

CRQ Practice



CRQ One

Medical Statistics



CRQ One Answer

Regarding statistics in medicine:

a) Define the following measures of central tendency (3 marks)

Mode:	The most frequently occurring value within a data set.
Median:	The middle value of a data set when all values are listed in ascending order.
Mean:	The sum of the values in a data set divided by the number of values in the data set.

b) What is the most appropriate measure of central tendency (1 mark) and spread (1 mark) to use when describing non-parametric quantitative data?

Central Tendency:	Median
Spread:	Interquartile Range

c) Define the standard error of the mean (1 mark)

- An estimate of how likely the sample mean reflects the mean of the population from which it is taken.

CRQ One Answer

d) What factors affect the standard error of the mean? (2 marks)

- Standard Deviation (or Variance) *of the sample*.
- Size of the sample

[Mean of the sample indirectly when calculating the standard deviation of the sample]

e) Define the null hypothesis (1 mark)

- Initial assumption that there is no statistical difference between the samples and that they originate from the same population.

f) List four factors that should be taken into consideration when deciding which statistical test to use when analysing quantitative data (4 marks)

- Type of data
- Distribution of data
- Number of groups
- Paired or unpaired data

CRQ One Answer

g) In terms of the alternative hypothesis, what is a type I error? Quantify an acceptable type I error (2 marks)

- False positive: The alternative hypothesis is incorrectly accepted.
- 5% is an acceptable type I error ($p < 0.05$)

h) In terms of the alternative hypothesis, what is a type II error? Quantify an acceptable type II error (2 marks)

- False negative: The alternative hypothesis is incorrectly rejected.
- 20% (0.8) is an acceptable type II error.

i) List two statistical tests that can be applied to non-parametric data (2 marks)

- Wilcoxon signed rank test
- Mann-Whitney U test
- Friedman's test
- Kruskal-Wallis test

j) When would you decide to use an ANOVA test to analyse data in preference to a Student t Test? (1 mark)

- Where more than 2 groups are being analysed.

CRQ Two

Bone Cement





Sir John Charnley



Bone Cement

You are asked to anaesthetise an 85-year-old patient who had a mechanical fall at home and sustained a hip fracture. He is listed for a cemented hemiarthroplasty of his hip.

- a) List two advantages that a cemented hip hemiarthroplasty has compared to an uncemented prosthesis (2 marks)
- Increases the likelihood of pain-free mobility after surgery
 - Reduces the risk of re-operation
 - Is associated with a lower mortality rate at 30 days

