

SPINAL, EPIDURAL AND CAUDAL ANAESTHESIA CASE STUDIES

Case No 12.1

Tsahim is 65 years old and weighs 67 kg and is 178 cm tall. He is scheduled to undergo an open reduction and internal fixation of a neck of femur fracture. He has mild hypertension that is well controlled and is a heavy smoker with a persistent cough and shortness of breath on exertion.

Discuss the options for anaesthesia including the advantages and disadvantages of each.

Anaesthesia for a hip fracture most commonly involves either a general or a regional anaesthetic.

General anaesthesia can be induced and maintained by induction agents or volatiles depending on the anaesthetist's preference and the patient's condition. The airway can be maintained using a laryngeal mask or endotracheal tube with ventilation either spontaneous or mechanical. A regional technique such as a lumbar plexus block, a "3 in 1 block" or a fascia iliaca block can often be employed in conjunction to provide intra- and postoperative analgesia

Regional anaesthesia usually takes the form of a spinal injection but an epidural can also be used. Sedatives are often used in conjunction for the patient's comfort during the intraoperative period.

In general, there are only marginal advantages for regional anaesthesia compared to general anaesthesia, and therefore each patient's specific condition must be taken into account.

Benefit of general anaesthesia compared with regional anaesthesia

- *Small reduction in length of the operation.*
- *Tendency towards a lower incidence of cerebrovascular accident and hypotension.*
- *Bleeding, infection, aortic/mitral stenosis, neurological disease and previous back surgery are not an issue.*
- *Avoid the rare complications of a spinal such as permanent neuropathy, epidural abscess and haematoma.*

Benefit of regional anaesthesia compared with general anaesthesia

- *Reduced incidence of postoperative nausea and vomiting, oral trauma, sore throat and corneal abrasions.*
- *Improved PaO₂ and oxygen saturation and reduced risk of pulmonary infection (specifically relevant for Tsahim).*
- *Tendency towards a lower incidence of myocardial infarction, confusion and postoperative hypoxia.*
- *Decreased early mortality.*
- *Decreased risk of deep vein thrombosis.*

1. Urwin, SC; Parker, MJ; Griffiths, R. General versus regional anaesthesia for hip fracture surgery: a meta analysis of randomized trials. *BJA* 2000, 84(4):450-5.

2. Fischer, B. Does regional anaesthesia improve outcome? *Anaesthesia and Intensive Care Medicine* 2009, 10:11:545-8.

3. Baker, B; Jenkins, K. "Anaesthetic Risk." (Chapter) p19-21. Allman K, Wilson I. *Oxford Handbook of Anaesthesia*. Oxford University Press 2006.

You decide on a spinal anaesthetic given the probability of respiratory disease. What type and dose of local anaesthetic will you administer?

For hip surgery, a block up to T₁₀ is required.

2.5-3mls of 0.5% heavy or plain bupivacaine can therefore be used to achieve this.

1. Pescod, David. Developing Anaesthesia Textbook 1.6 p128.

2. Conn, D; Nicholls, B. "Central Neuroaxial Blocks." (Chapter) p1100. Allman K, Wilson I. Oxford Handbook of Anaesthesia. Oxford University Press 2006.

He is very concerned about the risks of spinal anaesthesia. Detail what you would tell him before the procedure.

Explain to Tsahim:

- 1. Benefits of spinal anaesthesia over general anaesthesia and why you think that this is the safer technique – specifically that you are concerned about his underlying respiratory function and that he is certainly at increased risk of developing respiratory complications with a general anaesthetic.*
- 2. Risks of spinal anaesthesia and what in particular he is concerned about, clearing up any misconceptions. Reassure him that it is a very safe and common procedure, and that severe complications such as permanent neurology and local anaesthetic toxicity are extremely rare. Other problems such as hypotension, nausea, headache, backache and failure of block are easily treated or self-limiting.*
- 3. Reassure patient that he will be closely monitored at all times for potential complications.*

1. Pescod, David. Developing Anaesthesia Textbook 1.6 p132-135.

2. Baker, B; Jenkins, K. "Anaesthetic Risk." (Chapter) p18. Allman K, Wilson I. Oxford Handbook of Anaesthesia. Oxford University Press 2006.

In the recovery room, his blood pressure is 90/50 mmHg and he is feeling nauseated. What are the potential causes of his low blood pressure? Outline your management of this situation.

