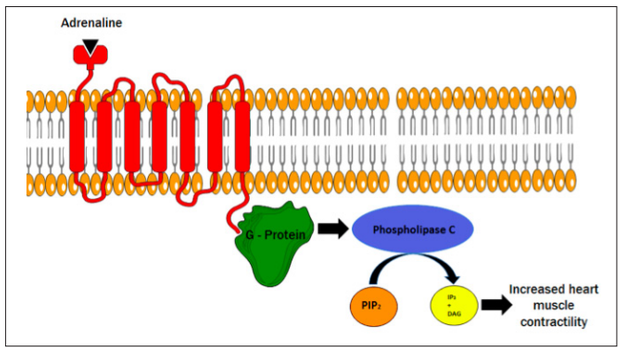

Figure 4. α1-adrenoceptor and the G protein-coupled receptor action

- α2 is coupled with Gi proteins, which cause a decrease of cAMP activity resulting in smooth muscle relaxation. α2 are located throughout the CNS and on platelets and mediate sedation, analgesia and platelet aggregation.(4,6)
- β-adrenoceptors have the subtypes β1, β2, and β3. All three are linked to Gs proteins (although β2 also couples to Gi), which in turn are linked to adenyl cyclase. Agonist binding thus causes a rise in the intracellular concentration of the second messenger cAMP. Downstream effectors of cAMP include cAMP-dependent protein kinase A (PKA), which mediates some of the intracellular events following hormone binding.(4,6)
- β1 are located in the heart and mediated increased contractility and heart rate
- β2 are located mainly in smooth muscle of bronchi and mediate bronchodilation but are also located in blood vessels and cause dilation of coronary and skeletal vessels
- β3 are located mainly in adipose tissue and are involved in the regulation of lipolysis and thermogenesis in skeletal muscle.(3,5,6)

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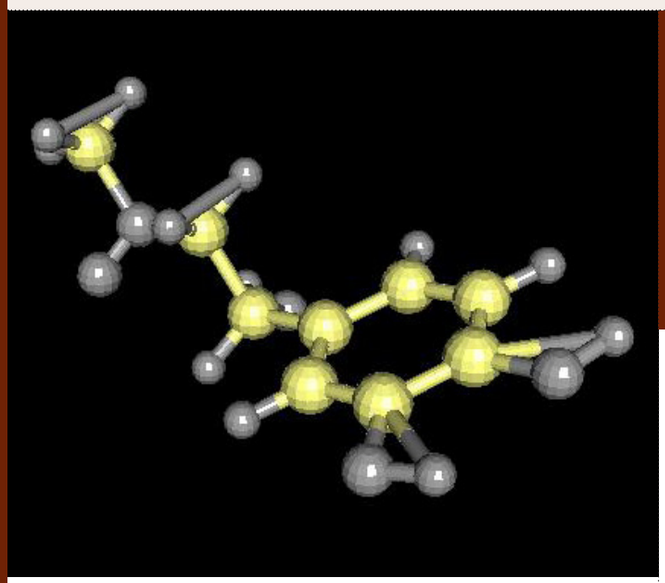

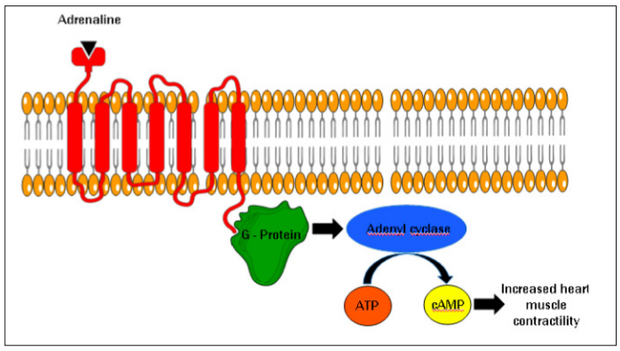

Figure 5. β1-adrenoceptor and the G protein-coupled receptor action

Non-central nervous system dopaminergic (DA) receptors are also G-protein coupled receptors, acting via similar mechanisms. The pulmonary artery expresses D1, D2, D4 and D5 which may account for vasodilatory effects of dopamine in the blood.(7) D1- like receptors are present in the juxtaglomerular apparatus and renal tubules of the kidney and D2-like receptors are present on the renal tubules, glomeruli, post-ganglionic sympathetic nerve terminals and zona glomerulosa of the adrenal cortex.(8) Dopamine increases myocardial contractility and cardiac output, without changing heart rate, by signalling through these dopamine receptors. Dopamine also signals diuresis and natriuresis.(8) In short, DA receptor stimulation causes coronary, renal and mesenteric vasodilation.

Receptor	Heart	Peripheral vessels	Splanchnic vessels	Metabolic
□1	Nil	Constriction	Constriction	
□2	Centrally mediated bradycardia	Dilatation	Nil	Platelet aggregation
□1	Inotrope and Chronotrope	Nil	Nil	
□2	(Inotrope and Chronotrope)	Constriction	Dilatation	Increased glycogenolysis and insulin release
DA1			Dilatation	
DA2				Anterior pituitary inhibition

Table 1. Main actions of adrenergic and dopaminergic receptors(5)

Inotropes.
Cardiothoracic & Critical Care.

What is an inotrope?

Since the initial discovery of epinephrine (adrenaline), the principle active substance from the adrenal gland, the pharmacology and physiology of a large group of endogenous and synthetic catecholamines or sympathomimetics have been characterized.(9) These are generally referred to as 'positive inotropes.'

Both positive and negative inotropes are used in the management of various cardiovascular conditions. The choice of agent depends largely on specific pharmacological effects of individual agents with respect to the condition. One of the most important factors affecting inotropic state is the level of calcium in the cytoplasm of the muscle cell. Positive inotropes usually increase this level, while negative inotropes decrease it. The term "inotropes", used in the clinical setting, usually refers to the positive inotropic agents.

Positive inotropic agents increase myocardial contractility, and are used to support cardiac function in conditions such as decompensated congestive cardiac failure, cardiogenic shock, septic shock, myocardial infarction and cardiomyopathy.

The most common agents used in a critical care or peri-operative setting include:

1. Sympathomimetics

(a) Naturally occurring (endogenous)

(i) Adrenaline
(ii) Noradrenaline
(iii) Dopamine

(b) Synthetic (exogenous)

(i) Dobutamine
(ii) Dopexamine
(iii) Phenylephrine
(iv) Metaraminol
(v) Ephedrine
(vi) Isoprenaline

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2. Other inotropes (which have sympathomimetic action but are not considered as such)

(a) cAMP dependent

(i) Phosphodiesterase (PDE) inhibitors
· Non-selective e.g. Aminophylline
· Selective (PDE3) e.g. Milrinone, Enoximone
(ii) Glucagon

(b) Non-cAMP dependent

(i) Digoxin
(ii) Calcium
(iii) Calcium sensitizing agents e.g. Levosimendan
(iv) Methylene blue
(v) Other vasopressors = Vasopressin

The main actions of each are illustrated in the tables below:

DRUG	CHEMICAL STRUCTURE	INDICATION	EFFECT			MODE OF ACTION			
			Inotropy	Peripheral vasoconstriction	Peripheral vasodilatation	□1	□1	□2	DA
Adrenaline		Shock (cardiogenic, vasodilatory) Cardiac arrest Bronchospasm/Anaphylaxis Symptomatic bradycardia or heart block unresponsive to atropine or pacing	+	+		++++	+++	++	
Noradrenaline		Shock (cardiogenic, vasodilatory)	+	+		++++	+	+	
Dopamine		Shock (cardiogenic, vasodilatory) Heart failure Symptomatic bradycardia unresponsive to atropine or pacing	+	variable	variable	++	+++	+	++++

Table 2. Naturally occurring (endogenous) sympathomimetics(10,11)

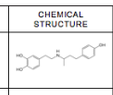
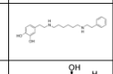
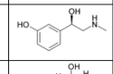
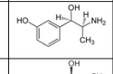
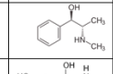
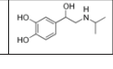
DRUG	CHEMICAL STRUCTURE	INDICATION	EFFECT			MODE OF ACTION			
			Inotropy	Peripheral vasoconstriction	Peripheral vasodilatation	□1	□1	□2	DA
Dobutamine		Low cardiac output (decompensated HF, cardiogenic shock, sepsis-induced myocardial dysfunction) Symptomatic bradycardia unresponsive to atropine or pacing	+	* (high doses)	* (low doses)	+	++++	+	
Dopexamine		Low cardiac output (decompensated HF, cardiogenic shock, sepsis-induced)	+		+			++++	++++
Phenylephrine		Hypotension (vagally-mediated, drug-induced) Increase MAP with AS and hypotension Decrease LVOT gradient in HOCM	+		+	++++			
Metaraminol		Acute hypotension in shock states	+	+		++++	+		
Ephedrine		Hypotension (vagally-mediated, drug-induced)	+	+		++++	+++	++	
Isoproterenol		Complete heart block Bradyarrhythmias (especially Torsades de Pointes) Brugada syndrome	+			+	++++	++++	

Table 3. Synthetic (exogenous) sympathomimetics(10,11)

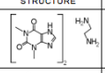
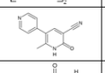
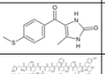
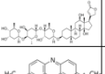
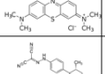
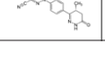
DRUG	CHEMICAL STRUCTURE	Indications	EFFECT			MODE OF ACTION
			Inotropy	Peripheral vasoconstriction	Peripheral vasodilatation	
Aminophylline		Low cardiac output (decompensated HF, after cardiotomy)	+		+	Phosphodiesterase inhibitor (non-selective)
Milrinone		Low cardiac output (decompensated HF, after cardiotomy)	+		+	Phosphodiesterase 3 inhibitor (selective)
Enoximone		Low cardiac output (decompensated HF, after cardiotomy)	+		+	Phosphodiesterase 3 inhibitor (selective)
Glucagon		Low cardiac output (decompensated HF, cardiogenic shock)	+			cAMP-dependent inotropy
Digoxin		Atrial fibrillation and flutter Heart failure	+			Inhibition of Na^+K^+-ATPase
Methylene blue		Various low output shock states	+	+		Guanylate cyclase inhibitor
Levosimendan		Treatment of acute heart failure syndromes resulting from a variety of aetiologies.	+			Calcium sensitiser - Ca^{2+} dependent binding to troponin C Simulation of ATP-sensitive K^+ channels

Table 4. cAMP dependent and non-cAMP dependent inotropes(10,11)

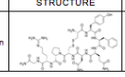
DRUG	CHEMICAL STRUCTURE	INDICATION	EFFECT			MODE OF ACTION
			Inotropy	Peripheral vasoconstriction	Peripheral vasodilatation	
Vasopressin		Shock (cardiogenic, vasodilatory) Cardiac arrest		+		Vasopressin agonists

Table 5. Vasopressor analogues(10,11)

What are the key points of inotrope therapy

1. Short half-life – (refers to most inotropes as not all do have a short half-life e.g. enoxamine) consequently can only be given as continuous infusions and should never be stopped abruptly but weaned gradually.(12,13,14)

2. Clinical features of hypotension, compensated tachycardia, peripheral vasoconstriction and oliguria can be the result of hypovolaemia, inadequate cardiac function or both. Before starting inotropes it is important to ensure filling is adequate. However, an adequate perfusion pressure (MAP) is important and maintaining this with inotropes whilst catching up with filling can be useful.(13,14)

3. When starting inotropes, the dose should be increased until the desired effect is achieved, as opposed to starting with a high dose and decreasing it until effect is maintained.(13,14)

4. Most inotropes must be given via a central line because of their vasoconstrictive nature, which if given peripherally can cause tissue necrosis via extravasation. However, some can be further diluted and given peripherally but this has the disadvantage of the patient receiving unwanted fluid volume.(13,14)

5. Monitoring whilst on inotropes should be invasive (due to risk of life-threatening dysrhythmias) in the form of an arterial line for continuous waveform, blood pressure and blood gases and a central line to administer drugs and gauge fluid loading. More invasive monitoring can be considered in the form of:

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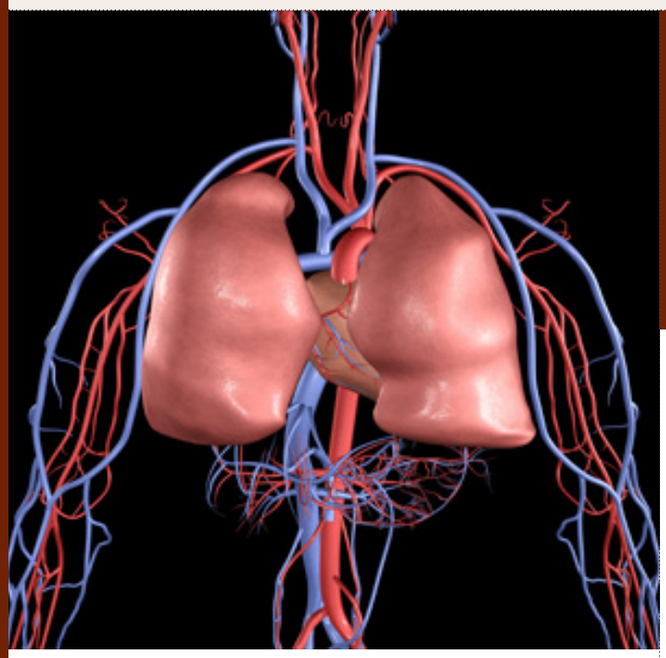

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- Pulmonary artery catheter (Swan-Ganz catheter) to measure the preload more effectively where CVP line will be inaccurate e.g. pulmonary hypertension, right ventricular infarction, tricuspid disease.(15)

Measuring Cardiac output15

- Also done via PA catheter
- PiCCO (Pulse induced Contour Cardiac Output – measures CO by thermodilution
- LiDCO (Lithium dilution Cardiac Output) – measures CO by lithium dilution
- Echo Doppler – measures blood flow in the aorta via an oesophageal doppler
- Echocardiography – transthoracic or transoesophageal

6. Myocardial oxygen demand. It is important to meet increased demand for oxygen by maintaining arterial oxygen saturations, haemoglobin levels and by respiratory intervention(13,14) so as not to deny the myocardium itself of oxygen, thus preventing ischaemia.

