MALAYSIAN SOCIETY OF ANAESTHESIOLOGISTS YEAR BOOK 2014/2015

KESELAMATAN DALAM BIUS

MALAYSIAN SOCIETY OF ANAESTHESIOLOGISTS

Year Book 2014/2015

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Foreword

It is a great personal honour to write the foreword for this seventh edition of the Malaysian Society of Anaesthesiologists (MSA) Year Book 2014/2015. The theme of this edition is "Mother and Child", whereby 11 topics, covering different aspects of the parturient and children related to anaesthesia, are presented. This most recent endeavour is meant not only to educate those in the obstetric and paediatric anaesthesiology subspecialties, but also others who are not directly involved in the daily care of the mother and child. Like it or not, we invariably encounter these subtypes of patients frequently, and thus, must have an understanding of their physiology and be able to manage their care. The topics are not only varied but have been thoroughly researched, well-written and interesting. Certain aspects are definitely a bit distanced from our usual anaesthetic practice, such as the alternative methods of labour analgesia and needle phobia. These cases may be rare, but we may come across one or two of them in our professional lifetime.

Apart from being launched on our Anaesthesia Day 2015, this Year Book holds a special place as being the first of our MSA Year Book to be awarded an ISSN. With this elevated status, the Year Book will grow from strength to strength and encourage future contributions for the benefit of generations to come.

I would like to extend my utmost gratitude to all the authors and peer reviewers for writing and reviewing the articles. Last but not least, I would like to thank this year's editors, Associate Professor Dr Ina Ismiarti Sharifuddin and Dr Muhammad Maaya for spending countless hours refining the contribution of the writers to produce the MSA Year Book 2014/2015.

Thank You and well done everyone!

Dr Raveenthiran Rasiah
President
Malaysian Society of Anesthesiologists

Preface

We would like to extend our gratitude to the Malaysian Society of Anaesthesiologists (MSA) for the honour given to us as the Editors for this 7th edition of MSA Year Book for the year 2014/2015.

For this edition, the theme is centred on the anaesthetic care of the mother and child. This year book compiles review articles written by not only the obstetric and paediatric anaesthesiologists, but also from others in our field as there would be implications on the care and well-being of these two sub-groups of patients. The topics range from the common to the rare and we fervently hope that these articles would educate us for the better.

Last but not least, we thank all the authors and reviewers for taking time off from their busy schedules to write and review the articles. We hope that this endeavour will continue in years to come and enlighten the current and future generations.

Associate Professor Dr Ina Ismiarti Shariffuddin
Dr Muhammad Maaya
Editors
MSA Year Book 2014/2015

Acknowledgements - Reviewers

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Professor Dr Karis Misiran
Head & Consultant Anaesthesiologist, Department of Anaesthesiology & Intensive Care, Faculty of Medicine, Universiti Teknologi Mara, Kuala Lumpur, Malaysia

Professor Dr Ramani Vijayan Sannasi
Professor & Senior Consultant Anaesthesiologist, Department of Anaesthesiology & Intensive Care, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

Professor Dr Lucy Chan
Professor & Senior Consultant Anaesthesiologist, Department of Anaesthesiology & Intensive Care, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

Dr Hari Krishnan A/L SK Puvaneswaran
Consultant Anaesthetist, Ara Damansara Medical Centre, Shah Alam, Selangor, Malaysia

Dr Nadia Md Nor
Lecturer and Consultant Anaesthesiologist, Department of Anaesthesiology & Intensive Care, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia

Dr Julina Santhi Johami
Consultant Anaesthetist, ParkCity Medical Centre, Desa ParkCity, Kuala Lumpur, Malaysia

Dr Usha Nair
Consultant Anasthesiologist, Department of Anaesthesiology, Hospital Raja Permaisuri Bainun, Ipoh, Malaysia

Labour Analgesia: The Alternative Methods

Azlina Masdar, MD (UKM), FCA (Ireland), Fellowship in Obstetric Anaesthesia (Ireland)
Lecturer & Anaesthesiologist, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia

INTRODUCTION

One of the major concerns of a parturient is having to go through and finding methods to relieve labour pain, with considerable implications for the course, quality, outcome and cost of intrapartum care.[1] Factors that can be modified to influence labour pain are environmental conditions, coping strategies, fear, anxiety, maternal expectations and her confidence in the ability to cope with the pain.[2] A wide range of labour analgesia can be used by parturients during childbirth.[1,3-5] This can be divided into non-pharmacological methods, which include immersion in water, massage, relaxation techniques, transcutaneous electrical nerve stimulation (TENS), acupuncture, hypnosis, injected water papules; and the pharmacological methods, which are epidural and intrathecal analgesia, inhalational analgesia, opioids, non-opioids and nerve blocks.[3] Few studies had concluded the superiority of epidural as labour analgesia but evidence is still lacking on the alternative methods.[3-5]

LABOUR EPIDURAL

In 1946, epidural analgesia was first used in obstetric practice, and over the years its use for alleviating labour pain has steadily increased.[5] It is a central neuraxial block technique achieved by injection of local anaesthetic into the lower region of the spine close to the nerves that transmit painful stimuli from the contracting uterus and birth canal. Labour epidural analgesia can be delivered either as epidural alone, or in combination with spinal analgesia, combined spinal epidural.

Current evidence shows that epidural is the most effective labour analgesia compared to other methods. Epidural is not associated with prolonged first stage of labour, increased caesarean delivery rate or long term backache, and there is no significant effect on neonatal status and maternal satisfaction.[5] However, it increases the risk of instrumental vaginal delivery. Some adverse effects of epidural that may develop are low blood pressure, fever, urinary retention and lower limbs weakness.[4,5] Therefore, intravenous access and more intensive level of monitoring are needed, thus hindering the parturients from being mobile whilst in labour.[4]

ALTERNATIVE METHODS OF LABOUR ANALGESIA

Complementary and alternative medicine (CAM) refers to a group of diverse health care practices and products not traditionally associated with the medical profession or public health system.[6] Worldwide, many parturients prefer to avoid pharmacological or invasive methods of labour analgesia thus contributing towards the popularity of CAM methods of pain management.[7] Some of the methods can be used as a sole labour analgesia while others alleviate labour pain by means of delaying the needs for pharmacological intervention.[3,6,7]

Immersion in water

A Cochrane systematic review in 2012 looked at 12 trials involving 3243 subjects and concluded that water immersion during the first stage of labour reduced the requirement for epidural/spinal analgesia and the first stage labour duration without adversely affecting operative delivery rates or maternal and neonatal wellbeing.[8] However, the studies were very variable and heterogenous. In a recent United Kingdom (UK) guideline, parturients should be offered the opportunity to labour in water for pain relief if such facility were available.[4] The following are recommendations for labouring in water immersion:

- Hourly monitoring of the labouring parturient and the water
- The water temperature should not be above 37.5ºC
- The bath or birthing pool should be kept clean according to a protocol in line with the hospital's microbiology department
- The birthing pool must be in accordance with the manufacturer's guideline

Massage

Massage provides physical contact with the parturient, potentiates the effect of relaxation, reduces emotional stress as well as promotes pain relief.[9] Several theories proposed the mechanism by which massage might relieve pain; a reduction in noradrenaline and cortisol levels, increased serotonin level, stimulation of endorphine release, facilitation of toxin excretion through lymphatic system, the inhibition of pain pathway sensory transmission and improvement in the blood flow with consequent increased oxygen supply to the tissues.[3,9] Smith et al concluded that massage, taught to the parturient's birth companion during antenatal classes, may have a role in pain reduction and improvement in maternal emotional experience during labour.[10] Gallo et al found that 30 minutes of massage during labour reduced the severity of labour pain.[9] The recent UK guideline stated the support of the parturient's choice for massage as labour analgesia.[4]

Relaxation techniques (yoga, music, audio stimulus)

Both a Cochrane review (2012) and the NICE guideline (2014) support the use of relaxation techniques during labour, as they provide pain relief, higher satisfaction with the pain relief and childbirth, reduction in forceps and ventouse vaginal delivery.[3,4]

Originated from India, yoga is an ancient mind-body practice that uses breathing exercises (*pranayama*), physical postures (*asana*), meditation (*dhayana*), concentration (*dharana*) and contemplative practice which may improve quality of life, stress levels, interpersonal relationship, autonomic nervous system function and labour pain.[11] Curtis et al reviewed yoga for pregnant women and concluded that a pre-natal yoga program is beneficial during pregnancy, throughout labour and on birth outcomes.[11]

Music, on the other hand, has been known for centuries to have therapeutic effects on the body and mind. According to the gate control theory, the impulses triggered by music auditory stimulus override the pain signals carried by smaller nerve fibres and also may stimulate endorphin release by pituitary gland for decreasing pain.[12] Liu et al discovered that during the latent phase of labour (2-4 cm cervical dilatation), music was able to provide relaxation, reduce the anxiety and pain of the parturient. The Taiwanese primigravid ladies were able to choose one of the following types of music: classical (e.g. Beethoven's "Für Elise"), light (e.g. Franz Liszt's "Liebestraum"), popular (e.g. Simon and Garfunkel's "Sound of Silence"), crystal children's (e.g. "Doll Country") or religious music. However, they found no difference between the music listeners and the control group during the active phase (5-7 cm cervical dilatation).[12]

Transcutaneous Electrical Nerve Stimulation (TENS)

TENS is a non-invasive analgesic technique whereby patient can self-administer and titrate non-noxious electrical stimuli as required.[13] Electrodes are placed on intact skin surface to activate the underlying nerves. Low-intensity non-noxious TENS paraesthesia (conventional) relieves pain by segmental mechanism. Higher intensity TENS activates extra segmental descending pain inhibitory pathways as well as activating diffuse noxious inhibitory controls via counter-irritant effects. Dowswell et al, in a Cochrane review (2009), examined 17 trials which comprised of

1466 parturients and concluded there was limited evidence that TENS reduce pain in labour, with no impact on the maternal and neonatal outcomes.[14] As a similar conclusion was drawn in a later Cochrane review (2012), NICE guidelines suggested women in established labour should not be offered TENS.[3,4]

Acupuncture

Acupuncture, involving insertion of fine needles into specific parts of the body called acupuncture points, was first introduced as labour analgesia in the 1970s and has been used to relieve pain and facilitate labour process.[15] For labour analgesia, the acupuncture points are located on the hands, feet and ears.[3] Few theories has been proposed for its mechanism of action; pain impulses at the 'pain gates' in the spinal cord are blocked by stimulation of touch fibres and acupuncture stimulates endorphins release in the body. Cho et al (2010) reviewed 10 randomised controlled trials (RCT) involving 2038 parturients and concluded that the evidence did not support the use of acupuncture for labour pain.[15] However, in a Cochrane review (2012), acupuncture was found to provide labour analgesia and better satisfaction, as well as reduced the use of forceps, ventouse and number of caesarean section.[3]

Hypnosis

Hypnotherapy, practiced for more than a century in pregnancy and childbirth, encompasses an altered state of consciousness, for example daydreaming or meditation, resulting in a failure to reach conscious awareness in normally perceived experiences.[16] Such states of hypnosis are characterised by an increased receptivity to verbal and non-verbal communications, commonly referred to as suggestions, which help achieve therapeutic goals, e.g. reduction of anxiety or pain. The anterior cingulate gyrus of the limbic system is one of the sites in the brain affected by hypnotic modulation of pain. The suppression of neural activity between the amygdala-limbic system and sensory cortex appears to inhibit the emotional interpretation of pain sensation.[16]

Cyna et al studied 5 RCTs and 14 non-randomised comparisons involving 8395 women where hypnosis was used for labour analgesia, and concluded the needs for further well-designed trials to confirm the effects of hypnosis on childbirth. Despite being able to show that hypnosis reduces analgesia requirement during labour, the studies were lacking in random allocation, concealment and blinding method. Therefore, NICE guidelines did not recommend hypnosis to be offered but had no objection to labouring parturients who are interested in such method.[4]

Injected water papules

Small amounts of sterile water, injected either subcutaneously or intracutaneously at 4 points lateral to the lumbosacral spine, was first used to ease the pain associated with kidney stones, and later introduced to obstetrics analgesia in the 1970s.[17] These injections are associated with acute somatic pain which lasts for 30 seconds, but as the injection pain subsides, the visceral referred pain of the lower back is also reduced. This technique is thought to work through endorphins and encephalins release and is based on gate control pain theories, but there is insufficient evidence to support and recommend this technique for pain management in labour.[3,4]

CONCLUSION

Labour pain varies greatly between parturients, and for most, the pain is significant enough to require some form of pain relief. For parturients who wish to avoid invasive and pharmacological methods of analgesia, water birthing, massage and relaxation are not only safe for both the mother and unborn foetus but also proven to be effective.

References

1. Caton D, Corry MP, Frigoletto FD, et al. The nature and management of labor pain: executive summary. *Am J Obstet Gynecol* 2002; **186(5)**: S1-15

2. Lowe NK. The nature of labor pain. *Am J Obstet Gynecol* 2002; **186(5)**: S16-24

3. Jones L, Othman M, Dowswell T, Alfirevic Z, et al. Pain management for women in labour: an overview of systematic reviews. *Cochrane Database of Systematic Reviews* 2012, Issue 3. CD009234

4. National Institute for Health and Clinical Excellence (NICE). Intrapartum care: care of healthy women and their babies during childbirth. Clinical guideline 190. *NICE* 2014

5. Anim-Somuah M, Smyth RMD, Jones L. Epidural versus non-epidural or no analgesia in labour. *Cochrane Database of Systematic Reviews* 2011, Issue 2. CD000331

6. Adams J, Lui C-W, Sibbritt D, Broom A, Wardle J, Homer C, Beck S. Women's use of complementary and alternative medicine during pregnancy: a critical review of the literature. *Birth* 2009; **36(3)**: 237-45

7. Eisenberg DM, Davis RB, Ettner SL, et al. Trends in alternative medicine use in the United States, 1990-1997: results of a follow-up national survey. *JAMA* 1998; **280(18)**: 1569-75

8. Cluett ER, Nikodem CVC, McCandish RE, Burns E. Immersion in water, labour and birth. *Cochrane Database of Systematic Reviews* 2012, Issue 2. CD000111

9. Gallo RBS, Santana LS, Ferreira CHJ, et al. Massage reduced severity of pain during labour: a randomised trial. *Journal of Physiotherapy* 2013; **59(2)**: 109-16

10. Smith CA, Levett KM, Collins CT, Jones L. Massage, reflexology and other manual methods for pain management in labour. *Cochrane Database of Systematic Reviews* 2012, Issue 2. CD009290

11. Curtis K, Weinrib A, Katz J. Systematic review of yoga for pregnant women: current status and future directions. *Evidence-Based Complementary and Alternative Medicine* 2012. (DOI: 10.1155/2012/715942)

12. Liu Y-H, Chang M-Y, Chen C-H. Effects of music therapy on labour pain and anxiety in Taiwanese first-time mothers. *Journal of Clinical Nursing* 2010; **19**: 1065-72

13. Jones I, Johnson MI. Transcutaneous electrical nerve stimulation. *CEACCP* 2009; **9**: 130-35

14. Dowswell T, Bedwell C, Lavender T, Neilson JP. Transcutaneous electrical nerve stimulation (TENS) for pain management in labour. *Cochrane Database of Systematic Reviews* 2009, Issue 2. CD007214

15. Cho S-H, Lee H, Ernst. Acupuncture for pain relief in labour: a systematic review and meta-analysis. *BJOG* 2010; **117(8)**: 907-20

16. Cyna AM, McAuliffe GL, Andrew MI. Hypnosis for pain relief in labour and childbirth: a systematic review. *Br J Anaesth* 2004; **93(4)**: 505-11

17. Hutton EK, Kasperink M, Rutten M, Reitsma A, Wainman B. Sterile water injection for labour pain: a systematic review and meta-analysis of randomised controlled trials. *BJOG* 2009; **116(9)**: 1158-66

Ultrasound-Guided Regional Anaesthesia in Paediatric Patients

Muhammad Habibullah Zakaria, MD (UKM), M Med (Anaesthesiology) USM
Paediatric Anaesthesiologist, Hospital Sultanah Nur Zahirah, Kuala Terengganu, Terengganu, Malaysia

INTRODUCTION

Regional anaesthesia (RA) for the paediatric population continues to grow in popularity and has become a cornerstone for perioperative care for children of all ages. The introduction of real-time ultrasound-guided regional anaesthesia has provided a huge breakthrough in RA, in adults as well as children.[1-3]

BACKGROUND OF ULTRASOUND IN PAEDIATRIC REGIONAL ANAESTHESIA

The use of RA in children remains limited in some institutions. Regional anaesthesia techniques in children have often been considered challenging due to various factors as listed below:

(1) Targeting neural structures that often course very close to critical structures (e.g., nerves of the brachial plexus run close to the pleura as they transverse the supraclavicular region), and particularly during central neuraxial blocks where the safety margin is narrow for needle placement particularly close to the spinal cord.

(2) The prerequisite for sedation or general anaesthesia masking potential warning signs (paraesthesia).

(3) The need for limiting the volume of local anaesthetic solution below toxic levels, which can be very small volume in children.

The first usage of ultrasound in regional anaesthesia

In 1978 La Grange and colleagues reported the use of a Doppler flow ultrasound detector to find the subclavian artery and thereby facilitate supraclavicular blockade of the brachial plexus. This is acknowledged as the first study in which an indirect sonographic approach was used for regional anaesthesia.[4]

Sixteen years later in 1994, Kapral and colleagues in Vienna published the first report on direct or real-time ultrasonographic use in regional anaesthesia. This seminal study investigated ultrasound-guided (USG) supraclavicular plexus blockade of the brachial plexus in adults and was the first to describe the visualisation of the spread of the local anaesthetic (LA) in relation to the target nerve structures.[5] Marhofer *et al* in 2004 introduced ultrasound guidance in paediatric regional anaesthesia and the first review article on USG RA was published in British Journal of Anaesthesia 2005.[6,7]

ADVANTAGES OF ULTRASOUND-GUIDED REGIONAL ANAESTHESIA

Visualisation of target structures

With USG, it is possible to identify the target nerve structures and also other relevant anatomical structures e.g. vessels, fascia, pleura, peritoneum and bone. USG also allows anatomical variations to be detected and, thus, the technical approach can be modified to avoid complications and increase the success rate. In a number of various nerve blocks, it may not be possible to truly visualise the target nerve structures but the use of USG can still direct the needle tip to the correct anatomical position, will verify that the LA is deposited in the right place and help in avoiding unintentional puncture of important structures in close proximity.

Monitoring of needle placement and distribution of local anaesthetics

Ultrasonography provides the ability to monitor the needle and the needle tip in real-time. The needle and needle tip can either be visualised in its entirety when using an "in-plane" or longitudinal approach or only the needle tip if an "out-of-plane" or transverse technique is applied. Subsequently the injection of LA can be viewed directly and the adequacy of the spread of the administered LA can immediately be determined, the aim being to completely surround the target nerve structures with LA. If the LA spread is found suboptimal e.g. placed in the inappropriate fascial layer, then the needle can be repositioned and further injections can be performed until an optimal distribution of the LA is accomplished.[8]

Visualisation of smaller nerves and blocking sensory nerves

The development of improved quality of image acquisition enable proper visualisation of small peripheral nerves and nerve branches.[9] Blocking a sensory nerve with nerve stimulator is quite difficult since this relies on the identification of paraesthesia within the sensory distribution of the nerve by the patient and this is obviously not at all possible in deeply sedated or anaesthetised patients. With USG, it is possible to block sensory nerves with high success rates even if the patient is under general anaesthesia, which represents the norm in paediatric anaesthesia.

Reduction of the total dose and volume of local anaesthetics

The use of USG allows for a considerable reduction of the volume of LA needed to accomplish a successful block.[10] This will not only reduce the risk for systemic LA toxicity but will also decrease the risk for unintentional "spillover blocks" of nerves that are located close to the target area (e.g. the phrenic nerve, the stellate ganglion or the recurrent laryngeal nerve when performing an interscalene brachial plexus block). The use of USG may reduce the volume of LA needed for a successful block by as much as 80% compared to using a landmark-based technique.[10]

The reduction of the amount of LA may not only be possible but also desirable when using USG since pharmacokinetic data indicate faster absorption and higher maximal plasma concentration of LA when ultrasound is used for ilioinguinal-iliohypogastric nerve blocks in children as compared with the traditional landmark based technique.[11] Such increased absorption may be caused by the appropriate deposition of LA between the fascial layer of the internal oblique and the transverse abdominis muscle, which will increase the area available for absorption, compared to the landmark-based technique that most often results in intramuscular deposition of the LA.[12]

Faster onset and longer duration

One of the major advantages of USG nerve blocks is that the operator can make sure that the entire nerve structure is surrounded by LA. This should, on theoretical grounds, substantially reduce the onset time of the block and a large number of publications, both in children and adults, have demonstrated significantly shorter onset times when USG is used.[13] Although data is not as consistent as for the reduction of onset time, a number of studies indicate that the duration of the nerve block is also moderately prolonged by the use of USG.[14]

Shorter time to conduct blocks

Due to the advantage of real-time visualisation, USG reduces the number of needle passes to reach the target nerve structures, which in turn can shorten the block performance time.[15]

Lower costs

Economic evaluations between different treatment options are often difficult to adequately perform but an ambitious comparison by Liu et al has found USG blocks to be cost-effective when compared to the nerve-stimulator guided technique.[16] A reduced onset time and better logistics will allow more adequate use of costly operation room time, which in turn results in a positive cost-benefit analysis for the use of USG.[17]

LIMITATIONS

Two major problems are associated with ultrasonography for paediatric regional anaesthesia: the need for appropriate equipment, and adequate education and training.[18]

A frequently stated argument against ultrasonography for regional anaesthesia is the high cost of ultrasonographic equipment. Recently, however, the market has seen the arrival of high-end portable ultrasonography sets approaching laptop format, which are considerably cheaper compared with large machines and may enable a larger number of anaesthesiologists to perform USG blocks in children.

Appropriate education in USG RA techniques is one of the major limitations of the method. Ultrasonography does not replace anatomical knowledge. The first step in education should be intensive theoretical training in anatomy and in the physics underlying ultrasonography. Prior experience in adult regional anaesthesia is an advantage. The second step is intensive ultrasonographic training. Specialised workshops including theory, practical needle guidance techniques, and intensive discussion of all topics in the field are useful during the initial education process. Finally, the acquired knowledge and skills should be implemented in the clinical practice following a step-by-step approach from 'peripheral to central'.

DOES ULTRASOUND INCREASE THE SAFETY IN REGIONAL ANAESTHESIA?

Even though it is possible to visualise vital structures e.g. the pleura, the peritoneum and various blood vessels when using ultrasound, there is yet insufficient evidence that it, in fact, reduce the frequency of more serious complications. Since the incidence of more serious complications in association with peripheral nerve blocks is quite low, very large studies will be necessary to show a reduced incidence of complications when USG is used.[19]

However, it should be reminded that USG is operator-dependent and thus, USG does not automatically provide a safeguard against complications. Even in experienced hands complications such as blood vessel puncture, intravascular injections, pneumothorax or inadvertent intraneural injections have been reported in the literature.[20]

EMERGING BLOCKS FOR CLINICAL PRACTICE

The availability of ultrasound visualisation has driven interest in less common paediatric blocks such as:

Maxillary nerve block

Cleft palate surgery is not only painful, but may also compromise the airway, particularly in children with craniofacial syndromes. Opiate analgesia has the potential to further compromise the airway, whereas bilateral maxillary nerve block can provide analgesia without the risk of respiratory depression in these vulnerable patients.

The approach to the maxillary nerve differs to that in adults since the facial configuration in infants undergoes changes with growth and development. Thus, bilateral maxillary nerve block is performed using a suprazygomatic approach and is based on a computer tomography study.[21] Despite the bony nature of the area, an USG approach is also feasible.[22] The block is remarkably easy to perform. Early indications suggest a low complication rate, and it also seems to improve pain relief, decrease the perioperative consumption of opioids and favour early feeding resumption after cleft palate repair in infants.[21]

Transversus abdominis plane (TAP) block

In 2008, the first TAP blocks under ultrasound guidance for paediatric patients were published and the TAP block was successfully used initially as a single shot technique in paediatric patients of all ages including small infants and neonates.[23,24]

Recent advances include USG techniques for the insertion of continuous catheters in patients of all ages including small infants.[25]

Paravertebral nerve block (PVNB)

In spite of the introduction of PVNB in children by Lönnqvist in 1992, the technique remains underutilised. Recently, PVNB may be experiencing a renewed interest for use in paediatric patients and placement with ultrasound guidance has been described.[26] PVNB is a very versatile block and can be bilateral or unilateral and used for either major or minor thoracic or abdominal surgeries in children. PVNB catheters are being placed in almost all paediatric populations including infants and outpatients.[27]

CONCLUSION

Direct ultrasonographic visualisation significantly improves the outcome of most techniques in paediatric peripheral regional anaesthesia. With the help of high-resolution ultrasonography, the anaesthetist can directly visualise relevant nerve structures for peripheral and central nerve blocks. Such direct visualisation improves the quality of nerve blocks and avoids complications.