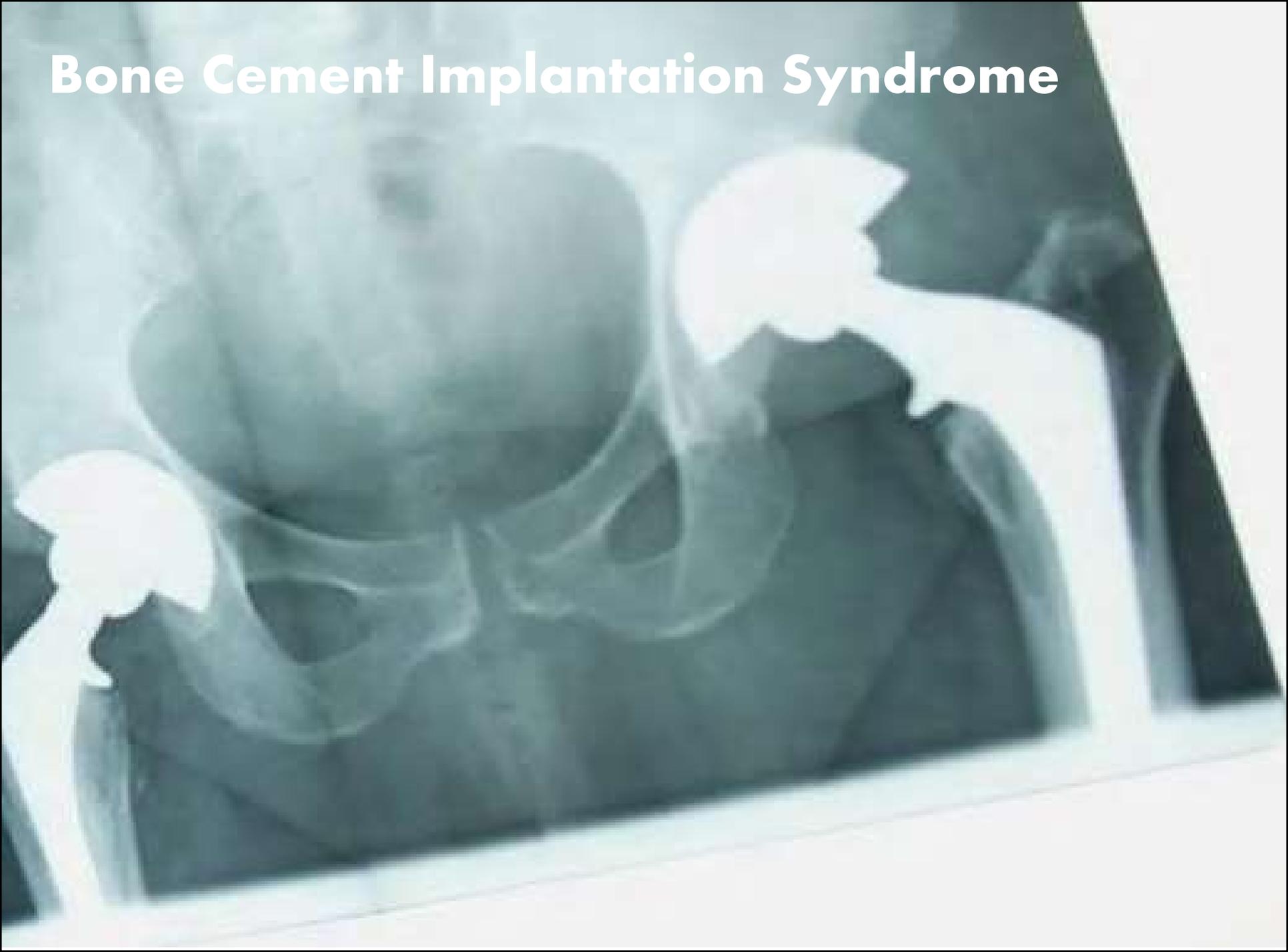
Bone Cement

- b) What is the primary ingredient of bone cement? (1 mark)
- Poly (methyl methacrylate) PMMA
- c) List two other substances that are added to bone cement (2 mark)
- Antibiotics
 - Radiopaque Contrast
 - Colouring – Chlorophyll

Table 1 Composition of bone cement

Poly(methyl methacrylate) (PMMA) (90%)	Powder polymer: pre-polymerized PMMA Initiator: dibenzoylperoxide Liquid monomer (MMA) Activator: <i>N,N</i> -dimethyl- <i>p</i> -toluidine
Antibiotics	Gentamicin, tobramycin, clindamycin
Radiographic contrast material (10%)	Zirconium dioxide or barium sulphate

Bone Cement Implantation Syndrome



Bone Cement Implantation Syndrome

- Bone cement implantation syndrome (BCIS) is a poorly understood phenomenon
- No agreed definition.
- It is an important cause of intraoperative mortality and morbidity and is most commonly, but not restricted to, being associated with cemented hip arthroplasty.
- The clinical features of BCIS typically occur at:
 - The time of cementation
 - Prosthesis insertion
 - Reduction in the joint
 - Deflation of a limb tourniquet.

Bone Cement

d) List four risk factors that would indicate a patient was at high risk for cardiorespiratory compromise during cementing of a hip prosthesis (4 marks)

- **Patient Factors**

- Increasing age
- ASA III-IV
- Significant cardiopulmonary disease
- Pre-existing pulmonary hypertension
- Diuretic use
- Male sex
- Osteoporosis

- **Surgical Factors**

- Pathological fracture
- Intertrochanteric fracture
- Long stem arthroplasty

Bone Cement

- e) Complete the table below which specifies the cardiorespiratory changes associated with different grades of bone cement implantation syndrome (BCIS) (4 marks)