7. As inotropes exert an effect on receptors, which in turn can affect contractility and rate, patients must be closely monitored to
a. titrate therapy
b. identify side effects(4)
i. Sympathomimetic side effects e.g. β1: Dysrhythmia, tachycardia, hypertension, angina.
ii. Dopamine agonist side effects
iii. Tachyphylaxis i.e. tolerance during prolonged use
iv. Extravasation of drugs increasing risk of ischaemic tissue necrosis

The ideal vasoactive agent would provide a predictable, titrateable increase in tissue perfusion without worsening the oxygen supply:demand ratio for any of the vital organs.(4)

Conclusion

Inotropes are very useful cardiovascular supportive agents which are used in peri-operative and critical care settings where invasive monitoring is possible. The use of inotropes and vasopressors has not been shown in randomized, controlled studies to ultimately lead to improved patient outcomes, at least in part because no clinical trials have been conducted with study size and power adequate (or ethical acceptability) to test their effect on improving survival. In the absence of such data, the definitive goals of therapy must be considered of primary importance, and the role of inotropic therapy should be kept in a supportive context to allow treatment of the underlying disorder, "cutting away the badness".

Case Presentation:

72 year old male presents to A&E with 48 hour history of rigors, constipation and abdominal pain. BNO 24hrs. Examination revealed a rigid and peritonitic acute abdomen. PR exam elicited an empty rectum to the end of the finger, a normal prostate, normal anal tone and sensation, no blood, no mucous, normal perianally. Observations: Temperature 38.9°C, RR 32, HR 124 (sinus rhythm), BP 72/40 and GCS14/15. PMH: myasthenia gravis and diverticular disease

What does this suggest?

Severe sepsis with an acute abdomen, likely to be a perforated viscus.

What will be your immediate management?

ABCDE.

15L O_2 via a non-rebreathe mask, 2 large bore cannulae in ACFs, bloods taken for FBC, UE, LFTs, CRP, amylase, COAG and X match for 4 units. Blood cultures should also be taken. 500ml boluses of crystalloid or colloid should be run through STAT. Perform an ABG to assess pH status and lactate.

Next Step?

Call a senior and arrange emergency theatres.

Over the next 30mins

ABx as per guidelines and further fluid challenges. With no improvement to blood pressure the patient is now in septic shock. Inform critical care team. ABG: pH 7.018, pO_2 20.4, pCO_2 3.04, HCO_3 14.2, Base excess -8, Lactate 7.9. Metabolic acidosis with some respiratory compensation.

Bloods: WCC 28.2, CRP 104, Na 140, K 4.1 Ur 12.1, Cr 88, INR 1.6.

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Over the next 15mins

Critical Care arrived and performed rapid sequence intubation. Boluses and infusion of metaraminol administered peripherally whilst RIJV cannulation performed allowing a noradrenaline infusion to be started. Invasive arterial line inserted to monitor MAP beat by beat.

Diagnosis

4-quadrant peritonitis secondary to perforated sigmoid colon. This patient required two-organ support and was extubated 48hrs post admission to ITU. He continued to require increasing amounts of noradrenaline (>0.5µg/kg/min) to keep his MAP >60, despite adequate filling with fluids.

Next step?

A large afterload and adequate preload but reduced MAP suggests his contractility is impaired. An echo showed moderate left ventricular systolic dysfunction. He was therefore started on dobutamine.

When can he leave the ICU to go to the ward?

He left ITU 7 days post op once he no longer required organ support and his inflammatory markers had normalized.

Questions

1. Which of these drugs does not have a positive inotropic effect?

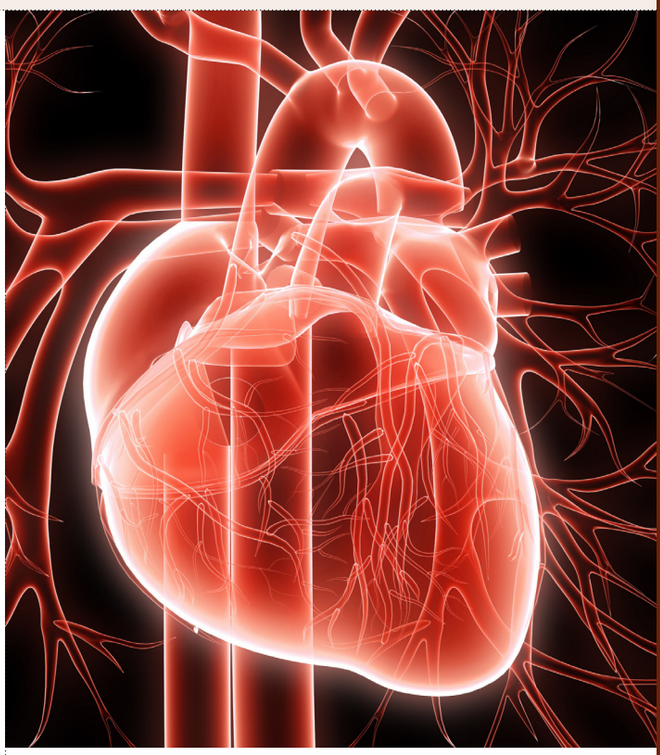
(a) Glucagon
(b) Levosimendan
(c) Digoxin
(d) Milrinone
(e) Nifedipine

2. What dose of adrenaline is administered during cardiac arrest?

(a) 1µg
(b) 1mg
(c) 1g
(d) 10mg
(e) 10µg

3. Which adrenoceptor mediates cardiac muscle contraction?

(a) α1
(b) α2
(c) β1
(d) β2
(e) β3



4. Which class of cardiac agents modify the degree of excitability of heart muscle?

(a) Inotropes
(b) Chronotropes
(c) Lusiotropes
(d) Dromotropes
(e) Bathmotropes

5. Which inotrope is a selective phosphodiesterase inhibitor?

(a) Adrenaline
(b) Noradrenaline
(c) Aminophylline
(d) Milrinone
(e) Methylene blue

Answers

1. (e) Nifedipine is a dihydropyridine calcium channel blocker that with its main indications being for angina and hypertension. The other four drugs have positive inotropic effects and in the clinical setting can be referred to as 'inotropes'. Glucagon acts via cAMP-dependent pathways, Levosimendan is a calcium sensitizer, digoxin acts via the Na+K+-ATPase pump and milrinone is a phosphodiesterase 3 inhibitor.

2. (b) For both anaphylaxis and cardiac arrest, the dose is 1mg, but using differing concentrations. For anaphylaxis the dose is 1mg IM (1mL of 1:1000). For cardiac arrest the dose is 1mg IV (10mL of 1:10 000).

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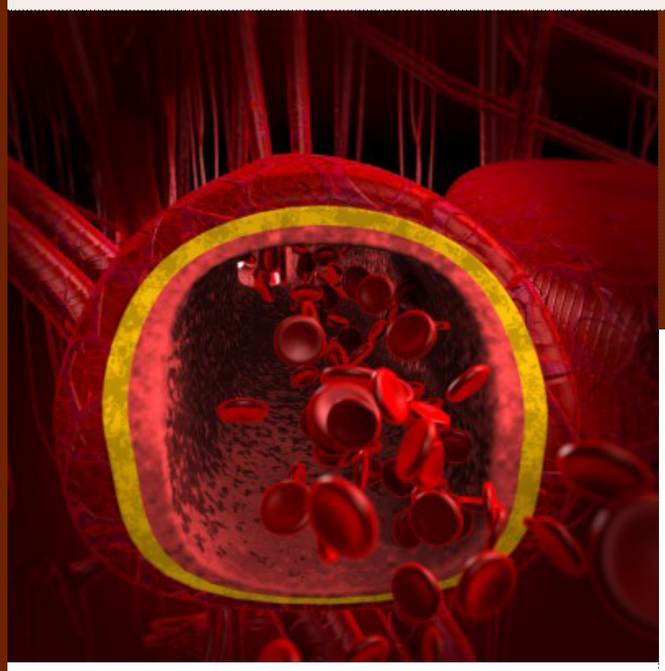

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3. (c) β1 receptors mediate an inotropic and chronotropic effect on the heart. β2 receptors mediate the main actions of bronchodilatation and vasodilatation. β3 receptors mediate lipolysis and thermogenesis. α1 receptors mediate vasoconstriction. α2 receptors cause centrally mediated bradycardia, vasodilation of peripheral vessels and platelet aggregation.

4. (e) Bathmotropes modify the degree of excitability of heart muscle. Inotropes increase the force of ventricular contraction. Chronotropes increase heart rate. Lusiotropes enhance myocardial relaxation. Dromotropes affects conduction velocity at the AV node, and subsequently heart rate.

5. (d) Milrinone is a phosphodiesterase 3 inhibitor and selective for this enzyme. Aminophylline is a phosphodiesterase inhibitor but it is not selective. Noradrenaline is a naturally occurring sympathomimetic, as is adrenaline. Methylene blue is a guanylate cyclase inhibitor.

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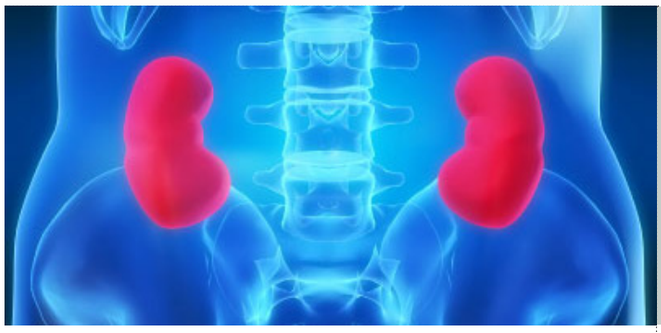
THE INVESTIGATION OF RENAL STONE DISEASE: A TRAINEES GUIDE

M Cumberbatch



The Investigation of Renal Stone Disease: A Trainees Guide. Urology.

Case study

As the CT1 on general surgical on-call, you are called to A&E to see a 36 year-old female who is in agony with left sided flank pain. She is unable to sit still on the examination trolley. She tells you that her father once had a kidney stone. How are you going to manage this patient?

Introduction

Renal stone disease is the result of impaction of a stone along the urinary tract. This may result in obstruction of the renal tract leading to complications such as pain, infection and a reduction in renal function. Stones are composed of minerals, for example uric acid and oxalate, and may be of mixed composition(1).

Renal stone disease has a lifetime risk of 5%. It is most common in men aged 30-60 years old. 90% are idiopathic, but risk factors include dehydration, immobility, and anatomical abnormalities such as horseshoe kidney. Metabolic abnormalities (e.g. hypercalcaemia secondary to hyperparathyroidism, vitamin D excess and cysteinuria) make up a further 10% of those at risk and one third of gout sufferers will have a stone episode. Uric acid stones also occur with high turnover purine in patients on chemotherapy. Furthermore, malabsorption (e.g. in Crohn's disease) leads to an increase in oxalate and thus stones.

When should I suspect renal stone disease?

The patient with renal stone disease will present with the following common features(1):

- Abrupt onset of colic pain.
- Severe pain with inability to remain still.
- They will localise pain to the affected flank and possibly report radiation from "loin to groin".
- Nausea and vomiting.
- Tachycardia.
- Pyrexia. Remember that "an obstructed hollow viscus leads to infection".
- Haematuria.

(2)

Important differentials(1)

- Appendicitis. In this case the pain usually starts central and moves to right iliac fossa (due to a switch from visceral to parietal pain fibre stimulation). Rovsing's sign may be present (pain replicated in the right iliac fossa (RIF) when the abdomen is palpated in the left iliac fossa (LIF)). There may be a pyrexia and raised inflammatory markers. It is commoner in younger patients.

- Diverticulitis. This usually presents with low abdominal pain, characteristically in the left iliac fossa and may be associated with bowel symptoms. It is commoner in the elderly.

- Ectopic Pregnancy. The patient will be female with a positive pregnancy test.

- Torsion of Ovarian Cyst. Again the patient will be female and the pain may come on during exercise. There may be a unilateral tender adenexae on vaginal examination(3).

- Biliary Colic. This will present with pain in the right upper quadrant and may follow a pattern with food intake.

- Rupturing AAA. The patient is likely to show signs of haemodynamically instability and may have a pulsatile, expansile mass on abdominal examination.

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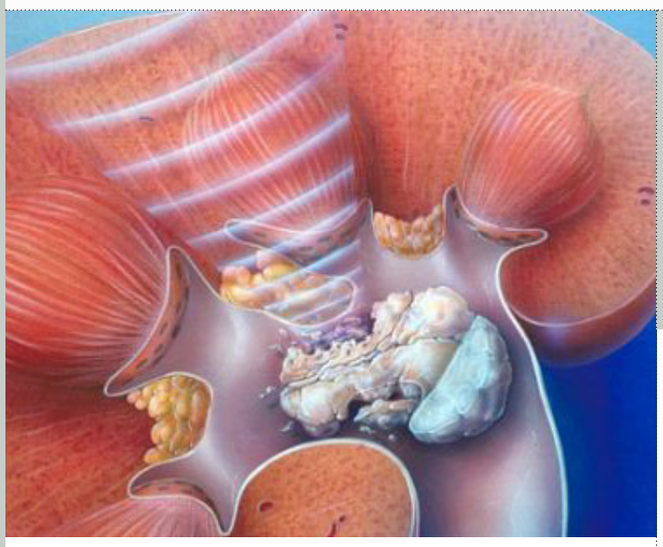


Investigation: how do I confirm my diagnosis?

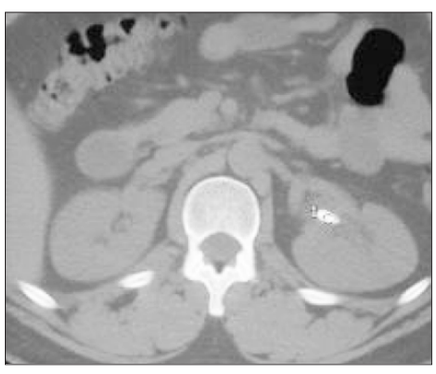
Types of investigation available:

· KUB plain film (An X-ray that exposes the Kidneys, Ureters and Bladder). 50% of stones are visible using this imaging modality. The renal outlines are seen at T12-L2. To assess for renal stones, follow the course of the ureters from this point down into the pelvis across the pelvic brim. The stone will be seen as a radio-opaque mass (NB. Urate stones (8% of urinary stones) are radio-lucent and as such will not be demonstrated using this technique)

· Intravenous Urogram (sometimes referred to as a contrast KUB). Contrast media is injected intravenously before serial X-rays are taken. Reveals information on obstruction, filling defects or abnormalities of bladder filling or emptying. Requires adequate renal function as contrast medium is nephrotoxic. Typically an eGFR of 50 and a creatinine of 100 are deemed acceptable.

· Renal Ultrasound. Reliable only for determining the presence of stones within the kidney matter itself. Will guide nephrostomy if this becomes necessary.

· Non-contrast computerised tomography (CT). Quick, sensitive and can determine the presence, location and size of radio-opaque and radio-lucent renal stones, and can elucidate alternative causes of flank pain which are not stone-related. This method avoids the complications of contrast (contrast leakage) and can be performed on those with poor renal function (avoids nephrotoxicity). This is the current Gold Standard (4,5).