References

1. Marhofer P, Chan VWS. Ultrasound-guided regional anesthesia: current concepts and future trends. *Anesth Analg* 2007; **104(5)**: 1265-69

2. Marhofer P, Frickey N. Ultrasonographic guidance in pediatric regional anesthesia. part 1: theoretical background. *Pediatr Anaesth* 2006; **16(10)**: 1008-18

3. Roberts S. Ultrasonographic guidance in pediatric regional anesthesia. part 2: techniques. *Pediatr Anaesth* 2006; **16(11)**: 1112-24

4. la Grange PDP, Foster PA, Pretorius LK. Application of the Doppler ultrasound bloodflow detector in supraclavicular brachial plexus block. *Br J Anaesth* 1978; **50(9)**: 965-67

5. Kapral S, Krafft P, Eibenberger K, Fitzgerald R, Gosch M, Weinstabl C. Ultrasound-guided supraclavicular approach for regional anesthesia of the brachial plexus. *Anesth Analg* 1994; **78(3)**: 507-13

6. Marhofer P, Sitzwohl C, Greher M, Kapral S. Ultrasound guidance for infraclavicular brachial plexus anaesthesia in children. *Anaesthesia* 2004; **59(7)**: 642-46

7. Marhofer P, Greher M, Kapral S. Ultrasound guidance in regional anaesthesia. *Br J Anaesth* 2005; **94(1)**: 7-17

8. Marhofer P. Ultrasound guidance in regional anaesthesia. Principles and practical implementation, New York, USA, Oxford University Press, 2010

9. Eichenberger U, Greher M, Kapral S, et al. Sonographic visualization and ultrasound-guided block of the third occipital nerve: prospective for a new method to diagnose C2-C3 zygapophysial joint pain. *Anesthesiology* 2006; **104(2)**: 303-08

10. Willschke H, Bösenberg A, Marhofer P, et al. Ultrasonographic-guided ilioinguinal/iliohypogastric nerve block in pediatric anesthesia: what is the optimal volume? *Anesth Analg* 2006; **102(6)**: 1680-84

11. Weintraud M, Lundblad M, Kettner SC, et al. Ultrasound versus landmark-based technique for ilioinguinal-iliohypogastric nerve blockade in children: the implications on plasma levels of ropivacaine. *Anesth Analg* 2009; **108(5)**: 1488-92

12. Weintraud M, Marhofer P, Bösenberg A, et al. Ilioinguinal/iliohypogastric blocks in children: where do we administer the local anesthetic without direct visualization? *Anesth Analg* 2008; **106(1)**: 89-93

13. Rubin K, Sullivan D, Sadhasivam S. Are peripheral and neuraxial blocks with ultrasound guidance more effective and safe in children? *Pediatr Anaesth* 2009; **19(2)**: 92-96

14. Abrahams MS, Aziz MF, Fu RF, Horn JL. Ultrasound guidance compared with electrical neurostimulation for peripheral nerve block: a systematic review and meta-analysis of randomized controlled trials. *Br J Anaesth* 2009; **102(3)**: 408-17

15. Koscielniak-Nielsen ZJ. Ultrasound-guided peripheral nerve blocks: what are the benefits? *Acta Anaesth Scand* 2008; **52(6)**: 727-37

16. Liu SS, John RS. Modeling cost of ultrasound versus nerve stimulator guidance for nerve blocks with sensitivity analysis. *Reg Anesth Pain Med* 2010; **35(1)**: 57-63

17. Sandhu NS, Sidhu DS, Capan LM. The cost comparison of infraclavicular brachial plexus block by nerve stimulator and ultrasound guidance. *Anesth. Analg* 2004; **98(1)**: 267-68

18. Tsui BC, Suresh S. Ultrasound imaging for regional anesthesia in infants, children, and adolescents: a review of current literature and its application in the practice of neuraxial blocks. *Anesthesiology* 2010; **112(3)**: 719-28

19. Neal JM, Brull R, Chan VWS, et al. The ASRA evidence-based medicine assessment of ultrasound-guided regional anesthesia and pain medicine: executive summary *Region Anesth Pain Med* 2010; **35(3)**: S1-S9

20. Koscielniak-Nielsen ZJ, Rasmussen H, Hesselbjerg L. Pneumothorax after an ultrasound-guided lateral sagittal infraclavicular block. *Acta Anaesth Scand* 2008; **52(8)**: 1176-77

21. Mesnil M, Dadure C, Captier G, et al. A new approach for peri-operative analgesia of cleft palate repair in infants: the bilateral suprazygomatic maxillary nerve block. *Pediatr Anaesth* 2010; **20(4)**: 343-49

22. Sola C, Raux O, Savath L, et al. Ultrasound guidance characteristics and efficiency of suprazygomatic maxillary nerve blocks in infants: a descriptive prospective study. *Pediatr Anaesth* 2012; **22(9)**: 841-46

23. Fredrickson M, Seal P, Houghton J. Early experience with the transversus abdominis plane block in children. *Pediatr Anesth* 2008; **18**: 891-92

24. Jacobs A, Bergmans E, Arul GS, et al. The transversus abdominis plane (TAP) block in neonates and infants-results of an audit. *Pediatr Anesth* 2011; **21(10)**: 1078-80

25. Visoiu M, Boretsky KR, Goyal G, et al. Postoperative analgesia via transversus abdominis plane (TAP) catheter for small weight children-our initial experience. *Paediatr Anaesth* 2012; **22**: 281-84

26. Lönnqvist PA. Continuous paravertebral block in children. Initial experience. *Anaesthesia* 1992; **47**: 607-09

27. Boretsky K, Visoiu M, Bigeleisen P. Ultrasound-guided approach to the paravertebral space for catheter insertion in infants and children. *Pediatr Anaesth* 2013; **23(12)**: 1193-98

The Obese Parturient

Norliza Mohd Nor, MD (USM), M Med (Anaesth) UKM, AMM
Consultant Anaesthesiologist in Obstetrics & Gynaecology, Hospital Selayang, Selangor, Malaysia

INTRODUCTION

Obesity, characterised by the World Health Organization (WHO) as a pandemic issue, has nearly doubled since 1980.[1] In 2008, 35% of adult aged 20 and over were overweight and 11% were obese. Locally, data from 2011 showed 33.6% of adult Malaysians were overweight and 19.5% were obese.[2] Overweight and obesity are leading risks for global deaths, whereby around 3.4 million adults die each year as a result of these two conditions.[1]

Obesity has a higher prevalence in women compared to men, and maternal obesity has become one of the most commonly occurring risk factors in obstetric practice. Obesity in pregnancy is usually defined as a Body Mass Index (BMI) of 30 kg/m^2 or more at the first antenatal consultation (by 10 weeks of gestation).[3] WHO classified obesity into 3 separate classes which recognised the continuous relationship between increasing BMI with morbidity and mortality.[3,4]

Table I: WHO classification of Obesity[1]

Classification	BMI : kg/m^{-2}	Risk of co-morbidities
Normal	18.5 - 24.9	Average
Overweight	≥ 25	
Pre-obese	25 - 29.9	Increased
Obese class 1	30 - 34.9	Moderate
Obese class 2	35 - 39.9	Severe
Obese class 3	≥ 40	Very severe

Morbidly obese patients are commonly referred as patient with BMI >40 kg/m^2 or BMI>35kg/m^2 in the presence of obesity-related co-morbidities.

Obesity, identified as a significant risk factor for anaesthesia and anaesthesia-related mortality, requires the anaesthesiologists to have a thorough understanding of the pathophysiology of the concurrent medical problems and complications that can occur in this group of patients.[5] Morbidly obese pregnant women are at an increased risk for hypertensive disorders (e.g. preeclampsia, chronic hypertension), coronary artery disease, respiratory disorders (e.g. asthma, obstructive sleep apnoea), cerebrovascular disease, diabetes mellitus, non-alcoholic fatty liver disease as well as thromboembolic disease.[6-8] Evidence also suggest that obesity may be a risk factor for maternal death.[5,7] The Confidential Enquiry into Maternal and Child Health's report on maternal deaths in the 2003-2005 triennium showed that 28% of mothers who died during that period were obese.[9]

Obesity in pregnancy is also associated with an increased risk of a number of serious adverse obstetric outcomes, including miscarriage, foetal congenital anomaly, postpartum haemorrhage, wound infections, dysfunctional labour, stillbirth and neonatal death.[10-16] There is an increased rate of lower segment caesarean section (LSCS) and lower breastfeeding rate of in this group of women compared to women with a normal BMI.[17-19]

PATHOPHYSIOLOGICAL CHANGES IN OBESITY AND PREGNANCY

Both pregnancy and obesity results in physiological changes involving multiple organ systems that can lead to profound functional impairment, decreased physiological reserve, as well as an increased obstetric and anaesthetic complications.[5]

Cardiovascular system

Pregnancy is associated with a wide range of cardiovascular changes in line with an increased oxygen demand. Obesity adds on further pathological changes with profound effect on the cardiovascular function. The extent of cardiovascular pathological changes secondary to obesity is dependent on the duration and severity of obesity.[5,20] **Table II** summarises these changes in the non-obese pregnant, non-pregnant obese and pregnant obese patients.[5]

Pregnancy increases the blood and plasma volume. In the obese patients, cardiac output and blood volume further rises to meet the increased demand of the extra fat tissue. The increased volume load initially causes left ventricular hypertrophy against an increased pressure overload and this eventually leads to myocardial dilatation. The heart rate increases in line with the cardiac output, decreasing the diastolic interval and time for myocardial perfusion.[5] Common complications include hypertension, ischaemic heart disease, pulmonary hypertension and heart failure.

Aortocaval compression is more prominent in the obese parturient due to the extra weight of the gravid uterus and abdominal wall. This may result in severe hypotension or even cardiac arrest when parturients are placed in supine position, especially after a neuraxial block.

Respiratory system

All aspects of oxygenation and ventilation are affected in pregnancy. **Table III** summarises the respiratory changes in the non-obese pregnant, non-pregnant obese and pregnant obese patients.[5] Chest wall compliance is decreased due to excess adipose tissue weight. Respiratory work and oxygen consumption are increased. Functional residual capacity (FRC), markedly reduced in obesity, often fall below the closing capacity causing small airway collapse, V/Q mismatch and hypoxia. Trendelenberg position is poorly tolerated due to accentuation of these stated problems.

Although the prevalence of obstructive sleep apnea (OSA) in pregnancy is unknown, OSA in the morbidly obese parturient is more likely. In many cases, this disorder may be undiagnosed. Diagnosis may be difficult because sleep disturbance and daytime fatigue are common during pregnancy, especially near term. OSA should be suspected in a parturient with a BMI greater than 35kg/m^2. Following diagnosis by polysomnography, continuous positive airway pressure may be needed during the perioperative period. These parturient are at risk of obesity hypoventilation syndrome (Pickwickian syndrome), pulmonary hypertension, cardiomegaly, polycythaemia and right heart failure.

Gastrointestinal system

The gastric volume in the obese parturient is five times greater than the non-obese parturient.[5] The frequency of gastro-oesophageal reflux strongly correlates with an increasing BMI. Although hiatus hernia is more common in obese individuals compared to the non-obese, it is unknown whether the effects of obesity are additive with pregnancy in reducing the lower oesophageal sphincter tone. Nevertheless, pregnancy and obesity are at risk for regurgitation and aspiration of gastric contents.[5]

Table II: Changes in the cardiovascular system associated with pregnancy, obesity and its combination.[5]

Parameter	Pregnant (Non-obese)	Obesity (Not Pregnant)	Pregnant Obese
Heart rate	↑	↑↑	↑↑
Stroke volume	↑↑	↑	↑
Cardiac output	↑↑	↑↑	↑↑↑
Cardiac index	↑ or ↔	↔	↔ or ↓
Haematocrit	↓↓	↑	↓
Blood volume	↑↑	↑	↑
Systemic vascular resistance	↓↓	↑	↔ or ↓
Mean arterial pressure	↑	↑↑	↑↑
Supine hypotension	Present	Present	↑↑
Left ventricular morphology	Hypertrophy	Hypertrophy & Dilatation	Hypertrophy & Dilatation
Sympathetic activity	↑	↑↑	↑↑↑
Systolic function	↔	↔ or ↓	↔ or ↓
Diastolic function	↔	↓	↓
Central venous pressure	↔	↑	↑↑
Pulmonary wedge pressure	↔	↑↑	↑↑
Pulmonary hypotension	Absent	May be present	May be present
Pre-eclampsia	↔	Not applicable	↑↑

↑ = increase, ↓ = decrease, ↔ = no change (multiple arrows represent the degree of intensity)

Table III: Changes in the respiratory system associated with pregnancy, obesity and its combination.[5]

Parameter	Pregnant (Non-obese)	Obesity (Not Pregnant)	Pregnant Obese
Progesterone level	↑	↔	↑
Sensitivity to CO_2	↑	↓	↑
Tidal volume	↑	↓	↑
Respiratory rate	↑	↔ or	↑
Minute volume	↑	↓ or ↔	↑
Inspiratory capacity	↑	↓	↑
Inspiratory reserve volume	↑	↓	↑
Expiratory reserve volume	↓	↓↓	↓
Residual volume	↓	↓ or ↔	↑
FRC	↓↓	↓↓↓	↓↓
Vital capacity	↔	↓	↓
FEV_1	↔	↓ or ↔	↔
FEV_1/VC	↔	↔	↔
Total lung capacity	↓	↓↓	↓
Compliance	↔	↓↓	↓
Work of breathing	↑	↑↑	↑
Resistance	↓	↑	↓
V/Q mismatch	↑	↑	↑↑
DLCO	↑ or ↔	↔	↔
PaO_2	↓	↓↓	↓
$PaCO_2$	↓	↑	↓

↑ = increase, ↓ = decrease, ↔ = no change (multiple arrows represent the degree of intensity),

Haematological system

Dilutional anaemia is a normal physiological change in pregnancy. Obese parturients may exhibit polycythaemia reflecting the severity of OSA and degree of chronic hypoxia. Maternal obesity is associated with a significant risk of hypercoacoagulability during both the antenatal and postnatal period, which can result in pulmonary and venous thromboembolism, a leading cause of maternal mortality.[3,7,8]

Endocrine system

Diabetes mellitus and gestational diabetes are frequent endocrine disorders in morbidly obese parturients. This increases the risk for foetal macrosomia and obstetric interventions and complications.

ANAESTHETIC CONSIDERATIONS AND MANAGEMENT

The obese parturient should be managed by a multi-disciplinary team involving senior obstetrician, anaesthesiologist and other required specialties.[3-5] Early assessment allows review of antenatal consultations, identification of potential difficulties with regional and/or general anaesthesia and involvement of senior colleagues. The parturient should be alerted of potential difficulties with regards to intravenous access, regional anaesthesia and foetal surveillance during labour and subsequent management.

Labour analgesia

Although there are various modalities for labour analgesia, neuraxial blockade has been shown to be the most effective method.[5] The anticipated technical difficulties should not preclude the use of epidural analgesia in obese parturients. Early rather than late placement of the epidural catheter is advised as it may be time consuming and require more than one attempt. The involvement of senior anaesthesiologist is desirable to reduce failure and complications.

The choice of techniques, either epidural or combined spinal epidural, should be tailored to the clinical scenarios. Continuous spinal analgesia after inadvertent dural puncture provides excellent analgesia and may reduce the incidence of post-dural puncture headache.

The rate of LSCS does not increase with epidural analgesia, though obesity increases the need for caesarean delivery.[17,18] Complications during labour such as foetal distress, meconium liquor, failure to progress and abnormal presentation are common. Thus, a functional epidural analgesia is not only advantageous for a prolonged, difficult labour but also for LSCS and postoperative analgesia, should the need arise.

Entonox can be a useful adjunct for labour analgesia. Inhalational anaesthetic agents, such as sevoflurane, has been shown to provide better analgesia than entonox but cause more sedation and require special delivery equipment.[21] Intramuscular opioids may be unreliable, but intravenous patient controlled analgesia (PCA) has been used successfully, with the prospect of ultra-short acting opioids such as PCA remifentanil in the obese parturients an area yet unexplored.[5]

Anaesthesia for LSCS

Anticipation of problems and adequate preparation in terms of perioperative equipment, monitoring and personnel are of paramount importance for LSCS of the obese parturient. Adequate manpower is essential to safely transfer and position these parturients. Furthermore, invasive blood pressure monitoring may be required if non-invasive blood pressure cuffs cannot be properly placed on the parturient's arm.

As peripheral intravenous access can be difficult, central venous cannulation may be needed in extreme situations. Ultrasound imaging could improve the success rate for not only peripheral or central venous cannulation but also the performance of regional anaesthesia.[22,23]

Unless contraindicated, regional anaesthesia (RA) is the technique of choice for LSCS. If general anaesthesia (GA) is required, rapid sequence induction with tracheal intubation and controlled ventilation should be performed, with anticipation of difficult intubation and ventilation. At all times, either under RA or GA, left uterine displacement should be adopted to prevent aortocaval compression.[24]

The incidence of failed tracheal intubation in obstetric population is 1 in 280 as compared to 1 in 2230 in the general population.[25,26] Apart from increased oxygen consumption, pregnancy and obesity cause a pronounced reduction in FRC resulting in rapid oxygen desaturation during induction of GA. Therefore, preoxygenation and optimal positioning for intubation is essential. Optimum positioning (**Figure 1**) can be achieved by placing blankets or troop pillows below the head, neck and shoulders, horizontally aligning the tragus of the ear to the sternal notch (ramped or sniffing position).[22]

Figure 1. A morbidly obese patient is shown, prior to general anaesthesia. Note the ramped position, large blood pressure cuff and videolaryngoscope.

The physiological changes associated with obesity alter the pharmacokinetic properties of most drugs. Drugs administration based on total body weight (TBW) can result in overdose. Conversely, administration of drugs according to ideal body weight (IBW) can result in sub-therapeutic dose. Lean body weight is the optimal dosing scalar for the majority of anaesthetic drugs, including opioids and induction agents. For non-depolarising neuromuscular blocking agents, IBW is utilised, while depolarising neuromuscular blocker dosage is calculated according to the TBW.[27]

Postoperative care

Early mobilisation, thromboprophylaxis and adequate pain control are the key to an effective postoperative care. High dependency care and monitoring may be needed for obese parturients with significant co-morbidities. The Royal College of Obstetrics and Gynaecology Clinical Green Top Guideline advises that a woman with a BMI greater than 30kg/m^2 with two or more additional risk factors for thromboembolism to be considered for prophylactic low molecular weight heparin antenatally and continued until six weeks postpartum, accompanied with a postnatal risk assessment.[4]

Epidural infusion of local anaesthetic with opioids improves the quality of postoperative analgesia. Long acting opioids in the intrathecal or epidural spaces should be used with caution in the morbidly obese parturient. PCA opioids have also been successfully used in morbidly obese.[5,28]

A multimodal approach with oral or suppository analgesics should be adopted to minimise the use of opioids as a sole analgesic therapy in the postoperative period. Peripheral nerve blocks and Tranversus Abdominis Plane (TAP) block, combined with other analgesic techniques have been proven to provide effective postoperative analgesia for these patients.[29]

CONCLUSION

An obese pregnant woman is a high risk patient, mandating a specialist level of care. Pre-pregnancy counseling, anticipation of problems and carefully laid out birth plan should be done to improve outcome.

References

1. World Health Organization. Obesity: *Preventing and Managing the Global Epidemic. Report on WHO consultation*, WHO Technical Report Series 894. Geneva 2000

2. Mohamud WNW et al. Prevalence of overweight and obesity among adult Malaysians: an update. *Asia Pac J Clin Nutr* 2011; **20(1)**: 35-41

3. National Institute for Health and Clinical Excellence. Obesity. Guidance on the prevention, identification, assessment and management of overweight and obesity in adults and children. London: National Institute for Health and Clinical Excellence (NICE), 2006

4. Management of women with obesity in pregnancy. CEMACE/ RCOG Joint Guidelines, March 2010

5. Saravanakumar K, Rao G, Cooper GM. Obesity and obstetric anaesthesia. *Anaesthesia* 2006; **61(1)**: 36-48

6. O'Brien TE, Ray JG, Chan W-S. Maternal body mass index and the risk of preeclampsia: a systematic overview. *Epidemiology* 2003; **14(3)**: 368-74

7. Jacobsen AF, Skjeldestad FE, Sandset PM. Ante- and postnatal risk factors of venous thrombosis: a hospital-based case-control study. *Journal of Thrombosis and Haemostasis* 2008; **6(6)**: 905-12

8. Larsen TB, Sørensen HT, Gislum M, Johnsen SP. Maternal smoking, obesity, and risk of venous thromboembolism during pregnancy and the puerperium: a population-based nested case-control study. *Thrombosis Research* 2007; **120(4)**: 505-09

9. Lewis G, editor. *Confidential Enquiry into Maternal and Child Health. Saving Mothers' Lives- Reviewing maternal deaths to make motherhood safer 2003-2005*. London: CEMACH, 2007

10. Lashen H, Fear K, Sturdee DW. Obesity is associated with increased risk of first trimester and recurrent miscarriage: matched case-control study. *Human Reproduction* 2004; **19(7)**: 1644-46

11. Rasmussen SA, Chu SY, Kim SY, Schmid CH, Lau J. Maternal obesity and risk of neural tube defects: a metaanalysis. *American Journal of Obstetrics and Gynecology* 2008; **198(6)**: 611-19

12. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 2001; **25(8)**: 1175-82

13. Chu SY, Kim SY, Lau J, Schmid CH, Dietz PM, Callaghan WM, et al. Maternal obesity and risk of stillbirth: a metaanalysis. *American Journal of Obstetrics & Gynecology* 2007; **197(3)**: 223-28

14. Kristensen J, Vestergaard M, Wisborg K, Kesmodel U, Secher NJ. Pre-pregnancy weight and the risk of stillbirth and neonatal death. *BJOG* 2005; **112(4)**: 403-08

15. Cedergren MI. Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstetrics and Gynecology* 2004; **103(2)**: 219-24

16. Shah A, Sands J, Kenny L. Maternal obesity and the risk of still birth and neonatal death. *Journal of Obstetrics and Gynaecology* 2006; **26**: S19

17. Weiss JL, Malone FD, Eming D, Ball RH, Nyberg DA, et al. Obesity, obstetric complications and cesarean delivery rate: a population-based screening study. *Am J Obstet Gynecol* 2004; **190(4)**: 1091-97

18. Chu SY, Kim SY, Schmid CH, Dietz PM, Callaghan WM, Lau J, et al. Maternal obesity and risk of cesarean delivery: a meta-analysis. *Obesity Reviews* 2007; **8(5)**: 385-94

19. Amir LH, Donath S. A systematic review of maternal obesity and breastfeeding intention, initiation and duration. *BMC Pregnancy and Childbirth* 2007; **7**: 9

20. Vasan RS. Cardiac function and obesity (editorial). *Heart* 2003; **89**: 1127-29

21. Yeo ST, Holdcroft A, Yentis SM, Stewart A & Basett P. Analgesia with sevoflurane during labour: II. Sevoflurane compared with entonox for labour analgesia. *Br J Anaesth* 2007; **98(1)**: 110-15

22. Mhyre JM. What's new in obstetrics anaesthesia? Review article. *International Journal of Obstetric Anaesthesia* 2011; **20(2)**: 149-59

23. Sahin T, Balaban O, Sahin L, Solak M, Toker K. A randomized controlled trial of preinsertion ultrasound guidance for spinal anaesthesia in pregnancy: outcomes among obese and lean parturient. *J Anaesth* 2014; **28**: 413-19

24. Otto B. Mastering BLS Ventilation: Algorithms. EMS Basics Aug 2012

25. 25. Hawthrone L, Wilson R, Lyon G, Dresner M. Failed intubation revisited: a 17-year experience in a teaching maternity unit. *Br J Anaesth* 1996; **76(5)**: 680-84

26. Barnardo PD, Jenkins JG. Failed tracheal intubation in obstetrics: a 6 year review in a UK region. *Anaesthesia* 2000; **55(7)**: 685-94

27. Ingrande J, Lemmens JM. Dose adjustment of anaesthetics in morbidly obese. *Br J Anaesth* 2010; **105(S1)**: i16-i23

28. Charghi R, Backman S, Christou N, Rouah F, Schricker T. Patient controlled iv analgesia is an acceptable pain management strategy in morbidly obese patients undergoing gastric bypass surgery. A retrospective comparison with epidural analgesia. *Can J Anaesth* 2003; **50(7)**: 672-78

29. Chaudhuri S, Goyal SS. Ultrasound-guided transversus abdominis plane block: A technically easier analgesic option in obese compared to epidural. *Anaesth Essays Res* 2012; **6(2)**: 226-28

Anaesthesia Management for Craniosynostosis Repair: The Hospital Kuala Lumpur Experience

Vanitha M Sivanaser[1], MBBS (MAHE), M.Anaest (UM), Fellowship Neuroanaest (UOToronto), AMM
Nik Azizah Nik Junoh[2], MD (UKM), M Med (Anaesthesiology) USM, Fellowship Paeds Anaest (UK)
Thavaranjitham Sandrasegaram[2], MBBS (Manipal), M Med (Anaesth) UKM, Fellowship Paeds Anaest (UK)
Sivasakhthi Velayuthapillai[3], MBBS (Mysore), FANZCA
[1]Neuroanaesthesiologist, [2]Consultant Paediatric Anaesthesiologist, [3]Head of Anaesthesia Service, Ministry of Health Malaysia, Head & Consultant Anaesthesiologist, Department of Anaesthesiology & Intensive Care, Hospital Kuala Lumpur, Malaysia

INTRODUCTION

Craniosynostosis is the premature fusion of the cranial sutures, which causes change in the growth pattern of the skull resulting in an abnormal head shape and facial features.

Craniosynostosis can occur either in isolation or as part of a syndrome. The former is more commonly encountered than the latter. Syndromic craniosynostosis usually manifests with premature fusion of more than one suture, in occurrence with other facial bony abnormalities and in turn resulting in disproportion of the cranium and the cerebrum, due to the unavailability of the cranium in providing enough space. This condition often contributes to the occurrence of raised intracranial pressure (ICP). Presenting symptoms of raised ICP includes headaches, vomiting, seizures, and obtunded conscious levels. Isolated craniosynostosis are relatively simpler to manage and are not associated with syndromic states.

Craniofacial surgery (CFS) refers to the surgical correction of premature fusion disorders affecting the skull base, orbits and facial bones. CFS is commonly performed electively at early infancy between 3 to 6 months of age, although there have been corrections done at later ages.

Few centres carry out CFS in Malaysia. This article chronicles the anaesthetic management of CFS at Hospital Kuala Lumpur (HKL), which commenced in 2006. Over the past 9 years, 26 cases of CSF had been performed in HKL. We attempt to formulate a detailed and thorough blueprint for preoperative assessment and standardisation of method of induction and maintenance of anaesthesia in the local arena of CFS.

METHODOLOGY

A retrospective review of charts and database (CODTS) was analysed to obtain pertinent information of the anaesthetic management, demographics and complications between the years 2007 to 2015.

Records obtained were not complete as some parts of case notes were not traceable; hence, thorough analysis was far from accurate. However details on the anaesthesia technique, demographic and complications were obtainable. Analysis and documentation of preoperative assessments were looked at. Documentation was deemed complete if the presence of respiratory morbidities: Obstructive Sleep Apnoea (OSA), wheeze, airway complications and neurocognitive function as a baseline for possible cerebral complications that can occur intra operatively, along with regular assessments were documented.

Further details with regards to blood loss, transfusion thresholds, intensive care stay and airway intubation techniques were not analysed due to the unavailability or poor documentation of these parameters. Cases that required immediate re-surgery or repeated surgeries and outcomes of the surgery were also not included in the analysis.

RESULTS

Most of the patients operated were between 6 months to 2 years of age. The oldest patient operated upon was below 5 years old (**Table I**).

All patients were seen in the ward 2 to 3 days prior to the scheduled operative day. All cases had direct referrals from the surgeons to the attending paediatric anaesthesiologists. The more complex cases had multidisciplinary team meetings to discuss the operative, intraoperative and postoperative approaches to anticipate problems which might have arisen. Anaesthesia documentation did not particularly mention the presence of wheeze, the presence of OSA or the neurocognitive function of most of the patients (**Table II**). All patients received thorough airway assessment while most documented an anticipated difficult airway.