Common causes of his hypotension include:

- 1. Vasodilation from neuroaxial blockade.*
- 2. Hypovolaemia from inadequate fluid resuscitation or bleeding.*
- 3. Equipment failure e.g. wrong cuff size.*

Uncommon causes would include:

- 1. Anaphylaxis.*
- 2. Drug Error.*
- 3. Cardiac dysrhythmias.*
- 4. Pneumothorax.*
- 5. Embolism*
- 6. Adrenocortical insufficiency.*
- 7. Acute Mitral Valve Rupture.*
- 8. Pericardial Tamponade.*

Management would be:

- 1. Given that the patient is known to be hypertensive and is symptomatic with a blood pressure of 90/60 mmHg, further treatment is required.*
- 2. Apply oxygen.*
- 3. Check NIBP monitor – repeat cycle, check cuff size and check manually by palpating artery for a pulse.*
- 4. Quickly check ECG for any arrhythmias.*
- 5. Provide circulatory support using volume resuscitation and vasopressors.*
- 6. Assess block height.*
- 7. Exclude bleeding and other uncommon causes.*
- 8. Nausea should resolve with treatment of his hypotension – otherwise treat with appropriate anti-emetics.*

1. Pescod, David. Developing Anaesthesia Textbook 1.6 p133.

2. Thomas, R. <http://anaesthesia.org.au/emac/cardio/cardio/hypotension.html> 2009.

Case No 12.2

Enkhzaya is a 25 year old woman who has come to your hospital in spontaneous labour at 42 weeks. She is requesting labour analgesia.

Discuss the options for analgesia including the advantages and disadvantages of each.

Options	Advantages	Disadvantages
<i>Non-pharmacological – psychological, positioning and movement, relaxation and breathing techniques, massage, heat and cold, imagery, hypnosis, acupuncture and transcutaneous electrical nerve stimulation.</i>	<ul style="list-style-type: none"> - Harmless techniques in reducing pain. 	<ul style="list-style-type: none"> - Have to be learnt beforehand. - Success rate variable and often insufficient as sole modality requiring other pharmacological adjuvants.
<i>Inhalational – Entonox</i>	<ul style="list-style-type: none"> - Simple to use. - Cheap. - Short duration of action. - Safe for labouring women and their babies. 	<ul style="list-style-type: none"> - Can cause drowsiness, dizziness and nausea. - Peak action is 45 secs before a contraction which is difficult to time. - Analgesic efficacy is limited compared with regional anaesthesia.
<i>Parenteral – Opioids (e.g. pethidine, fentanyl and remifentanyl).</i>	<ul style="list-style-type: none"> - Simple to use as both a stat dose and as patient controlled analgesia. - Cheap. - Provides good pain relief. - A viable substitute when regional analgesia is contraindicated or refused. 	<ul style="list-style-type: none"> - Can cause confusion, sedation and respiratory depression to the mother. - Can cause respiratory depression in the neonate especially pethidine in the compromised acidotic foetus. - Close maternal, foetal and neonatal monitoring required.
<i>Regional – Epidural, spinal or combined spinal epidural.</i>	<ul style="list-style-type: none"> - The most effective and reliable way of initiating and maintaining analgesia. 	<ul style="list-style-type: none"> - Requires a greater level of skill to insert and monitor. - Can fail or cause hypotension, backache, delayed progress of labour and headache. - Rare complications include total spinal, local anaesthetic toxicity, epidural haematoma or abscess and permanent neurology. - Absolute contraindications include coagulopathy, infection and relative contraindications include aortic/mitral stenosis and neurological disease.