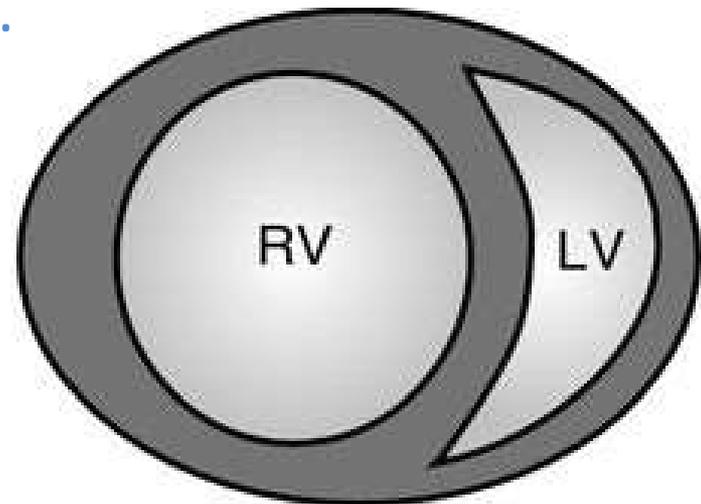
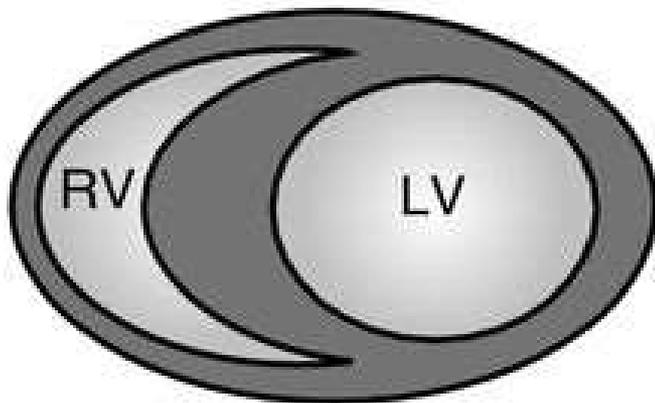
	Arterial Oxygen Saturation	Percentage drop in Systolic Blood Pressure
Grade 1	< 94%	> 20%
Grade 2	< 88%	> 40%
Grade 3	Cardiopulmonary Resuscitation Required	

Bone Cement

- f) Name the two models that have been proposed to explain the pathophysiological changes seen in BCIS (2 marks)
- The monomer-mediated model
 - The embolus-mediated model
- g) What is the common pathophysiological change explained by these models and thought to be the cause of the clinical picture seen in BCIS? (1 mark)
- These mechanisms result in increased Pulmonary Vascular Resistance
- This is responsible for V/Q mismatch resulting in hypoxaemia.*
- Accept: Worsening pulmonary hypertension or right ventricular failure*

Acute Right Heart Failure

- Sudden increase in Pulmonary Vascular Resistance [monomer/embolus related]
- Increased pulmonary artery pressure (PAP)
- The thin-walled and compliant right ventricle rapidly dilates and shifts of the interventricular septum to the left thereby reducing the volume of the LV cavity.
- [The total volume of the heart cannot expand within such a rapid time frame, as it is constrained by the pericardium.]
- These changes cause an immediate decrease in left ventricular compliance, reduced ventricular filling, and cardiac output (CO).



Bone Cement

- g) Other than avoiding using cemented prostheses, list four ways in which a surgeon might reduce the risk of bone cement implantation syndrome (4 marks)
- Inform the anaesthetist that they are about to insert cement
 - Thoroughly wash and dry the femoral canal
 - Apply cement in retrograde fashion using the cement gun
 - Insert a suction catheter and an intramedullary plug in the femoral shaft
 - Avoid vigorous pressurisation of cement in patients judged to be at risk

Bone Cement

Bone cement and the implications for anaesthesia

Gautam Khanna FCARCSI, EDRA
Jan Cernovsky FRCA



Revalidation
FOR ANAESTHETISTS
RCA Revalidation matrix
Matrix reference 2A06, 3A08