The CFS multidisciplinary team at HKL has progressively grown in strength and number since 2007. It now compromises of a dedicated team of neurosurgeons, plastic surgeons, paediatric and neuroanaesthesiologists. There has been a steady progress in the number of cases operated upon with the most in 2013 (n=13). The cases have always had the presence of the paediatric anaesthesiologists as complex syndromic CFS almost often has difficult airway.1 However, there were more involvement of the neuroanaethesiologisst by 2013.

All cases were performed under general anaesthesia with administration of non-depolarising neuromuscular agents (NMBA) (rocuronium or atracurium) and fentanyl to facilitate the intubation of the tracheal with an armoured (flexometallic) endotracheal tube (ETT). Atracurium was the NMBA of choice in most number of the cases in our series, while rocuronium usage has gain momentum in usage over the past year with neuroanaesthesiologist dominating its use.

There was no documentation of the use of nasopharyngeal (NPA) or oropharyngeal airway (OPA) to facilitate bag mask ventilation. There was no specific preference of route of intubation; some were intubated via oral route while others via the nasal route. We can only presume the choice of route of intubation was individualised by the anaesthesiologist preference and surgical requisite.

There was no standard practice for fixation of the ETT; some were anchored using stitches, while some secured with the normal anchoring tape. There was no untoward incidence in relation to airway manipulation and tracheal intubation. The attending anaesthesiologists intubated all the cases. All cases anaesthetised had throat pack sited.

Anaesthesia was maintained with a sevoflurane/ oxygen/air mixture in all cases. Fluids infused as maintenance were 0.9% sodium chloride and human albumin 5% for resuscitation along with packed red blood cell (RBC) transfusion. There was no usage of Ringer's lactate and this may be attributed to the possibility of developing raised ICP intraoperatively. All patients received RBC with a few cases needing fresh frozen plasma and platelet transfusion. Further analyses of thresholds for blood product transfusions were not possible due to poor documentation. Morphine was administered in all cases as postoperative analgesia.

The standard practice was to have two peripheral lines inserted, a femoral double lumen catheter and an indwelling arterial line for beat-to-beat arterial line monitoring and blood gas analysis. Oropharyngeal temperature probes were routinely employed for temperature monitoring. Nasopharyngeal temperature probes were rarely used as they may interfere with the surgical site. Forced air warmers and limbs were insulated to conserve heat loss.

There were two documented incidences of cardiovascular collapse during CFS. This was attributed to gross hypovolaemia during surgical dissection. Blood transfusion was commenced prior to the cardiovascular collapse. Both patients received a single IV bolus of each atropine and adrenaline as part of their resuscitation. Cardiopulmonary resuscitation lasted less than 3 minutes in both cases. Haemodynamic parameters improved with packed RBC transfusion and blood

Table I: Demographic Data

	(n=26)
Age	
6 months-1 year	12
1 years -2 years	12
3 years - 4 years	1
4 years - 5 years	1
Syndromic (Yes:No)	13:13
Type of Syndrome	
Apert's	10
Cruzon's	3
Completeness of preoperative assessment	
Respiratory issues such as URTI and or wheeze	4
Presence of OSA	2
Documentation of anticipated difficult airway	26
Neurocognitive documentation	1
Complications	
Blood loss requiring blood transfusion	26
Hypothermia (T < 35°C)	18
Accidental extubation of ETT	1
Raised ICP/brain bulge	2
Cardiovascular collapse	2
Compartmental syndrome secondary to intravenous extravasation	1

Table II: Analysis of Preoperative Assessment

Preoperative Assessment Documentation	Number of cases documented/total cases	Percentage of complete preoperative assessment
OSA	2/26	7.6%
Wheeze	4/26	15%
Airway Complications	26/26	100%
Neurocognitive function	1/26	19.23%

products. Surgeons stopped their dissection to allow for proper resuscitative measures and the operative procedure was abandoned and patients were admitted in the intensive care unit. Both cases were operated upon successfully 48-72 hours afterwards. They were discharged from the Paediatric Intensive Care Unit (PICU). The records on their recovery and neurocognitive development were not available.

All operated cases remained intubated after completion of the surgical procedure. There were 2 cases of accidental extubation of ETT during transfer. In both cases, the ETTs were secured preoperatively with tape. In these cases, the trachea was re-intubated with the GlideScope® with no untoward complications.

DISCUSSION

PREOPERATIVE ASSESSMENT

The importance of the preoperative assessment cannot be overstated. While the preoperative assessment of the patients listed for CFS were thorough, it is prudent to establish a standardised assessment that incorporates major and common problems seen in this population of patients. Discussed below are points that are pertinent for the proper evaluation for CFS.

Preoperative anaesthetic issues of craniofacialsynostosis

Preparation of the patient scheduled for CSF is of paramount importance. The parents or guardians should be informed preoperatively of the potential complications and concerns of high-risk nature of this surgery. This includes information on the likelihood for prolonged surgery, bleeding requiring massive blood transfusion, PICU admission and postoperative ventilation.

Patients requiring CFS are associated with syndromes, such as Apert and Cruzon, which are notorious in terms of airway challenges.[1] Anticipated airway challenges include difficulty in mask ventilation due to midface hypoplasia, proptosis and asymmetry of facial bone structure.[1] Other associated anomalies include small nares and choanal atresia which may hamper effective bag-mask ventilation, necessitating the use of a NPA or OPA.[2,3] Cervical vertebrae fusion may often be present in patients with Apert Syndrome.[4]

OSA may be present in these patients, attributed mainly to the midface hypoplasia and choanal atresia.[2,4] Treatment modes include the use of NPA, OPA or tracheostomy in more severe cases.[5] A detailed history is required and proper planning is imperative prior to the scheduled operative day. Commencement of treatment is important due to the physiological impact of OSA on the central nervous system.[6] Chronic obstruction can lead to an increase in arterial carbon dioxide levels, in turn causing long-term neurocognitive impairment due to the negative effect of the elevated arterial carbon dioxide on the ICP and in turn cerebral perfusion pressure.[7]

INDUCTION AND MAINTENANCE OF ANAESTHESIA

Commencement of induction and anaesthesia for CFS requires the presence of highly skilled and trained anaesthesiologists. Often the expertise of the paediatric anaesthesiologist is required in view of the potential issues that may challenge the anaesthesia. These include difficult mask ventilation, difficult laryngoscopy or both and possibly, difficult venous access.

The use of the OPA and NPA is often used during the induction of anaesthesia, especially in children with established upper airway obstruction.[2,5] Its usage allows for better bag-mask ventilation along with chin lift manoeuvres. Although in general, an armoured ETT is often used, a south facing RAE ETT can be used with no documented complications. Once the trachea has been intubated, special attention has to be given to fixing and securing the ETT. Many established centres advocate fixing the tube with a stitch.

In our centre, all cases for CFS were induced via inhalation anaesthesia. Practices vary with institutional preferences and attending anaesthesiologist expertise. Till date, there is no article that favours inhalational induction over intravenous or vice versa.[8,9] Being cognizant of the potential problems that can arise with either methods of induction is imperative.

In our centre, balanced anaesthesia is maintained with inhalational anaesthesia, sevoflurane, with an oxygen/air mixture. The choice of NMBA administered, either rocuronium or atracurium, is at the discretion of the anaesthesiologist.

Intraoperative analgesia, in the form of fentanyl or remifentanil, is administered at our centre, with the practice of using remifentanil increasing over the past two years. Its easy titrating abilities, good intraoperative analgesic properties and impressive pharmacokinetic profile account for its fast gain of popularity in usage. Due to the unavailability of the TCI software for the paediatric population at HKL, constant rate infusion at rates of 0.05-0.5 µg/kg/min are infused. In a study comparing 22 children undergoing CFS, who are randomised to sevoflurane/remifentanil and isoflurance/ remifentanil anaesthesia, there was no superiority in recovery and hemodynamic parameters between the two groups.[10] While the use of remifentanil has gained momentum in HKL, fentanyl (5-7 µg/kg) is administered in a fair amount of cases. Abdallah, in his study, concluded that fentanyl was more effective than remifentanil in preventing increases in cerebral blood flow in children undergoing sevoflurane anaesthesia.[11] Morphine (0.2 mg/kg) and IV paracetamol (10-15 mg/kg) are used towards the end of the surgery. The use of suppository paracetamol (30-40mg/kg) is also commonly employed and if so, IV infusion is not administered towards the end of surgery. Non-steroidal anti-inflammatory suppositories are never administered owing to the potential intraoperative bleeding that often takes place during these types of surgeries.

In HKL, the majority of CFS are Fronto-Orbital Advancement and remodeling (FOAR) requiring supine positioning. CFS can be performed in prone surgery as well. Positioning is of paramount importance to facilitate surgical access and additionally to prevent complications, which include orbital injuries and corneal abrasions, either from direct orbital pressure or pre-existing proptosis associated with existing syndromes. Attention is required for proper head and neck positioning. This is to prevent excessive flexion and extension on the cervical vertebrae, as well as ensuring adequate venous and lymphatic drainage of the head and neck are maintained. Care and detailed attention to the position of the limbs are mandatory to prevent nerve palsies and pressure sores.

The monitoring employed apart from the standard anaesthesia monitoring include the intra-arterial blood pressure and the central venous pressure monitoring. The femoral route is often the site of choice at HKL for central venous catheter in insertion. The cannulation of the femoral vein is facilitated by the use of ultrasonography as evidence points to higher first attempt success rates and fewer needle passes.[12] The internal jugular vein (IJV) has been used and its cannulation will depend on the compliance of the brain and the potential for development of the elevated ICP. An IJV line is then rendered hazardous should the latter condition develop.

Massive blood loss is a major challenge in CFS. Blood loss occurs primarily as a consequence of the large surface area of the infants head creating an increased surface for blood loss and complex surgical dissection worsened by hypothermia-induced coagulopathy.[13,14] Bleeding usually happens during the initial scalp dissection and raising the periosteum. Constant vigilance and attention to concealed bleeding will help in mitigating any untoward events related to hypovolaemia. Fluid resuscitation in the form of crystalloids, albumin or packed RBCs should be commenced early.[14] Many reports have chronicled cardiovascular collapse during the surgery attributed to inadequate fluid and blood resuscitation. It is prudent to commence blood and blood product transfusion when blood volume loss approaches 10% of the infant's body volume. There is little research evidence to propose clinical guidelines for managing children with major haemorrhage. Principals designed for adults have been extrapolated to the management of major haemorrhage in children.[15] Intra operative coagulation screening should be sent to the laboratory periodically to govern further transfusion of blood products. Transfusion strategy employed in our institution is as follows: Transfusion of blood products when PT or APTT values >1.5x normal, fibrinogen level <0.8-lg%, platelets counts < 50-80,000 or clinical evidence of coagulopathy.

In HKL, the blood conservation techniques include pre-emptive infiltration of local anaesthesia with adrenaline, the use of diathermy and bone wax along with a meticulous surgical technique. A good communication with the surgeons is important and cannot be overlooked. The use of an antifibrinolytics is routinely administered at our centre since 2013. Its use is effective in reducing preoperative blood loss and transfusion requirements in children undergoing CFS.[16,17] IV tranxenamic acid 10 mg/kg is infused over 20 minutes at the start of surgery and is continued as an infusion of 2 mg/kg/hr until the last skin stitch.

Venous Air Embolism (VAE) as a catastrophic complication can occur during CFS. Its incidence, in a study of 23 children undergoing craniectomy for craniosynostosis, was 82.6%.[18] The high incidence of VAE was not however associated with haemodynamic. This highlights the necessity for strict vigilance for signs of VAE during CFS while additionally highlighting the need for better monitoring devices for VAE.[18]

POSTOPERATIVE PERIOD

The majority of the patients are sent, intubated and ventilated, to the PICU, for reasons of prolonged surgery, hypothermia, massive fluid shifts and massive blood loss. It is beyond the scope of this article to detail the course of patient in the PICU.

CONCLUSION

Anaesthesia for CFS is a challenge for the anaesthesiologist. Understanding and anticipating the challenges helps in a long way to prevent or mitigate complications. CFS is fast growing entity in HKL and in this country. It is imperative that we prepare ourselves with the knowledge to handle this challenging population of patients. A proper and thorough preoperative assessment that looks not only into the general systematic review of the patient, but also incorporates the major assessment into airway, cardio respiratory and neurocognitive function of the patients is needed. Anticipating problems and the ability to handle challenges such as the difficult airway, prolonged surgery and massive haemorrhage alongside the metabolic and acid base issues that accompany CFS surgery will help us as anaesthesiologists to make a valuable contribution toward the outcome of the surgery.

References

1. Nargozian C. The airway in patients with airway abnormalities. *Pediatr Anesth* 2004; **14(1)**: 53-59
2. Cohen MM. An etiologic and nosologic overview of craniosynotosis syndrome. *Birth Defects Orig Artic Ser* 1975; **11(2)**: 137-89
3. Hemmer K, McAlister WH, Marsh JL. Cervical spine anomalies in craniosynotosis syndromes. *Cleft Palate J* 1987; **24**: 328-33
4. Moore M. Upper airway obstruction in the syndromal craniosynotoses. *Br J Plast Surg* 1993; **46(5)**: 355-62
5. Ahmed J, Marucci D, Cochrane L et al. The role of nasopharyngeal airway for obstructive sleep apnea in syndromic craniosynotoses. *J Craniofac Surg* 2008; **19(3)**: 659-663
6. Schafer M. Upper airway obstruction and sleep disorders in children with craniofacial anomalies. *Clin Plast Surg* 1982; **9(4)**: 555-67
7. Hayward R, Gonsalez S. How low can you go? Intracranial pressure, cerebral perfusion pressure, and respiratory obstruction in children with complex cranisynotosis. *J Neurosurg* 2005; **102(1)**: 16-22

8. Zielinska M, Holtby H, Wolf A. Pro-con debate: intravenous vs inhalational induction of anesthesia in children. *Pediatric Anesthesia* 2011; **21(2)**: 159-68

9. Aguilera IM et al. Perioperative anxiety and postoperative behavioral disturbances in children undergoing intravenous or inhalational induction of anaesthesia. *Pediatric Anesth* 2003; **13(6)**: 501-07

10. Pietrini D, Ciano F, Forte E et al. Sevoflurane-remifentanil vs isoflurance-remifentanil for the surgical correction of craniosynostosis in infants. *Pediatric Anesthesia* 2005; **15(8)**: 653-62

11. Abdallah C, Karsli C, Bissonnette B. Fentanyl is more effective than remifentanil at preventing increases in cerebral blood flow velocity during intubation in children. *Can J Anaesth* 2002; **49(10)**: 1070-75

12. Aouad MT, Kanazi GE, Abdallah FW et al. Femoral vein cannulation performed by residents: a comparison between ultrasound-guided and landmark technique in infants and children undergoing cardiac surgery. *Anesth Analg* 2010; **111(3)**: 724-28

13. Meyer P, Renier D, Arnaud R et al. Blood loss during repair of craniosynostosis. *Br J Anaesth* 1993; **71(6)**: 854-57

14. Hughes C, Thomas K, Johnson D, Das S. Anesthesia for surgery related to craniosynostosis: a review. Part 2. *Pediatr Anesth* 2013; **23(1)**: 22-27

15. JPAC Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services. Transfusion Handbook 10:4 Major Hemorrhage in infants and children. Professional Advisory Committee 2013

16. Holcomb JB. Tranxenamic acid in elective craniosynostosis surgery: it works, but how? *Anesthesiology* 2011; **114**: 737-38

17. Goobie SM, Meier PM, Pereira LM et al. Efficacy of tranexamic acid in pediatric Craniosynostosis surgery: a double blinded, placebo controlled trail. *Anaesthesiology* 2011; **114(4)**: 737-8

18. 18. Faberowski LW, Black S, Mickle PJ. Incidence of venous air embolism during craniectomy for craniocynostosis repair. *Anesthesiology* 2000; **92(1)**: 20-23

Intrathecal Catheter Insertion Following Accidental Dural Puncture

Lee Choon Yee, MBBS (Mal), M Med (Anaesth) UKM, FANZCA, FAMM
Clinical Professor & Consultant Anaesthesiologist in Obstetrics & Gynaecology, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia

INTRODUCTION

Neuraxial analgesia is the most effective form of pain relief for labour and is well established in modern day obstetric practice. However, accidental dural puncture (ADP) and subsequent post-dural puncture headache (PDPH) are its known complications and may be associated with significant morbidity. Reported incidence of ADP in obstetrics ranges between 0.19 to 3.6%.[1] Its occurrence may be obvious by free flow of cerebrospinal fluid (CSF) from the hub of the epidural needle when the dura is perforated by the epidural needle; or may go unrecognised at the time of epidural catheter insertion if the epidural needle damages the dura, which subsequently is fully perforated by the epidural catheter. If ADP is not recognised at once, the patient is at risk of respiratory failure from a high block if a larger dose of local anaesthetic is delivered into the catheter in the subarachnoid space.[2]

PREVENTION OF PDPH

While it is well known that the incidence of PDPH is approximately 75% following ADP using a 16-18G epidural needle, up to 38% of PDPH can actually occur after an uneventful procedure.[3] In the obstetric setting, PDPH may be severe or incapacitating, may interfere with maternal-baby interaction, causes increased anaesthetic workload, prolonged hospitalisation, increased cost of health care and is a potential source of litigation in anaesthetic practice. Left untreated, the headache may become chronic and persist for months or even years.[3] As such, prophylactic or proactive action is justified to prevent possible morbidity rather than waiting to begin treatment once symptoms of PDPH appear.

Various preventive measures have been suggested, including adopting the lateral rather than sitting position for the procedure, limiting the size of the epidural needle, identifying the epidural space by means of loss of resistance to saline rather than air, and having an experienced anaesthetist to perform the procedure. No clear consensus exists on how to best prevent PDPH from occurring after ADP. Preventive measures, as shown in a systematic review by Apfel *et al* (2010),[4] include the avoidance of bearing down during second stage, conservative measures in the post-natal period (bed rest, aggressive hydration, and simple analgesics), epidural morphine, epidural saline (either bolus or infusion), intrathecal saline bolus and prophylactic epidural blood patch. Intrathecal catheter (ITC), if used, is left *in situ* for various lengths of time and removed either after delivery or 24 hours later. **Table I** summarises the advantages and disadvantages of the two approaches; the traditional (re-siting the epidural catheter) and the new (ITC).

IMMEDIATE MANAGEMENT OF ADP

When an obvious ADP occurs, the traditional approach has been removal of the epidural needle and either abandoning the procedure or repeating the procedure in another interspace. Recent surveys have demonstrated a trend towards the use of ITC following ADP. A debate at the Obstetric Anaesthetists' Association Controversies Meeting in 2001 revealed that 43% and 44% of delegates favoured conversion to spinal analgesia and repeating the epidural, respectively.[5,6] A postal survey on the management of ADP in the United Kingdom in 2003 showed that the epidural catheter was routinely placed intrathecally in 28% of units,[7] in contrast to a similar survey in 1993, which found that catheters were re-sited in 99% of units.[8] The two most commonly cited reasons for the use of ITC were to avoid further dural puncture (76%) and to allow immediate analgesia for labour (75%).[7] In a North American survey in 2008, 25% of the respondents reported almost always using an ITC

Table I: Comparison of the Traditional and the New Approach following ADP

	Traditional (Epidural catheter)	**New (Intrathecal catheter)**
Advantages	Familiarity for both the anaesthetist and the midwife May be used for prophylactic interventions: - epidural blood patch - epidural saline - epidural morphine (Effectiveness not verified)	Technically simple, high success rate Rapid establishment of neuraxial block Risk of second ADP avoided in a difficult epidural Desired characteristics of a subarachnoid block: - Rapid onset of dense block - Small doses of local anaesthetic ± opioid required - Low incidence of patchy blocks - Reduced incidence of PDPH and requirement for EBP (as yet unproven)
Disadvantages	Can be technically difficult or impossible Possibility of a repeat ADP Takes time to establish, analgesia is delayed Top-ups should be administered carefully due to unpredictable spread (flux through the dural tear)	Unfamiliarity, relatively new technique Risk of accidental administration of an epidural dose with dire consequences Confusion regarding dose for maintenance of analgesia/anaesthesia Risk of infection

following ADP.[9] In 2007, 35% of Australian obstetric anaesthetists reported that they would usually utilise an ITC following ADP and a further 42% would consider an ITC under certain situations.[10] The Australian survey also revealed that the most common reason for not using an ITC was concern about clinical safety, with accidental misuse, high block and infection the issues most commonly raised.

THE EFFECT OF INTRATHECAL CATHETER ON PDPH AND EPIDURAL BLOOD PATCH (EBP)

Data on the effect of converting to spinal analgesia on PDPH and EBP rates are mixed.[1,3,11,12] This is hampered by the low incidence of ADP and the fact that a randomised controlled trial that is sufficiently powered would need a large number of patients, would be costly and time consuming. Our current knowledge is largely based on non-randomised retrospective studies, institutional surveys, meta-analysis and systematic reviews.

While it is intuitive to think that ITC would help to reduce the incidence of both PDPH and EBP, only a retrospective study by Ayad *et al* (2003) documented that ITC placement after wet tap in obstetric patients reduced the PDPH rate and did so to a greater extent if left in place for 24 hours after delivery.[12] A meta-analysis by Apfel *et al* (2010) reviewed six studies and concluded there was no significant difference in the incidence of PDPH for short term (< 24 hours) and long term (> 24 hours) ITC.[4] As more data become available, Heesen *et al* (2013) carried out another meta-analysis with the aim of delineating the effect of ITC on development of PDPH and the need for EBP.[13] The authors found that the incidence of PDPH was not significantly different but the need for an EBP was significantly reduced. Possible explanation was that the ITC decreased the loss of CSF and resulted in milder headache, which resolved with conservative management without resorting to EBP.

As in most systematic reviews, there is much heterogeneity in study protocols in various institutions. The duration of ITC- immediate removal vs. 24-36 hours later - is different according to institutional protocol. The obstetric course may be confounding factors (e.g. labouring vs. non-labouring parturients, vaginal vs. Caesarean delivery), as uterine contractions may increase CSF leak, and CSF efflux may be significant during periods of Valsalva manoeuvres during second stage of labour, which may affect the incidence and/or severity of PDPH.

How does the ITC help to reduce the severity of PDPH? The immediate effect is attributed to the ITC partially occluding the dural tear and reducing CSF leak, while any subsequent effect is attributable to inflammatory fibrous reaction around ITC at the site of the dural tear. However, these postulated mechanisms are speculative at best. In an animal study on cats, the inflammatory response was observed only 19-21 days after ITC placement. Time consideration aside, whether this result can be extrapolated to human subjects is another issue to be addressed. Additionally, the epidural catheter is made of medical plastic which is implant tested, inert and generates no significant tissue reaction.[13]

PRACTICAL RECOMMENDATIONS FOLLOWING ADP

The first step is to recognise that ADP has occurred; remembering that its presentation can be subtle if the dura has only been partially breached.

In the face of an obvious ADP, one needs to quickly decide the next course of action, whether to remove the epidural needle and repeat the procedure or to insert the epidural catheter into the intrathecal space. These options are influenced by the experience and preference of anaesthetist and the surrounding circumstances - an ITC would be a better option if the epidural procedure had been technically difficult or if the parturient had been in severe pain and unable to offer full cooperation. If ITC is the option of choice, the catheter should be inserted 3-5 cm into the intrathecal space. An initial dose is then administered following confirmation that CSF can be aspirated from the catheter.

The next course of action is to inform the parturient regarding ADP, offer reassurance and outline the subsequent management. Anaesthesia colleagues and consultants in charge, as well as all personnel involved in the care of the parturient (obstetricians, midwives) should be informed. There should also be detailed documentation in the case notes, anaesthetic chart and incidence report forms.

The ITC should be clearly labelled and everyone made aware of its use. Subsequent labour analgesia is maintained by anaesthetist-administered top-ups of local anaesthetic and/or opioid mixtures in various volumes and concentrations, depending on institutional protocol (See **Table II**, unpublished data). The parturient's block height, haemodynamic

Table II: Use and Practice of ITC following ADP in Institutions

Institution	Initial Dose	Subsequent Dose	Duration of ITC
Countess of Chester Hospital, UK[a]	0.25% bupivacaine 1 ml + fentanyl 25 µg + normal saline 0.5 ml	0.1% bupivacaine 2 ml + fentanyl 2 µg/ml	
Queen Charlotte's Hospital London, UK[a]	Low dose mixture 0.5-2 ml	Low dose epidural mixture 0.5-2 ml	Left in *situ* for 24 hr
Royal Cornwall Hospital, UK[b]	0.25% bupivacaine 1 ml + fentanyl 25 µg, flushed with normal saline 2 ml	Plain 0.25% bupivacaine 0.5-1.5 ml	
Westmead Hospital, NSW, Australia[b]	0.125% bupivacaine 2 ml + fentanyl 5 µg/ml	Same dose & dilution	Left in *situ* for 24 hr
King Edward Memorial Hospital, Perth, WA, Australia[b]	0.125% bupivacaine 2 ml + fentanyl 5 µg/ml	PCSA* Solution: 0.0625% bupivacaine 2 ml + fentanyl 2.5 µg/ml; bolus 3 ml; lockout interval 45 min	
UKM Medical Centre	0.25% levo-bupivacaine 1 ml or 0.2% ropivacaine 1 ml + fentanyl 15-25 µg	0.25% levo-bupivacaine 0.5-1.5 ml	Removed after delivery
Hospital Kuala Lumpur[a]	Fentanyl 25 µg	0.5% bupivacaine 0.5 ml	Left *in situ* for 24 hr
Hospital Selayang[a]	0.05% bupivacaine 3-5 ml + fentanyl 2 µg/ml	0.05% bupivacaine 3-5 ml + fentanyl 2 µg/ml	Left *in situ* for 24 hr

* PCSA = Patient controlled spinal anaesthesia
[a]Personal communication; [b]Protocol on the Internet

and respiratory parameters should be monitored and at regular intervals. If caesarean delivery is required, the existing block height should be checked and 0.5-1 ml doses of 0.5% bupivacaine and fentanyl 15 µg administered with a 1-ml saline flush.

All parturients should be followed up post delivery and early management of PDPH instituted if it occurs.

CONCLUSION

Placement of ITC is a promising intervention following ADP. This intervention has additional benefits including a reduced risk of repeat dural puncture, rapid onset of action and use for anaesthesia. The effects of ITC on the incidence and severity of PDPH as well as the requirement for EBP need further evaluation.