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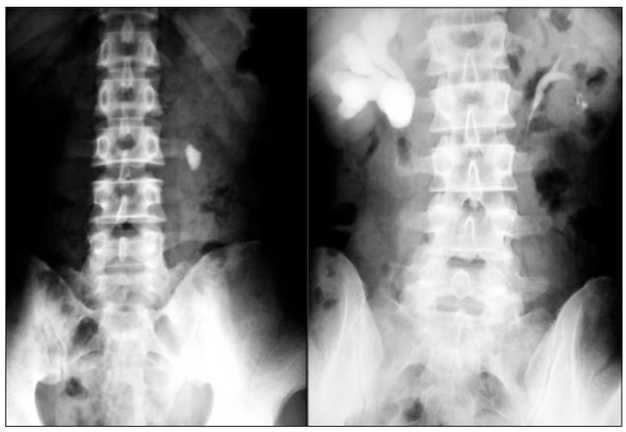
An Intravenous Urogram explained

1. Patient has urea and electrolytes blood tests checked for suitability.
2. They will lie supine whilst a plain film X-ray of the kidneys, ureter and bladder is taken.
3. Intravenous contrast will be injected.
4. Further X-rays will be taken at 1,5,10 and 15 minute intervals.
5. The Radiographer may compress the abdomen at intervals to facilitate ureteric contrast capture within the imaging process.
6. Patient may be asked to micturate so that a post-void film can be taken.

Advise on interpreting intravenous urograms (6)



[Plain film KUB with a stone in the left kidney].

[Intravenous Urogram with dilatation of the right renal pelvis caused by an obstructive stone]

Steps to interpreting an Intravenous urogram (7):

1. Assess the size of the kidneys. The normal kidney should range from 9-13cm from pole to pole. Symmetry should be evaluated.

2. Assess the inter-papillary line (see diagram – the inter-papillary line is represented by the dotted line).

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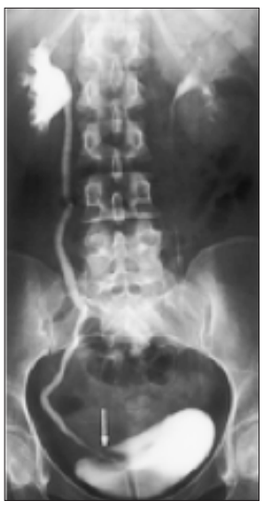
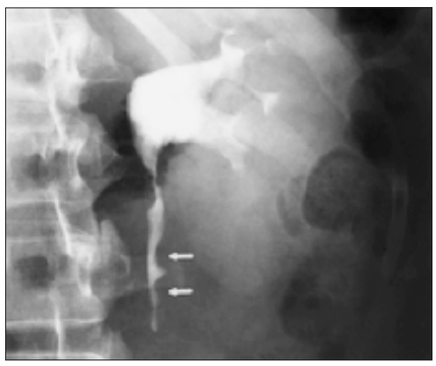
Indentations in this line represent an increase in parenchymal thickness. This may represent stone-related scarring.

3. Assess the position of the kidney. The upper pole should be partially under the 12th rib and the vertical axis in line with the psoas muscle. A change in position can represent a congenital abnormality or presence of a mass.
4. Assess the collecting system, calices and pelvis. Look in particular for size and shape. Calices should be chalice shaped. Blunting or rounding of this shape could represent increased pressure from a stone. Eventually, with high pressures, clubbing is seen.
5. Assess the filling of the ureters. Standing columns may represent obstruction at a level below the column. However, columns can be related to ureteric ileus secondary to inflammation. The ureters usually begin at the level of L3, passing along the transverse processes of the lumbar vertebrae. They then cross the iliac vasculature and pass into the anatomic pelvis, down the inner margin of the iliac bone into the urinary bladder.



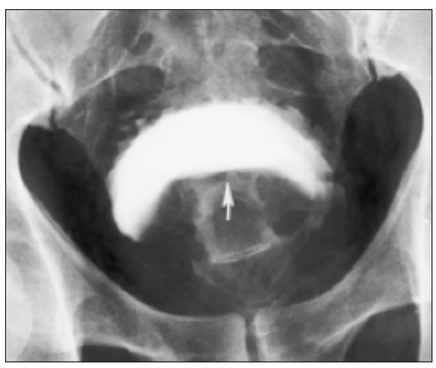
(Impacted stone at the vesico-ureteric junction) (7)

6. Assess Ureteric diameter. It is accepted that an absolute width or more than 8mm represents dilatation. However, asymmetric diameters are more significant. Chronic obstruction is related to greater dilatations than acute.
7. Assess the luminal surfaces of the ureters. Are there any point indentations or expansions that need explaining? There are expected indentations e.g. during normal peristalsis and where the ureters and the gonadal veins cross.



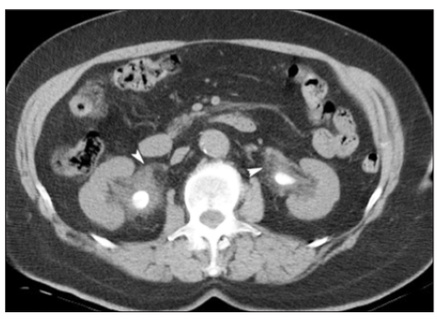
(Indentations made by the gonadal vessels) (7)

8. Assess the bladder. Observe for smooth and spherical filling. Post void films may also have been captured to evaluate bladder emptying and calculate the residual volume.



(Bladder base defect caused by Prostatic enlargement) (7)

A closer look at Non-contrast CT imaging of urinary stones (7)



[Bilateral renal pelvis calculi]

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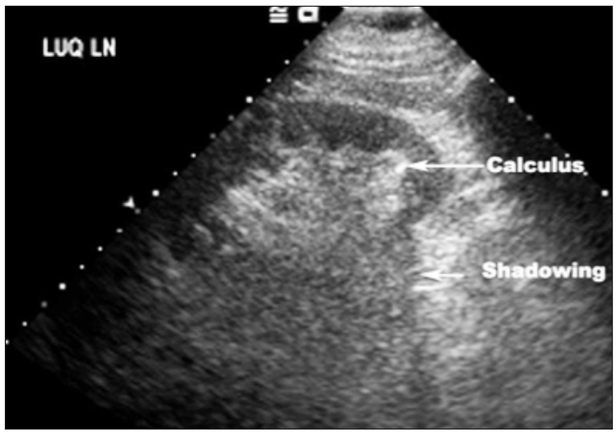
Advice on interpreting non-contrast CT

1. Follow anatomy caudally
2. Stones will appear as white, dense areas of opacification within the urinary tract architecture.

Ultrasound imaging of urinary stones (7)



Advice on interpreting renal ultrasound

1. Stones will appear as areas of highly echogenic foci
2. There may be distal shadowing caused by the stone.

Conclusion: What are the practical steps should you take to thoroughly investigate renal stone disease?

Step 1: Take a focused history and examination.

Step 2: Rule out coexisting infection with temperature, pulse and blood pressure readings and by taking routine bloods including a full blood count and c-reactive protein, urate and calcium. Determine the degree of obstruction and renal impairment by radiographic means and by analysing the urea, creatinine and glomerular filtration rate.

Step 3: Perform a urine dip to look for haematuria (90% of ureteric colic have microscopic haematuria). If the patient is young or a recurrent stone former then a urine cysteine can be performed also.

Step 4: Confirm diagnosis using Non-contrast CT and determine the location and size of the stone.

Step 5: If a stone is found on NCCT then an XR KUB should be ordered – as it has benefits for the follow up of patients, in fluoroscopic screening and in the use of extra-corperal shock wave lithotripsy (ESWL).

Top tips

- Urate stones are radio-lucent
- Non-contrast CT is the current Gold Standard investigation modality
- Signs of infection may mean pyonephrosis which needs immediate antibiotics cover (see your hospital protocol) and possible drainage by nephrostomy. Contact the Urology Registrar urgently.
- Investigation doesn't end with identifying a stone. The cause must be found and metabolic disease ruled out.

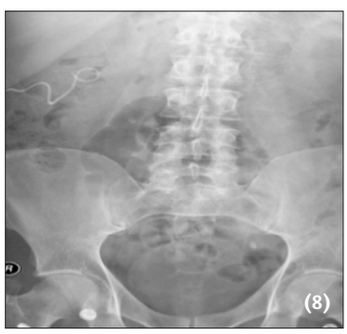
Questions

1. Where are the three most common sites for renal stones to lodge?

a) Within the kidney, within the bladder and at the pelvic brim.
b) At the pelvi-ureteric junction, within the kidney and within the bladder.
c) At the pelvi-ureteric junction, at the pelvic brim and at the uretero-vesicle junction.

2. This patient has had a nephrostomy. Why?

a) They had renal angle pain, a temperature and hydronephrosis on USS, and they were therefore diagnosed with pyonephrosis.
b) They had renal angle pain with raised inflammatory markers and a positive urine dipstick, and they were therefore diagnosed with pyelonephritis.
c) They had a stone at the level of the pelvi-ureteric junction on CTKUB and due to the high risk of obstruction they were offered a nephostomy.



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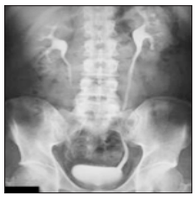
3. Which is the most important differential to rule out when diagnosing someone with renal colic?

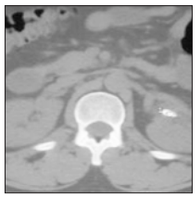
a) An abdominal Aortic Aneurysm.
b) Pancreatitis.
c) A ruptured ectopic.
d) all of the above.

4. Which of the below diagnositic tools is the gold standard investigation for a patient with renal colic (9, 10, 11)?

a)



b)



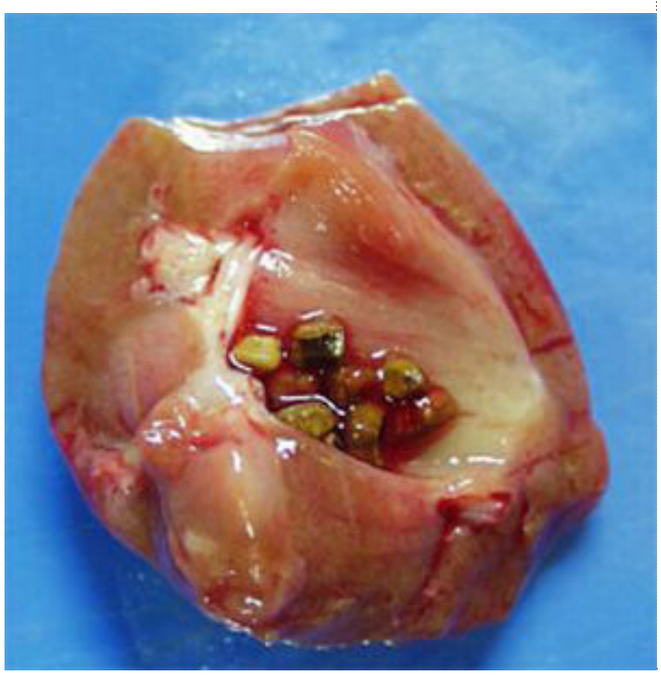
c)

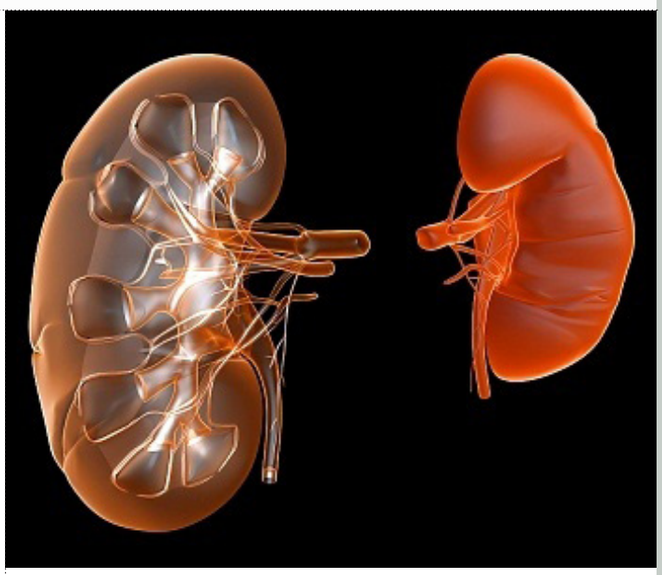
5. Which of theses statements is correct?

a) Urate stones are radio-opaque.
b) Hypocalcaemia and hyperparathyroidism are risks for renal stone disease.
c) Gout sufferers are likely to get stone disease.

Answers

1. (c)
2. (a)
3. (d)
4. (c)
5. (c)





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FLEXIBLE FIBREOPTIC LARYNGOSCOPY

J Risley

Flexible Fibreoptic Laryngoscopy.
Otorhinolaryngology & Neck Surgery.

Most surgical trainees will at some point encounter the flexible scope. Whether it be during a formal post as an ENT SHO or cross-covering at night, it is likely that you will be expected to use this bit of kit. You may also be asked to perform the examination on a model as part of the DO-HNS OSCE.

The good news is that it is just as easy as passing an NG tube, and even simpler due to the fact that you can actually see where you are going.

This article intends to talk through a step by step approach on how to use it, as well as defining the anatomy and landmarks that you should document.

The indications for using the scope (or P3, FLO amongst many other names) are varied, and we have split them into those encountered during routine working hours (Table 1) and also on call out-of-hours indications (Table 2):

OPD Clinic	
Nasal obstruction	Assess for a deviated septum, rhinitis, hypertrophied turbinates, post nasal space lesions.
Epistaxis	Any prominent vessels or lesions not seen via anterior rhinoscopy.
Otitis media with effusion	In the older age group examine post nasal space for lesions obstructing the Eustachian tubes.
Acute sore throats with voice change	Any evidence of supraglottitis or epiglottitis
Chronic odynophagia	Evidence of malignancy.
Dysphagia	Any oropharyngeal lesions, benign webs, strictures
Any neck lump	Evidence of malignancy.
Hoarseness of voice	Examine for vocal cord lesions and mobility.
Pre-operative documentation	Prior to thyroid procedures to assess cord mobility, in case of recurrent laryngeal nerve injury and post op hoarseness Vocal cord appearance prior to surgical intervention for vocal cord polyps etc.

Table 1

Oncall	
Stridor	Assess the patency of the airway
Epistaxis	Following removing of nasal packing, to assess for any prominent vessels.
Fish bone in throat or obstructed food bolus.	Assess for any obvious foreign body or pooling of saliva.

Table 2

Once deciding that its use is indicated, you should now proceed to inform the patient of what you are going to do. Walking towards a patient brandishing the scope with a look of uncertainty in your eyes can easily raise the anxiety levels of patients, so it is important to point out that it will not hurt, but that it may be uncomfortable. Verbal consent is sufficient for this procedure.