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Bone Cement

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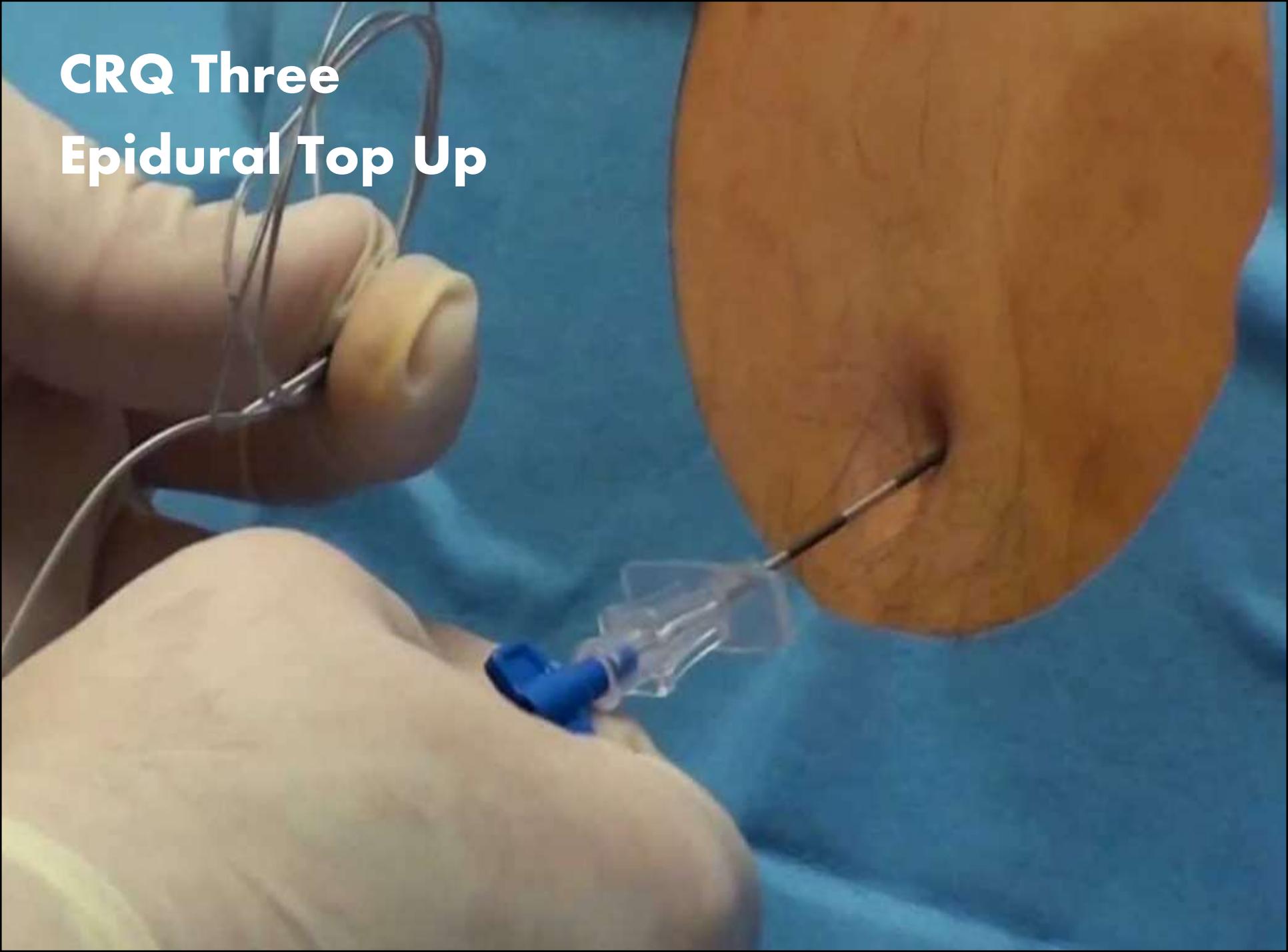


Reducing the risk from cemented hemiarthroplasty for hip fracture 2015

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British Orthopaedic Association
British Geriatric Society

February 2015

CRQ Three Epidural Top Up



Epidural Top Up

You are called to the delivery suite by a midwife. The obstetricians are reviewing a primigravida lady in labour whom they believe may require an emergency caesarean section.