1. Pescod, David. *Developing Anaesthesia Textbook* 1.6 p106-110.

2. Wee, M. *Analgesia in labour: inhalational and parenteral. Anaesthesia and Intensive Care Medicine* 2007, 8:7: 276-8.

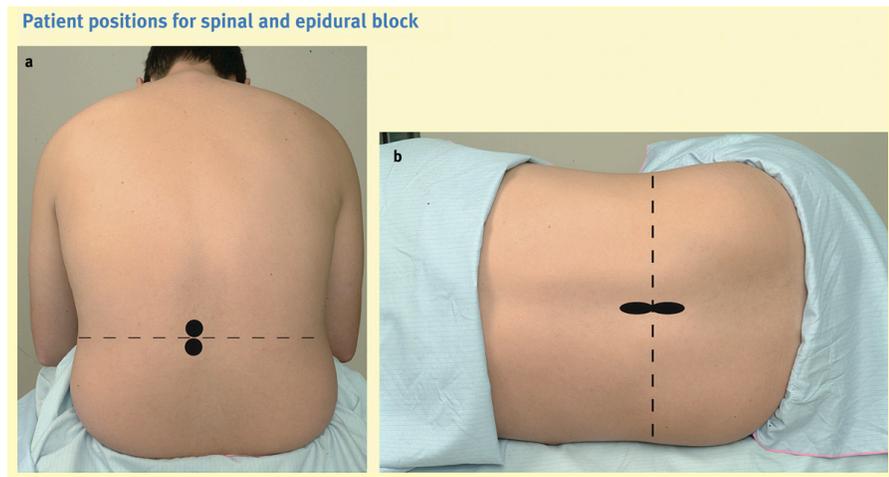
After a long discussion with you, she decides that she would like an epidural for labour analgesia. Describe in detail how you would perform the epidural.

Preparation

- Perform a preoperative assessment and obtain informed consent.
- Ensure environment is clean, well lit and quiet.
- Ensure a skilled assistant, intravenous access and appropriate monitoring is in place.
- Resuscitation drugs and equipment should be readily available and checked.
- Ensure a sterile technique with gowns, gloves and face mask.

Position the patient

- Position the patient in the lateral or sitting position and identify Tuffier's line which joins the two iliac crests and passes through the L₃/L₄ interspace.



Approach to the epidural space

- Infiltrate the skin and subcutaneous tissues over the chosen vertebral interspace (usually L₃/L₄ or L₄/L₅) with 1% lignocaine.
- An 18 or 16 gauge Touhy needle is introduced in the mid-line with the bevel directed cephalad. The needle passes through skin, supraspinous ligament and then into the interspinous ligament.
- At this point, remove the Touhy stylet and attach the Loss of Resistance (LOR) syringe using either air or saline.
- LOR should be detected as the needle passes through the ligamentum flavum and into the epidural space.

Inserting the catheter

- Insert the 20 gauge catheter to a sufficient depth and carefully withdraw the needle ensuring the catheter is not withdrawn with the needle.
- Calculate the depth to the epidural space and gently withdraw the catheter until it is 4-5cm in the epidural space.
- Attach the catheter hub and filter and apply a sterile dressing to the site.

Injection of test dose

- Aspirate for any CSF or blood and then inject 2-3mls of 2% lignocaine with adrenaline to detect an accidental subarachnoid or intravascular placement.

Establishing and maintaining analgesia

- The total dose of local anaesthetic (e.g. 10-15mls of 0.1% bupivacaine with or without fentanyl or 8-12mls of 0.25% bupivacaine) is given in increments until the correct block height (T_{10} for 1st stage of labour).
- An infusion of 0.125% bupivacaine or 0.2% ropivacaine with 2mcg/ml of fentanyl at 6-12mlshr can be started to provide ongoing analgesia with further top ups as required for breakthrough pain.

1. Pescod, David. *Developing Anaesthesia Textbook* 1.6 p108-109.

2. Fischer, B. *Techniques of epidural block. Anaesthesia and Intensive Care Medicine* 2009, 10:11: 552-6.

What is a test dose and why is it performed?

A test dose is a small amount of local anaesthetic to detect an accidental subarachnoid or intravascular placement.

1. Fischer, B. *Techniques of epidural block. Anaesthesia and Intensive Care Medicine* 2009, 10:11: 552-6.

Further reading

The use and choice of a test dose in labour epidural analgesia is controversial. The use now of ultradilute solutions (0.1% bupivacaine compared with the traditional 0.25%) and the lack of sensitivity and specificity of a test dose questions its usefulness as a diagnostic tool. And as aspiration is often diagnostic some authors believe a test dose is unnecessary.

Aspiration itself however has a low negative predictive value (i.e. if there is no CSF or blood aspirated, it does not exclude an intrathecal or intravascular placement), and so others maintain the importance of test dose to improve detection.

Another controversy is the use of adrenaline, which although has shown to produce a reliable increase in heart rate in volunteers, is less predictive with labouring patients where maternal heart rate can vary with the pain from uterine contractions. Intravenous adrenaline may also theoretically reduce uterine blood flow putting the foetus at risk. Nevertheless, no clinical data as yet suggest that any foetus has been harmed with the use of adrenaline as part of a test dose.