References

1. Rutter SV, Shields F, Broadbent CR, Popat M & Russell R. Management of accidental dural puncture in labour with intrathecal catheters: an analysis of 10 years' experience. *Int J Obstet Anesth* 2001; **10(3)**: 177-81

2. Sprigge JS, Harper SJ. Accidental dural puncture and post dural puncture headache in obstetric anaesthesia: presentation and management: a 23-year survey in a district general hospital. *Anaesthesia* 2008; **63(1)**: 36-43

3. Van de Velde M, Schepers R, Berends N, Vandermeersch E & De Buck F. Ten years of experience with accidental dural puncture and post-dural puncture headache in a tertiary obstetric anaesthesia department. *Int J Obstet Anesth* 2008; **17(4)**: 329-35

4. Apfel CC, Saxena A, Cakmakkaya OS, Gaiser R, George E & Radke O. Prevention of postdural puncture headache after accidental dural puncture: a quantitative systematic review. *Br J Anaesth* 2010; **105(3)**: 255-63

5. Russell I. In the event of accidental dural puncture by an epidural needle in labour, the catheter should be passed into the subarachnoid space (Proposer). *Int J Obstet Anesth* 2002; **11**: 23-25

6. Laishley R. In the event of accidental dural puncture by an epidural needle in labour, the catheter should be passed into the subarachnoid space (Opposer). *Int J Obstet Anesth* 2002; **11**: 26-27

7. Baraz R, Collis RE. The management of accidental dural puncture during labour epidural analgesia: a survey of UK practice. *Anaesthesia* 2005; **60(7)**: 673-79

8. Sajjad T, Ryan TD. Current management of inadvertent dural taps occurring during the siting of epidurals for pain relief in labour. A survey of maternity units in the United Kingdom. *Anaesthesia* 1995; **50(2)**: 156-61

9. Baysinger CL, Pope JE, Lockhart EM, Mercaldo ND. The management of accidental dural puncture and postdural puncture headache: a North American survey *J Clin Anesth* 2011; **23(5)**: 349-60

10. Newman MJ, Cyna AM. Immediate management of inadvertent dural puncture during insertion of a labour epidural: a survey of Australian obstetric anaesthetists. *Anaesth Intens Care* 2008; **36(1)**: 96-101

11. Russell IF. A prospective controlled study of continuous spinal analgesia versus repeat epidural analgesia after accidental dural puncture in labour. *Int J Obstet Anesth* 2012; **21(1)**: 7-16

12. Ayad S, Demian Y, Narouze SN, Tetzlaff JE. Subarachnoid catheter placement after wet tap for analgesia in labor: influence on the risk of headache in obstetric patients. *Reg Anesth Pain Med* 2003; **28(6)**: 512-15

13. Heesen M, Klöhr S, Rossaint R, Walters M, Straube S, Van de Velde M. Insertion of intrathecal catheter following accidental dural puncture: a meta-analysis. *Int J Obstet Anesth* 2013; **22(1)**: 26-30

Perioperative Fluid Management in Paediatric Patients

Sanah Mohtar, MBBS (UM), M Med (Anaesth) UKM
Paediatric Anaesthesiologist, Department of Anaesthesiology & Intensive Care,
Hospital Kuala Lumpur, Malaysia

INTRODUCTION

Perioperative therapy is aimed at providing the maintenance fluid requirements, correct the fluid deficit and replace the ongoing fluid losses in order to maintain adequate tissues perfusion and fluid homeostasis. A meta-analysis of randomised controlled trial of fluid therapy in major elective open abdominal surgery in adult suggests that the goal should be 'enough but not too much'.[1] The same concept should be applicable to children even in neonates.[2]

For more than 50 years, this concept of fluid therapy was based on Holliday and Segar's formula, which calculated to meet children's water and electrolyte daily needs according to weight-based calculation using hypotonic solutions with the addition of 5% glucose.[3] These recommendations were planned to match free water requirements and energy expenditure in healthy children. Holliday and Segar's practice best known as a "4-2-1" rule has been widely used in paediatric anaesthesia practice for many years, due to it attractive simplicity without questioning its adequacy and safety in the surgical paediatric patients.

Recent literature challenges this classic concept for fluid requirements. There have been reports of postoperative deaths or significant neurological damage due to hospital-acquired hypernatraemia in previously healthy children receiving hypotonic maintenance solutions during and after elective surgery.[4,5] Hence, the recommendations regarding both ideal volume and composition of perioperative fluid therapy for children have been the topic of current controversies. The fundamental concepts of perioperative fluid therapy for paediatric patients include the physiological considerations of fluid therapy, perioperative fluid management (pre, intra and postoperative) and the needs of glucose and sodium content and its rationale, as well as the recent recommendations of fluid therapy in children are discussed in this article.

PHYSIOLOGICAL CONSIDERATIONS OF FLUID THERAPY IN INFANTS AND CHILDREN

Changes in body fluid compartments

Body fluid compositions vary according to age in the paediatric populations. Early in foetal life, 90% of the body weight is water, and the extracellular fluid (ECF) is expanded, representing 60% of body weight. Naturesis and diuresis result in reduction of the interstitial fluid volume as a foetus grows. By term, the total body water (TBW) of a newborn is 75-80% and reduces gradually to the adult level of approximately 60% by age 10 years, as fat and muscle content increase with age.[6,7] At term, the ECF is 45% of the body weight and by the age 1 year it represents 30% of body weight (**Table I**).[8] Whereas the normal blood volume in neonate is approximately 80-90 ml/kg (depending on the time the cord is clamped), in preterm infants this is approximately 100 ml/kg (**Table II**). This large ECF volume and its high percentage relative to other compartments cause a high turnover of water and electrolyte, especially the sodium. Therefore, the term infant can compensate more than the preterm infant. Furthermore, a newborns have a larger surface-to-weight ratio (about three times greater than adults) resulting in a higher insensible loss from the skin. The limited renal ability to concentrate, higher total water content and metabolic rate could contribute to clinical dehydration that occurs over a very short period.[9]

Maintenance fluid requirements

Maintenance fluid therapy represents the volume of fluid as well as the amount of electrolytes required to restore anticipated physiological losses from breathing, sweating and urine output. Holliday

Table I: Variation in TBW composition and ECF volume in children and adults

Age group	Body weight (BW) (g)	TBW (% BW)	ECF volume (% BW)
23-27 weeks	500-1000	85-90	60-70
28-32 weeks	1000-2000	80-85	50-60
36-40 weeks	>2500	75-80	~45
Infant	6000	70	30
Adult	70kg	50-60	20

Table II: Estimated circulating blood volume of various ages

Age	Estimated blood volume (ml/kg)
Preterm infant	90-100
Term infant - 3 months	85-90
Children older than 3 months	80
School age	70
Adult	60

and Segar described a practical method to calculate maintenance fluid requirements based on estimated total caloric expenditure of hospitalised patients from their body weight.[3] Normally, 1 ml of water is needed to metabolise 1 kcal, taking into consideration insensible losses from skin and respiratory tract, and urinary water losses, resulting in the classic "4-2-1 rule" for maintenance fluid therapy in children (**Table III**). In the similar study, the maintenance electrolyte requirements were calculated from the amount of electrolyte delivered by the same volume of human milk and cow's milk. Hence, Holliday and Segar recommended daily needs of 3 mmol/kg/day of sodium and 2 mmol/kg/day of both potassium and chloride. Based on this concept, these electrolyte requirements are theoretically met by the hypotonic maintenance solutions (0.2% saline equivalent) used in hospitalised children. Despite recent controversies, this practice have been adopted by paediatricians for many decades and is still popular.[10-14] In another study by Lindahl, the energy expenditure during anaesthesia was 50% lower than calculated by Holliday and Segar for hospitalised children, and closed to the basal metabolic rate.[15]

PREOPERATIVE ASSESSMENT: ESTIMATION OF FLUID DEFICIT

Fluid deficits consist of preoperative losses (fasting, gastrointestinal, renal and cutaneous losses), haemorrhage and third space losses, which were mainly due to ECF losses from trauma and surgery. Preoperatively, the patient's hydration status varies from no or minimal fluid deficit in minor elective procedures to a significant fluid deficit from blood and interstitial volume in severely injured children.

Table III: Fluid management regime in paediatric patients

1957, Holliday and Segar[3]	2004, Holliday and Segar et al.[13]
Hypotonic solutions	Isotonic solutions
Perioperative and postoperative fluid infusion rates:	Perioperative fluid infusion rates: 20-40 ml/kg/h over 2-4hr
4 ml/kg/h for first 10kg 2 ml/kg/h for second 10kg 1 ml/kg/h for subsequent >20kg	Postoperative inpatient infusion rates: 2/1/0.5 ml/kg/h for first and second 10kg and >20kg respectively

Table IV: Fasting guidelines for elective surgery

Ingested material	Minimum fasting period (hour)
Clear liquids	2
Breast milk	4
Infant formula	4 (<3 month) - 6 (> 3 month)
Non-human milk	6
Light meal	6

Current recommendations allow administration of clear fluid up to two hours prior to anaesthesia, as published in the new fasting guidelines for elective surgery issued by the American Society of Anaesthesiologist (**Table IV**).[16] Shorter fasting time has been associated with patient contentment and hydration, which is of furthermost crucial for infants and small children. Furthermore, there is considerable evidence that free intake of clear fluids up to 2 hours preoperatively does not affect the pH or volume of gastric contents at induction of anaesthesia in children.[17]

However, not all patients will be fasted accordingly prior to surgery and some may have significant deficits related to their disease process such as vomiting, diarrhoea and fever, especially for emergency surgeries. Therefore, the assessment of the degree of dehydration is necessary, which is based on classical clinical signs (**Table V**). A child's weight loss is generally an exquisite implication of total water loss in acute illness. Urine output monitoring is also essential for evaluation of fluid deficit, as kidney function is one of the most important sign of normal hydration status. Any degree of dehydration needs to be replaced accordingly. As a rule of thumb, 1% dehydration correction requires about 10 ml/kg of fluids and so on.[18] For fluid resuscitation, 20 ml/kg of crystalloid solutions should be administered as a fast bolus in dehydrated paediatric surgical patients. In cases of more severe dehydration, this bolus may need to be repeated.

The composition of fluids administered should take into consideration the nature of fluid loss (**Table VI**). During the initial resuscitation period, crystalloid solutions such as Hartmann's or normal saline, or even a colloid solution mainly 5% albumin can be

Table V: The clinical assessment for degree of dehydration

Severity of dehydration	Percentage dehydration		Clinical sign and symptoms
	Infants (%)	Child (%)	
Mild	5	3-4	Increased thirst, tears present, mucous membranes moist, capillary refill >2 secs centrally, urine output specific gravity > 1.020
Moderate	10	6-8	Tacky to dry mucous membrane, decreased tears, pulse rate may be elevated, fontanelle may be sunken, oliguria, capillary refill time 2-4 secs, decreased skin turgor
Severe	15	10	Tears absent, dry mucous membrane, sunken eyes, tachycardia, slow capillary refill, poor skin turgor, cool extremities, orthostatic to shock, somnolence
Shock	>15	>10	Physiological decompensation: Insufficient perfusion to meet end-organ demand, poor oxygen delivery, decreased blood pressure

Table VI: Electrolyte composition of body fluids (the units are in meq/L)

Electrolyte	Gastric	Pancreatic	Bile	Ileostomy	Diarrhoea
Na^+	70	140	120	130	50
K^+	5-15	5	5	15-20	35
Cl^-	120	50-100	100	120	40
HCO_3^-	0	35	40	25-30	50

used, especially in small infants and neonates.[19] It is important to note that potassium should only be added after acidosis correction and production of urine output. The prognosis of certain medical illness such as septic shock depends on the amount and promptness of fluid resuscitation: the younger the child, the greater the amount of fluid resuscitation needed related to body weight.[20]

INTRAOPERATIVE FLUID MANAGEMENT

Volume of intraoperative fluids

Traditionally, preoperative fluid deficits were presumed to occur due to continuing insensible losses and urine output as consequences of prolonged fasting. Furman *et al*. suggested calculating preoperative deficit by multiplying the hourly maintenance fluid requirement (as per 4-2-1 rule) by the number of fasting hours.[21] Half of this preoperative fluid deficit is replaced during the first hour of surgery and followed by the other half over the next 2 hours. However, in 1986, Berry designed streamlined guidelines for fluid regime according to the child's age and the severity of surgical trauma (**Table VII**).[22] Both Furman and Berry guidelines were adapted based on the conventional recommendation 'NPO after midnight'. Hence, the amount of fluid given during the first hour should be scaled down if the children are fasting for a shorter period or if the child is already obtained some amounts of intravenous fluid preceding the surgery.

Table VII: Guidelines for fluid administration of balanced salt solution in children according to the age and the severity of tissue trauma

1	**First hour (plus item 3 below)** **25 ml/kg in children aged 3 years and under** **15 ml/kg in children aged 4 and over**
2	All other hours (plus item 3 below) Maintenance + trauma = basic hourly fluid Maintenance volume = 4 ml/kg/h Maintenance + mild trauma = 6 ml/kg/h Maintenance + moderate trauma = 8 ml/kg/h Maintenance + severe trauma = 10 ml/kg/h
3	Blood replacement 1:1 with blood or colloid or 3:1 with crystalloids

Surgical trauma leads to fluid translocation from functional extracellular fluid volume (FEFV) to a non-functional extracellular space, which is referred to third space losses. In paediatric patients, these losses may vary from 1 ml/kg/h for a minor surgical procedure to as high 15-20 ml/kg/h for major abdominal procedures, and even up to 50 ml/kg/h for surgery of necrotising enterocolitis in premature infants.[19] It could be explained by the greater magnitude of losses due to the larger ECF volume in infants compared with older children. A balanced solution such as Hartmann's is the fluid of choice for restoration of the third space loss. A randomised study found out that a large quantity of normal saline is associated with hyperchloraemic metabolic acidosis, which does not develop after Ringer's lactate administration.[23]

The conventional method of liberal isotonic fluid transfusion in major paediatric surgeries may have detrimental effects.[19] The guidelines are best adjusted by observations in haemodynamic parameters such as heart rate, blood pressure, capillary filling time, urine output as well as arterial and central venous pressure in major surgical procedures. An individualised goal-directed fluid management in the perioperative period is necessary in order to improve overall outcomes.[24-26] However, the use of non-invasive tools to guide and determine optimum intravascular volume status in children is currently still lacking.[27]

Two important considerations of fluid management that are essential for a safe fluid management in small children are the glucose requirement and the sodium content of the infusion fluid.

1. Glucose during maintenance fluid therapy: the rationale for avoiding both hyper- and hypoglycaemia

Both hypoglycaemia and hyperglycaemia can have disastrous effects in paediatric patients. Glucose, like oxygen, is essential for a normal brain function and it is known that hypoglycaemia induces brain damage especially in neonates. Hypoglycaemia induces a stress response and alters cerebral blood flow and metabolism. This may result in permanent neurodevelopmental impairment mainly in small infants even if hypoglycaemia is mild, particularly if it occurs associated with mild hypoxia or ischaemia.[28]

Furthermore, inadequate glucose supply will promote lipolysis resulting in the production of ketone bodies and free fatty acids that is not necessarily accompanied by hypoglycaemia.[29]

Hyperglycaemia is also harmful to the nervous system particularly in the presence of an ischemic or hypoxic event. The anaerobic metabolism of excess glucose causes an increase in lactate and a reduction in intracellular pH, which will jeopardise cellular function, with risks of global or focal cerebral ischaemia and cell death.[30] Furthermore, hyperglycaemia can promote an osmotic diuresis that may result in dehydration and electrolyte abnormalities in the paediatric patients especially in small premature infants with immature tubular function.[31]

Previously, dextrose administration was considered compulsory to prevent intraoperative hypoglycaemia that may be missed in an anaesthetised child. Nevertheless, the risk of hyperglycaemia at that time was underrated as the glucose need during surgery should be less than maintenance due to the neuroendocrine stress response to surgery. Nishina et al. revealed that up to 30% of children receiving 5% dextrose (D_5) lactated Ringer's solution developed hyperglycaemia of more than 11 mmol/l.[29] In another study by Welborn *et al.*, the average blood glucose concentrations in children receiving preoperative D_5 lactated Ringer's solution was 13.4 mmol/l, with the highest at 17 mmol/l.[32]

More recent studies demonstrated that the risk of preoperative hypoglycaemia actually has been low (0-2.5%) in normal healthy infants and children.[32-35] The hypoglycaemic cases were frequently associated with long fasting durations from 8 to 19 hours (median 10 hours), far beyond the current recommended fasting guidelines (**Table VIII**).

As several studies had shown that 5% dextrose solutions are correlated with an unacceptable high blood glucose level, it is recommended to avoid them. Few clinical trials comparing the perioperative use of infusion solutions containing no glucose, 1%, 2.5% or 5% glucose showed that the administration of 1% glucose prevents hypoglycaemia, ketogenesis and lipid mobilisation. It is also associated with blood glucose concentrations in the normal range with no life-threatening event in cases of accidental hyperhydration.[33,34,36] Whereas, the intraoperative administration of 2% or 2.5% glucose solutions often resulted in both hyperglycaemia due to stress-induced insulin resistance and dilutional hypernatraemia.[29,37,38]

When the rate and glucose concentration of the solutions are taken into account, the glucose content of the solutions providing an acceptable glucose level is approximately 300 mg/kg/h (4-6 mg/kg/min) or less, which is the basal glucose requirement in children.[31] Nevertheless, Mikawa et al. revealed that this glucose infusion rate could still account for pronounced hyperglycaemia (>16.5 mmol/l) when administered during extended operations.[38] In the same study, it was suggested a lower glucose infusion rate of 120 mg/kg/h is adequate to keep an acceptable blood glucose level and prohibit lipid mobilisation in infants and children. However, neonates who have inadequate glycogen stores and do not have the same hyperglycaemic response to the stress of surgery may require 10% dextrose. Nevertheless, monitoring the blood glucose level

Table VIII: Blood glucose levels and incidence of hypoglycaemia at induction of anaesthesia in the literature

Author, year, (Reference)	No. of patients	Age (range or mean)	Fasting duration (protocol) hr.	Fasting duration (effective) hr.	Blood glucose at induction (mmol/l)	Hypoglycemia, N (%) (threshold level, mmol/l)	Type of surgery
Welborn et at. 1986 (32)	446	1 month to 6 years	Solids: midnight, clear fluids 4h < 1 year; 6 h: 1-6 years	6.1-12.7	4.6-4.7	2 (0.4%) (<2.8)	Minor
Welborn et al. 1987 (33)	162	2.5-2.9 years	Solids: midnight Clear fluids 4h <1 years; 6h 1-6 years	11-12	4.3-4.6	2 (1.2%) (<2.8)	Minor
Hongnat et al. 1991 (37)	68	3 months to 10 years	Solids and fluids: midnight Clear fluids 4h if < 6 months	10.8-12.3	4.3 ± 0.8 to 4.6 ± 0.7	5 (7.4%) (3.5) 0 (< 2.2)	Minor
Mikawa et al. 1991 (38)	45	18 months to 9 years	Solids: midnight clear fluids 4-6h	6.1	5.5 ± 0.5	0 (< 2.8)	Long duration
Dubois et al. 1992 (34)	79	3 months to 10 years	Solids: midnight clear fluids 4h if < 1 year; 6h if > 1 year	Not available	4.3 ± 0.7 to 4.9 ± 0.8	2 (2.5%) (<2.6)	Minor
Welborn et al. 1993 (35)	200	1-10 years	Solids: midnight Clear fluids 6h (grp A) or 2-3h (grp B)	2.9-13.1	4.4-4.3	2 (1.8%) Group A, 0 Group B, (<2.8)	Minor
Nishina et al. 1995 (29)	60	1-11 months	Milk: ≤4 months 6h; >5 months midnight clear fluids: 3h	Not available	5.5 ± 2.5	0 (<2.7)	Minor

and steady adjustment of infusion rate are crucial in neonatal surgery to avoid excessive fluctuations in blood glucose.[31]

2. Sodium content of the infusion solution: the principle for choosing isotonic hydrating solutions

During surgery, most of the fluids required is for restoration of ongoing fluid losses mainly from the ECF. Therefore, fluid solutions should comprise high sodium and chloride but a low concentration of bicarbonate, calcium and potassium.[18] Recently, both the composition and volume of maintenance fluids during the perioperative period have been criticised. While the calculation of the amount of the maintenance requirement often seems too excessive in a perioperative child, the current evidence suggests that the administration of hypotonic solution significantly increases the risk of hyponatraemia that occasionally resulted in permanent neurological damage or even death.[4,5,14,18] Conversely, the used of isotonic solutions was associated with a steady sodium level (**Table IX**).

Although its actual incidence is unknown, perioperative hyponatraemia has been reported as high as 31% in surgical patients.[12,39] Perioperative dilutional hyponatraemia occurs as a result of impaired ability to excrete hypotonic urine secondary to an increased antidiuretic hormone (ADH) secretion, in combination with a positive balance of electrolyte free water with infusion of hypotonic solutions.[4,5] An increased plasma ADH is a result from both osmotic and various non-osmotic stimuli such as hypovolaemia, pain, stress, anxiety, nausea and vomiting, narcotics and non-inflammatory drugs.[4,18,19] This prevents the surgical patient from eliminating electrolyte-free water even in the presence of extracellular water excess. Moreover, recent studies demonstrated that children who are administered glucose-saline solutions, become effectively hypotonic, thus promoting hyponatraemia.[19,37,38,40,41] Hence, isotonic solutions as intraoperative maintenance fluid for surgical paediatric patients should be recommended to reduce the incidence of postoperative hyponatraemia.

Table IX: The effects of perioperative infusion of isotonic or hypotonic fluids in surgical patients in the literature

Author, year, (Reference)	Type of surgery	No. of patients	Infusion solutions	Na^+ concentration preoperatively mmol/l	Na^+ concentration postoperatively mmol/l
Cowley, 1988 (40)	Spine	8	0.45% NaCl	140 ± 1.1	134.1 ± 1.3
Brazel, 1996 (41)	Spine	5	Hartmann's solution	141 ± 2.8	138 ± 1.9
		7	0.18% or 0.3% NaCl	142.5	129.5
Dubois, 1992 (34)	Minor	27 25 27	LR D_1LR $D_{2.5}LR_{½}$	139 ± 1.5 139.6 ± 1.5 139.5 ± 1.5	138.6 ± 1.4 139 ± 1.4 136.3 ± 2.5
Geib, 1993 (42)	Minor	19 22	D_1LR $D_{0.9}$LR	139 ± 0.8 139 ± 1.3	138 ± 1.2 138 ± 1.3

Clinical guidelines for intraoperative fluid therapy

As discussed above, the current practice of prescribing maintenance fluid is based on historical data.[3] Although no consensus has been made, intraoperative glucose-free isotonic solutions administration should be the standard practice for most surgeries in healthy children in order to avoid hyponatraemia.[18] If glucose needs to be added to maintenance infusion, close monitoring of blood glucose level during surgery should be considered mandatory for children. This includes neonates and premature or small infants, children suffering hepatic dysfunction or disorders of metabolism, those requiring preoperative glucose infusion or parenteral nutrition, poor nutrition status or low body weight (<3rd centile) or having extensive regional anaesthesia with a reduced stress response.[18,31]

With expanding consensus regarding selective administration of intraoperative glucose in those children at higher risk of hypoglycaemia, the choice of lower dextrose concentrations (e.g. 1% or 2%) in lactated Ringer is applicable.[33,34,37] In early neonatal period whereby maintenance fluid with 10% dextrose solution is being continued intraoperatively, it should be at a reduced rate.[42] Whenever glucose-containing solution is used for intraoperative fluid maintenance, separate intravenous lines should be used to give fluid boluses or replacements of measured losses.

Dharmrait et al. in their recent survey among members of the Association of Paediatric Anaesthetists of Great Britain and Ireland has identified a significant difference in daily practice of perioperative fluid management in children, which stated that 60% of anaesthesiologists were still using hypotonic dextrose saline solutions in the intraoperative period.[42] Holliday and Segar revised their perioperative fluid recommendations in 2004 to address these current concerns (**Table III**).[13]

Few factors should be considered when deciding the choice of crystalloids or colloids which include the nature of fluid deficit (fluid or plasma loss) and also the after effect of the replacement solutions (**Table X**) on the intravascular volume, coagulation cascade, microcirculation and risk of allergic reactions.[4,19] Despite the debate regarding the choice of a crystalloid and colloid, most would acknowledge that the intravenous fluid administration should start with balanced solutions such as Hartmann's or Ringers Lactate. The advantages of crystalloid solutions include low cost, lack of effect on coagulation, no risk of anaphylactic reaction and no risk of an infectious agent. On the other hand, the main disadvantage is that within two hour's period, most of the administered solution distribute to all the active body fluid compartments. To re-establish cardiovascular stability, normally 10-20 ml/kg of balanced solution over 15-20 minutes is required, and after a total 30-50 ml/kg of crystalloid solution infusion, the administration of a colloid solution is indicated to preserve the intravascular osmotic pressure.[18] Blood should be administered as appropriate. However, the discussion on colloids and blood is beyond the capacity of this review.

Postoperative fluids therapy

The majority of children undergoing uncomplicated day case or minor surgery are expected to resume eating and drinking soon postoperatively. Administration of intraoperative fluids in these cases has been shown to be associated with a reduced incidence of PONV and a significantly reduced postoperative increase in ADH concentration which probably related to adequate intravascular status. Hence, for these children, a full volume maintenance fluid would be appropriate during the short intraoperative and immediate postoperative period. Once the oral intake is resumed well, the intravenous fluids should be discontinued.

Conversely, for children expected to remain nil-by-mouth for at least 24 hours after surgery or undergoing major surgery, the postoperative maintenance fluids are required to replace insensible losses, urinary losses as well as to provide energy source. Urine output may vary according to the clinical situations and the effects of ADH and caloric expenditure is also reduced in hospitalised children. During the first postoperative day, decreased volumes of 50-70% in the maintenance fluid of isotonic solution is recommended, provided that the child is normovolaemic.[18,19] A reduction is also suggested by Holliday and Segar in their revised regime in 2004.[13] Postoperative ongoing losses should be replaced with isotonic solutions with glucose 5% added to provide caloric value. Optimal postoperative fluid therapy results in satisfactory tissue perfusion, as observed from adequate urine output and normal laboratory data on electrolyte balance, base deficit, lactate and sugar levels.