- a) Complete the following table indicating decision to delivery times for caesarean sections as recommended by the Royal College of Anaesthetists (2 marks)

	Decision to Delivery time for > 90% of cases (minutes)
Category One	Less than 30 minutes
Category Two	Less than 75 minutes

Epidural Top Up

After reviewing this patient, the obstetricians confirm that the patient needs to come to theatre for an operative delivery and declare a category two caesarean section.

- b) What is the definition of a category two caesarean section? (2 marks)
- Maternal or fetal compromise
 - No immediate threat to maternal or fetal life

Epidural Top Up

Earlier in labour, a colleague had provided the patient with an epidural. This has been providing good quality pain relief during labour. You decide, after discussion with the obstetrician, to convert the analgesia provided by this epidural into surgical anaesthesia in the form of an epidural “top up”.

Epidural Top Up

- c) List five risk factors associated with the failure of conversion of epidural analgesia for labour to surgical anaesthesia for caesarean section (5 marks)

Consistent factors

- Greater number of unscheduled epidural top-ups needed to maintain effective analgesia in labour
- Increased parturient reported pain in the 2 h before Caesarean section
- Management by a non-obstetric anaesthetist
- Urgency of the Caesarean section

Inconsistent factors

- Increased BMI or weight
- Cervical dilatation at the commencement of labour epidural analgesia
- Epidural rather than CSE for analgesia in labour
- Increasing duration of epidural analgesia

Epidural Top Up

You transfer the patient to theatre but, despite an appropriate dose of local anaesthetic and additional opioid given via the epidural route, the block is insufficient for caesarean section. You decide that you are unable to proceed under epidural “top-up”. The midwife and obstetrician confirm there is no immediate threat to maternal or fetal life and the urgency of caesarean section remains a category two indication.

d) List three options you now have available to provide surgical regional anaesthesia for this patient (3 marks)

- Re-site the epidural and top-up the new epidural
- Spinal anaesthesia
- Combined spinal epidural anaesthesia

Accept: “Manipulate the existing epidural and top-up again” although this is the least favourable option

Epidural Top Up

- e) The patient has a lean body weight of 60kg at booking. What would be her maximum dose of the following local anaesthetic drugs? (3 marks)

Local Anaesthetic Agent	Maximum dose without Adrenaline (mg)	Maximum dose with Adrenaline (mg)
Lidocaine	180mg	420mg
Bupivacaine	120mg [accept 150mg]	120mg [accept 150mg]
Ropivacaine	180mg	180mg

Epidural Top Up

While preparing to initiate an alternative regional anaesthetic strategy, the midwife informs you that there is a sudden sustained drop in fetal heart rate. The obstetrician examines the patient and confirms that there is an immediate threat to fetal life and informs you that this is now a category one indication for caesarean section. You decide that a general anaesthetic is required.

Epidural Top Up

f) List five specific disadvantages or risks of performing caesarean section under general anaesthesia compare to regional anaesthesia (5 marks)

- Accidental awareness
- Risk of failed intubation and airway management
- Risk of pulmonary aspiration of gastric contents
- Greater maternal and neonatal sedation
- Increased risk of poor uterine tone and blood loss
- Depressed Apgar scores at 5 minutes
- The greater need for bag mask ventilation of the neonate
- The greater need for admission to neonatal intensive care
- Increased postoperative pain
- Increased postoperative nausea and vomiting
- Impairment of early breast feeding and maternal-neonatal bonding

Epidural Top Up



Resuscitation
COUNCIL
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Conversion of labour epidural analgesia to surgical anaesthesia for emergency intrapartum Caesarean section