Some anaesthetists will use 10-15mls of 0.1% bupivacaine as both the test and main dose, where a complete absence of a detectable block suggests intravascular placement and rapid onset of analgesia, motor block and sympathetic block suggest intrathecal placement.

1. Birnbach, D; Browne, I. "Anesthesia for Obstetrics." (Chapter 69). Miller, R. *Miller's Anesthesia* 7th Edition. Churchill Livingstone 2009.

2. Collis, R. *Analgesia in labour: Induction and maintenance. Anaesthesia and Intensive Care Medicine* 2007, 8:7 : 273-5.

3. Eldridge, J. "Epidural analgesia for labour." (Chapter) p700. Allman K, Wilson I. *Oxford Handbook of Anaesthesia*. Oxford University Press 2006.

What medications will you use in your epidural to establish labour analgesia?

10-15mls of 0.1% bupivacaine with or without 2mcg/ml fentanyl or 8-12mls of 0.25% bupivacaine can be given in increments to establish labour analgesia.

1. Pescod, David. *Developing Anaesthesia Textbook 1.6 p109.*
2. Collis, R. *Analgesia in labour: Induction and maintenance. Anaesthesia and Intensive Care Medicine 2007, 8:7 : 273-5.*
3. Eldridge, J. "Epidural analgesia for labour." (Chapter) p700. Allman K, Wilson I. *Oxford Handbook of Anaesthesia. Oxford University Press 2006.*

What monitoring will you perform initially after you administer your local anaesthetic dose? How long will you stay with the patient?

Monitor conscious state, blood pressure, heart rate, respiratory rate and oxygen saturation and stay with the patient for at least 20 minutes as cardiovascular effects are most pronounced then.

1. Pescod, David. *Developing Anaesthesia Textbook 1.6 p109.*

The midwives would like to know what observations to perform of Enhzaya and her unborn baby? What instructions will you give them?

Advise the midwives to monitor maternal blood pressure and heart rate, height of the block and foetal heart rate every 5 minutes after a top-up or the establishment of the epidural block for at least 20mins.

Once the block is stable, observations can be performed half-hourly with continuous cardiotocography (CTG) monitoring.

1. Pescod, David. *Developing Anaesthesia Textbook 1.6 p109.*
2. Eldridge, J. "Epidural analgesia for labour." (Chapter) p700. Allman K, Wilson I. *Oxford Handbook of Anaesthesia. Oxford University Press 2006.*

The obstetricians are concerned that Enkhzaya will not be able to push in second stage for delivery of the baby. Does having an epidural have any influence on the ability to deliver vaginally? Are there any ways to reduce the likelihood of a forceps or assisted delivery?

Yes, an epidural has been associated with a decreased ability to deliver vaginally, which is likely due to:

1. *Motor block reducing the effectiveness of maternal pushing.*
2. *Sensory block reducing the coordination between maternal pushing and uterine contractions.*
3. *Decreasing the secretion of oxytocin from disruption of the neuro-endocrine reflex.*
4. *Decreasing uterine contractility.*

However, there is also evidence to show that epidural analgesia may accelerate an already prolonged and exhausting labour and reduce the need for delivery by caesarean section for failure to progress.

Method to decrease the likelihood of a forceps or assisted delivery include:

- 1. Running ropivacaine (0.2%) or low dose bupivacaine (0.1%) with opioids (2mcg/ml fentanyl) as the infusion.*
- 2. Augmentation with oxytocin.*
- 3. Proceeding to caesarean section rather than instrumental delivery.*

- 1. Comparative Obstetric Mobile Epidural Trial (COMET) Study Group UK. Effect of low dose mobile versus traditional epidural techniques on mode of delivery: a randomised control trial. Lancet 2001; 358: 19-23.*
- 2. Halpern, S; Walsh, V. Epidural Ropivacaine Versus Bupivacaine for Labor: A Meta-Analysis. Anaesthesia Analgesia 2003; 96:1473-9.*
- 3. Thorburn J, Moir DD; Extradural analgesia: the influence of volume and concentration of bupivacaine on the mode of delivery, analgesic efficacy, and motor block. Br.J. Anaesth. 1981; 53:933*
- 4. Bates RG, Helm CW; Uterine activity in the second stage of labour and the effect of epidural analgesia. British Journal of Obstetrics and Gynaecology, Dec 1985, 92 1246-1250.*
- 5. Matadial L, Cibils L; The effect of epidural analgesia on uterine activity and blood pressure. Am. J. Obstet. Gynecol., July 1976, 125:6 846-854.*
- 6. Lederman RP, Lederman E, Work B, McCann DS: Anxiety and epinephrine in multiparous women in labour: Relationship to duration of labour and fetal heart pattern. Am J. Obstet Gyaecol. Dec 15th, 1985 153:8 870-877.*
- 7. Maltau JM, Andersen HT; Epidural anaesthesia as an alternative to caesarean section in the treatment of prolonged, exhaustive labour. Acta Anaesth. Scand. 1975 19; 349-354.*
- 8. Crawford JS; The second thousand epidural blocks in an obstetric hospital practice. Brit. J. Anaesth. 1972; 44; 1277-1286.*
- 9. Schnider SM, Abboud TK, Artal R, Henriksen EH, et al; Maternal catecholamines decrease during labor after lumbar epidural anesthesia. Am. J. Obstet. Gynecol. Sep 1, 1983,147:1 13-15.*