The use of local anaesthetic spray is a personal one, as although it may make it slightly more comfortable, the spray itself can be unpleasant. A common spray used is Xylocaine 1%. Remember to spray both nostrils as one nasal passage may be tighter than the other and hence make the introduction of the scope more difficult. Warn the patient not to have anything hot to eat or drink for the next few hours, as the anaesthetic will work its way from the nose into the oropharynx, resulting in the patient inadvertently burning their throat or aspirating.

Once the nasal cavity is anaesthetised, it is time to pass the scope. Place a small amount of Aquagel onto the end of the scope. Remember to pass it along the floor of the nasal cavity not upwards. Keep asking the patient to breathe through their nose, as this will open the nasopharynx. Thus, after passing it directly along the floor of the nose and into the post nasal space, you should be able to curve the tip downwards and pass it through into the oropharnyx and then the hypopharynx until the vocal cords are clearly seen in the larynx.

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Below in table 3 are the various bits of anatomy that you will come across, along with the important things to document:

Nose	
Septum	Deviation or perforation, septal spurs prominent vessels for cautery. (Fig 1)
Middle meatus	Mucopus, polyps (Fig 2)
Post Nasal Space	
Post nasal space	Adenoidal hypertrophy, masses, patency of Eustachian tubes. (Fig 3)
Throat	
Base of tongue and lingual tonsil	Ask the patient to open their mouth and put their tongue out to open up this space and see the valleculae (Fig 4)
Vallecula	Oedema, erythema, or lesions. (Fig 5 & 6)
Epiglottis	Oedema, erythema, or lesions. (Fig 4)
Piriform Fossa	Oedema, erythema, pooling or lesions. (Fig 8)
Arytenoids and aryepiglottic folds	Examine for erythema and oedema (Laryngopharyngoreflux/LPR). (Fig 7)
Vestibular folds/False Cords	Oedema, erythema, or lesions. (Fig 8)
Hypopharynx	Ask the patient to valsalva – this will open up the post cricoid region (Fig 7)
Vocal cords	Assess movement, and for lesions such as nodules, cysts, polyps, oedema or malignancy. Ask the patient to say 'eeeeeeee' and then the days of the week. Look at how the cords are moving – is there a phonation gap or paralysis? (Fig 8)

Table 3

A problem you may encounter is misting - ask the patient to swallow - the saliva should de-mist the end, or you can dab the end of the scope on an alcohol Steret before the examination begins.

Some departments will have the scope linked up to a display unit, enabling the examination to be recorded. If you see any pathology, print out a photo for the notes – extremely useful for future examinations as reference. Also, if you feel that the patient warrants a referral to the Speech and Language Team, a photo of the cords during phonation can be very useful for them and will be appreciated.

Once the examination is finished, remove the scope and clean it. There will be a cleaning system which usually requires a three stage process. You then need to document your findings in the notes along the lines below.

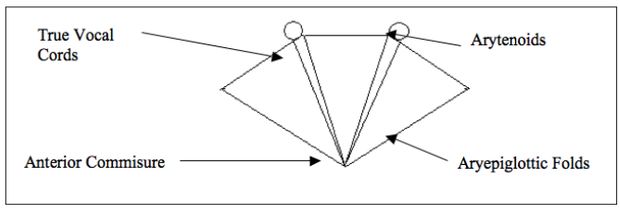

Diagram 1

Like a lot of the ENT examination, the interpretation of findings is subjective – it is important to consult a senior.

Practice makes perfect and the only tried and tested way to improve your ability is to gain more experience, so try to scope as many patients as opportunity will allow and treat it as a learning opportunity.

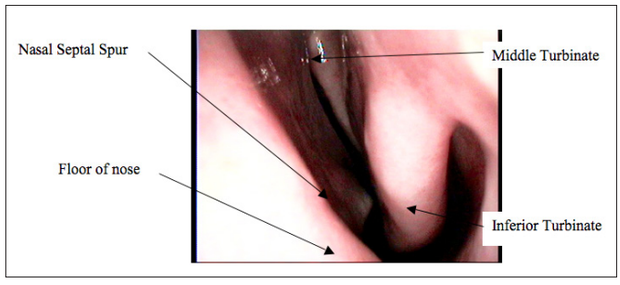

Figure 1: Inferior turbinate.

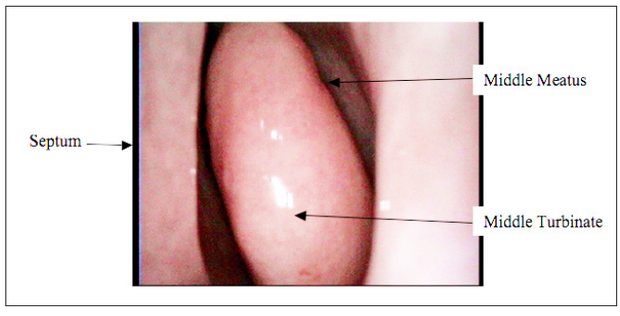

Figure 2: Middle Turbinate.

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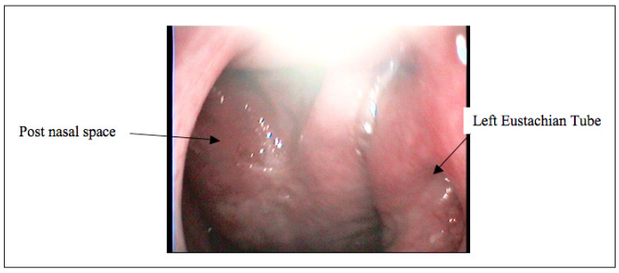

Figure 3: Post nasal space.

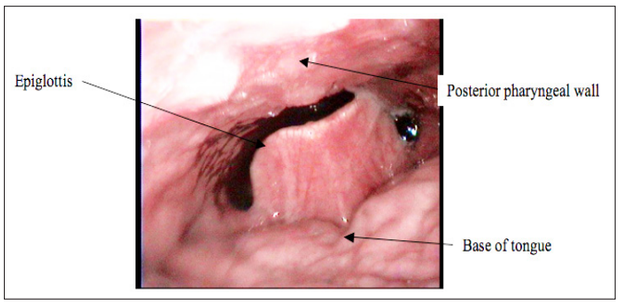

Figure 4: Base of tongue.

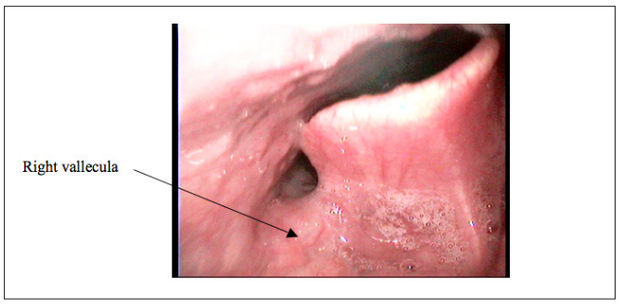

Figure 5: Right vallecula.

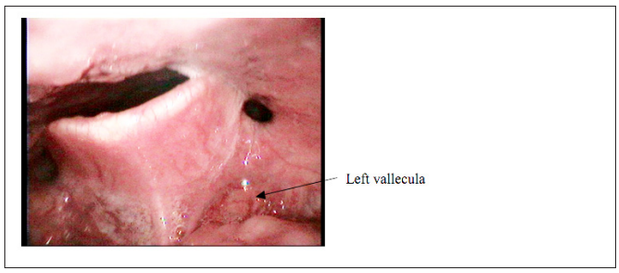

Figure 6: Left vallecula.

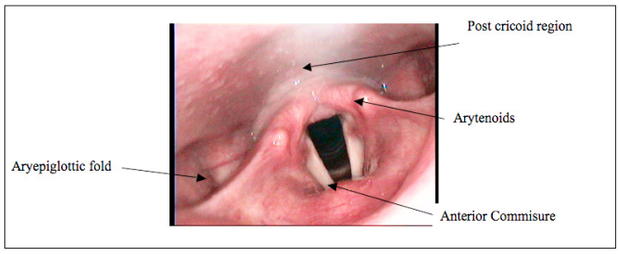

Figure 7: Laryngeal inlet on inspiration.

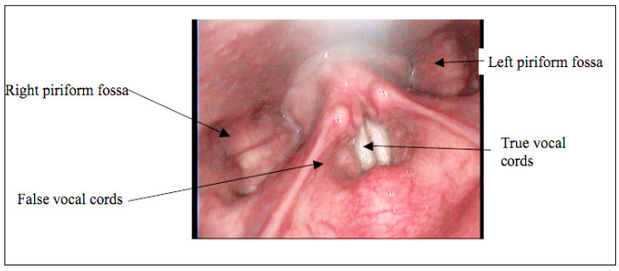

Figure 8: Laryngeal inlet on phonation.

FLEXIBLE FIBREOPTIC LARYNGOSCOPY

J Risley

Flexible Fibreoptic Laryngoscopy.
Otorhinolaryngology & Neck Surgery.

Questions

True or false?

1) Sensory innervation to the glottis is from the internal branch of the superior laryngeal nerve.

2) Cricothyroid muscle is innervate by the superior laryngeal nerve.

3) The lateral cricoarytenoids muscles adduct and internally rotate the arytenoids.

4) Abduction of the vocal cords is via the posterior cricoarytenoid.

5) The larynx consists of nine cartilages.

Answers

1) True

2) True

3) True

4) True

5) True

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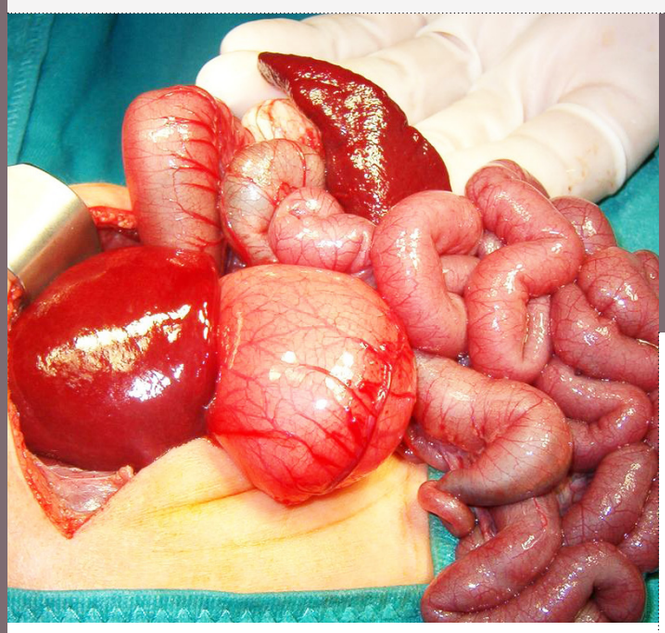
CONGENITAL DIAPHRAGMATIC HERNIA

S Jayakumar



Congenital Diaphragmatic Hernia.
Paediatric Surgery.

A newborn male infant at 34 weeks gestational age is born by c-section to a 27 year old primigravida mother who conceived an IVF pregnancy. She has no significant past medical history and routine antenatal scans were normal. At birth, the baby cried immediately and the APGAR scores were 8 and 10 at 1 and 5 minutes respectively. Within an hour of birth the baby developed respiratory distress. Surfactant was administered and a chest X-ray was taken and is shown in figure 1.

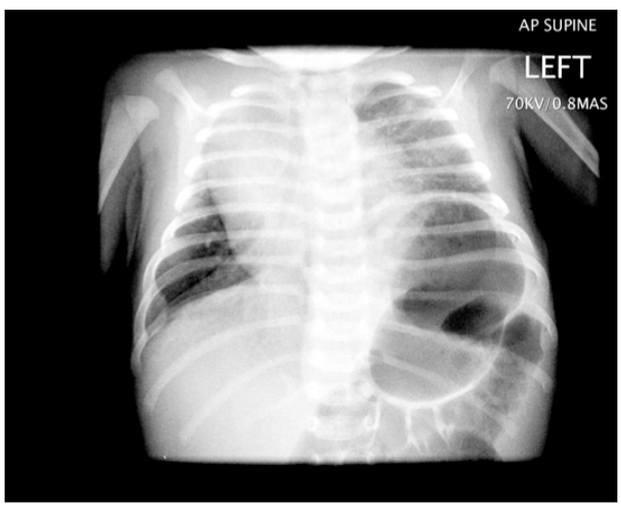


Figure 1

1. What is the initial management for this neonate?

2. What are the differential diagnoses?

3. Is surgery required immediately?

Introduction

The first description of congenital diaphragmatic hernia (CDH) was made by McCauley in 1754.(1) Further reports of CDH followed in the 18th century and the most common type of CDH – posterolateral was described by Bochdalek, who postulated the embryology behind this type of CDH(2), and it still carries his name today. In 1946, Gross performed the first successful repair and survival of a neonate with CDH less than 24 hours old.(3) Despite further advances in neonatal care and ventilation strategies, management of CDH patients poses significant challenges. This article focuses on the epidemiology, etiology, embryology, pathophysiology, diagnosis, antenatal and postnatal management and surgical correction.

Epidemiology

Historically, the incidence of CDH has been reported as 1 in 3,600 live births and if the affected fetuses are also taken into account the incidence increased to 1 in 2,200.(4) Amore recent study in the UK showed a birth prevalence of 3.5/10000 births among 547,025 births(5) Most CDH defects are seen on the left side; around 80% and 20% are seen on the right side. Bilateral CDH have been reported but they are very rare.(6)

There is a 60% male predominance reported in a large study that included live births only(7). However, if stillbirths are included, there is a slight female preponderance.(8)

Etiology

The exact cause of CDH is still unknown. Although genetic predisposition has been reported sporadic occurrence of CDH is still most common. CDH can present in isolation or with other non-CDH related congenital anomalies like central nervous system, cardio-vascular and skeletal abnormalities. In cases detected prenatally the incidence of non-CDH related congenital anomalies was reported as high as 72.7%, whereas the incidence of non-CDH related congenital anomalies in postnatally detected CDH patients was only 36.3%.(9)

CONGENITAL DIAPHRAGMATIC HERNIA

S Jayakumar

In the UK the incidence of non-isolated CDH incidence was reported around 46% in a large study.(5) Non-isolated CDH has been associated with many syndromes including Fryn's, Donnai – Barrow, Thoracoabdominal, Craniofrontonasal, Cornelia de Lange, Beckwith-Weidemann and Simpson-Golabi-Behmel syndromes. CDH has also been reported in association with chromosomal abnormalities, more commonly as seen in Trisomy (13, 18, 21) and Turner's Syndrome.(10) The search for the gene responsible for CDH is still ongoing. However genetic testing and counselling should be offered to all patients with non-isolated CDH.