Table X: Summarises the currently available intravenous fluid solutions commonly use in paediatric practice

Electrolyte	Normal saline	Ringer's lactate	Plasmalyte A	Albumin 5%	D5% NS
Na^+ (meq/L)	154	130	140	154	154
K^+ (meq/L)	-	4	5	-	-
Cl^- (meq/L)	154	109	98	154	154
Ca^{++} (meq/L)	-	3	-	-	-
Mg^{++} (meq/L)	-	-	3	-	-
Acetate (meq/L)	-	-	27	-	-
Lactate (meq/L)	-	28	-	-	-
Glucose (gm%)	-	-	-	-	-
Phosphate (mg%)	-	-	-	-	-
Osmolality (mOsm/L)	308	274	295	310	308

CONCLUSION

Intravenous fluid therapy is a medical prescription, which needs to be ordered with accuracy both in composition and volumes. Understanding the pathophysiological needs in each child enable anaesthetist to individualise fluid therapy and contribute to a safe outcome. Isotonic solutions is preferred over hypotonic solutions for the intraoperative period and hypotonic solutions is restricted to very specialised clinical areas with careful monitoring of plasma electrolytes as a safe strategy. In children at risk of hypoglycaemia, glucose should be administered and sugar level monitored during surgery. Otherwise, all other solutions should be glucose-free. Excessive fluid administration should be avoided and it is important to re-evaluate hydration status after fluid boluses.

References

1. Varadhan KK, Lobo DN. A meta-analysis of randomized controlled trials of intravenous fluid therapy in major elective open abdominal surgery: getting the balance right. *Proc Nutr Soc* 2010; **69**: 488-98

2. Jansen LA, Safavi A, Lin Y et al. Preclosure fluid resuscitation influences outcomes in gastroschisis. *Am J Pernatol* 2012; **29(4)**: 307-12

3. Holliday M, Segar W. The maintenance need for water in parenteral fluid therapy. *Pediatrics* 1957; **19(5)**: 823-32

4. Paut O, Lacroix F. Recent developments in the perioperative fluid management for paediatric patient. *Curr Opin Anaesthesiol* 2006; **19(3)**: 268-77

5. Arieff AI. Postoperative hyponatraemic encephalopathy following elective surgery children. *Paediatr Anaesth* 1988; **8(1)**: 1-4

6. Friis-Hansen B. Body water compartments in children: changes during growth and related changes in body composition. *Pediatrics* 1961; **28(2)**: 169-81

7. Arya VK. Basics of fluid and blood transfusion therapy in paediatric surgical patients. *Indian J Anaesth* 2012; **56(5)**: 454-62

8. Friis-Hansen BJ, Holiday M, Stapleton T, Wallace WM. Total body water in children. *Pediatrics* 1951; **7(3)**: 321-27

9. Holliday MA, Ray PE, Friedman AL. Fluid therapy for children: Facts, fashions and questions. *Arch Dis Child* 2007; **92**: 546-50

10. Bohn D. Problems associated with intravenous fluid administration in children: do we have the right solutions? *Curr Opin Pediatr* 2000; **12(3)**: 217-21

11. Duke T, Molyneux EM. Intravenous fluids for seriously ill children: time to reconsider. *Lancet* 2003; **362**: 1320-23

12. Moritz M, Ayus J. Prevention of hospitalized-acquired hyponatremia: a case using isotonic saline. *Pediatrics* 2003; **111(2)**: 227-30

13. Holliday MA, Friedman AL, Segar WE et al. Acute hospitalized-induced hyponatremia in children: a physiologic approach. *J Pediatr* 2004; **145**: 584-87

14. Halberthal M, Halperin ML, Bohn D. Lesson of the week: Acute hyponatremia in children admitted to hospital: Retrospective analysis of factors contributing to its development and resolution. *BMJ* 2001; **322(7298)**: 780-82

15. Lindahl SG. Energy expenditure and fluid and electrolyte requirements in anaesthetized infants and children. *Anesthesiology* 1988; **69(3)**: 377-82

16. ASA Task force on preoperative fasting. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: Application to healthy patients undergoing elective procedures. *Anesthesiology* 1999; **90**: 896-905

17. Splinter WM, Schaefer JD. Unlimited clear fluids ingestion two hours before surgery in children does not affect volume or pH of stomach contents. *Anaesth Intensive Care* 1990; **18(4)**: 522-26

18. Murat I, Dubois M-C. Perioperative fluid therapy in pediatrics. *Pediatr Anesth* 2008; **18(5)**: 363-70

19. Bailey AG, McNaull PP, Jooste E, Tuchman JB. Perioperative crystalloid and colloid fluid management in children: where are we and how did we get here? *Anesth Analg* 2010; **110(2)**: 375-90

20. Carcillo JA, Davis AL, Zaritsky A. Role of early fluid resuscitation in pediatric septic shock. *JAMA* 1991; **266(9)**: 1242-45

21. Furman E, Roman DG, Lemmer La, Jairabet J, Jasinka M, Laver MB. Specific therapy in water, electrolyte and blood volume replacement during pediatric surgery. *Anesthesiology* 1975; **42**: 187-93

22. Berry F. Practical aspects of fluid and electrolyte therapy. In: Berry F, ed. Anesthetic management of difficult and routine pediatric patients. New York: Churchill Livingstone, 1986: 107-35

23. O'Malley CM, Frumento RJ, Hardy MA, et al. A randomized, double-blind comparison of lactated Ringer's solution and 0.9% NaCI during renal transplantation. *Anesth Analg* 2005; **100**: 1518-24

24. Wakeling HG, MsFall MR, Jenkins CS, et al. Intraoperative esophageal Doppler guided fluid management shortens postoperative hospital stay after major bowel surgery. *Br J Anaesth* 2005; **95**: 634-42

25. Kehlet H. Goal-directed perioperative fluid management. Why, when and how? *Anesthesiology* 2009; **110**: 453-55

26. Doherty M, Buggy DJ. Intraoperative fluids: how much is too much? *Br J Anaesth* 2012; **109**: 69-79

27. de Souza Neto EP, Grousson S, Duflo F, et al. Predicting fluid responsiveness in mechanically ventilated children under general anaesthesia using dynamic parameters and transthoracic echocardiography. *Br J Anaesth* 2011; **106**: 856-64

28. Burns CM, Rutherford MA, Boardman JP, Cowan FM. Pattern of cerebral injury and neurodevelopmental outcomes after symptomatic neonatal hypoglycemia. *Pediatrics* 2008; **122(1)**: 65-74

29. Nishina K, Mikawa K, Maekawa N, et al. Effects of exogenous intravenous glucose on plasma glucose and lipid homeostasis in anesthetized infants. *Anesthesiology* 1995; **83**: 258-63

30. Hirshberg E, Larsen G, Van Duker H. Alterations in glucose homeostasis in the pediatric intensive care unit: hyperglycemia and glucose variability are associated with increased mortality and morbidity. *Pediatr Crit Care Med* 2008; **9**: 361-66

31. Leelanukrom R, Cunliffe M. Intraoperative fluid and glucose management in children. *Paediatr Anaesth* 2000; **10(4)**: 353-59

32. Welborn LG, McGill WA, Hannallah RS, et al. Perioperative blood glucose concentrations in pediatric outpatients. *Anesthesiology* 1986; **65(5)**: 543-47

33. Welborn LG, Hannallah RS, McGill WA, et al. Glucose concentrations for routine intravenous infusion in pediatric outpatient surgery. *Anesthesiology* 1987; **67(3)**: 427-30

34. Dubois M, Gouyet I, Maurat I. Lactated Ringer with 1% dextrose: an appropriate solution for perioperative fluid therapy in children. *Paediatr Anaesth* 1992; **2**: 99-104

35. Welborn LG, Norden JM, Seiden N, et al. Effect of minimizing preoperative fasting on perioperative blood glucose homeostasis in children. *Paediatr Anaesth* 1993; **3(3)**: 167-71

36. Sümpelmann R, Mader T, Eich C, et al. A novel isotonic-balanced solution with 1% glucose for intraoperative fluid therapy in children: results of a prospective multicentre observational post-authorization safety study (PASS). *Pediatr Anaesth* 2010; **20(11)**: 977-81

37. Hongnat JM, Murat I, Saint-Maurice C. Evaluation of current paediatric guidelines for fluid therapy using two different dextrose hydrating solutions. *Paediatr Anaesth* 1991; **1(2)**: 95-100

38. Mikawa K, Maekawa N, Goto R, et al. Effects of exogenous intravenous glucose on plasma glucose and lipid homeostasis in anaesthetized children. *Anesthesiology* 1991; **74(6)**: 1017-22

39. Eulmesekian PG, Perez A, Minces PG, Bohn D. Hospital-acquired hypernatremia in postoperative pediatric patients: prospective observational study. *Pediatr Crit Care Med* 2010; **11(4)**: 479-83

40. Cowley D, Pabari M, Sinton T, et al. Pathogenesis of postoperative hyponatremia following correction of scoliosis in children. *Austr N Zeal J Surg* 1988; **58(6)**: 485-89

41. Brazel PW, McPhee IB. Inappropriate secretion of antidiuretic hormone in postoperative scoliosis patients: the role of fluid management. *Spine* 1996; **21(6)**: 724-27

42. Way C, Dhamrait R, Wade A, Walker I. Perioperative fluid therapy in children: survey of current prescribing practice. *Br J Anaesth* 2006; **97(3)**: 371-79

Difficult Airway in the Obstetric Patient

Muhammad Maaya, Bsc Med Science (St Andrews), MBChB (Manchester), FRCA, AMM
Convenor for Airway Management Special Interest Group, Lecturer & Consultant Anaesthesiologist, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia

INTRODUCTION

Endotracheal intubation of an obstetric patient for lower segment Caesarean section can be daunting to a fair number of anaesthesiologists, as the incidence of failed tracheal intubation in this patient population was traditionally quoted to be eight times higher than the non-pregnant population.[1] Studies conducted at different time periods found failed intubation, defined as failure of placement of the endotracheal tube after multiple attempts, to have a constant incidence of approximately 1 in 230 parturients.[2-4] A more recent literature review, which analysed data from 1970 onwards, discovered that tracheal intubation failed in 1 in 390 per all obstetric general anaesthesia, and 1 in 443 per Caesarean section.[5] The authors also stated that maternal mortality, which resulted from oesophageal intubation, causing aspiration and hypoxaemia secondary to airway obstruction, was 1 death per 90 failed tracheal intubations.

AIRWAY CHANGES DURING PREGNANCY

Changes in the oestrogen hormone level results in fluid retention and increased circulating volume which can contribute to capillary engorgement and oedema of the upper airway, including the pharynx, glottis and aretynoids.[6,7] A smaller diameter of endotracheal tube may be required due to the laryngeal oedema. Oedema may not only reduce the view of the laryngeal inlet, but may also make the upper airway mucosa friable. Therefore, repeated attempts at intubation can produce bleeding in the airway, further limiting visualisation of the laryngeal inlet. Bleeding due to coagulopathy may also occur in severely eclamptic patients.[8] Fluid retention may result in facial oedema, making facemask manoeuvres difficult. A larger chest girth, coupled with enlarged breasts, makes laryngoscopy more challenging with a standard Macintosh blade.

In the lower airway, the gravid uterus pushes the diaphragm cranially, reducing functional residual capacity (FRC), more so in the supine position.[7] This position reduced FRC results in a smaller oxygen reservoir, predisposing the parturient to rapid oxygen desaturation when no effective ventilation is achieved.

PRESSURE TO PERFORM

The safety of central neuraxial block over general anaesthesia for Caesarean section has led to a reduction in the number of Caesarean section surgeries done under general anaesthesia, thus anaesthesia personnel may have less experience in handling the obstetric airway.[9] Furthermore, in a rushed emergency situation with a compromised foetus, inadequate airway assessment, suboptimal patient positioning and performance under pressure may add on to the potential difficulties of a parturient's challenging anatomy, resulting in unanticipated difficult or failed intubation.[8,9] Maternal morbidity and mortality risks increase in emergency situations whereby the parturient may well be attended by a junior anaesthetic doctor, whose clinical judgement may be additionally impaired by exhaustion and sleep deprivation.[4]

PRIOR TO INDUCTION

Adequate preoperative preparation which include airway assessment, proper patient positioning and pre-oxygenation can help avoid problems. A recent literature review found that preoperative airway assessment was documented in 60% of actual difficult intubation for obstetric surgery, with the remaining 40% either not performed or performed but not documented.[5] However, the Mallampati score, commonly used by the anaesthesiologists, is not a sensitive tool as it correctly predicted only one-third of difficult airway.[4] Nevertheless, when an anaesthesiologist anticipates a difficult airway, specialised equipment, for example the videolaryngoscope can be made readily available and in the extreme circumstance, the otolaryngology surgeon may be asked to be present if tracheostomy is deemed necessary.

A ramped (30° elevation of the head and upper back) position is helpful in facilitating laryngoscope insertion and aligning the axis of the upper airway for better visualisation of the vocal cords.[8] This position (shown on page 19) also increases oxygen reservoir by improving FRC.

Another method of increasing the oxygen reservoir is by effective pre-oxygenation, which can be achieved optimally by administering 10 l/min of 100% oxygen over 3 minutes of tidal volume breathing or 8 vital capacity breaths.[8] Proper pre-oxygenation can delay the time before oxygen desaturation which might reduce the stress amongst the medical providers involved during an event of a difficult intubation.

FAILED INTUBATION ALGORITHM

Currently, there is no universal algorithm for failed intubation specific for the obstetric patient, resulting in a variety of guidelines by different institutions. However, these guidelines do not differ greatly as they were adapted from the general difficult airway algorithm.[5,8,10] **Figure 1** presents a simplified flowchart outlining the steps to securing the obstetric airway. Failure to oxygenate the patient is more serious than the failure to intubate, especially when the arterial oxygen saturation falls below 90%.[10] A maximum of two intubation attempts is suggested as repeated endotracheal tube insertions into the upper airway may cause airway injury and progressive oedema with subsequent difficulty in ventilation and total airway obstruction.

The gum elastic bougie is one of the most readily available airway adjuncts in the operating theatre. Although it is simple to use, it has been associated with airway injury, especially in situations where multiple insertions was attempted due to poor glottic view.[8] An overly excessive cricoid pressure can push the glottis in such a way that intubation is inadvertently made difficult despite a good view.[5] Videolaryngoscopes, which are now widely available, produce better visualisation of the vocal cords compared to conventional laryngoscopes.[11] The possible disadvantages associated with new technology are unfamiliarity with the equipment and the learning curve required before one is skilled in using the various types of videolaryngoscopes which are manipulated and function differently.[8]

Supraglottic Airway Devices

Supraglottic airway devices (SADs) are easily accessible during emergency situations and are recognised as a rapid and reliable rescue measure when intubation fails.[10] A group of authors, who conducted a large study on selected patients undergoing elective Caesarean section using the first generation of SAD, recommended that cricoid pressure be released during SAD insertion and reapplied after confirmation of effective airway maintenance and satisfactory ventilation.[12]

Aspiration, reported in 1 of 16 cases of failed intubation, is of great concern amongst many anaesthesiologists when SADs are used for Caesarean section.[3] Apart from sustaining cricoid pressure during surgery, aspiration risk can also be avoided or minimised by ensuring proper placement of the SAD over the larynx, using a SAD with a gastric drain, limiting positive airway pressure, allowing spontaneous ventilation, maintaining adequate depth of anaesthesia and limiting uterine fundal pressure.[5,10] The SAD may be dislodged if the patient coughs due to light anaesthesia. Unlike the endotracheal tube, SADs are designed to be inserted blindly. Thus, to ensure the SAD is properly placed, it can be inserted with a bougie in the gastric channel or a flexible scope within the main tube. If regurgitation occurs, a gastric tube can be inserted to decompress the stomach, and the patient positioned laterally with the head down whilst suctioning the oral cavity.[13] Bronchoscopy and tracheobronchial toilet may be required.

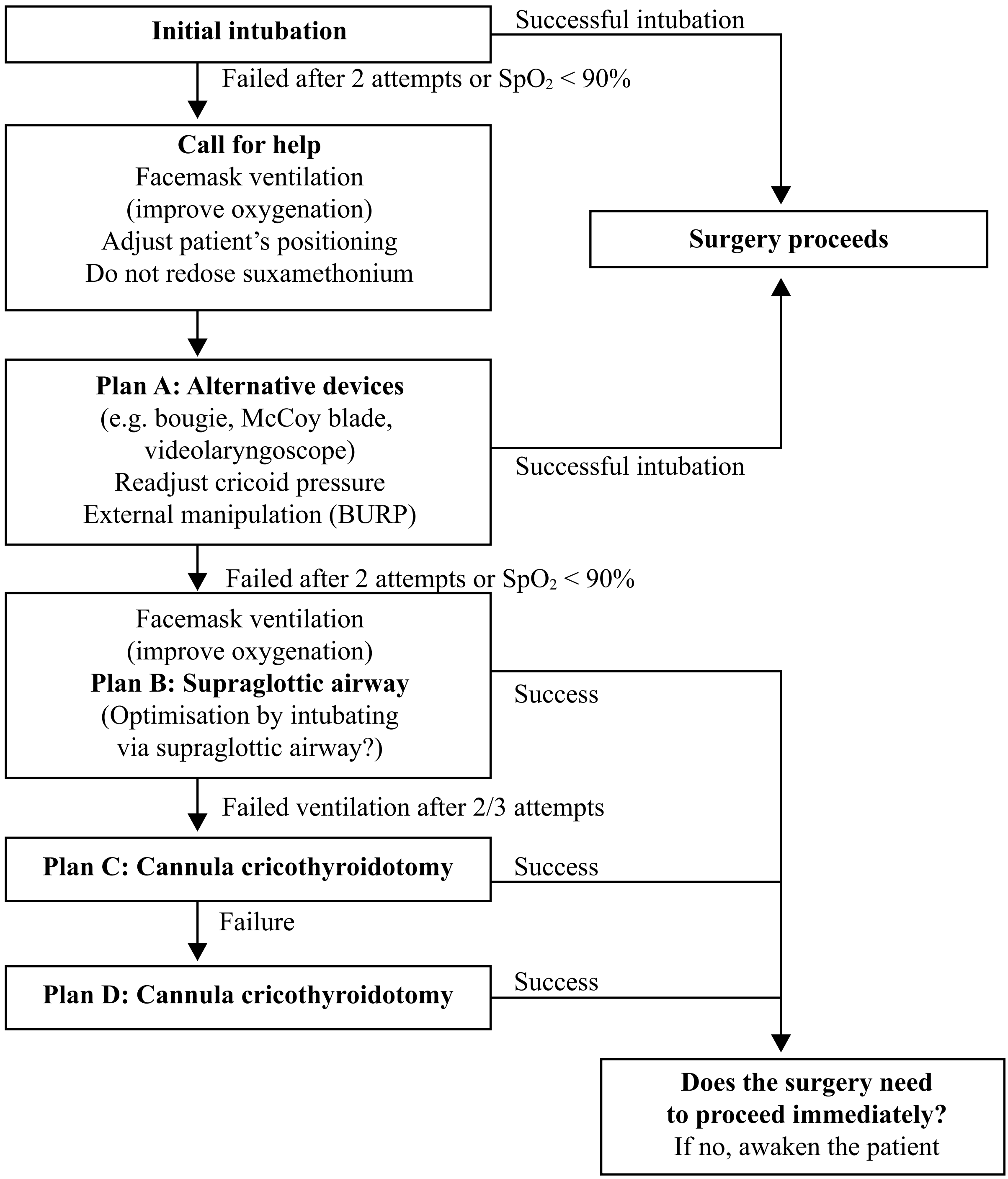


Figure 1: Failed intubation flowchart for the obstetric patient.

Provided ventilation is adequate, the next question is whether to insert a definitive airway (e.g. endotracheal tube) and if so, the most appropriate time for this. Despite most second generation SADs are designed for easy passage of endotracheal tube, a review suggested that further intubation attempts only be made after the neonate has been delivered, preferably under flexible optical guidance in order to avoid further airway trauma.[10]

Another consideration is whether the patient should be awakened if surgery is not urgent, as recommended by a guideline of clinical practice.[8,14] Nevertheless, there are reports of patients who were not awakened and Caesarean section had proceeded without a definitive airway, despite surgical urgency being graded 3 or 4 (elective cases with no compromise to the mother or foetus).[4] Despite reports of success with the use of SADs for elective Caesarean section, it is important to note that the outcome for an emergency case of a non-fasted, obese mother may be different from a carefully selected, elective case of a fasted, non-obese parturient.[11]

Can't Intubate, Can't Ventilate

The incidence of a "Can't Intubate, Can't Ventilate" (CICV) situation varies from 5 to 28 per 100 failed intubation for Caesarean section.[5] Risk factors associated with CICV are high body mass index, enlarged tonsils and neck haematoma.[8] Under these circumstances, needle or surgical cricothyroidotomy may be life-saving. Needle cricothyroidotomy, though produces less trauma, risks barotrauma and soft tissue injury from jet ventilation.[8] Nevertheless, both of these invasive airway techniques are very rare occurrences and would be performed under extreme stress, and therefore require regular training in order to improve their safety and effectiveness.

Cardiac Arrest

In the event of maternal cardiac arrest due to failed oxygenation in a patient greater than 20 weeks of gestation age, perimortem Caesarean delivery is indicated.[15] This must take place within 5 minutes of arrest in order to optimise efficiency of chest compressions during resuscitation. However, this decision depends on the likelihood of the gravid uterus interfering with maternal circulation. It would be interesting to know if there would be any changes to this indication in the next update from the American Heart Association Guidelines, expected in late 2015.

CONCLUSION

Difficult or failed intubation are rare occurrences and probably can be managed efficiently with proper planning. Optimum patient positioning, adequate pre-oxygenation, preparation of specialised equipment for difficult airway management, and a general idea of the failed intubation drill may help in this situation.

References

1. Samsoon GL, Young JRB. Difficult tracheal intubation: a retrospective study. *Anaesthesia* 1987; **42(5)**: 487-90

2. Apfelbaum JL et al. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anaesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology* 2013; **118(2)**: 251-70

3. Rahman K, Jenkins JG. Failed tracheal intubation in obstetrics: no more frequent but still managed badly. *Anaesthesia* 2005; **60(2)**: 168-71

4. Quinn AC, Milne D, Columb M, Gorton H & Knight M. Failed tracheal intubation in obstetric anaesthesia: 2 yr national case-control study in the UK. *Br J Anaesth* 2013; **110(1)**: 74-80

5. Kinsella SM, Winton ALS, Mushambi MC, Ramaswamy K, Swales H, Quinn AC, Popat M. Failed tracheal intubation during obstetric general anaesthesia: a literature review. *Int J Obstet Anaesth* 2015 (In Press. Accepted Manuscript in June 2015)

6. Vasdev GM, Harrison BA, Keegan MT, Burkle CM. Management of the difficult and failed airway in obstetric anaesthesia. *J Anesth* 2008; **22(1)**: 38-48

7. Heidemann BH, McClure JH. Changes in maternal physiology during pregnancy. *Continuing Education in Anaesthesia, Critical Care & Pain* 2003; **3(3)**: 65-68

8. Rucklidge M, Hinton C. Difficult and failed intubation in obstetrics. *Continuing Education in Anaesthesia, Critical Care & Pain* 2012; **12(2)**: 86-91

9. Russell R. Failed intubation in obstetrics: a self-fulfilling prophecy? *Int J Obstet Anaesth* 2007; **16**: 1-3

10. Mhyre JM, Healy D. The Unanticipated Difficult Intubation in obstetrics. *Anesthesia & Analgesia* 2011; **112(3)**: 648-52

11. Van Zundert A, Pieters B, Doerges V & Gatt S. Videolaryngoscopy allows a better view of the pharynx and larynx than classic laryngscopy. *Br J Anaesth* 2012; **109**: 1014-15

12. Han T-H, Brimacombe J, Lee E-J & Yang H-S. The laryngeal mask airway is effective (and probably safe) in selected healthy parturients for elective cesarean section: a prospective study of 1067 cases. *Can J Anaesth* 2001; **48(11)**: 1117-21

13. Keller C, Brimacombe J, Bittersohl J, Lirk P, von Goedecke A. Aspiration and laryngeal mask airway: three cases and a review of the literature. *Br J Anaesth* 2004; **93(4)**: 579-82

14. Good Practice No. 11. Classification of urgency of caesarean section- a continuum of risk. Royal College of Obstetrician and Gynaecologists with The Royal College of Anaesthetists. April 2010

15. Hoek TLV et al. Part 12: Cardiac Arrest in Special Situations: 2010 American Heart Association Guidelines for Cardiopulmoary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2010; **122**: S829-61

Anaesthesia and Obesity in Children

Ina Ismiarti Shariffuddin, MBChB (Dundee), M.Anaes (UM), Fellowship Paed.Anaes (Sing), Associate Professor, Department of Anaesthesiology and Intensive Care, University Malaya Medical Centre, Kuala Lumpur, Malaysia

INTRODUCTION

Globally, the prevalence of obesity in children is increasing. In 2013, it was estimated that 42 million children under the age of 5 are obese worldwide.[1] In the developed countries such as USA, 32% of the children are overweight.[2] In Malaysia, the incidence is about 6% in both sexes.[3] Obesity has many implications on the safe delivery of anaesthesia in children. Hence, the anaesthetist looking after the paediatrics population is not just facing the challenge of paediatric anaesthesia, but also the concerns related to obesity. The aim of this article is to focus on the special issues related to the perioperative care of the obese children.

DEFINITIONS AND AETIOLOGY

Defining obesity in children is a challenge. In adults, a body mass index (BMI = weight/height^2) above 25 and 30 defines overweight and obesity, respectively. However in children, this is not applicable as age and its appropriate body size varies in children who are constantly growing. World Health Organisation (WHO) defines overweight and obesity in children using specific BMI chart.[1] These were derived from the mean Body Mass Index (BMI) using data collected under the WHO multicentre growth reference study group. These charts are different for boys, for girls, for different ages 0-2 years, 0-5 years and above 5 years. U.S. Centres for Disease Control and Prevention defines overweight in children as a BMI at or above the 85th percentile and below the 95th percentile for children and teens of the same age and sex, whereas obesity is defined as a BMI at or above the 95th percentile for children and teens of the same age and sex.[4]

The primary cause of obesity in children is excessive caloric intake or low energy output or both factors combined.[5] In fact, low energy consumption during leisure time such as more time spent watching television may be the main cause of current epidemic of obesity.[6] The secondary cause of obesity is due to pathological states, such as endocrine dysfunction, syndromes (Prader Willi syndromes), inability to move (late stage Duchenne's muscular dystrophy) and iatrogenic (prolong use of high dose steroid therapy).[7] Majority of cases (>90%) of overweight and obesity are due to excessive caloric intake or reduced output, whilst only 5% of cases have medical cause.