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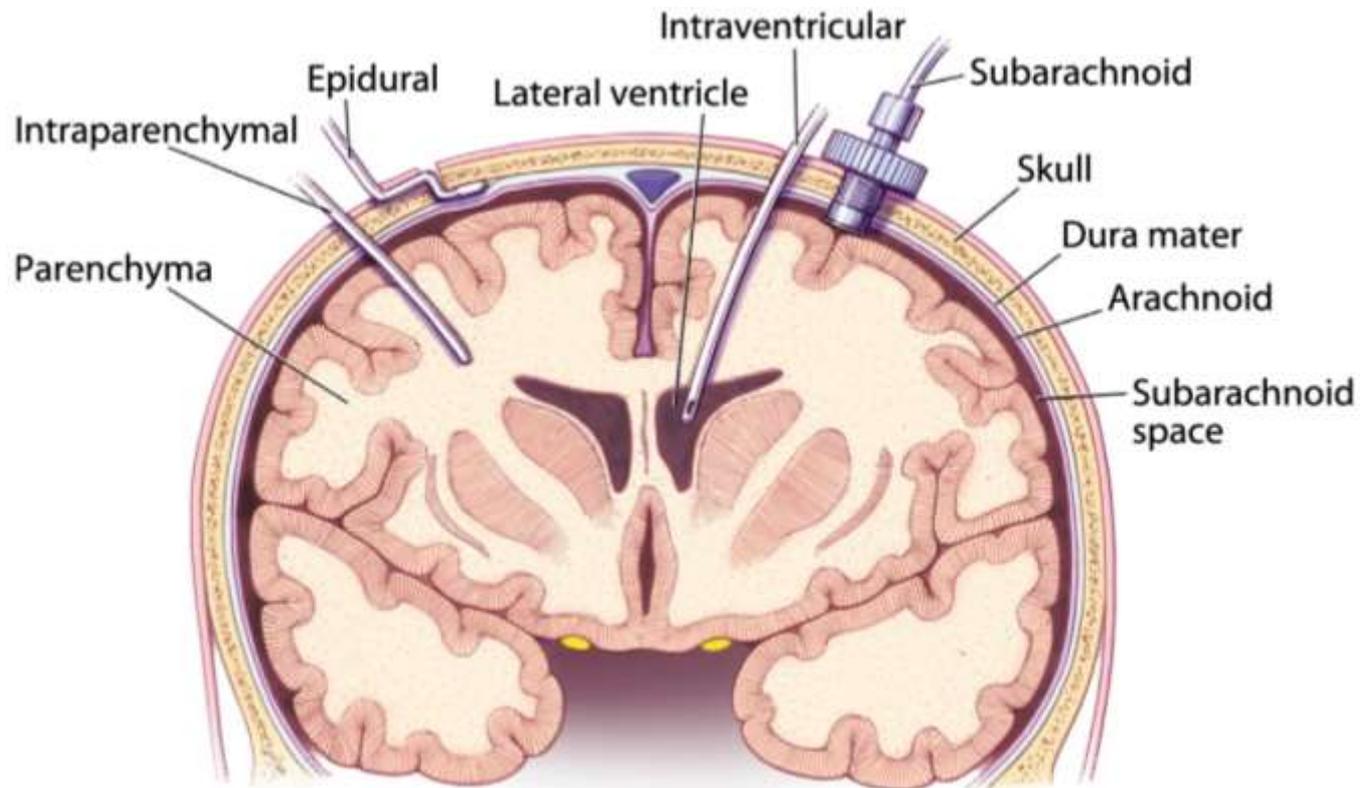
CRQ Four

Monitoring the Brain



Methods of Measuring ICP

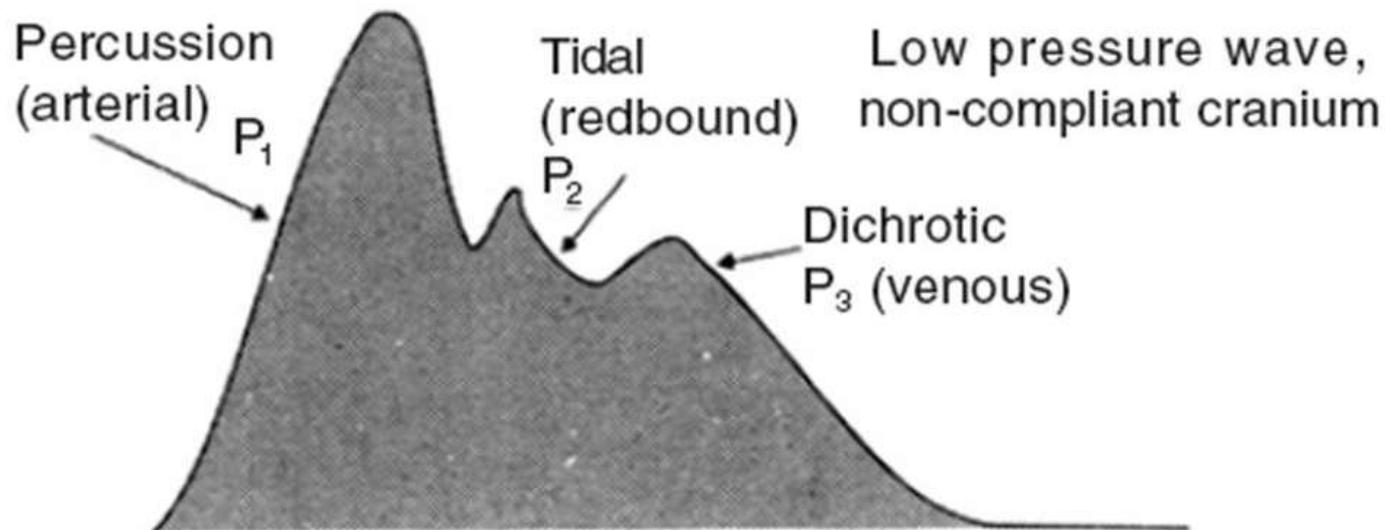
- Monitoring of ICP is useful in a range of pathologies, including traumatic brain injury (TBI), hydrocephalus, stroke, and encephalopathy.
- It can be measured using devices inserted into the ventricle, brain parenchyma, and subdural or sub-arachnoid spaces.