Embryology

The diaphragm as shown in figure 2; develops from four distinct components: (i) Pleuroperitoneal folds, (ii) Septum transversum, (iii) Oesophageal mesentery and (iv) Thoracic intercostals muscle group (Lateral body wall). It is believed that the failure of closure of the pleuroperitoneal folds that occurs in normal fetuses at 8-10 weeks of gestation, results in CDH.(11) Subsequently the abdominal viscera herniate into the thoracic cavity and restrict the development of the ipsilateral lung and also produce a mediastinal shift that in turn affects the development of the contralateral lung. This results in pulmonary hypoplasia and subsequent pulmonary hypertension which play a large role in the morbidity and mortality of patients with CDH. Anatomically the right hemi diaphragm closes first and also the development of liver on the right side prevents easy access for the bowel to herniate. This might explain the increased incidence of left sided CDH.

Around 6 weeks of gestation, physiological herniation of the developing midgut occurs into the extra-embryonic coelom of the umbilical cord. The gut proliferates rapidly while outside and returns to the abdominal cavity by 12 weeks of gestation. By this time the diaphragm had developed separating the pleural and peritoneal cavity. In cases of CDH the development of diaphragm is defective and thus the gut herniates into the pleural cavity. The normal fixation of gut producing a broad mesentery is absent and the bowel is non-rotated in most cases of CDH. Almost all the contents of the abdomen have been reported to be seen in the pleural cavity including liver, spleen, kidneys and entire GI tract.

Figure 2: Embryology of Diaphragm

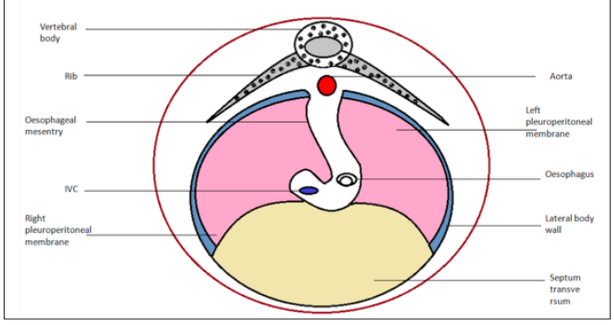
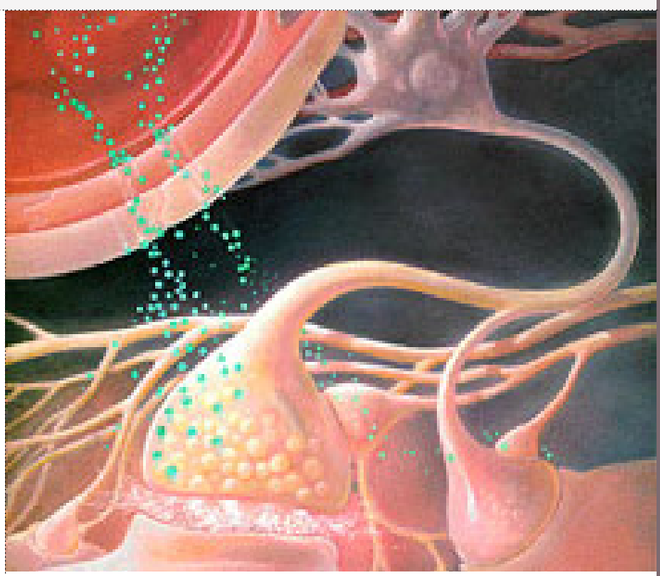


Figure 2



Pathophysiology

Most commonly the defect in CDH appears posterolaterally and this is referred as the Bochdalek hernia. The defect can occur anteriorly as well and this is referred as the Morgagni's hernia. The central tendon of the diaphragm might be deficient and this defect is also reported. A hiatus hernia as seen in the adults is also seen in the neonates and could be congenital. Congenital eventration of diaphragm is a rare type of CDH and is indistinguishable from the common CDH with hernial sac. The diaphragm is weak or poorly developed and allows herniation of abdominal viscera into the chest. The weakness could also be the result of a traumatic injury at birth or can be seen in cases of acquired phrenic nerve paralysis.

Fetal lung development starts at 3rd week of gestation and is divided into 5 stages: embryonic, pseudoglandular, canalicular, saccular and alveolar.(12) The pseudoglandular phase takes place between the 7th and 16th weeks of gestation. In fetuses with CDH this phase of lung development is affected and therefore subsequent stages of lung development as well. Lung growth seems to be influenced primarily by physical factors such as intrathoracic space, lung liquid volume and pressure, and amniotic fluid volume.(12) In fetuses with CDH the physical factors induced by herniated abdominal viscera, hinder the development of not only the ipsilateral lung but also the contralateral lung as well producing significant pulmonary hypoplasia.

Pulmonary vasculature development occurs at later stages of lung development. In utero the pulmonary blood flow accounts for only 7% of the cardiac output and this ratio is completely inversed immediately after birth. At the first breath, haemodynamic changes occur in the circulation of the baby and as the lungs expand the pulmonary vascular resistance falls dramatically. In cases of CDH due to pulmonary hypoplasia and poorly developed pulmonary vasculature the pulmonary vascular resistance remains high creating pulmonary hypertension. This results in significant shunting of blood and hypoxia. Thus ECMO (Extracorporeal membrane oxygenation), high frequency ventilation and nitric oxide have a role to play in these patients.

CONGENITAL DIAPHRAGMATIC HERNIA

S Jayakumar

Congenital Diaphragmatic Hernia.
Paediatric Surgery.

Diagnosis

Antenatal: Prenatal ultrasound scans can detect CDH in fetuses as early as 11 weeks of gestation and are a good initial investigating tool. Polyhydraminos with findings of stomach and other abdominal viscera in the chest suggest CDH on USS. However USS can miss CDH with small defect and also to note it is observer dependant. In a study on 136 patients with CDH, the false-negative rate remained approximately at 55%.(13) Fetal MRI has shown to add more information of the nature of the defect in CDH fetuses along with detection of associated anomalies.(14)

Postnatal: In a large study on 201 patients with CDH, antenatal scans detected the abnormality in only 50% of the patients, (13) suggesting many patients with CDH are still detected postnatally. At birth, respiratory distress is the first sign noted in CDH patients and the respiratory symptoms according to the degree of pulmonary hypoplasia and pulmonary hypertension. Further examination reveals a scaphoid abdomen and bowel sounds may be heard in the chest. A plain chest x-ray is sufficient to diagnose most patients with CDH. The demonstration of gastric bubble in the chest with the placement of a nasogastric tube confirms the diagnosis. Also mediastinal shift with poorly ventilated ipsilateral and contralateral lung may be noted on the chest x-ray. Very rarely an upper GI contrast may be necessary to differentiate the diagnosis from congenital cystic disease of lung and complete agenesis of lung.

Antenatal management

Prenatal diagnosis of CDH should be evaluated in detail, looking in particular for prognostic factors like associated anomalies, Liver herniation, Lung head ratio (LHR) and side of defect. Fetal MRI supplements the confirmation of diagnosis with addition of information on other prognostic indicators. A metanalysis of 19 studies showed that MRI measurements of fetal lung volumes, liver position and side of the defect correlated well with neonatal survival in fetuses with isolated CDH.(15) Amniocentesis or fetal blood sampling for karyotyping to detect chromosomal disorders is offered upon detection of non-isolated CDH. All CDH patients should be planned for delivery at tertiary centers' to facilitate prompt and adequate resuscitation at birth. Adequate counseling of parents is essential in all cases of CDH and careful consideration of termination of pregnancy could be offered in CDH patients with chromosomal disorders known to be incompatible with life.

Fetal intervention

In patients with CDH, pulmonary hypoplasia and resultant pulmonary hypertension dictate their survival. Therefore, fetal interventions aimed at promoting lung growth have been attempted. Fetal endoscopic tracheal occlusion (FETO) around 24 weeks of gestation with a tracheal balloon and removal at 34 weeks of gestation has been attempted in many experimental studies. The principle of FETO is that fetal tracheal occlusion results in lung enlargement and thereby promoting lung growth. Many trials on FETO have shown improved survival rates in fetuses with CDH.(16) However, as this is still in the experimental stages a randomized controlled trial in Europe has been started (TOTAL trial)(17) and its results would add evidence on the benefits of FETO.

Postnatal management

At birth, patients with CDH should be resuscitated adequately aiming to stabilize the cardio-respiratory status. CDH patients develop respiratory distress corresponding to the degree of pulmonary hypoplasia. Endotracheal intubation is carried out and conventional ventilation started. A nasogastric tube should be inserted and aspirated to decompress the stomach in all cases. The stomach and intestine are intrathoracic in most cases of CDH and therefore CPAP (Continuous positive airway pressure) and mask ventilation are contraindicated. Immediate intravenous access must be secured and the patient fluid resuscitated adequately. Umbilical artery and venous catheters are inserted to aid blood gas sampling and measurement of central venous pressures.

Most patients with CDH can be managed with conventional ventilation. Ventilation strategies should be aimed at keeping low pressures and modifying the pulmonary vascular tone to reverse pulmonary hypertension. Nitric oxide (NO) is a potent vasodilator and also an easily diffusible gas. It has been administered in CDH patients with improvement in oxygen saturation levels.18 High frequency oscillatory ventilation (HFOV) has been shown to reduce the injury to lung during ventilation and also effective in removing carbon dioxide. A study compared outcomes including survival and chronic lung disease in 65 CDH patients who had either conventional ventilation and systemic vasodilators or HFOV and NO. The results showed significantly improved survival (38% vs. 73%) and chronic lung disease (45% vs. 30%) with elective use of HFOV and NO compared to CMV and systemic vasodilators.(19) Despite the advances in ventilation strategies the management of CDH patients with severe pulmonary hypoplasia remains challenging.

CONGENITAL DIAPHRAGMATIC HERNIA

S Jayakumar

ECMO

Extracorporeal membrane oxygenation (ECMO) support is offered to patients whose heart and lungs are diseased and unable to support adequate oxygenation and carbon dioxide removal. Evolved from the heart-lung bypass unit, it was initially offered to patients following cardiac surgery for postoperative support. Its use has now been extended to neonates with significant lung disease as seen in patients with CDH and meconium aspiration. An example of ECMO circuit model is shown in figure 3. In CDH patients who have failed to stabilize the cardio-respiratory status with conventional and high frequency ventilation and NO therapy are considered for ECMO. Patients who have a high oxygen index and a high predictive mortality on conventional ventilation have been considered for ECMO as well. Lung head ratio (LHR) <1.0, prematurity and liver herniation have been shown as significant prenatal predictors of the need for ECMO or survival in cases with CDH.20 However, the clinical criteria for offering ECMO to CDH patients have to be evaluated carefully taking in consideration anomalies that are incompatible with life such as Edward's and Patau syndrome.

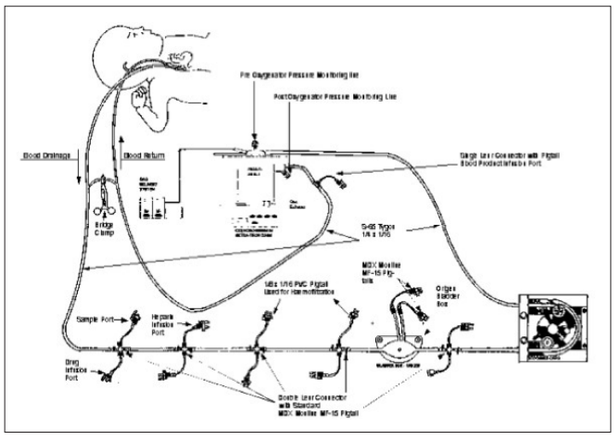
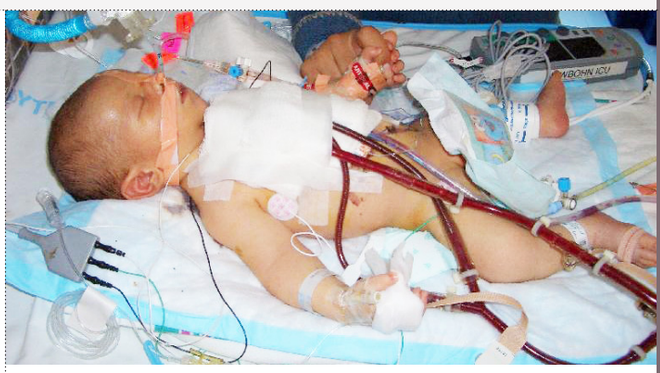


Figure 3: VA-ECMO circuit model

Surgical repair

Stabilising the cardio respiratory status of the patient is essential prior to surgical repair of CDH. Immediate surgery to reduce the hernia is not required. The survival of patients with CDH undergoing early repair (within 4 hours of birth) or delayed repair (more than 24 hours after birth) were similar in a randomized study on 44 patients.(21) The aim of repair is to reduce the herniated contents back into the abdomen and close the defect. Mobilisation of herniated liver and spleen pose significant challenge and care must be taken to avoid disruption of blood supply to these organs. The defect in diaphragm can be approached by a subcostal incision or by a thoracotomy. A hernial sac can be seen during the repair and this should be excised completely. Association of hernial sac and recurrence of hernia has been reported as high as 45% in a study on 66 CDH patients.(22)



Minimally invasive repairs by laparoscopy or thoracoscopy have also been described. Both minimally invasive techniques have been shown to have successful outcomes, although thoracoscopy is preferred in neonates with posterolateral Bochdalek defect.(23) Many studies have compared the outcomes of open and minimally invasive techniques. Even though thoracoscopy is gaining popularity the recurrence rates reported are high. A large study on 4,400 CDH patients reported a recurrence rate of 7.9% with 151 thoracoscopic repairs in comparison to 2.7% with 4,249 open repairs and this was statistically significant (p value<0.05).(24)

Small defects can be closed primarily with non-absorbable sutures. However larger defects as in cases of agenesis of hemidiaphragm, may need a patch repair with a prosthetic material. In a study on 182 patients who underwent CDH repair, 31% required patch repair (PR) and 64% were repaired without a patch. The baseline characteristics of both groups were similar, however PR was shown as an independent predictor of mortality with an odds ratio of 17.1 (95%CI 2.0–149.2) and was independently associated with secondary outcome measures of morbidity, including the need for oxygen at discharge and the duration of ventilation.(25)

Various prosthetic materials have been used. The common ones used are Gore-tex, Surgisis and Permacol. Gore-tex is a synthetic prosthetic material made of poly-tetra-fluro-ethylene (PTFE), while Surgisis is a bioactive prosthesis. The type of prosthetic material used is an individual preference. Grethel et al showed that the Incidence of recurrence and small bowel obstruction was similar in 72 patients who had either Gore-tex or Surgisis patch repair for CDH.(26)

Post-operative management should be tailored towards stabilizing the cardio respiratory status. Post-operative complications include bleeding, sepsis, pneumothorax, abdominal compartment syndrome, bowel adhesions and recurrence. Although direct monitoring of intarabdominal pressure (IAP) is difficult, intravesical catheter has been used to monitor the IAP indirectly. (27) A retrospective study on 155 neonates suggested that intra-abdominal pressure of ≥20 mmHg can be considered as a point of development of abdominal compartment syndrome. The grade of hypertension was noted to be in close correlation with patient outcome.(28) In the long term, despite successful surgical repair a significant amount of co-morbidities are seen in CDH patients including gastro-esophageal reflux, chronic lung disease, chest wall deformities and neurodevelopmental delay.