Case No 12.3

Ganbat is a one year old boy who is about to undergo an orchidopexy for an undescended testis. He is otherwise fit and well and you have planned a general anaesthetic with a caudal anaesthetic for analgesia

What are the advantages of a regional technique in a child?

The advantages should be assessed for each individual child to confirm that the intended benefits outweigh the risks.

The advantages are:

- 1. Provides excellent post-operative analgesia.*
- 2. Reduces the requirement for post-operative opioids – thus decreasing the adverse effects of opioids – e.g. nausea, vomiting, pruritus, apnoea, sedation, and constipation.*
- 3. Maintains normal respiratory function after surgery.*
- 4. Reduces the stress response to surgery.*

1. Moriarty, T; Brown, R. "Neuroaxial blockade in children". Anaesthesia and Intensive Care Medicine 8:5 2007:194-199

Further reading

Specific advantages of individual techniques are as follows.

Caudal

- 1. Provides reliable and good-quality analgesia*
- 2. Technique is relatively simple and has a favourable risk-to-benefit ratio.*
- 3. Catheters can be inserted easily to extend the duration or height of the block.*

Lumbar epidurals

- 1. Improve outcome after open fundoplication or repair of tracheo-oesophageal fistula.*
- 2. Reduce spasm in children with cerebral palsy or following hip surgery.*

Spinals

- 1. Used in ex-premature babies (the premature baby that survives the neonatal period) who are considered at risk of postoperative apnoea.*
- 2. Appropriate in older children with severe neuromuscular disease.*

1. Moriarty, T; Brown, R. "Neuroaxial blockade in children". Anaesthesia and Intensive Care Medicine 8:5 2007:194-199

Describe the technique for caudal anaesthesia for an orchidopexy that will require both a scrotal and inguinal incision.

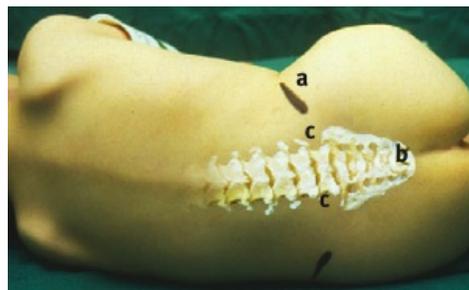
Patient should be fasted and all appropriate equipment and drugs made available to treat the potential complications from an accidental intravascular injection or total spinal. Intravenous access is therefore required before starting.

Technique:

1. Position the patient in the Simms position (on their side with upper leg fully flexed and lower leg partially flexed). Procedure can also be done supine.
2. Use a sterile technique using antiseptic skin preparation and gloves.
3. Find landmarks:
 - a. The sacrococcygeal membrane is bounded by the two sacral cornua and the apex of the tip of the fourth sacral spine which forms a "V" shape. (Picture 1a)
 - b. A line drawn perpendicular to the thigh crosses the sacral hiatus. (Picture 1b)
 - c. The sacral hiatus also lies at the apex of an equilateral triangle formed by the posterior superior iliac spines.

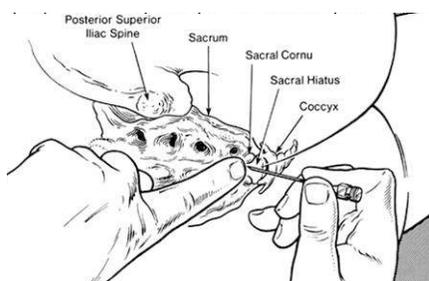


Picture 1



Picture 2

4. Insert a short 22G needle at about 45° between the two sacral cornua until it is through the sacrococcygeal ligament which is identified by a loss of resistance or "pop."