Methods of Measuring ICP

- An intraventricular catheter is the gold standard method

P1 (percussion wave) represents arterial pulsations.
P2 (rebound wave) reflects intracranial compliance.
P3 (dichrotic wave) represents venous pulsations.



Lundberg Waves

- As intracranial compliance decreases, pathological waves start to appear.
- Lundberg described three types of pressure waves: A, B, and C
- This classification is no longer considered to be useful clinically.

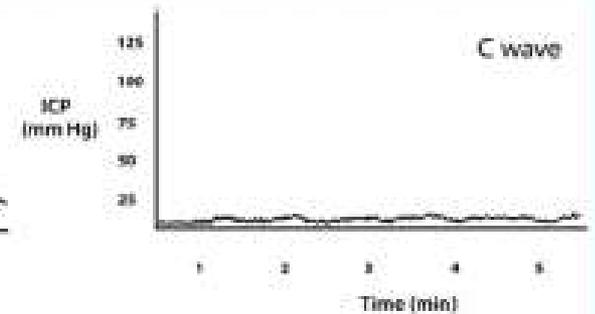
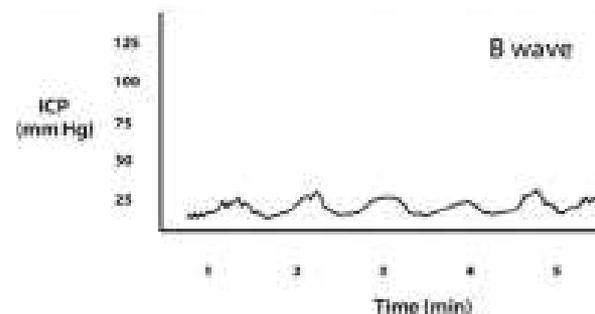
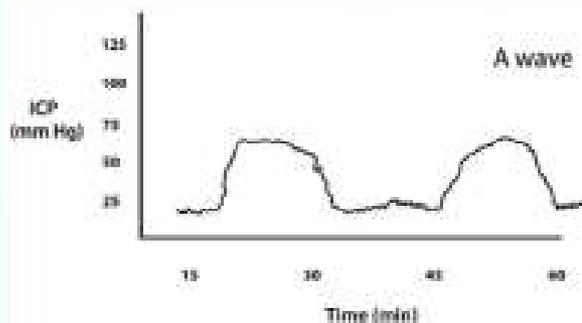
Table 1 Lundberg waves: variations in the intracranial pressure waveform

Types of ICP wave

A waves: pathological, plateau shaped, amplitude 50–100 mm Hg, last 5–20 min, suggestive of low brain compliance

B waves: rhythmic oscillations, amplitude <50 mm Hg, occur every 1–2 min, seen in patients undergoing mechanical ventilation, less useful clinically, suggestive of low brain compliance

C waves: rhythmic oscillations, amplitude <20 mm Hg, occur every 4–8 min, synchronous with spontaneous variations in arterial blood pressure, non-pathological



Monitoring the Brain

a) Other than the measurement of intracranial pressure (ICP), list two other advantages of using an intraventricular catheter to measure ICP over other techniques (2 marks)

- The ICP is likely to represent global ICP rather than regional ICP
- In Vivo calibration is permitted to reducing the risk of drift over time
- Therapeutic drainage of CSF can be done
- CSF samples can be taken for laboratory investigation
- Intrathecal drugs can be given

Disadvantages?