CONGENITAL DIAPHRAGMATIC HERNIA

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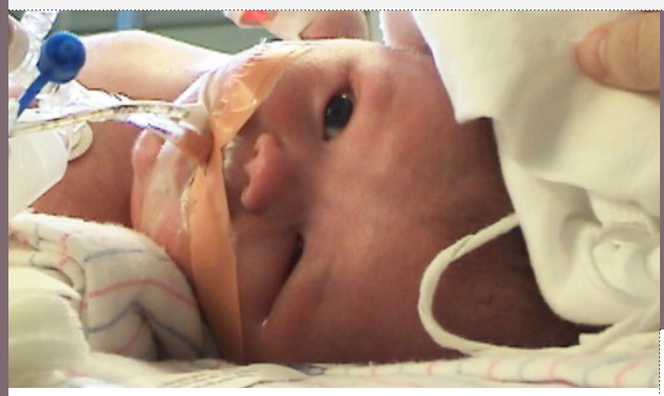

Congenital Diaphragmatic Hernia.
Paediatric Surgery.

In summary, despite further advances in neonatal care and ventilation strategies, management of CDH patients poses significant challenges. The exact cause of CDH is still unknown. Antenatal scans detect CDH abnormality in only 50% of the patients. Stabilising the cardio respiratory status of the patient is essential prior to surgical repair of CDH. Although a wide range of morbidity and mortality rates are reported, the prognosis of isolated CDH patients who have undergone successful repair is good.

Questions, Choose One Answer.

1: The diaphragm develops from the following except:
a) Pleuroperitoneal folds
b) Septum transversum
c) Thoracic intercostals
d) Oesophageal mesentery
e) Aortic mesentery

2: Congenital diaphragmatic hernia is more common on the left side, as
a) The left hemi diaphragm closes first
b) The right hemi diaphragm closes first
c) The liver prevents easy herniation of bowel through the left hemi diaphragm
d) The left lung is significantly smaller than the right lung
e) Small bowel selectively herniate through the left hemi diaphragm

3: The following are suggestive of CDH except:
a) Abdominal viscera seen in the chest at 20 weeks antenatal scan
b) Chest x-ray showing NG tube curling up into the chest
c) Bowel sounds heard during chest auscultation
d) Scaphoid abdomen
e) Oligohydraminos on antenatal scans

4: The prognostic factors detected on antenatal scans in a fetus with CDH include all except:
a) Herniation of liver
b) Presence of stomach in the chest
c) Associated anomalies
d) Lung head ratio < 1.0
e) Side of the defect

5: The initial management of antenatally diagnosed CDH in a neonate with respiratory distress is to
a) Start CPAP (continuous positive airway pressure)
b) Intubate and ventilate the patient with minimal inspiratory and expiratory pressures
c) Immediate surgical repair of CDH
d) Start ECMO support
e) Obtain upper GI contrast study to confirm the diagnosis

Answers

1: e) 2: b) 3: e) 4: b) 5: b)

Acknowledgement

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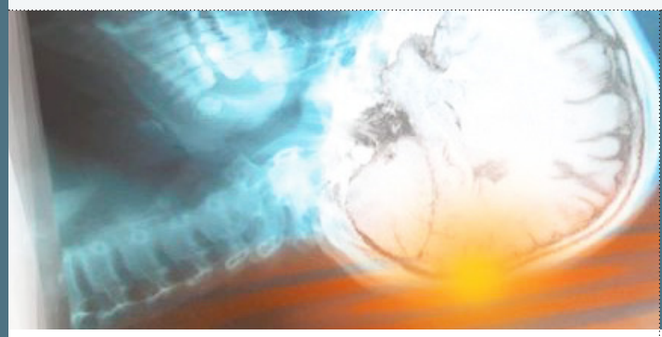
CERVICAL SPINE TRAUMA MANAGEMENT

M Petrie, F Shivji



Cervical Spine Trauma Management.
Neurosurgery.

Poly-trauma patients often have complex and multiple injuries. One of the greatest responsibilities, beyond the 'golden hour', involves clearing and managing trauma to the cervical spine. High cervical spine injuries can be fatal. Cervical spine injuries can result in tetraplegia causing significant detriment to quality of life and a considerable economic and social burden. (1) A cervical spine injury should be assumed in any patient who has suffered multisystem trauma, especially with an altered level of consciousness or due to a blunt injury above the clavicle.

Epidemiology

Cervical spine trauma can occur at any age, with peaks between 15-35 years and greater than 65 years of age. Cervical spine injuries occur in 1.5-3.0% of all major trauma cases and are commonly due to motor vehicle accidents (50-70%) or falls (6-10%).(2,3) The majority of spinal injuries occur within the cervical spine (55%)(1) and are often associated with both cerebral injury or a further fracture in a non-contiguous vertebrae (10-20%).(4) Cervical spine injuries can be unstable (20-75%) and 30-70% of these injuries have an associated neurological injury.(2,4)

It has been suggested that between 3 and 25%(2) of spinal cord injuries occur during stabilisation within the field, transfer of the patient to hospital or after arrival at the emergency department. Progression of neurological injury can be witnessed in more than 5% of patients after arrival at the emergency department.(4) The aim is to minimise secondary injury, as the primary trauma cannot be influenced.

Initial Assessment and Management of Cervical Spine Trauma

Use of the ATLS protocol is accepted practice in the UK and requires rapid and systematic assessment of the patient. The goal of the 'primary survey' is to identify and treat immediately life-threatening injuries. The following sequence is widely practised.(4)

A - Airway maintenance with cervical spine protection
B - Breathing and ventilation
C - Circulation with haemorrhage control
D - Disability: Neurologic status
E - Exposure/environmental control: Undress, but prevent hypothermia

Airway maintenance with cervical spine protection

Whilst assessing the patient's airway the head should be maintained in a neutral position using manual in-line stabilisation until appropriate immobilisation can be employed. The patient should be supine, with the spine in a neutral position on a spinal board, and secured using the attached straps.

A semi-rigid neck collar with blocks (or sand bags), secured by tape across the forehead, is used to protect the cervical spine, the so-called 'triple immobilisation'. These devices should remain in place until cervical spine injury can be excluded.(4)

A 4-man log roll should be used to move the patient if necessary. Every effort should be made to remove the patient from the spinal board as soon as practically possible to reduce the risk of pressure sores. It should be remembered that infants have a relatively large occiput and placing these patients supine leaves the neck in relative flexion. A folded sheet or similar can be used to raise the body 1-2cm, leaving the head unsupported at the occiput, restoring a neutral position of the cervical spine.(4)

Figure 1:
a) In-line stabilisation
b) Immobilisation with semi-rigid collar, blocks and tape (triple immobilisation)

Situations may occur where it becomes impossible to immobilise a patient. Forced restraints in patients that are agitated secondary to hypoxia, intoxication, shock or head injury can risk further injury to the spine and it may be safer to remove them.(4)

Measures to establish airway patency should be performed whilst protecting the cervical spine as described above. The chin-lift or jaw-thrust manoeuvres are the recommended techniques.

CERVICAL SPINE TRAUMA MANAGEMENT

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In addition to cervical spine stabilisation, attention to the primary survey is of paramount importance to outcome in cervical spine trauma. Ensuring the cord is adequately perfused with oxygenated blood minimises secondary injury and will be achieved if the primary survey is respected. The goals of spinal cord management are 'protection and perfusion'. Vigilance to the presence of neurogenic shock (a cardiovascular phenomenon) is essential, inotropic support may be required alongside adequate fluid resuscitation (often requiring central venous pressure monitoring).

Previously a lateral cervical spine radiograph was considered an imaging 'adjunct' to the primary survey in conjunction with both a chest and AP pelvic radiograph. This investigation has no practical use at this point in the ongoing resuscitation and is no longer considered part of the 'trauma series'.

1. Spinal immobilisation is a priority in multiple trauma patients; spinal clearance is not. Protect the cord.

2. Primary survey with on-going resuscitation is vital. Perfuse the cord.

3. Imaging the spine no longer occurs in the primary survey.

4. The spine should be assessed and cleared when appropriate.

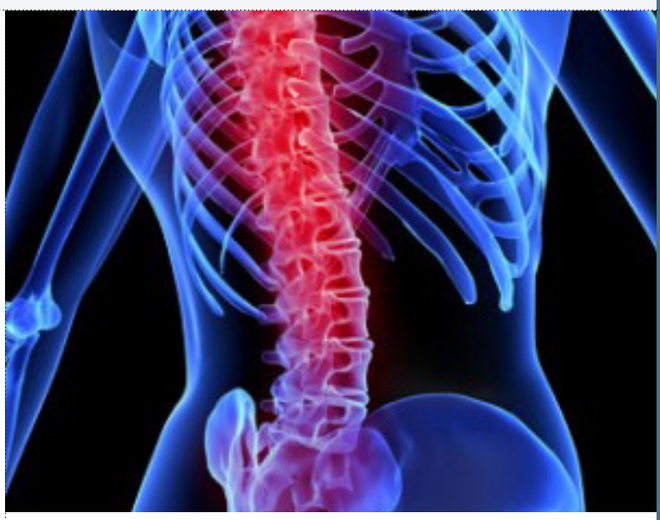
Secondary Survey

The secondary survey is a complete history and head-to-toe examination of the patient. The objective is to identify and treat potentially life-threatening injuries and recognise all other systemic injuries.

The spine is examined during the secondary survey using the log roll technique, respecting spinal stabilisation. Examination should involve inspection for any signs of injury or posterior bruising and palpation to identify any tenderness, boggy swelling or palpable deformity. A rectal examination is mandatory to assess peri-anal sensation and tone. Consideration should be given to the timing of a log roll if a pelvic fracture is present, with early log roll risking disturbance of the pelvic clot.

Neurological Examination

Practically, only assessment of motor function and sensation are performed. When examining motor supply, myotomes should be graded from 0 (paralysis) to 5 (normal strength), as described in the Medical Research Council's muscle strength grading system.(5) Serial documented examinations are useful in assessing improvement or deterioration in neurological state. In addition a digital rectal examination should be performed to assess voluntary contraction of the external anal sphincter.



Dermatomes

C5 - Area over deltoid
C6 - Thumb and index finger
C7 - Middle finger
C8 - Ring and little finger
T1 - Inner aspect of upper arm

Myotomes

C5 - Biceps
C6 - Wrist Dorsiflexion
C7 - Elbow Extensors
C8 - Middle Finger Flexors
T1 - Interossei

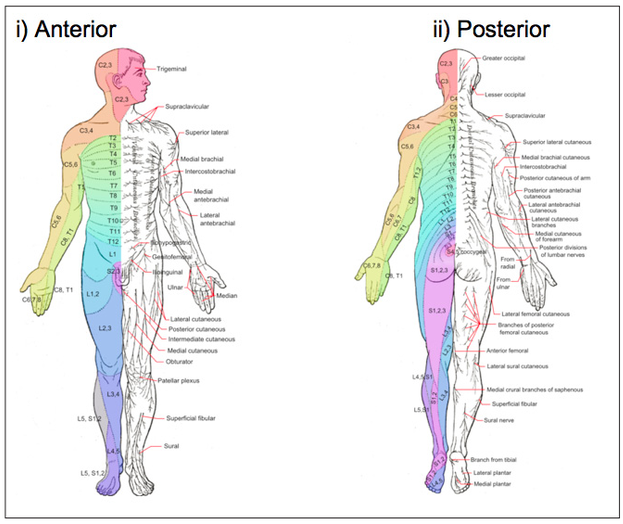


Figure 2: Dermatome distribution

CERVICAL SPINE TRAUMA MANAGEMENT

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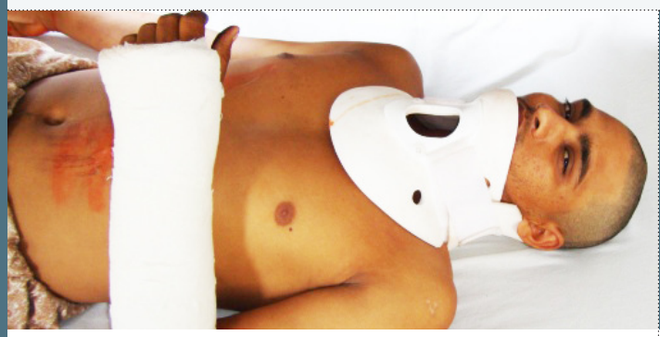

5	Normal muscle contraction against full resistance
4	Strength reduced but contraction still moves joint against resistance
3	Muscle can only move joint against gravity
2	Muscle can only move joint when force of gravity removed
1	Flicker of movement/fasciculation only
0	No movement observed

Figure 3: Muscle Strength Grading[5]

A complete spinal cord injury, which at the cervical level results in tetraplegia, is the absence of demonstrable sensory or motor function distal to the site of injury. If one of the spinal tracts remains intact (the presence of some motor or sensory function), this is termed an incomplete spinal cord injury and caries a significantly greater recovery potential than that of a complete injury. Identifying sacral sparing is therefore important.

Spinal shock (a neurological phenomenon) due to cord injury is an absence of the bulbocavernosus reflex and is of prognostic significance. This is a spinal cord-mediated reflex arc involving the S1-3 nerve roots and can be elicited by anal sphincter contraction in response to tugging on the glans penis or Foley catheter. Spinal shock must be resolved (usually within 48 hours) before the extent of spinal cord injury can be evaluated.6 The adjacent cervical vertebra defines the bony level of injury. The neurologic level of spinal injury is described as the most caudal motor segment with at least MRC grade 3 power bilaterally. There may be a discrepancy between the two levels.

The cervical spine is the most mobile and exposed spinal region, hence the most vulnerable to injury. Approximately 1/3 of patients with upper cervical injuries (above C2) die at the scene of the accident due to apnoea secondary to loss of central innervation of the phrenic nerves.(4) The width of the spinal canal decreases as it travels caudally, therefore, an unstable fracture of the upper cervical spine must displace proportionally further to cause neurologic compromise than in the lower cervical spine.