Picture 3

5. The needle should then be depressed towards the skin to align the needle with the long axis of the canal and advanced a few millimetres to ensure complete insertion of the tip of the needle. The needle should then be aspirated, looking for cerebrospinal fluid or blood but knowing that this does not exclude the needle penetrating through the dura or a blood vessel.
6. A test dose (4mls) should then be given looking for signs of an intravascular injection (arrhythmia, hypotension) or a misguided subcutaneous injection.
7. If the test dose is normal, the whole dose can be given slowly at a rate no more than 10mls/30secs.

1. Pescod, David. *Developing Anaesthesia Textbook* 1.6 p104.

2. Moriarty, T; Brown, R. "Neuroaxial blockade in children". *Anaesthesia and Intensive Care Medicine* 8:5 2007:194-199

3. Siddiqui, A. "Caudal blockade in children". *Techniques in Regional Anesthesia and Pain Management* 2007; 11:203-207

What type and dose of local anaesthetic will you use?

An orchidopexy requires a scrotal and inguinal incision and therefore a thoracolumbar block is required.

The optimum concentration of bupivacaine is 0.125-0.175%. Compared with the usual 0.25% preparation, it still provides a similar duration of postoperative analgesia (4 to 8 hours) but with less motor blockade. A dose of 1ml/kg to a maximum volume of 30mls can reliably provide a T₁₀ sensory block.

Other alternatives include 1 ml/kg of 0.2% ropivacaine or 0.8 ml/kg of 0.25% levobupivacaine.

1. Pescod, David. *Developing Anaesthesia Textbook* 1.6 p104.

2. http://nysora.com/regional_anesthesia/sub-specialties/pediatric_anesthesia/3087-pediatric_epidural_and_caudal_analgesia_and_anesthesia_in_childr.html NYSORA 2009.

Further reading

Preservative free adjuvants that can be used to prolong the duration of the block include:

1. Fentanyl 2 mcg/kg or morphine 50 mcg/kg.
2. Clonidine 1 mcg/kg
3. Ketamine 0.25-0.5 mg/kg

1. http://nysora.com/regional_anesthesia/sub-specialties/pediatric_anesthesia/3087-pediatric_epidural_and_caudal_analgesia_and_anesthesia_in_childr.html NYSORA 2009.

2. Berg, S. "Caudal Block." (Chapter) p784. Allman K, Wilson I. *Oxford Handbook of Anaesthesia*.

Oxford University Press 2006.

Are there any risks you need to discuss with the parents before the procedure?

A caudal block is remarkably safe. The risks are 1:10,000 for serious complications and 1:40,000 for catastrophic complications. These include neurological injury, haematoma, infection including an epidural abscess and meningitis, dural puncture with a total spinal (1:2000-1:3000) and local anaesthetic toxicity from an intravascular injection.

Other adverse side effects are temporary and include leg weakness, hypotension and urinary retention.

There can also be a failure of the block from a subcutaneous injection.

1. Pescod, David. *Developing Anaesthesia Textbook* 1.6 p105.

2. http://nysora.com/regional_anesthesia/sub-specialties/pediatric_anesthesia/3087-pediatric_epidural_and_caudal_analgesia_and_anesthesia_in_childr.html NYSORA 2009.

3. Berg, S. "Caudal Block." (Chapter) p785. Allman K, Wilson I. *Oxford Handbook of Anaesthesia*. Oxford University Press 2006.

4. Moriarty, T; Brown, R. "Neuroaxial blockade in children". *Anaesthesia and Intensive Care Medicine* 8:5 2007:194-199

The recovery room nurses have noticed that Ganbat is very agitated in the recovery room. What are the possible causes of this agitation?

Possible causes of his agitation include:

1. *Rapid return of consciousness in an unfamiliar, noisy environment.*
2. *Use of volatiles especially desflurane and sevoflurane.*
3. *Pain from failure of block, sore throat, urinary retention.*
4. *Airway obstruction or hypoxia.*
5. *Child's personality.*
6. *Local anaesthetic toxicity (rare).*

1. Pescod, David. *Developing Anaesthesia Textbook* 1.6 p148.

2. Muniz da Silva, L; Braz, LG; Modolo, NSP. *Emergence agitation in pediatric anesthesia: current features. J Pediatr (Rio J)*. 2008; 84(2):107-113.