- Intraventricular catheters can be a source of infection
- Placement may be difficult in patients with small ventricles or cerebral oedema.

Monitoring the Brain

- b) At what ICP value does the British Trauma Foundation recommend starting treatment in the presence of a traumatic brain injury? (1 mark)
- ICP greater than 22 mmHg

Monitoring the Brain

- c) List five medical options for managing a raised ICP (5 marks)
- 30-45° head-up positioning
 - Loosen any restrictions on the neck – ETT ties or hard collars
 - Deepen sedation
 - Thiopentone infusion to cause burst suppression
 - Neuromuscular blockade
 - Maintain PaCO₂ 4-4.5 kPa
 - Prevention and treatment of pyrexia
 - Control seizure activity
 - Mannitol
 - Hypertonic saline

Monitoring the Brain

d) When calculating cerebral perfusion pressure, which anatomical landmarks should be used to zero both arterial and intracranial pressure systems? (2 marks)

- External Anatomical Landmark: External auditory meatus
- Corresponding Internal Anatomical Landmark: Foramen of Monro

Cerebral Perfusion Pressure

- Cerebral perfusion pressure is calculated as: $CPP = MAP - ICP$.
- For accurate calculation of CPP, the transducers measuring both MAP and ICP should be zeroed at the level of the foramen of Monro (external auditory meatus)
- The primary goal of an adequate CPP is to maintain cerebral blood flow (CBF) and tissue oxygenation
- Its manipulation has become central to the management of TBI.
- Current guidelines, for survival and favourable outcomes, target a CPP between 60 and 70 mm Hg.
 - The minimum optimal CPP threshold is unclear and may depend upon the patient's capacity for cerebral autoregulation.
 - An individualised target CPP for each patient has been proposed.

Monitoring the Brain

e) When inserting a catheter to measure jugular venous oxygen saturation, at what level should the catheter tip lie and how should this be determined? (2 marks)

- Level of Catheter Tip: C1/C2 intervertebral disc
- Method of Determining Tip Position: Lateral cervical spine X-Ray

If the tip is in the wrong position, significant error may result from admixture with extracranial blood.

Jugular Venous Saturation

- S_{ijv}O₂ reflects the balance between the oxygen supply (CBF, SpO₂) and demand
- Normal S_{ijv}O₂ is between 55% and 75%.
- Values below this suggest hypoperfusion with oxygen demand exceeding supply.
- Cerebral ischaemia is present when S_{ijv}O₂ is <55%, but cannot be assumed to be absent at higher values.
- High S_{ijv}O₂ values indicate hyperaemia or reduced metabolic demand.

Monitoring the Brain

- f) List three causes of a low jugular venous oxygen saturation (3 marks)
- g) List three causes of a high jugular venous oxygen saturation (3 marks)

Table 2 Factors affecting jugular venous oxygen saturation (SjvO₂)

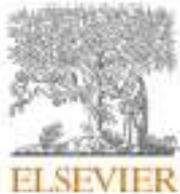
Low SjvO ₂	High SjvO ₂
<i>Reduction in oxygen delivery</i>	<i>Reduced cerebral oxygen consumption</i>
Raised ICP	Coma
Reduced CBF	Hypothermia
Hypoxia	Cerebral infarction
Profound hypocarbia	
<i>Increased cerebral oxygen demand</i>	<i>Increased oxygen delivery</i>
Seizures	Hypercapnia
Pyrexia	Vasodilation

Monitoring the Brain

h) Transcranial doppler can be used to assess cerebral blood flow. List two other indications for its use (2 marks)

- Detection of microemboli
- Intraoperative monitoring during carotid surgery
- Estimation of ICP

Monitoring the Brain



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Monitoring the brain

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