Cervical Spine Trauma Management.
Neurosurgery.

Radiology

C-spine fractures can be excluded in the conscious, orientated patient with a thorough history, normal neurological examination and painless cervical spine motion.(2) It must be emphasised that distracting injuries can create a false negative assessment and usually negate clinical 'clearance' of the cervical spine.

There are several guidelines published that may help in the decision making of safe clearance or whether radiology is required in orientated patients; see the Canadian C-Spine Rule(7) and the NEXUS Clinical Criteria.(8)
The NEXUS Clinical Criteria(8)

1. Tenderness at the posterior midline of the cervical spine

2. Focal neurologic deficit

3. Decreased level of alertness

4. Evidence of intoxication

5. Clinically apparent pain that might distract the patient from the pain of a cervical spine injury

The presence of any one of the above findings is considered to be clinical evidence that a patient is at increased risk for cervical spine injury and requires radiographic evaluation. The criterion has a sensitivity of 99.6%, a negative predictive value (NPV) of 99.9%, a specificity of 12.9%, and a positive predictive value (PPV) of 2.7% for the identification of clinically significant cervical spine injuries.(8)

Radiographic assessment of the cervical spine is performed when there is suspicion of injury from the history or examination. The standard 3 view plain film series required for the cervical spine are a cross-table lateral view, anteroposterior view and open-mouth view of the odontoid. The lateral film must include the base of the occiput to the cervico-thoracic junction. Occasionally caudal traction on the arms or a swimmers view radiograph is required to allow adequate exposure of the lower cervical spine. The increased use of computed tomography (CT) usually prevents the need for these views.(9)

CERVICAL SPINE TRAUMA MANAGEMENT

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Clearance becomes more challenging when the patient has a reduced conscious level due to the lack of clinical information. In an adult, intubated trauma patient the incidence of an unstable spinal injury is 10%, with 2.5% of these patients having normal plain films.(2) Plain radiography has now been supplemented by thin-cut 2mm Computed Tomography (CT) with sagittal and coronal reconstruction as the primary imaging modality in patients who require imaging. The combination of plain radiography and CT has been evaluated by several studies each concluding that it is highly sensitive (negative predictive value of 98.9%).(10)

In the presence of normal imaging, all immobilisation was removed without onset of adverse neurology. Any irregularities on the CT suggestive of a ligamentous injury, including disc space or interspinous widening, anterolisthesis or rotational abnormalities should be evaluated by a spinal surgeon and a magnetic resonance imaging (MRI) scan may be indicated. (11,12,13) MRI is very sensitive in detecting ligamentous injuries, however, there is no convincing evidence that MRI adds further diagnostic value in patients who have had a negative CT scan.(10)

Patients who are expected to regain full consciousness in the following 24-48 hours can be nursed with full spinal precautions until such a time when the spine can be examined. However, spinal immobilisation can cause complications. Cervical collars can raise intra-cranial pressure, venous thromboemboli or pressure sores can develop and logrolling requires additional personnel. A pragmatic approach is frequently employed. A fine-slice CT scan with coronal and sagittal reconstructions, reported by an experienced Consultant Musculo-skeletal Radiologist can be expected to miss only 0.1% of injuries. The benefit of removing stabilisation early outweighs the small risk of missing an injury.

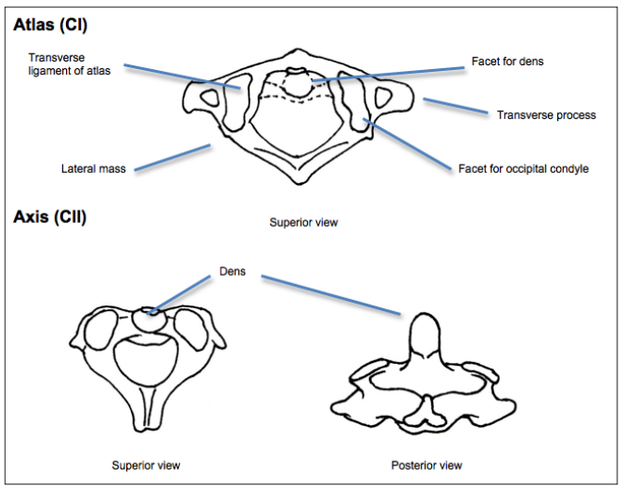


Figure 4: Cervical spine anatomy(14)

Specific Spinal Injuries

Atlanto-Occipital Dislocation

These injuries are uncommon and often fatal. They are usually distraction injuries. Initial management is spinal immobilisation. This can be very challenging to detect radiographically and expert radiological advice should be sought.(4)

Atlas (C1) Fracture

Fractures of the C1 vertebra account for 5% of C-Spine fractures and are often associated with a fracture of C2. The most common is a burst (Jefferson) fracture, caused by an axial loading mechanism. This fracture involves both the anterior and posterior rings with lateral displacement of the lateral masses, better appreciated on an open-mouth view (typified by splaying of the C1 lateral masses relative to the C2 vertebral body). These fractures are infrequently associated with spinal cord damage due to the relatively large diameter of the canal at this level. They can be unstable, particularly if the combined overhang of the lateral masses is >6.9mm –

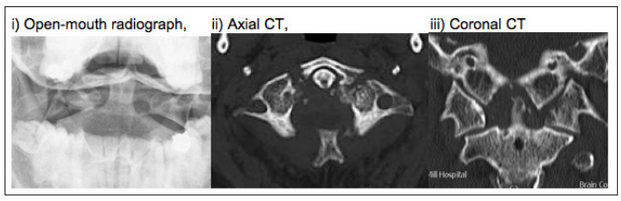


Figure 5: Jefferson Fracture

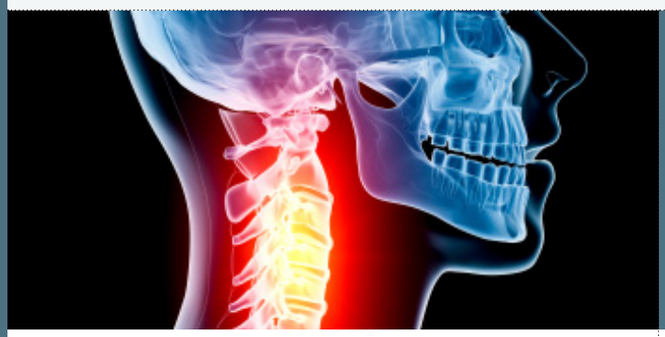
Spence's rule (15) Initial treatment is spinal immobilisation and discussion with a spinal surgeon

Axis (C2) Fractures

18% of all cervical spine fractures occur in the axis, with the majority involving the odontoid process. They can be seen on the lateral projection or open-mouth view; however, a CT is often needed for further evaluation. Type I odontoid fractures involve the tip whilst the more common type II fractures involve the base of the dens. Type III fractures extend from the base of the dens through the body of the vertebra (D'Alonzo and Andersen classification).16 A Hangman's fracture (20% of C2 fractures) is a fracture through the pars interarticularis of C2. It is usually sustained by a hyperextension injury as the name suggests. Spinal stabilisation is the initial treatment. Sub-axial cervical fractures most commonly involve C5. Injury patterns are compression, flexion, distraction or rotation. Uni-facet dislocation (with anterolisthesis of up to 25% of the vertebral body) or bi-facet dislocation (with anterolisthesis of >25% of the vertebral body) are relatively common injuries in the sub-axial spine. The initial treatment of all cervical spine fractures is stabilisation to protect the spine and appropriate management in the primary survey to ensure optimal cord perfusion.

CERVICAL SPINE TRAUMA MANAGEMENT

M Petrie, F Shivji



Cervical Spine Trauma Management.
Neurosurgery.

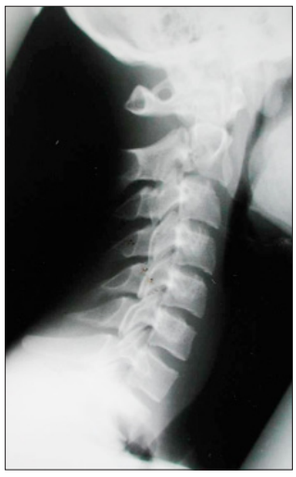


Figure 6:
Lateral Radiograph of the cervical spine showing a Hangman's fracture

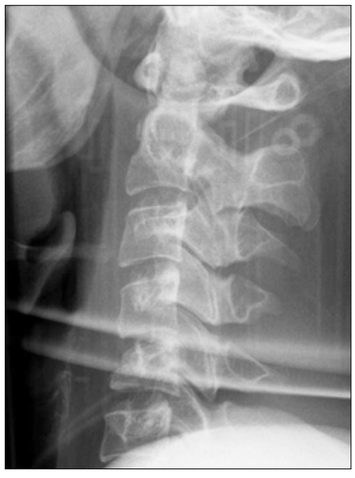


Figure 7:
Lateral radiograph of the cervical spine showing a fracture dislocation of C6

The definitive management of the broad range of cervical spine trauma is beyond the scope of this review. Fortunately the initial management of all these injuries is identical. Knowledge of the injury mechanism, careful clinical assessment and expert interpretation of necessary imaging will allow the experienced spinal surgeon to decide on the appropriate management plan. Stable injuries, those that will not displace under physiological load to cause severe pain, neurological deficit or deformity, can be treated with simple orthotic devices. Unstable injuries require surgical management involving anterior, posterior or combined surgical approaches.

Summary

The cervical spine should be immobilised in all trauma patients, assuming an injury to be present until it can safely be excluded. Attention to the primary survey and ongoing resuscitation ensures optimal cord perfusion. The spine can be cleared in an awake, conscious patient with no distracting injuries and a normal examination and neurological assessment. If this is not possible spinal precautions should continue with consideration given to radiological clearance with fine slice CT imaging.

Questions

1. Which of the following is not included in the 'triple immobilisation' technique to secure the cervical spine?
a) Semi-rigid neck collar
b) Spinal board with straps
c) Head blocks
d) Tape to secure the forehead

2. When should the logroll technique not be performed during the secondary survey?
a) For patient transfer
b) When an unstable spinal injury is considered
c) When there is suspicion of a pelvic haemorrhage
d) To remove the spinal board for patient comfort

3. Which of the following takes lowest priority during the primary survey?
a) Patient resuscitation – cord perfusion
b) Spinal immobilisation
c) Full external examination of the patient
d) Imaging of the cervical spine

CERVICAL SPINE TRAUMA MANAGEMENT

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4. Which of the following criteria is not part of the NEXUS guideline for cervical spine clearance?

a) Focal neurological deficit
b) Evidence of intoxication
c) Distraction injury
d) Haemodynamic instability

5. Which of the following cervical spine fractures is often caused by a hyperextension injury of the neck?

a) Jefferson fracture
b) Atlanto-occipital dislocation
c) Hangman's fracture
d) Type II Odontoid fracture

Answers

1. (b) 2. (c) 3. (c) 4. (d) 5. (c)

Acknowledgements

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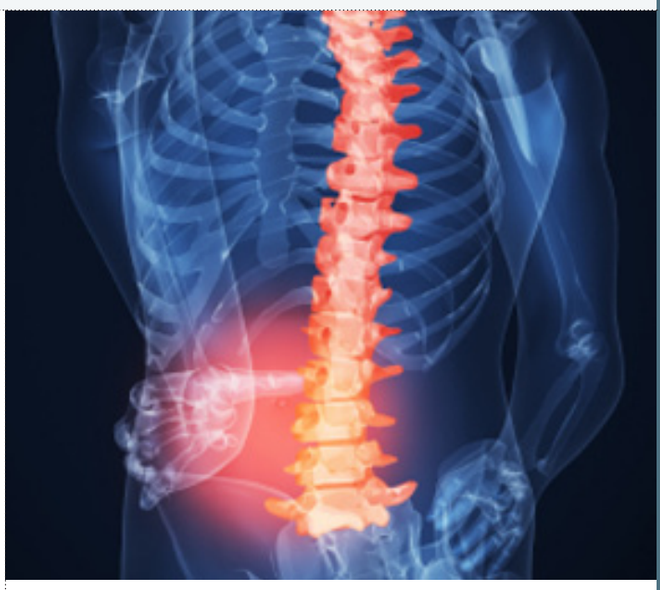

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DIPLOMA OF OTOLARYNGOLOGY HEAD AND NECK SURGERY (DO-HNS)

J Risley

Diploma of Otolaryngology Head and Neck Surgery (DO-HNS). Career Focus.

The DO-HNS has developed over the past few years from what was considered as an exam for general practioners into a requirement for entry into ST3 for ENT trainees.

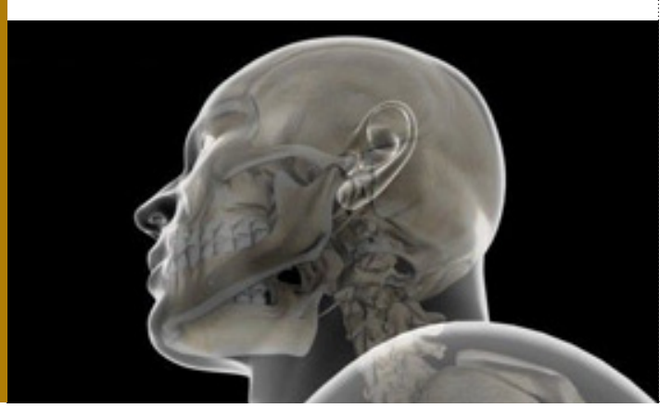
It is now possible to obtain the MRCS diploma by passing the Part A MRCS paper and the DO-HNS OSCE. This would lead to a MRCS(ENT) and allow the trainee to enter ST3 training.

This appears to reflect the change in training, as for most trainees the time and expense of passing the MRCS Part A and B in time for applications for ST3 is challenging enough. Added to this the further time and expense of passing both written and OSCE elements of the DO-HNS would leave many ENT trainees feeling in a rush with unwelcomed additional pressure.

The trainee will be faced with the choice of two paths – completing the MRCS and DO-HNS as separate diplomas, or undertake the shortened route with the award of the MRCS(ENT). Both have their advantages and disadvantages which need to be taken into account.

The MRCS(ENT) would be cheaper and involve less time. It would also be specialty specific, which may be welcomed by trainees – after all some trainees may wonder why it is necessary to be examined on, amongst other things, examination of the knee or undergo a viva on the anatomy of the foot when they intend to pursue a career in ENT.

However, some trainees may feel more comfortable with the thought that they have a more rounded knowledge base, with a breadth and depth that the MRCS(ENT) may not provide. It would also allow for the possibility of changing specialty – the full MRCS diploma would provide the flexibility to do so.