PATHOPHYSIOLOGICAL CHANGES OF CHILDHOOD OBESITY

Obesity in children leads to pathophysiological changes that increase the risk of perioperative morbidity and mortality. In addition, it has been shown that they are also at an increased risk of having co-morbidities such as hypertension, type II diabetes, asthma, gastro-oesophageal reflux, and obstructive sleep apnoea like adult. Therefore, to enable the anaesthetist to provide a safe anaesthesia to obese children, one must understand the pathophysiological changes caused by childhood obesity.

Respiratory System

Obesity reduces functional residual capacity (FRC), forced vital capacity (FVC) and diffusion capacity (DLCO).[8] A reduction in FRC can lead to atelectasis, increased ventilation perfusion mismatched and increased the work of breathing. As a result, hypoxaemia can occur more readily in obese children. These physiological changes are exaggerated when the obese child lies supine.

The incidence of bronchial activity also increases in obese children. Approximately 30% of obese children have asthma. In fact there is a linear relationship between increased BMI in children and both incidence and severity of asthma.[9]

Cardiovascular System

Circulating blood volume, stroke volume and cardiac output are increased in obese children. They are also at a higher risk of having hypertension in which the incidence of hypertension has a positive correlation with the increasing BMI.[10] In addition, left ventricular hypertrophy, hypercholesterolaemia and hyperlipidaemia is common in obese children.[11]

Endocrine System

The obese children have a higher incidence of metabolic syndromes that renders them to be at a higher risk of developing type 2 Diabetes Mellitus (DM). In the US, 45% of paediatric DM are caused by type 2 DM.[12]

Hepatic and Gastrointestinal System

There is a positive correlation between the degree obesity and the incidence of gastroesophageal reflux disease (GERD).[1] However, the gastric emptying time of morbidly obese and normal weight children is similar.[13] Non-alcoholic fatty liver disease is also common in obese child.[6]

Pharmacological

Drug dosage in children is normally administered according to a milligram per kilogram basis. However, dose calculation according to the total body weight of the obese children may lead to overdose and unwanted side effects. Therefore, the calculation of drug dosing on ideal body weight or even lean body mass may be preferred. Below is the formula typically used to calculate the lean body weight and ideal body weight:

i. Total body weight (TBW) is the patient's actual weight.
ii. Ideal body weight (IBW):
(BMI at the 50th percentile for the child's age) x (height (m))^2
iii. Lean body weight (LBW):
IBW + 0.3 x (TBW - IBW)

As a guide, dosages of highly lipophilic drugs such as thiopentone and propofol should be based on the TBW. On the other hand, dosages of hydrophilic drugs such as muscle relaxants should be based on IBW.[1] However, suxamethonium is an exception to this rule as it is given according to TBW. This is because of the increased of pseudocholineterase activity in the obese children.[14]

Obstructive Sleep Apnoea

Obstructive sleep apnoea (OSA) is reported in 13-59% of obese children, compared to 1-2% of normal weight children.[14] Obese children with OSA are at a higher risk of developing postoperative complications such as postoperative respiratory depression and airway obstruction. These children are also predisposed to the side effects of chronic hypoxaemia such as pulmonary hypertension.

ANAESTHETIC MANAGEMENT

Provision of anaesthesia for obese children is challenging. Thus, anaesthetic care should be provided at a specialist level. It is of utmost importance to identify these obese children with the co-morbids preoperatively. The screening process to rule out any major co morbidities in the obese children should be done pro-actively.

Preoperative Assessment

Once identified, obese children should undergo routine pulse and blood pressure measurement. In addition they should have other investigation such as electrocardiogram (ECG), blood glucose, and cholesterol measurement. OSA should be ruled out from the obese child. Screening symptoms such as snoring, restless sleep, mouth breathing, poor concentration in school, daytime somnolence and bedwetting should be enquired. British Medical Journal in the 19th century described a patient with OSA to be "*the stupid-lazy child who frequently suffers from headaches at school, breathes through his mouth instead of nose, snores and is restless at night, and wakes up with a dry mouth in the morning.*" A doctor, who faces these sign and symptoms in a child, should further investigate this child with the sleep study to determine the severity of the OSA.

Polysomnography is the "gold standard" for diagnosing and quantifying OSA.[15] However, its usage is expensive and labour intensive. Therefore, a continuous portable pulse oximetry has been used. It assesses the severity of OSA by quantifying the number and severity of oxyhaemoglobin desaturations during sleep. The child who has 3 or more desaturations below 90% on continuous overnight nocturnal oximetry recording is considered abnormal. The McGill Oxymetry Scoring system was developed to determine the severity of OSA. If they desaturate to <90%, they are considered mild, if they desaturate to <85%, then they are considered to have moderate OSA and those who desaturate to <80% are considered to be severe OSA.[16] An obese child with confirmed OSA should have an ECG and echocardiography. A paediatric cardiologist should assess them prior to any elective surgery to rule out any increased in pulmonary pressures resulting in cor pulmonale.

An obese child is known for potential difficult airway. In comparison to normal weight children, obese children have a higher incidence of difficult mask ventilation (2.2% vs. 7.4%) and difficult laryngoscopy (0.4% vs. 1.6%).[16] Therefore, a thorough airway assessment should be performed during the preoperative assessment. Obese children are also prone to upper airway collapsed during general anaesthesia. S. El-Metainy et al concluded that there were significant associations between obese children and adverse respiratory events, namely difficult mask ventilation, airway obstruction, bronchospasm and haemoglobin desaturation.[17] Hence, in situation where there is difficult mask ventilation, hypoxia can occur especially when combined with higher oxygen consumption and less oxygen reserve.

The limbs of the obese child should also be examined for potential difficult intra venous access. Amethocaine gel rather than EMLA cream should be applied to provide topical LA to the area of venous access if as it causes vasodilatation as compared to vasoconstriction.[18] They should be assessed for any symptoms of gastro-oesophageal reflux. If it is present premedication with the suitable medication before surgery is indicated. Premedication with heavy sedation for anxiolytics purpose should be avoided if possible as it can cause respiratory depression.

Conduct of Anaesthesia

Induction

Patient should be monitored with routine monitoring, which include pulse oxymeter, ECG, non-invasive blood pressure, capnography and multi gas analyser. Appropriate size of cuff should be used to obtain accurate measurement of the blood pressure. In the event where the appropriate cuff is not available, the insertion of arterial line to monitor the blood pressure may be necessary. The use of equipment to monitor depth of anaesthesia in the obese children such as bispectral index (BIS) could be useful in titrating the anaesthetic drugs.

The obese child should be positioned with head up 25^{o} and pre oxygenated for three minutes prior to induction of anaesthesia. In these children, IV induction is preferred as it is more difficult to maintain a patent airway, and obese children desaturate even more quickly than their non-obese peers with gas induction.[2] Obese children with severe adenotonsillar hypertrophy and/or midface hypoplasia obstruct their airway almost immediately after induction due to the loss of pharyngeal tone. This obstruction may be relieved by jaw thrust and the application of CPAP up to 10 cmH_2O.[2] If this fails, then an oral airway should be inserted as soon as the child is deep enough to relieve the obstruction.

It is advisable to intubate this group of patient with endotracheal tube even for minor surgery as poor lung and chest wall compliance in obese children may lead to difficult ventilation with a supraglottic airway (SGA). Intubation in obese children generally has not been shown to cause much problem but it is prudent to have the equipment for difficult intubation at hand.[2] It is wise to intubate the obese children with muscle relaxant as intubation under deep anaesthesia only can render a relatively easy intubation, difficult. If the patient is identified to be at risk of aspiration, then rapid sequence induction with cricoid pressure is indicated. If a SGA device is planned, then the second generation SGA is preferable as it has a nasogastric tube outlet and it provides better sealing pressure. Sizes of LMA in obese children should follow the total body weight. This has been shown to significantly increase the oropharyngeal leak pressure and gives better ventilating condition in overweight children.[19]

Maintenance of Anaesthesia

All studies investigating the effect of obesity and anaesthesia are mainly done in adult patients. There is no available data on recommendation on the choice of intubation or LMA and ventilation strategy in obese children. Hence, all ventilation strategies applied to the obese children are extrapolated from adult data. The work of breathing of the total respiratory system increases with the increase BMI. This is mainly due to the decrease in the functional residual capacity, reduced compliance of the lung and increased resistance of the lung.[20] Hence, it is recommended to use positive pressure ventilation and application of positive end expiratory pressure (PEEP) to optimise oxygenation. PEEP ventilation has been shown to markedly reduce venous admixture in the obese adult and should be used in these patients if there is arterial hypoxaemia despite a high-inspired oxygen concentration.[21]

For maintenance of anaesthesia, desflurane may be the ideal volatile agent because of its low blood-lipid solubility and therefore may provide a faster restoration of protective airway reflexes and subsequently faster recovery.[22] However, the use of desflurane in children has also been shown to increase the risk of developing emergence delirium.[23]

Provision of analgesia for obese children can be difficult. Multimodal approach with the combination of regional anaesthesia and simple analgesia such as paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) is ideal wherever possible. Opioids should be used cautiously. Morphine can be used but it should be in titrated doses. Obese patient with OSA is generally sensitive to effect of opioids and are estimated to require 50% less opioids than normal children.[24] This is postulated to be due to the up-regulation of opioid receptors.[25] Although useful for the opioid sparring effects, regional anaesthesia and central neuroaxial block in obese children can be technically difficult. In an adult study, Hood et al described an initial success rate of only 42% for placing epidural catheters in obese patients compared with an initial 94% success rate in non-obese controls.[26] However, the advancement of ultra sound guided regional anaesthesia has increase the successful rate.[27]

Obese children need careful positioning throughout anaesthesia. All the pressure points should be padded to prevent pressure necrosis especially in anticipated long duration of surgery. In the obese adolescent, it is prudent to ensure that the operating tables can take greater weights as required. Prone position in the obese children is more challenging. It is important to ensure that that the ventilation is adequate when there are in the prone position as it may be impossible to achieve adequate ventilation due to diaphragmatic splinting secondary to increased abdominal girth and pressure effects.

Postoperative care

Patient should be extubated when fully awake and should have adequate strength to maintain the upper airway patency before tracheal extubation. Then they should be placed in the semi recumbent position to decrease the abdominal pressure on the diaphragm, to improve the FRC and hence improves the oxygenation. Obese patients with severe OSA will need postoperative monitoring in the high dependency unit or paediatric intensive care unit overnight. For those with moderate OSA, the presence of other co-morbidities such as Down syndrome, neuromuscular disease, craniofacial abnormalities and age less than 3 years old will be an indication for postoperative paediatric intensive care unit observation overnight.[28] The sensitivity to opioids still applies postoperatively. Hence, alternative analgesics such as paracetamol and NSAIDS should be provided at regular basis at the earliest for the opioid sparring effects.

CONCLUSION

The incidence of childhood obesity has reached epidemic level globally. This has led to more possibility of an anaesthetist having to provide anaesthesia to paediatric patients with added concerns of the obese children. A vigilant assessment combined with a carefully planned perioperative care is the cornerstone for provision of safe anaesthesia in this group of patient.

References

1. World Health Organization. The WHO Child growth standards. Available at: http://www.who.int/childgrowth/standards/en Accessed 1st July 2015

2. Mortensen A, Lenz K, Abildstørm H, Lauritsen TLB. Anesthetising the obese child. *Pediatric Anaesthesia* 2011; **21(6)**: 623-629

3. Ismail MN, Norimah AK, Mazlan N, Poh BK et al.(2003) Nutritional status and dietary habits of primary school children in Peninsular Malaysia. Final report for UKM-Nestle research project, Kuala Lumpur. Dept Of Nutrition and Dietetics, Faculty of Allied Health Sciences, UKM

4. Kuczmarski R, Ogden CL, Grummer-Strawn LM, et al. CDC Growth Charts: United States. Hyattsville, MD: National Center for Health Statistics; 2000

5. Stunkard AJ, Berkowitz RI, Stallings VA, Schoeller DA. Energy intake, not energy output, is a determinant of body size in infants. *Am J Clin Nutr* 1999; **69(3)**: 524-30

6. Martinez-Gonzalez MA, Alfredo Martinez J, Hu FB et al. Physical inactivity, sedentary lifestyle and obesity in the European Union. *Int. J Obesity* 1999; **23**: 1192-201

7. Veyckemans F. Child obesity and anaesthetic morbidity. *Curr Opin Anaesthesiol* 2008; **21(3)**: 308-12

8. Li AM, Chan D, Wong E et al. The effects of obesity on pulmonary function. *Arch Dis Child* 2003; **88(4)**: 361-63

9. Lang JE, Feng H, Lima JJ. Body mass index-percentile and diagnostic accuracy of childhood asthma. *J Asthma* 2009; **46(3)**: 291-99

10. Wabitsch M. Overweight and obesity in European children; definition and diagnostic procedures, risk factors and consequences for health outcome. *Eur J Paediatr* 2000; **159(suppl 1)**: S8-S13

11. Gidding SS, Nehgme R, Heise C et al. Severe obesity associated with cardiovascular deconditioning, high prevalence of cardiovascular risk factors, diabetes mellitus/hyperinsulinaemia, and respiratory compromise. *J Pediatric* 2004; **144(6)**: 766-69

12. American Diabetes Association. Type 2 Diabetes in children and adolescents. *Diabetes Care* 2000; **23**: 381-89

13. Chiloiro M, Caroli M, Guerra V et al. Gastric emptying in normal weight and obese children- an ultrasound study. *Int J Obesity* 1999; **23**:1303-06

14. Rose JB, Theroux MC, Katz MS. The potency of succinylcholine in obese adolescents. *Anesth Analg* 2000; **90(3)**: 576-78

15. American Thoracic Society. Standards and indications for cardiopulmonary sleep studies in children. *Am J Respir Crit Care Med*. 1996; **153(2)**: 866-78

16. Nafiu OO, Reynolds PI, Bambgade O, Tremper K, Welch K, Kasa-Vubu JZ. Childhood body mass index and perioperative complications. *Paediatric Anaest* 2007; **17**: 426-30

17. El-Metainy S, Ghoniem T, Aridae E, Abdel Wahab M. Incidence of perioperative adverse events in obese children undergoing elective general surgery. *Br J Anaesth* 2011; **106(3)**: 359-63

18. Woolfson AD, McCafferty DF, Boston V. Clinical experiences with a novel percutaneous amethocaine preparation: prevention of pain due to venepuncture in children. *Br J Clin Pharmacol* 1990: **30(2)**: 273-79

19. Kim HJ, Park MJ, Kim JT et al. Appropriate laryngeal mask airway size for overweight and underweight children. *Anaesthesia* 2010: **65(1)**: 50-53

20. Pelosi P, Croci M, Ravagnan et al. The effects of body mass on lung volumes, respiratory mechanics and gas exchange during general anesthesia. *Anesth Analg* 1998; **87(3)**: 654-60

21. Santesson J. Oxygen transport and venous admixture in the extremely obese. Influence of anaesthesia and artificial ventilation with and without positive end-expiratory pressure. *Acta Anaesth Scand* 1976; **20(4)**: 387-94

22. Mackay RE, Malhotra A, Cakmakkaya OS et al. Effect of increased body mass index and anaesthetic duration on recovery of protective airway reflexes after sevoflurane vs desflurane. *Br J Anaesth* 2010; **104(2)**: 175-82

23. Dahmani S et al. Pharmacological prevention of sevoflurane- and desflurane-related emergence agitation in children: a meta-analysis of published studies. *Br J Anaesth* 2010; **104(2)**: 216-23

24. Brown K et al. Recurrent hypoxaemia in children is associated with increased analgesic sensitivity in children. *Anaesthesiology* 2006; **105**: 665-69

25. Patino M, Sadhasivam S, Mahmoud M. Obstructive sleep apnoea in children: perioperative considerations. *Br J Anaesth* 2013; **111(S1)**: i83-95

26. Hood DD, Dewan DM. Anesthetic and obstetric outcome in morbidly obese parturients. *Anesthesiology* 1993; **79(6)**: 1210-18

27. Grau T, Leipold RW, Conradi R, Martin E. Ultrasound control for presumed difficult epidural puncture. *Acta Anaesthesiol Scand* 2001; **45(6)**: 766-71

28. Section on Pediatric Pulmonology SoOSASAAop. Clinical practice guideline: diagnosis and management of patients with obstructive sleep apnea syndrome. *Pediatrics* 2002: **109**: 704-12

Natural Childbirth: What is the Anaesthesiologists' Stand?

Noraslawati Razak, MD (UKM), M Med (Anaesthesiology) USM
Consultant Anaesthesiologist in Obstetrics & Gynaecology, Hospital Sultanah Nur Zahirah, Kuala Terengganu, Terengganu, Malaysia

INTRODUCTION

Giving birth is a life changing event. Therefore, the care that a woman receives during labour has the potency to affect her and the health of her newborn. Most parturients wish to be in control and be able to contribute in the labour process, which can result in a positive experience and the feeling of empowerment and respect. Therefore, many women nowadays choose to opt for natural childbirth, and in particular, home birthing.

Natural childbirth is a delivery process without the induction of labour, the aid of instruments, caesarean section, episiotomy and also without general, spinal or epidural anaesthesia. Generally, the parturients who undergo natural childbirth are attended by untrained birth attendants.

WHAT REALLY HAPPENED IN THE PAST?

Malaysia has shown progress in its steady and sustained decline in maternal mortality ratio (MMR) from over 130 deaths per 100,000 live births in the 1970s down to around 40 per 100,000 live births in the early 2000s.[1] In the 1970s, maternal mortality was at its highest in the most rural states and most of these childbirths were delivered at home without the benefit of skilled birth attendants. These maternal deaths were mainly due to:

1. Delay in seeking professional help.
2. Improper management of deliveries resulting in complications, such as postpartum haemorrhage, eclampsia, trauma/injury to birth canal and infection.
3. Lack of competence in lifesaving skills by the traditional birth attendants.

An initial steep reduction occured in the MMR between the 1970s and 1980s, which were attributed to:[1]

1. The national commitment to improve maternal health which enabled the Ministry of Health to obtain adequate allocation of resources.
2. Better access to professional care during pregnancies and childbirths.
3. An increased access to quality family planning services and information.

CHILBIRTH ATTENDED BY SKILLED HEALTH PROFESSIONALS

Access to professional care during pregnancy and childbirth, in particular for the management of the complications, is associated with the improving MMR trend. During the 1980s, the Malaysian MMR decreased in proportion with an increased childbirth attendance by trained health personnel, from over 50 down to around 20 deaths per 100,000 live births, which corresponded to 80% and 100% involvement of trained personnel, respectively.[1]

During this period, rapid development and upgrading of health-care services, which included the public awareness on family planning and establishment of nursing and midwifery schools led to the increase in not only the number of trained health personnel, but also helped improve the midwifery and obstetric skills through postgraduate and in-service training. Traditional Birth Attendants (TBAs) were also trained to be partners in health care with the government-trained midwifes, and they assisted in promoting the use of health facilities to women for antenatal care and delivery.[1]

In the mid-1980s and 90s, Malaysian parturients, especially those with complicated pregnancies, were encouraged to deliver in hospitals. Expectant mothers were also advised about the importance of skilled attendants for delivery and discouraged from the traditional custom of delivering at home.[1]

THE AIM OF THE CARE IN NORMAL BIRTHING AND TASKS OF THE CAREGIVER

The aim of a person who attended a parturient during childbirth is to have a safe delivery with an eventual outcome of both a healthy mother and infant with the least possible number of interventions. Therefore, the caregiver should:[2]

1. Provide psychological support given to the woman, her partner and family during labour, at the moment of childbirth and in the period thereafter.
2. Observe the parturient and monitor the foetal condition during labour.
3. Monitor the condition of the infant after birth, as well as perform assessment of risk factors and early detection of problems.
4. Perform minor interventions if necessary, such as amniotomy and episiotomy.
5. Refer to a higher level of care when justified, if risk factors are apparent or complications develop.

GENTLE CHILDBIRTH ADVOCATORS

With the rising numbers of gentle childbirth advocators, there is a concern whether they are able to provide the care mentioned above. In general, they would only able to administer psychological support during delivery as most of them are not trained to provide specific care during childbirth. They advocated the parturients to have printed birth plans, which include:[3]

1. Free mobility during labour
2. Allowing the mother to eat and drink during labour
3. No artificial rupture of membrane
4. No analgesia
5. No continuous foetal monitoring during labour
6. No augmentation of labour
7. No episiotomy
8. Delayed cord clamping
9. Immediate bonding between the mother and baby following childbirth

As most of the birth plans listed are not compliant and accepted by most health institution, the women attracted to the gentle childbirth plans opt for home delivery. However, some of them are not suitable for vaginal delivery or may develop complications. Ever since home birthing has gained popularity, there are rising reports worldwide involving mothers who died following home birthing, principally due to postpartum haemorrhage. The perinatal death for delivery at home has been associated with home birthing is also high, mainly as a result of intrapartum asphyxia which included shoulder dystocia and meconium aspiration.

THE GENTLE BIRTH ADVOCATORS' OPINION ON LABOUR PAIN

The gentle birth advocators state that hormones during the active phase of labour help the mothers to have a safe birth, as well as avoid unnecessary interventions.[3,4] The production of oxytocin, a natural uterotonic hormone, is lowered and does not rise during labour in the presence of epidural analgesia. Additionally, spinal anaesthesia has a greater effect on obtunding the oxytoxin release. These neuraxial blocks obliterate the peaked oxytocin level, which is required to generate the final powerful contraction just prior to delivery. Furthermore, epidurals reduce the release and levels of beta-endorphins, which builds up during natural labour, and an epidural analgesia can drop this to 20% of its natural level following delivery.[3,4] Beta-endorphins help alleviate labour pain and is associated with an altered state of consciousness which is part of a normal labour. The advocators thought the widespread use of epidural analgesia during labour reflect the ignorance of the importance of this hormonal shift, the difficulty with supporting mothers in this altered state and the preference for quiet, compliant parturients.

The gentle birth advocators discourage woman to have epidural analgesia as they claim that labour epidural analgesia may:[3]

1. Increase the timing of cervical dilatation during first stage of labour.
2. Increase the likelihood of cesarean section.
3. Increase the likelihood of postpartum haemorrhage and retained placenta.
4. Adversely affect breastfeeding.
5. Increase the likelihood of inability to urinate and stress incontinence.

EVIDENCE-BASED OBSTERIC OUTCOMES OF EPIDURAL ANALGESIA

Based on a meta-analysis, neuraxial analgesia during labour:[5]

1. Does not increase the risk of caesarean delivery. Epidural initiated during the latent phase of labour (cervix < 4 cm) also does not increase the need for caesarean delivery.
2. Was suggested to increase instrumental vaginal delivery.
3. Does not prolong the first stage.
4. Prolonged the second stage. Thus, the second stage of labour is allowed to exceed for an extra 44 minutes, on average, before a decision to deliver operatively can be made.

FEEDING DURING LABOUR AND PULMONARY ASPIRATION

Gentle birth advocators encouraged woman to continue oral intake during labour, instead of fasting and initiation of intravenous fluids. The anaesthesiologist are concerned about the risk of pulmonary aspiration of gastric contents, especially if a parturient who requires caesarean section is not fasted as this is one of the most feared complications of anaesthesia. The incidence of non-fatal aspiration in obstetric population is 1 in 6,000 with light general anaesthetic for vaginal deliveries resulting in only mild aspiration pneumonitis, which increases to 1 in 430 for caesarean section.[6] Physiological changes during pregnancy and immediately post-partum are important factors that increase the risk of pulmonary aspiration and also alter morbidity and mortality. The prevention of aspiration by identifying risk factors, pre-operative fasting, drugs and various anaesthetic maneuvers are essential for a safe anaesthetic practice. It is not known exactly if the change in anaesthetic practice with rapid induction of anaesthesia and cricoid pressure, or if pharmacological therapy to reduce gastric volume and increase gastric pH, have contributed to the reduced mortality since its first description in the obstetric patient.[6]

Mendelson described 66 cases of aspiration between 1932 and 1945, with the incidence of 1 in 667 parturients and 2 deaths caused by acute upper airway obstruction.[7] Following this publication, the triennial Confidential Enquiry Into Maternal Deaths (UK) reported a steady decline from 18 deaths in 1964-66 to 11 deaths in 1976-78 to one death in 1991-93.[8] As the total exact number of anaesthetics administered during that period was not known, the mortality rate for aspiration as a result of anaesthesia could not be determined. Harrison noted one death in an obstetric patient from vomiting and aspiration during a 10-yr survey involving 240,483 patients, but did not report the total number of obstetric general anaesthetics.[9]

The pulmonary consequences of gastric aspiration can be divided into three groups: particle-related, acid-related and bacterial-related aspiration.[6]

Particle-Related Aspiration

Particle-related complications, described as an acute airway obstruction leading to arterial hypoxaemia, may cause immediate death. Prompt removal of inhaled particles and tracheal intubation for oxygenation and prevention of further aspiration by tracheal intubation are essential for survival.[6]

Acid-Related Aspiration

Acid-related complications, introduced by Roberts and Shirley in 1974 from data obtained in rhesus monkeys, were extrapolated to humans to help identify patients at risk of pulmonary aspiration and make categorical statements about safety. The harmful effects of acid aspiration may occur in two phases; immediate direct tissue injury and subsequent inflammatory response. However, the critical pH of 2.5 and critical volume of 0.4 ml/kg body weight (or approximately 25 ml) have since been challenged.[6]

Bacterial-Related Aspiration

Bacterial-related complications can be caused purely by anaerobes or an aerobes-anaerobes mix. Community-acquired lung infections after aspiration are usually caused by anaerobes. Mixed aerobes-anaerobes are found in hospital-acquired aspiration pneumonia. *Pseudomonas aeruginosa, Klebsiella* and *Escherichia coli* account for most Gram-negative nosocomial pneumonias whereas *Staphylococcus aureus* is the main Gram-positive pathogen. This pattern is constant over the years and is similar in both children and adults. Gram-negative and ventilator-acquired pneumonias, 34% of which are caused by aspiration of gastric contents and oropharyngeal secretions, are thought to be significant determinants of death in postoperative pneumonia.[6]

MOTHER-FRIENDLY CARE DURING LABOUR

Mother-friendly care is one of the concepts highlighted in the Baby-Friendly Hospital Initiative (BFHI) guideline. Mother-friendly care is a practice that may help a woman feel competent, in control, supported and ready to interact with her baby who is alert. The mother-friendly care includes:[10]

1. Emotional support during labour.
2. Attention to the effects of pain medication on the baby.
3. Avoidance of opiates analgesia and epidural analgesia if applicable.
4. Offering light foods and fluids during early labour.
5. Freedom of movement during labour.
6. Avoidance of unnecessary caesarean sections.
7. Birthing position of mother's choice.
8. Early mother-baby contact.
9. Facilitating the first feed.