The one thing for certain is that whichever path is chosen, the OSCE will need to be tackled. It is suggested that the trainee has had at least 6 months in training prior to sitting either the written exam or OSCE, although a 4 month placement is likely to suffice. This is since what is expected relates to a level of experience that requires time to be achieved. Although as with most exams the majority of knowledge can be obtained from textbooks, the required level of practical expertise can only be gained with experience. The OSCE contains a combination of written and practical stations.

Candidates may be presented with CT or MRI scans, macroscopic and microscopic pathology sections, images of tympanic membranes to interpret, or pure tone audiograms. They may also be expected to obtain consent, explain an audiogram to patients, perform a flexible fibreoptic laryngoscopy, and take histories as well as perform examinations. Written communication skills may also be tested by asking you to complete an operation note or discharge summary for a straightforward procedure such as adenotonsillectomy or myringotomy and grommet insertion.

Clearly, it is advised that candidates are familiar and comfortable with the basic concepts of ENT prior to sitting the examination.

As with all examinations, there are a plethora of commercial courses available which claim to aid the trainee. This author has not participated in any and so cannot provide comment on their efficacy.

In summary, the candidate should decide on whether to pursue the MRCS(ENT) route or both the MRCS and DOHNS as separate entities – both have advantages and disadvantages. The trainee should then make sure that they do not undertake the examination lightly. It is a thorough test that will find gaps in your knowledge and experience.

Further information, including a syllabus, can be found at:
http://www.intercollegiatemrcs.org.uk/dohns

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EXPEDITION MEDICINE WITH RALEIGH INTERNATIONAL: SABAH REGION, BORNEO

C Huins

Expedition Medicine with Raleigh International: Sabah Region, Borneo.
Charitable Experience.

Introduction

Heading off abroad to a foreign land with its unknown healthcare system (if any) and treating things you may not be that familiar with, whilst being in the middle of nowhere with probably minimal equipment will either flick your switch or fill you with dread. Fear of the unknown, it could be argued, could hold you back. And yet charitable medicine can be hugely rewarding on multiple levels - for you personally, your clinical confidence and development, your CV, certainly not forgetting to mention those who you help.

There are many charities crying out for doctors to go out for variable periods of time, with varying degrees of acute exposure. I'd wanted to go on expedition with Raleigh International before university. That didn't materialise and so, when the opportunity for an out of program experience arose, I jumped at the chance to do so. And it lived up to every expectation I'd had and perhaps more.

What is Raleigh?

Operation Drake began in 1978, the brain-child of ex-army Colonel John Blashford-Snell and HRH Prince Charles. Following a period of time as Operation Raleigh, it morphed into Raleigh International in 1992 to reflect the number of volunteers from across the globe. Raleigh is a youth and sustainable development charity based in the UK, currently with expeditions in Borneo, India and Costa Rica/Nicaragua.

1. Sorting the emergency medical packs.

2. Practicing a medivac.

The idea is to take the 'venturers' - 17-24 year olds - and put them in challenging situations which, with the support of the 'project managers' (PMs - you), will enable them to personally develop and discover their potential whilst benefiting local communities in those countries. These situations are either project-based in remote villages, such as building a kindergarten or a gravity-fed water supply, surveying virgin rainforest, or heading out on an adventure phase - trekking through the rainforest and, in Borneo, followed by diving to survey and replant coral reefs.

Living and working in remote communities not only benefits the locals in terms of infrastructure, but is an incredible education for everyone involved. Learning about a different people, their culture and way of life whilst showing them yours through photographs and simply by example. Being welcomed into such a remote community, who've probably never seen a westerner in person before, is a very special experience. To then leave them something which will benefit their community, perhaps for several generations, is incredibly rewarding. And, by supporting the venturers through such an experience, you hope that you have helped open their eyes not only to the world around them but also to who they are and to their potential.

What's involved?

Expeditions are 10 weeks long, split into 3 three-week 'phases', with the PMs going out for 13 weeks - 2 weeks of training beforehand and a week of tidying up (report writing and preparing for the next expedition) afterwards. An advanced medic goes out a week before all the other PMs arrive, mainly to prepare the 13 medical packs which go with each group, together with the medical education program which you deliver to the non-medical PMs prior to the arrival of the venturers.

EXPEDITION MEDICINE WITH RALEIGH INTERNATIONAL: SABAH REGION, BORNEO

C Huins

3. After 12 days on trek, we finally arrived back

Generally each Raleigh International expedition has around 5 medics. Each medic will be the only doctor for the group of around 12 individuals on each 'phase', doubling up as one of two project managers for that group. Given how remote they are, each trek group has to have a medic, as does 'field base' - the central control hub of the whole expedition; depending on how many medics are on each expedition, the static sites might get a medic too.

With the aforementioned medical bag, which is based on army emergency medical packs and contains all the drugs and equipment you will need in the field, from antibiotics and antimalarials to sutures and adrenaline, you will be faced with anything from trench foot, sprains & strains, possible malaria or Dengue fever, to machete injuries and even trauma - road based, on a building site or deep in the jungle. The field base medic is the central advisor by radio to those on phase and would also co-ordinate any 'casevac' (casualty evacuation) should someone need extricating from somewhere remote and be transferred to hospital. On the whole though, everyone is young and fit and, infections aside, serious incidents are extremely rare due to a stringent health and safety protocol.

My experience

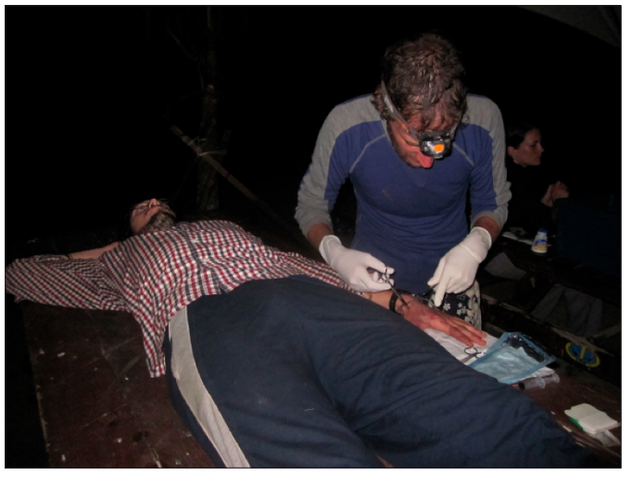
Having signed up for Raleigh, I attended a selection weekend in deepest East Sussex which involved various outdoor team tasks during which the relaxed assessors observed how everyone performed under a bit of gentle pressure, trying to simulate as best they could life on expedition.

Selection successfully negotiated (it was a very enjoyable weekend), I was asked to head out as the advance medic, arriving in Borneo with the advanced team a week before the other PMs. Each project site (6 of them), each trek group (3) and each land rover (3) needed a complete medical bag containing the essentials for treating common ailments on expedition (antibiotics, antimalarials, adrenaline, suture kits, analgesia and so on); my first week, therefore, was spent checking through these and updating them, together with writing the teaching program for the PMs as many project sites would not have a medic, the PMs having to deal with whatever occurred with the help of the field base medic on the end of the radio.

Two weeks of training followed the arrival of the PMs, before the 120 or so venturers poured off the arriving flights and expedition was underway. I was allocated to 'alpha 1', our group due to head to the most remote project site - building a kindergarten for a very isolated community in the north of the Sabah region, the poorest region of Malaysia.

Being so remote, they needed a medic on site since the nearest available health care was at least 6 hours away - 5 hours off road, one on - by 4x4 (unless the urgency called for the services of Sabah Air Services' helicopter). Unfortunately, being the tail end of the rainy season, incredibly heavy daily downpours made the dirt track waist-deep in mud and impassable to the 4x4s, forcing that project to be postponed. We were therefore reallocated to repairing a community hall for a small village which, despite all the building materials and activity, managed to pass without incident. Thankfully, our group also managed to avoid any stomach upsets which had plagued another group, something which can spread like wildfire when you're living so closely and eating out of the same pot.

My second project site - repairing the fencing around the Sun Bear Conservation Project site (the smallest bears in the world and often kept illegally as pets before being discarded) - also passed without major incident despite the presence of power tools.



4. Surgery on the beach

EXPEDITION MEDICINE WITH RALEIGH INTERNATIONAL: SABAH REGION, BORNEO

C Huins

Expedition Medicine with Raleigh International: Sabah Region, Borneo. Charitable Experience.

It was the trek phases which turned up the most entertainment from a medical point of view with some trench foot, a few possible cases of malaria (posing an interesting exercise in lateral thinking as to how to extricate the individuals from where we were - 3 hours trek from the nearest village, itself 5 hours by 4x4 to the nearest town and hence mobile reception, and that being 5 hours from Kota Kinabalu, the capital and location of the hospital and field base).

To exercise my surgical skills, my fellow PM kindly chopped his finger with a machete whilst cutting fire wood, thankfully only skin deep over the non-dominant index finger MCPJ and without tendon or nerve injury. However, dusk having fallen and with us trekking out of the rain forest the following day, I saved the suturing for the next day when we were on 'dive island', steristripping and splinting the wound instead. Suturing on a beach by head torch was indeed a new experience, as was drainage of a paronychial abscess under the same conditions.

And, to test my ATLS skills, one venturer slipped whilst traversing a narrow path on a steep, wood-covered hillside, her unbalanced, 20kg rucksack taking her suddenly over the edge. She tumbled down 20-30 metres before coming to an abrupt halt against a tree, miraculously escaping with only a few cuts and bruises, a bit of a sore neck for a few days and having experienced a large surge of adrenaline.

A few other medics, however, had a whole different experience, having come across a nasty RTA moments after it occurred in the middle of nowhere. The casualty lying unconscious in a ditch, with locals staring on in transfixed disbelief and the ambulance many miles away, it was fortunate that one of the team was a paramedic. Thankfully the casualty made a full recovery. Generally, Raleigh medics are only allowed to treat expedition members and not locals, but that was an exception.

And so, thanks to stringent health and safety policies employed by Raleigh, the whole expedition passed without major incident, despite intense preparation for the worst. Raleigh will take you to locations and put you in situations that you would never usually get to experience - living in local communities, traveling to remote parts of the globe that you wouldn't otherwise be able to get to and relying purely on your fellow group members for survival.

5. Coral planting

Trekking in remote rain forest strips away all the window dressing of western life (don't bring a mobile - the nearest reception is 7 hours away and the humidity will probably ruin it anyway; ditto a laptop; take your chances with a camera if you wish) and breaks life down into the basics: where will you sleep (choosing two appropriate trees to string your hammock up between is an important decision), what will you eat and drink and how are you going to prepare it, how can you keep warm and how will you entertain yourselves, and all using only what you can carry with you on your back. Not to mention the challenge of treating someone using supplies from an emergency medical pack whilst in the middle of nowhere.

Such an expedition not only exposes you to practicing medicine in a completely different way to what you are used to back home, placing you in new situations and working conditions, but also facilitates the development of other skills which are essential in your future life and careers - time and people skills, managing and reacting to unusual, perhaps stressful situations, planning not only the medical care of a patient but being lead co-ordinator for the logistics of delivery of that care.

I feel that I have come away from this experience with a broadened outlook on both healthcare and how I would like to practice. It was an amazingly refreshing 3½ months and one that I would not hesitate to recommend to anyone.

EXPEDITION MEDICINE WITH RALEIGH INTERNATIONAL: SABAH REGION, BORNEO

C Huins

6. On trek in the rain forest

When to go

If you are nearing a natural break - a change of job or direction, for example - or even just fancy some time away from the norm, a few months away on a charitable expedition is a fantastic use of your time.

Everyone's situation is different and it's best to discuss it with your Educational Supervisor or Program Director. However, with a plan in hand such as going away with Raleigh or another charity and by demonstrating a constructive use of your time, you are more likely to succeed in getting their approval. Whether a brief step off the treadmill of the medical pathway is viewed as detrimental or beneficial to your career is an interesting question, with many different opinions depending on who you ask. However, surely any time spent developing your skills, not only in a different aspect of medicine, but also your managerial skills and personal potential can only be beneficial?

How to arrange

Contact Sophie Pell at Raleigh's London offices on s.pell@raleighinternational.org, call on 020 7183 1270, or apply at www.raleighinternational.org At the time of writing they were looking for medics for their summer 2012 expeditions to Borneo, India and Costa Rica / Nicaragua, but they plan ahead extensively.

Expedition Medicine with Raleigh International: Sabah Region, Borneo.
Charitable Experience.

Preparation

Raleigh will provide a detailed checklist of everything required, from visas to an extensive kit list and country-specific vaccinations. However, check with your local travel clinic and plan your vaccinations and antimalarials in advance. Contact the relevant embassy for information and to get your visa in advance. Finally, Berghaus give a discount to Raleigh personnel on presentation of their Raleigh ID card too, so you can pick up some nice outdoor kit too.

Being a charity, you will not be paid and need to buy your flights and raise a target amount in order to be able to go. However, due to a bursary, medics have to raise considerably less than everyone else. Only £850 or so compared to £2,000 to £3,000. Once out there, however, your only costs will be personal indulgences.

Final word

There is no doubt that travel broadens the mind. Add to that working abroad, especially in conditions such as those afforded on expedition, and you can have a truly unique experience. As Mark Twain once said, "Twenty years from now you will be more disappointed by the things you didn't do than by the ones you did do. So throw off the bowlines, sail away from the safe harbour. Catch the trade winds in your sails. Explore. Dream. Discover."

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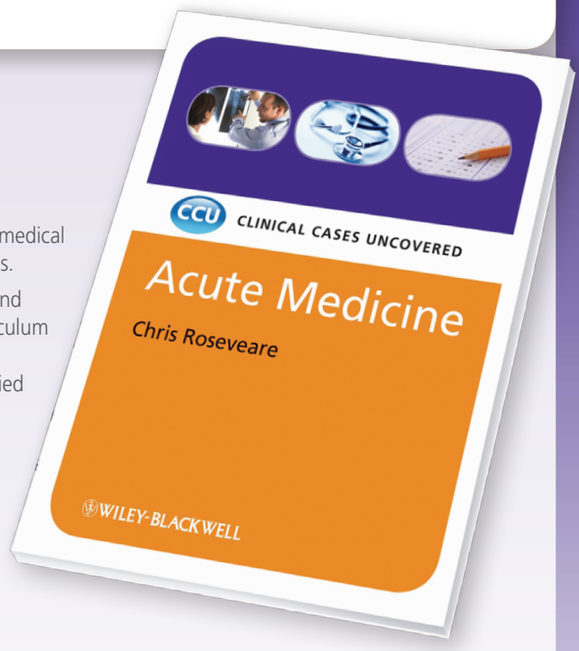
Acute Medicine

CLINICAL CASES UNCOVERED

Chris Roseveare,
Southampton General Hospital



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ISBN 9781405168830
FEBRUARY 2009 • Paperback • 256 pages

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