All government hospitals must obtain BFHI certification. Therefore, in other to be certified as BFHI hospital, they must comply to the BFHI guideline. However, each hospital must have written guidelines concerning feeding during labour that suit each own institution, especially when it involves parturients who are at high risk for cesarean section.

CONCLUSION

There is an increasing demand for gentle natural childbirth among Malaysian women, and as there is no ethics or law against the presence of untrained birth attendants during childbirth, the mother and infant may be at risk. We must educate our patients and clear their misunderstanding about the importance of labour analgesia which includes epidural. As the mother-friendly care is a part of BFHI guideline, all hospital must set up a local protocol for 'feeding during labour'.

References

1. United Nations Report. 2004. Malaysia: Achieving the Millennium Development Goals. *MDG 5: Improve Maternal Health*: 132-51

2. WHO. Care in normal birth: a practical guide. *Safe Motherhood*: 1996; 4-5

3. Buckley S. 2009. Gentle birth, gentle mothering: Epidural risks and concerns for mothers and Babies. 2009; 1-29

4. Buckley S. 2015. Hormonal Physiology of Childbearing: Evidence and Implications for Women, Babies, and Maternity Care. *Childbirth Connection* 2015; 80-84

5. Cambic CR & Wong CA. Labour analgesia and obstetric outcomes. *Br J Anaesth* 2010; **105(S1)**: i50-i60

6. Engelhardt T & Webster NR. Pulmonary aspiration of gastric contents in anaesthesia. *Br J Anaesth* 1999: **83(3)**: 453-60

7. Mendelson C. The aspiration of stomach contents into the lungs during obstetric anesthesia. *Am J Obstet Gynecol* 1946; **1(6)**: 837-39

8. Confidential Report into Maternal Deaths in the UK 1991-93. London: HMSO, 1996

9. Harrison GG. Death attributable to anaesthesia. A ten year survey (1967-1976). *Br J Anaesth* 1978; **50(10)**: 1041-46

10. WHO. Baby-friendly Hospital initiative: Revised, Updated and Expanded for Integrated Care. 2009; 83-87

Perioperative Pain Management in the Paediatric Patient

Lakshmi Thiyagarajan, MBBS (MAHE), M.Anaes (Malaya), Fellowship Paed. Anaes (Mal), Fellowship Paed.Anaes (Sing)
Consultant Anaesthesiologist, Hospital Sultanah Aminah , Johor Bharu, Malaysia

INTRODUCTION

Medical practitioners are morally and ethically obliged to make any patient's stay in hospital as pain-free as possible. Pain management in the perioperative period means evaluating and treating pain before, during and after a procedure with the intention to reduce or, if possible, eliminate postoperative pain before discharge. Perioperative pain in children should be addressed at an early stage i.e. from the time of admission. When it is not, it frequently results in an escalation of the intensity of pain experienced, trigger repeated episodes of pain and can result in chronic pain syndromes. It may also result in a longer recovery period, an increased risk of complications such as infection, longer hospitalisation, unplanned re-admissions and increased cost of hospitalisation.

The way children experience pain and react to painful situations is very different. Often, this is poorly addressed. One reason may be due to the lack of awareness amongst staff that the approach to pain assessment and treatment in neonates, infants and children differ greatly from adults. Children are not "little adults". In addition, the fear of side effects such as respiratory depression and the inability to differentiate actual pain from a patient's distress often deters the practitioner from administering sufficient analgesia to the patient, often preferring to err with under dosing on the pretext of safety.

Children's interpretation of pain is affected by developmental, social and psychological factors. It is also dependent on the severity of the surgical insult, the site of the surgery and co-existing diseases. Other factors that may intensify pain are purely circumstantial, e.g. a new environment, noise and separation from parents even for brief periods. Perioperative analgesia for the paediatric population should encompass the patient's age group, cognitive maturity, psychosocial background and the anaesthetist's understanding of the disease process to provide a more holistic approach to pain relief.

Effective perioperative pain management starts from:

a) Awareness of hospital staff regarding evaluation of pain:

   Improving pain assessment is an important strategy to improve pain management. The Ministry of Health (MOH), through a Director General of Health's Circular (no. 9/2008), implemented Pain as the 5th Vital Sign in MOH hospitals progressively from 2008 to 2011. In 2011, the MOH also introduced the "Pain Free Hospital" concept, in consonance with the Declaration of Montreal at the International Pain Summit 2010: "access to pain management is a fundamental human right".[1]

b) Implementation of a pain management guideline:

   MOH issued a guideline authored by the Pain Subspeciality Group in October 2013 as mentioned above which includes pain management for special groups such as Paediatrics, Obstetrics etc.[2]

c) Evaluation and history-taking from the patient and parents/guardian to form a pain management plan.

d) Involving the parents/guardian in the pain management plan.

e) Awareness amongst medical practitioners that neonates, toddlers, children and pre-teens differ from each other and pain management may differ significantly.

f) Standard methods of pain evaluation for different age groups and its use round the clock to determine effective pain management strategies and evaluate the response to such strategies.

The anaesthetist should be involved in pain management from early on and not just when the patient is seen in the operating theatre. Now with services comprising the Operating Theatre, the Paediatric/Neonatal Intensive Care Unit, Acute Pain Services and remote analgesia/sedation, it is possible to control pain from the time of admission up to when the patient is discharged from hospital and beyond to achieve a pain-free stay in hospital.

ASSESSMENT OF PAIN IN CHILDREN

A number of validated pain-scoring systems for children are used in Malaysian hospitals. These include the Face, Legs, Activity, Cry, Consolability scale (FLACC scale), the Wong-Baker Faces Scale and the numerical scale. The FLACC scale is mainly used for pre-verbal children, whereas the Wong-Baker Faces Scale is used for children aged 3 and above worldwide. There is no gold standard amongst pain scales. The pain scoring systems that are chosen for each age group of patients should be standardised for use throughout the hospital so that it becomes a tool for communication and should be user-friendly.

Scoring pain in children requires a little patience and, most often, observation from afar. Generally, children in pain get more agitated when approached by unfamiliar hospital personnel thus altering the pain score to a more severe one. Hence, parental assistance is helpful sometimes to get a more accurate answer. Parents should be thought on how to use the scale and then get them to ask their child.

APPROACH TO PERIOPERATIVE PAIN RELIEF IN CHILDREN

In Malaysia, the approach to perioperative analgesia in children amongst general anaesthetists is still fairly conservative and may rely on familiar techniques such as morphine infusions and local infiltration of local anaesthetics. Those who have had the benefit of paediatric training or working in a centre where there is a paediatric anaesthetist may be more inclined to include procedures like central neuroaxial block and peripheral nerves blocks.

METHODS OF PAIN RELIEF IN CHILDREN PERIOPERATIVELY

This can be divided into non-pharmacological and pharmacological methods.

1) Non-pharmacological

Babies and children may have a hard time adjusting to the environment of an open paediatric ward. Individual rooms but with an open play area may be more suitable. The 'odd' times for monitoring, blood-taking and doctors' rounds may disrupt their daily routine of meals, playtime and naps and make the overall experience unpleasant. Warmth, comfort, cheerful-looking wards with play areas, television and suitable décor for children is necessary. A parent/caregiver should be allowed to accompany the patient throughout their stay in hospital. This includes accompanying them for painful procedures and during induction of anaesthesia. The parent should be allowed into the recovery area/PACU as soon as the patient has been deemed to be stable so that the process of awakening is calmer. Children with suitable cognitive ability can be helped to understand the meaning of pain and its symptoms.

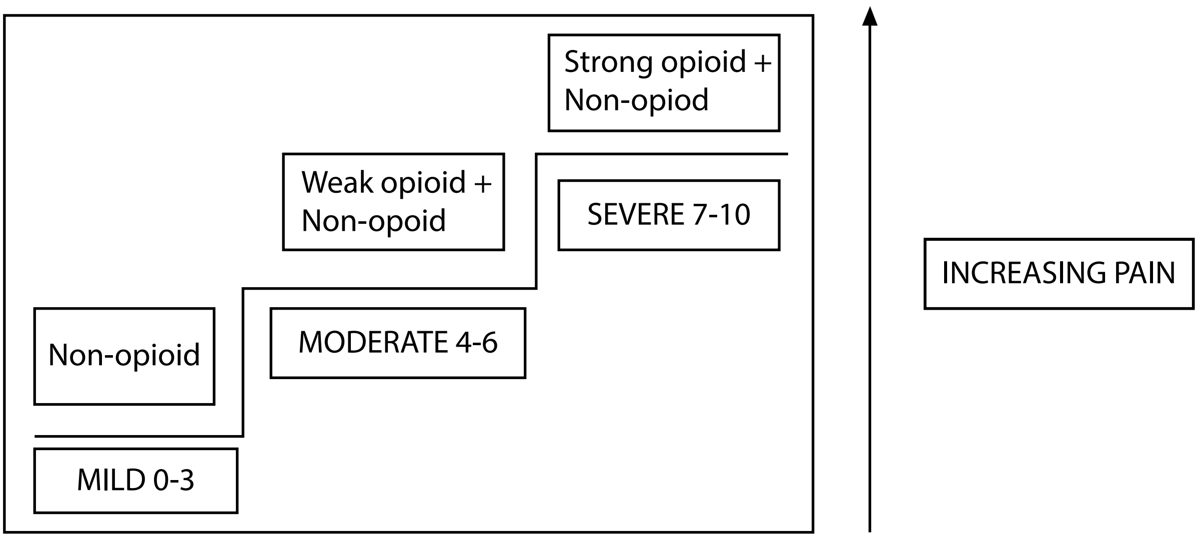
Parents/caregivers should be educated and given information on the child's pain, emotional distress and helpful strategies to combat the pain:

a) Provide and teach suitable non-pharmacological pain-relieving strategies, distraction techniques such as playing a game, blowing bubbles or cartoons.

b) Physical methods, e.g. getting the caregiver to massage a limb or forehead to distract attention away from the pain.

c) Provide emotional support and encourage the parents/caregiver to provide comfort to the child.

d) The anaesthesiologist should have contact with the child and the parents/caregiver prior to the procedure to increase familiarity, establish rapport and possibly improve cooperation.



Non-opioid: aspirin, NSAIDS, paracetamol
Weak opioid: tramadol
Strong opioid: morphine, fentanyl, oxycodone

Figure 1: The World Health Organization's 3-step ladder approach to pain relief

2) Pharmacological Strategies for Pain Control in Children

These are the World Health Organization's recommendations on how analgesia should be administered:

By the ladder: Protocol prescriptions of different drug classes ranging from non-opioids to strong opioids are prescribed according to the patient's pain score.

By the clock: Planned and protocol prescriptions of pain relief either via continuous infusion or regular dosing controls pain are better than a 'prn' regime.

By the mouth: The least invasive route of analgesic administration improves compliance with better pain scores.

Many hospitals with an established acute pain service follow the WHO recommendations on pain relief (**Figure 1**).

Pain is as a complex process and involving various receptors along different parts of the peripheral and central nervous system and is best treated with a combination of drugs, acting via different receptors (**Figure 2**). Analgesics with additive or synergistic effects are used to improve analgesia and minimise side-effects of individual drugs or techniques.[3] A multimodal regimen provides better pain control and functional outcome in children.[4] The main classes of drugs that may be used in combination are paracetamol, NSAIDs, local anaesthetics (local infiltration, peripheral blocks or central neuraxial blocks) and opioids.

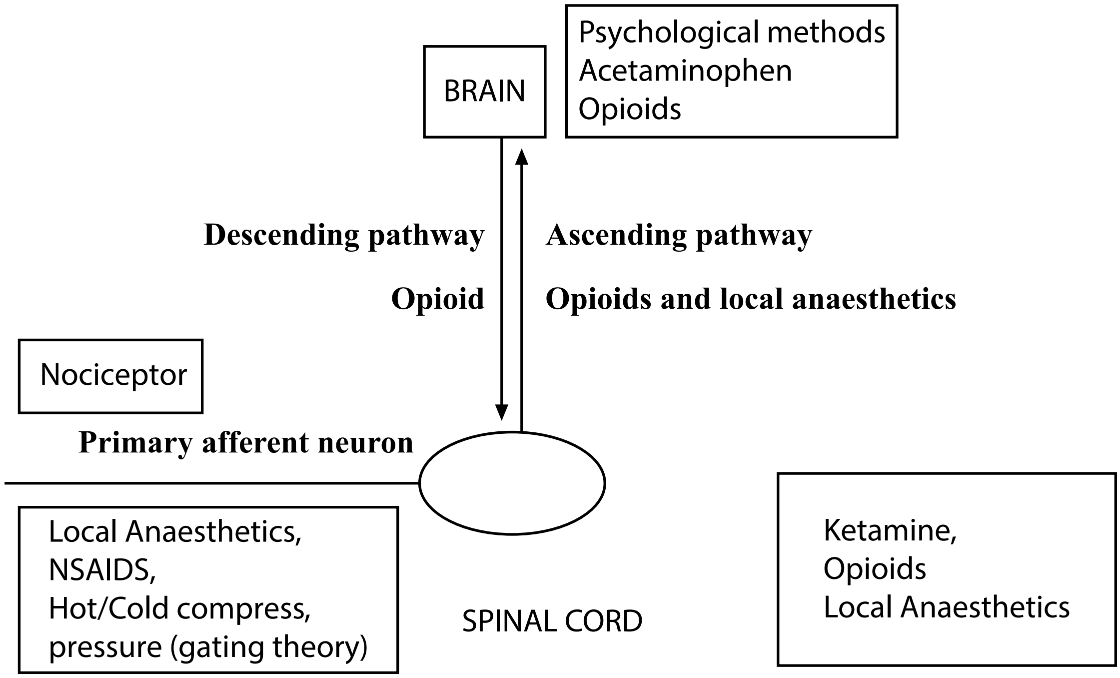


Figure 2: Sites of action of analgesics on the pain pathway

Non-Opioids

Acetaminophen (Paracetamol)

Long considered to be the 'wonder-drug' for paediatric practice, paracetamol is used solely to treat mild pain and moderate, or as part of a multimodal approach for severe pain. Apart from reducing pain scores significantly after major and minor surgery in combination with other modes of analgesia, it may reduce the opioid requirements in children.

Its availability in many forms (syrup, suppositories and intravenous) makes it ideal for use in the perioperative setting. Intravenous paracetamol is particularly useful in major and bowel surgery as an adjuvant analgesic especially as the patient is usually fasted for some time postoperatively.

Liver dysfunction is uncommon if the maximum daily dose of paracetamol is observed. Factors that may increase the risk of liver toxicity include diabetes mellitus, obesity, chronic undernutrition, prolonged fasting, family history of hepatotoxic reaction and a concomitant viral infection.[5] The recommended daily maximum dose and dosing schedule for paracetamol as shown in **Table I**.[6]

Non-Steroidal Anti-Inflammatory Drugs (NSAIDS)

Compared with adults, the volume of distribution and clearance of NSAIDs such as diclofenac and ibuprofen were increased in children. The elimination half-life was similar in children to that in adults. This may indicate that an increased loading dose per kg body weight is required in children. These drugs are usually given in combination with paracetamol or as a part of multimodal analgesia for the treatment of moderate pain. It has been shown that the co-administration of NSAIDs and opioids decreased both postoperative opioid requirement and side effects and increased pain relief.[7]

NSAIDs can cause acute kidney injury even at recommended doses.[8] If repeated doses are

Table I: The recommended daily maximum dose and dosing schedule for paracetamol

Age group	Maximum daily dose	Oral	Rectal	Intravenous
Preterm neonates (32-37 weeks)	60 mg/kg/day	10-15 mg/kg 8-12 hourly	Initial dose 30 mg/kg Maintenance 15 g/kg 8-12 hourly	10-15 mg/kg 8-12 hourly
Term neonates (37 weeks to 10days)	90 mg/kg/day	10-15 mg/kg 6-8 hourly	Initial dose 30 mg/kg Maintenance 20 mg/kg 6-8 hourly	10-15 mg/kg 6-8 hourly
Less than 2 years	60 mg/kg/day	Initial dose 15-20 mg/kg Maintenance 15 mg/kg 6 hourly	Initial dose 30-40 mg/kg Maintenance 15 mg/kg 6 hourly	7.5-15 mg/kg 6 hourly
2-12 years	75 mg/kg/day	10-15 mg/kg/dose 4-6 hourly	Initial dose 30-40 mg/kg Maintenance 15 mg/kg 6 hourly	15 mg/kg every 6 hours or 12.5 mg/kg every 4 hours

necessary, it must for a limited period with monitoring of the renal function. The safe duration for administration is not documented but most case reports state that acute kidney injury can occur anywhere between 1-5 days of administration of NSAIDs especially in patients who are dehydrated or who have a previously impaired renal function.[9] NSAIDS should be used with caution in children with liver dysfunction, impaired renal function, hypovolemia or hypotension, coagulation disorders, thrombocytopenia, or active bleeding from any cause. In contrast, it seems that most children with mild asthma may take NSAIDs unless they have a history of NSAID-induced asthma, multiple allergies or nasal polyps.[10]

Ibuprofen syrup 5-10 mg/kg is the preferred NSAID in children and is usually given to those above 2 years old. Diclofenac syrup 1-2 mg/kg and 12.5 and 25 mg suppository preparations are available in Malaysia and usually used in patients above 2 years old. The use of other NSAIDS such as COX-2 inhibitors (Celecoxib, Rofecoxib, Valdecoxib and Etoricoxib) are limited to children above 16 years old and over 40 kg. Celecoxib is approved for younger patients above the age of 2 years for juvenile rheumatoid arthritis.

Opioids

Opioid analgesics have long been the gold standard for treatment of severe acute pain in any age group. However, the main barrier to effective pain control in neonates and children would be the fear of the side effects such as sedation and respiratory depression. Undertreated patients may demonstrate pain by crying, arching their back, restlessness and many other parameters of pain described in textbooks and pain scales. In this situation, careful titration of further doses of opioids along with close monitoring of vital signs would be required. Often, more time would be needed to observe if pain control has been achieved. Whenever possible, opioids are administered with adjuvant drugs such as paracetamol.

Fentanyl

Fentanyl, a highly lipid soluble synthetic opioid, is appropriately administered in intravenous (IV) boluses of 0.5-1 µg/kg.[6] Its duration of action is fairly short (about 30 to 60 minutes) and apnoea is more likely with IV boluses. For continuous IV infusions, the dose is 0.1-0.2 µg/kg/min.[6] The pharmacokinetics of fentanyl widely vary in sick infants, especially in those with increased intra-abdominal pressure and facilities must be made available to ventilate such patients postoperatively.[11]

Morphine

Morphine is one of the most popular opioids for severe perioperative pain in children. The metabolism for morphine (phase II metabolism) is immature at birth and undergoes maturation from birth to 6 months.[12] Morphine-3-glucuronide is the predominant metabolite of morphine in young children and total body morphine clearance is 80% that of adult values by 6 months and 96% by 1 year of age. Metabolite formation clearances have been shown to decrease with increasing serum bilirubin concentration.[13]

The correct bolus dose adjusted to body weight is not established. However, experts recommend an initial bolus of 100 µg/kg followed by additional doses of 20-25 µg/kg every 5 min until pain relief or sedation occurs.[12] The recommended dose is 0.1-0.2 mg/kg in most texts. Sedation and respiratory depression incidence appear to be increased when the dosage range is exceeded.[12] However, further doses may be required especially in patients with severe pain due to burns or those with a low pain threshold. Analgesia in those who are sedated even at lower doses of morphine may be better achieved with the use of multimodal analgesia.

Remifentanil

Remifentanil, an ultra-short acting synthetic opioid, is extremely potent and therefore, must be given by infusion. Administration of propofol and remifentanil as part of a total intravenous anaesthesia appear to be gaining popularity for short procedures in children. Together they provide sedation, anxiolysis and analgesia, which must be provided by separate continuous infusions. A single IV dose for remifentanil is 0.1-1 µg/kg and continuous infusion dose is with 0.05-4 µg/kg/min.[6] At appropriate rates, there will be haemodynamic stability, minimal respiratory depression, with a rapid recovery profile.[14]

Remifentanil, metabolised by plasma esterases, has the advantage of a very short half-life of 3 minutes, thus side effects can easily be treated by terminating the infusion/adjusting the rate of infusion. For this very same reason, other drugs for analgesia must be instituted prior to stopping the infusion.

Pethidine

Routine administration of pethidine is not recommended in children due to the potential accumulation of its metabolite norpethidine that may cause seizures.[6]

Tramadol

This synthetic opioid is routinely used in adult patients for the treatment of moderate pain. In children, it has been used as an alternative for morphine due to its negligible effects on respiration. The recommended dose for use in patients above 1-year-old 1-2 mg/kg.[6]

Timed-release Oxycodone (OxyContin)

Although the use of Oxycodone in children has been mainly off-label in the past (only recommended for use in those above 18 years), the FDA (Food and Drug Administration) has in August 2015 approved of the use of OxyContin in children from the age of 11 to 16 years of age for severe pain. It is not intended to be a first-line analgesic for severe pain. The child's pain must be severe enough to require around-the-clock, long-term treatment and not managed well by other treatments.

METHODS OF OPIOID DELIVERY

Continuous opioid infusions

Morphine infusions (10-40 µg/kg/hr) would be the technique of choice for postoperative pain in children who do not have the cognitive ability to use a PCA machine. This method certainly provides better control of pain compared with ***pro re nata*** (*prn*) nurse administered dosing. The patient must have the opioids titrated intravenously to comfort level (pain score 3 or less). It is always safer to start with the lowest dose (10 µg/kg/hr) and gradually increase after pain assessment scoring. Continuous opioid infusions are associated with 1 in 10,000 episodes of serious harm.[15] Factors that may contribute include prescription and pump programming errors with equipment being amenable to manipulation by staff unfamiliar with the drug or equipment, concurrent administration with other sedative agents, poor selection of patients with practitioners being too generous with the dosing and patients not monitored closely.

Patient controlled analgesia (PCA) machine

Administrating opioids via PCA machine is beneficial for children who understand the concept of analgesia on the demand. PCA opioid delivery system usage can be easily taught to children as young as 5 years old resulting in effective analgesia.

Programming a PCA machine for children

The usual bolus dose would be 10 µg/kg/dose provided that the patient is titrated to a comfort level prior to being allowed to use the PCA. The patient must have a clear understanding of the pain score and that they should keep themselves within a level of comfort (pain score of 3 or less). Occasionally, the bolus dose may have to be increased (10-40 µg/kg/dose) depending on the severity of pain and the magnitude of the operative procedure. Commonly the lockout period is 5-10 minutes for morphine and 3 to 5 minutes for fentanyl.

PCA in children differ from that for adults in that it would not be unusual to prescribe a background infusion in addition to the PCA boluses (10-20 µg/kg/hr) depending on the pain threshold and the number of episodes of breakthrough pain. All patients must be monitored closely for signs of over sedation and respiratory depression in the ward.

REGIONAL ANAESTHESIA

Regional anaesthesia is rarely performed without the prior induction of heavy sedation or general anaesthesia in infants and children to facilitate cooperation and an immobile field.[16] Counseling and consent for such procedures is necessary with the caregiver fully informed regarding the procedure, benefits and potential risks. Regional anaesthetic techniques are increasingly used for both acute and chronic pain management in children. Advantages in ultrasound guidance and dosing regimens have facilitated their widespread use in paediatrics. It greatly aids in immediate control of moderate to severe pain intra- and postoperatively and can be the sole method of analgesia intraoperatively even without the use of opioids. Nerve plexus blocks and central neuraxial blockade for children should only be undertaken by experienced anaesthetists.

Regional Techniques for Minor Surgeries

These include penile block for circumcisions, ilioinguinal/iliohypogastric blocks for herniotomies, metacarpal/metatarsal block for syndactyly surgery, infraorbital nerve block for cleft lip repair and caudal epidural block for orchidopexy, circumcisions, inguinal hernia repair and orthopaedic procedures on the lower limbs. Transverse abdominal plane block is gaining popularity as analgesia for appendicectomies in children.

Caudal block

Caudal epidural anaesthesia is a simple central neuraxial blockade technique, commonly used in neonates and children undergoing surgeries in the lower limbs and abdomen. It is an easy, simple and safe anaesthetic technique. The rate of serious complications is reported as 1/40 000 and the total complication rate as 1.5/1000.[17] These include mainly vessel perforation and subcutaneous infiltration with a more serious complication being dural puncture. More common side effects in caudal block include motor block and urinary retention.

The local anaesthetic given via the caudal route is mainly calculated on a volume basis (ml/kg) to achieve the level of blockade rather than focusing on the concentration (not more than 0.25%, not exceeding the maximum recommended dose of local anaesthetic according to body weight and not more than 20 ml in total). It can be given as a bolus or an epidural catheter threaded into the space up to the intended level (in children up to 2 years old). The common recommended volumes for caudal blocks are shown in **Table II**.

Table II: Volumes in ml/kg for caudal blocks to achieve certain level of blockade

Level of blockade	Volume (ml/kg)
Perineal	**0.5**
Lower lumbar	**0.75**
Upper lumbar	**1.0**
Lower Thoracic	**1.25**

Comparing three different concentrations of levobupivacaine (0.125%, 0.20%, and 0.25%) for caudal blockade, the 0.125% resulted in less motor blockade but a significantly shorter duration of post-operative analgesia. The optimal concentration was found to be 0.2%.[18] In general, a caudal block with just local anaesthetic would be expected to last about 6 to 8 hours, in some cases up to 10 hours. The risk of hypotension and bradycardia is a rare occurrence in children. There are many studies on the usage of adjuvant drugs in caudal anaesthesia. The common adjuvant agents are morphine, fentanyl, ketamine, and clonidine.[19,20,21] Adrenaline was previously the most used adjuvant drug but not today due to its adverse effects.

Regional Techniques for Major Surgeries

Epidural Analgesia

Once only performed as a 'blind' procedure after general anaesthesia, there have been improvements in leaps and bounds with the introduction of ultrasound-guided epidurals. As with spinal anaesthesia, this procedure is usually only performed in children after the administration of general anaesthesia or deep sedation.

The single S+-isomers, ropivacaine (0.1-0.2%) and levobupivacaine 0.1%, are the drugs of choice in paediatric practice. Common adjuvant added to epidural infusions in children is fentanyl. Other adjuvants such as clonidine and ketamine are mostly used as adjuvants in single bolus caudal epidural blocks to prolong the duration of analgesia. In infants below 6 months, epidural additives should not be used because concerns about spinal cord toxicity and the risk of apnoea remain unanswered. Little or no accumulation occurs when ropivacaine 0.2% is infused epidurally for up to 72 h in children >3 months.[21] Recommended epidural infusion rates for children is as shown in **Table III**.

Peripheral nerve blocks

These include brachial plexus, lumbar plexus, femoral nerve and sciatic nerve blocks. Safety is increased with the use of the ultrasound. The use of continuous nerve block infusions with the insertion of a catheter enables prolonged analgesia and can even be used in a day-case set-up with an established patient follow-up at home.

ADJUVANTS OF INTEREST

α_2-agonists- Clonidine and Dexmedetomidine

Both have anxiolytic, sedative, and analgesic properties. They exert their analgesic action

Table III: Recommended epidural infusion rates for children

	Infants<6months	Infants>6months
Levobupivacaine 0.1%	0.2-0.25 mg/kg/hr	0.25-0.5 mg/kg/hr
Ropivacaine 0.2%	0.2 mg/kg/hr	0.4 mg/kg/hr
Duration of infusion	36 hours	Up to 72 hours

by stimulating the descending noradrenergic medullospinal pathways and inhibit the release of nociceptive neurotransmitters at the dorsal horn of the spinal cord. Addition of preservative free dexmedetomidine or clonidine to caudal bupivacaine significantly improves the quality and duration of analgesia in children (12-16 hours) undergoing lower abdominal surgeries.[22] In children, combining caudal dexmedetomodine with bupivacaine or levobupivicaine has been shown to reduce sevoflurane requirements, incidence of emergence agitation, dosage of local anaesthesia, adjuvant postoperative analgesics and duration of postoperative pain relief.[22]

Ketamine

This drug has many uses in managing pain: In acute pain, it can be used as the sole agent for short procedures such as toilet and suturing of minor laceration wounds or combined with opioids, as an adjuvant drug in caudals/epidurals, it can be used in managing chronic pain for opioid-tolerant patients and in sedation and analgesia for minor procedures and for control of pain in burns. Its attraction is that it preserves the respiratory effort whilst providing a dissociative state, good pain relief and maintaining blood pressure. Preservative-free S-ketamine can be used as an adjuvant in caudal blocks and epidural analgesia.

Ketamine is an extremely popular drug in use in Emergency and Anaesthesia departments for the management of painful procedures in children such as manual reduction fractures and suturing of laceration wounds. In anaesthetic practice, it has been shown that a single dose of ketamine either intravenously or subcutaneously induces efficient analgesia with its preventive properties in paediatric post tonsillectomy patients. Also it reduced postoperative analgesic medications consumption. Both routes of administration, IV or SC at the end of the operation have similar effects although the analgesia from a subcutaneous injection had a more lasting effect.[23]

Recommended ketamine doses: Analgesia is 4 µg/kg/min as an infusion and 1-2 mg/kg IV bolus for anaesthesia.

SPECIAL PATIENT POPULATIONS

Neonates

No discussion regarding pain relief in children would be complete without including a discussion on neonates as management of the neonate is part and parcel of work in any general operating theatre across Malaysia. Our healthcare system has not evolved to the point where neonates *must* be referred to institutions which are specialised in the management of this age group as very few of such centres exist. Hence, the general anaesthetist would have to have knowledge and skill in managing such cases.

A common misconception amongst medical personnel for decades before the late 1980s is that neonates have an immature pain pathway and that they are less likely to feel pain. There was a tendency to be less responsive and less aggressive towards neonatal suffering possibly compounded by the fear that overzealous administration of opioids will lead to further patient morbidity. Now, we know that the pain pathway in neonates is well established and the pain experienced by the neonate perioperatively causes a stress response as in children and adults such as tachycardia and hypertension.

Scoring pain in the neonate

Common pain scores used to evaluate pain in preverbal toddlers and children eg: FLACC scale cannot be extrapolated to the newborn. Several institutions have come up with objective pain assessment scores over the years. Unfortunately, there is not one gold-standard pain scale for assessment of neonatal perioperative pain. Neonates in intensive care (including the period spent in the operating theatre) are repeatedly subjected to painful stimuli. In general, as with children, repeated exposure to pain may result in hyperalgesia and allodynia and long-term changes in pain threshold. As this is particularly a critical period in brain development, repeated stresses may affect sleeping and feeding patterns, bonding with parents and overall development. Metabolic stresses as a result of repeated pain can affect morbidity and mortality.

There has not been any formal survey of the practices of neonatal intensive care units across Malaysia. However, in general, neonatal pain scores are not widely used. Some examples of pain scores that could be implemented are the Patient assessment tool scale for neonates (PAT scoring system), CRIES scale, Neonatal Pain, Agitation and Sedation Scale (N-PASS) and Neonatal Infant Pain Scale (NIPS).

Regional Anaesthesia/Analgesia for Neonates

Spinal Anaesthesia

In this region, this procedure is usually reserved for premature neonates who may benefit from the avoidance of general anaesthesia and the risk of respiratory depression that comes with it. This does not mean that a neonate cannot develop respiratory depression with spinal anaesthesia as the risks of a high spinal block and the stress of surgery and anaesthesia may cause apnoeic spells, too.

This is one of the few situations where regional anaesthesia is performed when the patient is awake. It is excellent for intraoperative analgesia for lower abdomen and lower limb surgeries but its use is limited to simple, short surgeries lasting for less than an hour for example herniotomies and circumcisions. Postoperatively, analgesia may be continued with simple analgesics like paracetamol.

In general, good candidates for this type of anaesthesia are premature babies with a stormy neonatal history, for example extreme prematurity with prolonged ventilation in the NICU (but now extubated), chronic lung disease, ex-premature baby with corrected age less than 60 weeks. What's important is that one has a good assistant to hold the baby while the procedure is being performed to provide an immobile field. Doses of local anaesthetic vary according to the weight.

Caudal Blocks and Epidural Analgesia

These are excellent methods for providing analgesia for the neonate while avoiding large doses of opioids thus enabling early extubation especially in procedures such as trachoeosophageal fistula repair and major abdominal surgeries. Most times the epidural catheter can be inserted caudally and threaded up to the level of surgery be it lower or upper lumbar or thoracic levels. The use of local anaesthetics with better safety profiles such as levobupivacaine and ropivacaine enable analgesia with a much lower risk of cardiotoxicity.

Day Case Surgery

Most minor surgeries in children can be done as day surgery, which not only has its social advantages but economical advantages to both the hospital as well as the patient's caregiver. The main issue is providing good pain relief without its potential disadvantages such as over sedation, respiratory depression and nausea and vomiting. Most institutions advocate a non-opioid approach and multimodal analgesia with short-acting opioids being employed for pain relief only when absolutely necessary. Hence, practitioners must be skilled at providing nerve-blocks which, when administered along with non-opioid analgesia (simple analgesics such as paracetamol and NSAIDs) render excellent pain relief for minor surgeries.[24]

Burns Patients

These patients are usually in the hospital for long periods of time and may undergo repeated painful procedures. Management of burns pain is complex as it not only involves controlling acute pain but may result in opioid tolerance. Repeated episodes of pain may interfere with wound care and therapies, lengthen hospitalisation, long-term post-traumatic stress and general emotional distress. Non-opioid drugs that may be employed during wound debridements and changes of dressings include ketamine, dexmedetomidine and lignocaine infusions.

CONCLUSION

A pain-free stay in hospital for children is possible with the anaesthetist taking charge of developing a holistic approach to the management of pain. More attention needs to be paid to training of staff to evaluate pain in children (pain as the 5th Vital Sign) to enable them to initiate pain therapy from the time of admission where necessary. Medical practitioners need to understand that addressing the contributing factors to pain and not just the pain itself can lead to better management of this patient group.

References

1. Pain as the 5th Vital Sign Guidelines: 2nd Edition, Quality Unit, Medical Development Section of the Medical Development Division, Ministry of Health Malaysia and the National Pain Free Hospital Committee. Dec 2013. MOH/P/PAK/270.13(GU)

2. Pain Management Handbook. Surgical and Emergency Medicine Services Unit, Medical Development Section of the Medical Development Division, Ministry of Health Malaysia and the Editorial Team for the Pain Management Handbook. Oct 2013 MOH/P/PAK/257.12 (HB). ISBN 978-967-0399-38-6

3. Lee CA. Postoperative analgesia in children: getting it right: review article. *South Afr J Anaesth Analg* 2011; **17(6)**: 359-61

4. Chiaretti et al. Current practice and recent advances in pediatric pain management. *European Review for Medical and Pharmacological Sciences* 2013; **17(Suppl 1)**: 112-26

5. Litalien C, Jacqz-Aigrain E. Risks and benefits of nonsteroidal anti-inflammatory drugs in children: a comparison with paracetamol. *Paediatr Drugs* 2001; **3(11)**: 817-58

6. Lönnqvist PA, Morton NS. Postoperative analgesia in infants and children. *Br J Anaesth* 2005; **95(1)**: 59-68.

7. Michelet D, Andreu-Gallien J, Bensalah T, Hilly J, Wood C, Nivoche Y, Mantz J, Dahmani S. A meta-analysis of the use of nonsteroidal antiinflammatory drugs for pediatric postoperative pain. *Anesth Analg* 2012; **114(2)**: 393-406

8. Misurac JM et al. Nonsteroidal anti-inflammatory drugs are an important cause of acute kidney injury in children. *The Journal of Pediatrics* 2013; **162(6)**: 1153-59

9. Patzer L. Nephrotoxicity as a cause of acute kidney injury in children. *Pediatr Nephrol* 2008; **23(12)**: 2159-73

10. Royal College of Anaesthetists. Guidelines for the use of non-steroidal anti-inflammatory drugs in the perioperative period. London: RCOA, 1998

11. Katz R, Kelly HW. Pharmacokinetics of continuous infusions of fentanyl in critically ill children. *Crit Care Med* 1993; **21(7)**: 995-1000.

12. Aubrun F, Mazoit JX, Riou B. Postoperative intravenous morphine titration. *Br J Anaesth* 2012; **108(2)**: 193-201

13. Bouwmeester NJ, Anderson BJ, Tibboel D, Holford NHG. Developmental pharmacokinetics of morphine and its metabolites in neonates, infants and young children. *Br J Anaesth* 2004; **92(2)**: 208-17

14. Marsh DF, Hodkinson B. Remifentanil in paediatric anaesthetic practice. *Anaesthesia* 2009; **64(3)**: 301-08

15. Morton NS, Errera A. APA national audit of pediatric opioid infusions. *Pediatr Anesth* 2010; **20(2)**: 119-25

16. Bernards CM, Hadzic A, Suresh S, Neal JM. Regional anesthesia in anesthetized or heavily sedated patients. *Reg Anesth Pain Med* 2008; **33(5)**: 449-60

17. Johr M. Regional anaesthesia in neonates, infants and children: an educational review *Eur J Anaesthesiol* 2015; **32**: 289-97

18. Ivani G, De Negri P, Lonnqvist PA, Eksborg S, Mossetti V, Grossetti R, Italiano S, Rosso F, Tonetti F, Codipietro L. A comparison of three different concentrations of levobupivacaine for caudal block in children. *Anesth Analg* 2003; **97(2)**: 368-71

19. Warner MA, Kunkel SE, Offord KO, Atchison SR, Dawson B. The effects of age, epinephrine, and operative site on duration of caudal analgesia in pediatric patients. *Anesth Analg* 1987; **66(10)**: 995-98

20. De Negri P, Ivani G, Tirri T, Favullo L, Nardelli A. New drugs, new techniques, new indications in pediatric regional anesthesia. *Minerva Anestesiol* 2002; **68(5)**: 420-27

21. Patel D. Epidural analgesia for children. *Contin Educ Anaesth Crit Care Pain* 2006; **6(2)**: 63-66

22. Saadawy I, Boker A, Elshahawy MA, et al. Effect of dexmedetomidine on the characteristics of bupivacaine in a caudal block in pediatrics. *Acta Anaesthesiol Scand* 2009; **53(2)**: 251-56

23. Javid MJ, Hajijafari M, Hajipour A, Makarem J, Khazaeipour Z. Evaluation of a low dose ketamine in post tonsillectomy pain relief: a randomized trial comparing intravenous and subcutaneous ketamine in pediatrics. *Anesth Pain Med* 2012; **2(2)**: 85-89

24. Shum S, Lim J, Page T, Lamb E, Gow J, Ansermino JM, Lauder G. An audit of pain management following pediatric day surgery at British Columbia Children's Hospital. *Pain Res Manag* 2012; **17(5)**: 328-34

The Parturient and Needle Phobia

Muhammad Zurrusydi Zainuddin[1]**,** MBBS (IIUM), Dr.Anaesth&CritCare (UKM)
Nurlia Yahya[2]**,** MBBS (Malaya), M Med (Anaesth) UKM
[1]Lecturer & Specialist Anaesthesiologist, [2]Senior Lecturer & Consultant Anaesthesiologist,
Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia

INTRODUCTION

Needle phobia is a subtype of blood-injection-injury (BII) phobia according to The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V).[1] Its incidence is estimated to be around 3.5%, but this is most likely to be underrated because people who suffer from needle phobia will often avoid healthcare settings whenever possible.[2]

Those afflicted with this phobia develop fear, which is marked and out of proportion, in anticipation of, or presence of needles and injections. Exposure to such stimulus provokes an immediate anxiety response, which can be associated with fainting due to strong vasovagal reflex in 75% of sufferers, a characteristic peculiar to needle phobia, in contrast to other types of phobias, e.g. acrophobia or arachnophobia.[3] Several deaths have been reported as a result of vasovagal reflex especially in patients with underlying atherosclerosis with impaired blood flow to the heart and brain.[4] The clinical findings associated with the vasovagal reflex reaction include: physical symptoms of syncope (fainting), near-syncope, light-headedness, or vertigo upon needle exposure, along with other autonomic symptoms, e.g., pallor, profuse sweating and nausea. ECG anomalies can occur with hypotension and bradycardia, which may initially be preceded by hypertension and tachycardia prior to the needle stick. The following hormones can also be elevated: antidiuretic hormone, human growth hormone, dopamine, catecholamines, corticosteroids, renin, endothelin, and beta-endorphin.

Needle phobia has very high familial links which classifies it as a distinct subtype of phobia. Approximately 80% of patients who have needle phobia also report strong needle fear in a first-degree relative.[4] The fear of needles and injections may also be acquired through classical conditioning whereby the specific phobia arises after a negative experience at a physician's or dentist's office or from witnessing another person having an adverse experience involving needles or injections.[5,6]

Implications of needle phobia on the obstetric and anaesthetic management along with the medico-legal aspect of both the parturient and foetus need to be understood. The anaesthetic management for parturients which is already demanding due to anatomical and physiological changes in pregnancy will be made more challenging in the presence of needle phobia. Managing foetal delivery in a parturient with needle phobia can be very challenging especially in an emergency situation.

OBSTETRIC IMPLICATIONS

The importance of early detection of needle phobia during routine antenatal assessment cannot be over-emphasised. Multidisciplinary medical intervention involving the obstetrician, psychiatrist and anaesthesiologist will be more effective when commenced early. It also allows more time to establish a trusting relationship with the patient and to formulate a well prepared plan for managing the patient throughout pregnancy.

In those with severe forms of needle phobia, the extreme fear may cause avoidance of medical care resulting in improper antenatal check-ups and treatment with frequent instances of prolonged pregnancy. These issues can be detrimental to both the patient and her foetal well-being especially in complicated pregnancy with co-morbidities. However, a retrospective study by MacAllister N *et al* found that although parturients with severe needle phobia, when compared with those with mild phobia, registered late with the antenatal services, had a significant delay in obtaining their first antenatal blood tests, consented less often to antenatal tests, had a higher demand for general anaesthesia and increased number of physiological deliveries of the placenta, the incidence of maternal and neonatal adverse outcomes in both groups were low.[7]

To date, there is limited evidence to suggest the better delivery option in a parturient with needle phobia, whether by vaginal delivery or Caesarean section. The delivery must be individualised based on multiple factors which include the urgency of delivery, associated medical and obstetric problems, severity of needle phobia and effectiveness of ongoing treatment. The risks and benefits of any medical intervention must be discussed with the patient. Special attention should also be given to postnatal care which includes discussion about contraception and proper planning for future pregnancies.

COGNITIVE BEHAVIOURAL THERAPY

Social attitudes, especially among the healthcare community who often perceive needle phobia as trivial, may eventually lead to stigmatisation of this true psychological disorder. The embarrassment and pressure on the patients and their main support persons to defend the behaviour may cause a negative impact on the patient-doctor relationship and eventual avoidance of all medical care, which may include life-saving treatment. Therefore, it is crucial for all healthcare personnel to acknowledge this disorder and refer them to a psychiatrist for evaluation and treatment.

Cognitive behavioural therapy (CBT) is considered the most effective method in treating needle phobia.[8,9] The main objectives of this approach are to provide patients with an empirically supported understanding of their anxiety, to challenge and restructure their erroneous beliefs about the feared stimuli, and to alleviate avoidance of the feared stimuli through gradual exposure.[10] Evidence also indicates that CBT's efficacy for needle phobia can be reinforced by applied muscle tension therapy, which contains a two-step approach to anticipate the potential vasovagal syncope often experienced by the sufferers.[11,12] Technically, applied muscle tension therapy encourages patients to continually tense muscles throughout the body for around 10 to 15 seconds followed by 20 to 30 seconds of muscle relaxation, intended to prevent an excessively aroused or relaxed state. Prior to engaging in graded exposure, it is suggested that the patient should acquire enough practice in this technique and by utilising muscle tension during exposure, the patient is able to "counteract" a sudden decrease in blood pressure and delay or prevent the onset of fainting sensations.[12] Adequate time is needed to consolidate this so called extinction learning technique, hence early detection of needle phobia in an expectant mothers and early referral to a psychiatrist is paramount.[13]

LEGAL ASPECTS IN EXTREME CASES

In severe cases of untreated BII phobia, a parturient may refuse any medical intervention including treatment which might be life-saving for her or her foetus. The law that determines whether a competent pregnant lady should have control of her own body when she is carrying a viable foetus originates from the 1914 New York (non-pregnant) case of Schloendorff vs Society of New York Hospital, in which Justice Cardozo stated: "*In the case at hand, the wrong complained of is not merely negligence. It is trespass. Every human being of adult years and sound mind has a right to determine what shall be done with his own body; and a surgeon who performs an operation without his patient's consent commits an assault, for which he is liable in damages*".[14] Valid consent for any medical intervention must be obtained from a patient with needle phobia who is of sound mind based on psychiatric evaluation.[15] Patients of sound mind have the right to determine what shall be done to their body and can refuse even life-saving interventions.[16] The patient's decision is not limited to what others might regard as sensible and must be respected.

The ethical question of foetal rights against maternal rights remains uncertain even though it has been well established in English law that the foetus has no legal rights until it is born.[17] Thus, no medical intervention, e.g. Caesarean section, can be performed on the refusing parturient of sound mind even when the foetus is at risk. However, there have been cases where Caesarean section was done on parturients who refused surgery following court involvement. Therefore, the medical team involved should have a close liaison with the hospital legal department when similar situations emerge.

Discussion and agreement with regards to medical intervention should be made clear between attending doctors and the patient. Proper documentation on the agreement is legally important and the records must be kept safe.

ANAESTHETIC IMPLICATIONS

Invariably, the obstetric management of such patients will involve the anaesthesiologist and thus early notification is advocated allowing more time for establishment of rapport with the patient. The anaesthesiologist may play a role in the patient's education during the antenatal period to ensure clear understanding of the anaesthetic aspects of management of delivery either vaginal or surgically. Anaesthetic plans and discussion of benefits and risks of anaesthetic procedures especially pain control management may allay anxiety in some patients.[18]

The anaesthesiologist should also bear in mind that the patient's fears may not be limited to needles and injections but may also extend towards other procedures, such as the application of the oxygen mask and possibly even distinct smells of disinfectants. Preparation and modification of anaesthetic management for these patients either for vaginal or operative delivery can be planned early to suit the patient.

Eutectic mixture of local anaesthetics (EMLA®) or the use of pain-modulator devices such as the Buzzy® at the site of injection or intravenous cannulation have been advocated to reduce pain and anxiety. Buzzy® uses the "gate control" method of nerve signal interference, in which vibration combined with cooling, blocks the nerves from transmitting the sensation of the needle entering the body.[19] Synera™ or Rapydan™ patches are self-warming anaesthetic patches containing a mixture of lidocaine and tetracaine (amethocaine) which are used in the United States, the United Kingdom, and throughout the European Union for needle procedures. Ametop™, a topical 4 percent tetracaine gel is available in many countries which has the additional advantage over EMLA® that it dilates veins, making them easier to cannulate. In contrast, prilocaine, in EMLA®, is a vasoconstrictor and can make venous access more difficult.[20]

The safety of sedative drugs used, with or without the above topical methods, to reduce anxiety and ensure compliance of the parturient during medical procedures has been documented. Other than oral midazolam, ketamine and remifentanil have been safely utilised in anxious parturients to ensure compliance to various medical procedures.[21-23] Sedation should be given with adequate monitoring and preparation for possible adverse outcomes associated with over sedation especially in those with potential difficult airway. A neonatologist should be alerted if the drug is given just prior to foetal delivery. However, sedatives might be counter-productive because it may cause loss of self-control in patients who were taught applied muscle tension to control their fear.[11]

Effective labour pain management is essential in needle phobic parturients planned for vaginal delivery. Methods of labour pain management should be discussed with the patient earlier if possible. Depending on the severity of needle phobia, some patients may actually agree for epidural labour analgesia. The possibility of intense vasovagal reflex causing lightheadedness or loss of consciousness during epidural catheter placement should be anticipated, requiring catheter placement in the lateral position instead of the sitting position.

For instances of Caesarean sections, the risks and benefits of both regional and general anaesthesia should be conveyed to the patient. Despite the established safety of central neuroaxial block over general anaesthesia for Caesarean section, the selection of anaesthetic technique should be made based on the urgency of delivery, potential problems associated with each technique, time constraints to address the psychological aspects of needle phobia, associated medical and obstetric problems and, last but not least, the patient's agreement. For obvious reasons, a higher demand for general anaesthesia is seen among needle phobic patients.[7] All necessary considerations for a safe general anaesthetic in obstetric patients in terms of handling a potential difficult airway, aspiration prophylaxis, appropriate drugs used etc. should not be forgotten.

Regardless of the anaesthetic technique, multi-modal analgesia is imperative to ensure effective intraoperative and postoperative analgesia. Additional types of analgesic techniques which may be incorporated include bilateral transverse abdominis plane (TAP) block or bilateral ilioinguinal nerve block.

CONCLUSION

Early detection of this often neglected psychological disorder followed by effective psychiatric intervention during the antenatal period is of utmost importance. Invariably, anaesthesiologists play an important role during the delivery process and should also be alerted as early as possible to evaluate the problems, establish rapport with the patient and plan the best anaesthetic management which can depend on various factors. Multidisciplinary assessment, discussion and management of delivery also involve the psychiatrist with possible input and support from the legal department in ensuring the safety of both the mother and foetus.

References

1. American Psychiatric Association. 2013. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. Washington, DC
2. Bienvenu OJ, Eaton WW. 1989. The epidemiology of blood-injection-injury phobia. *Psychological Medicine* **28**: 1129-36
3. Ayala ES, Meuret AE & Ritz T. 2009. Treatments for blood-injury-injection phobia: A critical review of current evidence. *J Psychiatr Res* **43**: 1235-42
4. Hamilton J. 1995. Needle phobia: A neglected diagnosis. *J Fam Pract* **41**: 169-70
5. Lemasney NJ, Holland T, O'Mullane D & O'Sullivan VR. 1989. The aetiology and treatment of needle phobia in the young patient - A review. *J Ir Dent Assoc* **35**:20-23
6. Ost LG. 1991. Acquisition of blood and injection phobia and anxiety response patterns in clinical patients. *Behav Res Ther* **29(4)**: 323-32
7. McAllister N, Elshtewi M, Badr L, Russell IF, Lindow SW. 2012. Pregnancy outcomes in women with severe needle phobia. *Eur J Obstet Gynecol Reprod Biol* **162(2)**: 149-52
8. Barlow DH. 2002. Anxiety and its disorders: The nature and treatment of anxiety and panic (2nd ed.). New York, NY: Guilford Press
9. Craske MG, Antony MM & Barlow DH. 2006. Mastering your fears and phobias: Therapist guides (2nd ed.). New York, NY: Oxford University Press
10. Cox D, Mohr DC. 2003. Managing difficulties with adherence to injectable medication due to blood, injection, and injury phobia and self-injection anxiety. *American Journal of Drug Delivery* **1**: 215-21
11. Ost LG, Sterner U. 1987. Applied tension: A specific behavioural method for treatment of blood phobia. *Behaviour Research & Therapy* **25**: 25-29
12. Mednick LM, Claar RL. 2012. Treatment of severe blood-injection-injury phobia with the applied tension method: Two adolescent case examples. *Clinical Case Studies* **11**: 24-34
13. Moscovitch DA, Antony MM & Swinson RP. 2009. Exposure-based treatments for anxiety disorders: Theory and process. Oxford handbook of anxiety and related disorders. New York: Oxford University Press

14. Schloendorff v Society of New York Hospital 211 NY 125 at 126 (1914)

15. Section 77. Mental Health Act 2001. Laws of Malaysia

16. Butler Sloss LJ. 1992. Re T (Refusal of Treatment). 2 FCR 861

17. Dalton KJ. 2006. Refusal of interventions to protect the life of the viable fetus - A case-based Transatlantic overview. *Med Leg J* **74(1)**: 16-24

18. Bailey L. 2010. Strategies for decreasing patient anxiety in the perioperative setting. *AORN Journal* **92(4)**: 445-60

19. Baxter AL, Cohen LL, McElvery HL, Lawson ML & von Baeyer CL.2011. An integration of vibration and cold relieves venipuncture pain in a pediatric emergency department. *Pediatr Emerg Care* **27(12)**:1151-56

20. Sawyer J, Febbraro S, Masud S, Ashburn MA, Campbell JC. 2009. Heated lidocaine/tetracaine patch (Synera™, Rapydan™) compared with lidocaine/prilocaine cream (EMLA®) for topical anaesthesia before vascular access. *Br J Anaesth* **102 (2)**: 210-15

21. Ahmet CS, Fatih M. 2014. Premedication with midazolam prior to caesarean section has no neonatal adverse effects. *Rev Bras Anestesiol* **64(1)**: 16-21

22. Lum Hee WC, Metias VF. 2001. Intramuscular ketamine in a parturient in whom preoperative intravenous access was not possible. *Br J Anaesth* **86**: 891-93

23. Hinova A, Fernando R. 2009. Systemic remifentanil for labour analgesia. *Anesthesia and Analgesia* **109**: 1925-29

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