Postoperative anaesthetic concerns in children: Postoperative pain, emergence delirium and postoperative nausea and vomiting

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ABSTRACT

The incidence of anaesthetic complications in children is much more than in adults and sometimes with a severe outcome. Patients under one year of age, those with co-morbidities and posted for emergency surgery are at increased risk for morbidities. Sources of information on the risk involved come from institutional audit, closed claim analysis, and large-scale studies of cardiac arrest. A strategy for preventing postoperative nausea and vomiting (PONV), emergence delirium (ED) and postoperative pain should be a part of every anaesthetic plan. A planned multimodal approach should be opted consisting of nonpharmacologic and pharmacologic prophylaxis along with interventions to reduce the baseline risks. The literature in this subject is reviewed extensively to give comprehensive information to postgraduate students about the current understanding of postoperative anaesthetic concerns. Relevant articles from Pub med, review articles, meta-analysis, and editorials were the primary source of information for this article.

Key words: Antiemetic drugs, dexmedetomidine, emergence delirium paediatric, laryngospasm, postoperative nausea and vomiting, postoperative pain

INTRODUCTION

Several postoperative complications are seen in paediatric anaesthesia. This review will focus mainly on postoperative pain, emergence delirium (ED), and postoperative nausea and vomiting (PONV) which are common postoperative concerns despite improvements in anaesthetic and surgical techniques.

The multimodal strategies including opioids, non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen, regional anaesthetic techniques, ketamine, dexamethasone, and alpha-2 adrenergic agonists play an important role in decreasing the postoperative morbidity.

Extensive literature was searched with keywords of various postoperative concerns in children from Pubmed and specific journals, namely, Pediatric Anesthesia.

POSTOPERATIVE PAIN

Pain, as defined by International Association for Study of Pain, is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage.[1] The multimodal approach to pain management involving cognitive, behavioural, physical, and pharmacological interventions is required for effective pain control and should be provided to all children, even for minor painful procedures to prevent the development of fear and anxiety. A careful assessment of the severity of pain using various age-specific pain scoring systems is essential for providing effective analgesia in paediatric patients.

Pain perception is fully developed at about 25 weeks of gestation while the endogenous descending inhibitory pain pathways remain underdeveloped

till mid-infancy.[2,3] All these can cause an increased inflammatory response to noxious stimuli as well as more pain-related physiological changes in children as compared to adults. The under treatment of acute pain in children can lead to activation of physiological and biochemical stress response, leading to impaired metabolic, endocrine, neurologic, pulmonary, and immunologic functions. The resulting adverse consequences are emergence delirium (ED) and postoperative nausea and vomiting (PONV) in the immediate postoperative period, and abnormal pain responses such as hyperalgesia and chronic pain states[4] in the later stages.

Assessment of pain can be done by various scoring systems [Table 1]. In neonates, infants, and toddlers, it is often difficult to assess pain as crying, a common sign is seen in other non-painful conditions as well. Premature Infant Pain Profile scale, CRIES postoperative pain scale, and FLACC scale use behavioural and physiologic parameters to assess pain [Tables 1 and 2].[5] A simple self-assessment scale with different facial

Table 1: Commonly used scales for the assessment of pain			
Age range	**Type**	**Description**	**Scale**
Neonates, infants, and Toddlers	Observational or behavioural scale	Based on a child's reaction to pain. It evaluates behavioural parameters (motor response, vocalisation, facial expression, sleep wake pattern and crying) And physiological parameters (HR, RR, BP)	PIPP (Premature Infant Pain Profile) scale CRIES scale FLACC scale
Children (Age 3-8 yrs)	Self-report pain scale	Based on a child's description of his experience of pain	Facial pain scales Facial pain scale revised Poker chip scale Oucher scale
Children (Age >8 yrs)	Self-report pain scale	Based on a child's description of his experience of pain	Scale (VAS) Scale (NPRS)

Table 2: Commonly used methods for the assessment of pain		
Age range	**Scale and indicators**	**Description**
Neonates, infants and Toddlers	CRIES postoperative pain Scale C - Crying R - Requires O2 for saturation>95% I - Increased vital signs E - Expression S - Sleeplessness	Two points are assigned to each parameter Total score ranges from 0-10 Score <4 - Requires non-pharmacological method of treatment Score >4 - Requires non-pharmacological and pharmacological method of treatment
Children (Age 2 months-7 yrs)[6]	FLACC Scale F - Face L - Legs A - Activity C - Cry C - Consolability	Each of the five behaviors is assigned a score of 2. Total score ranges from 0 to 10. 1 to 3 - Mild discomfort 4 to 6 Moderate pain 7 to 10 - Severe pain
Children (Age 3-8 yrs)	Wong Baker Facial Pain Scale Faces Pain Scale Revised (FPS-R)	Six line-drawn faces are assigned a numerical value and word description (No hurt, hurts little bit, hurts little more, hurts even more, hurts whole lot and hurts worst) Six cartoon faces range from neutral to high pain expression and are numbered 0, 2, 4,6,8,10
Children (Age >8 yrs)	Visual analogue scale (VAS) Verbal Numeric Pain Rating Scale (VNPRS)	Ten-centimeter horizontal line anchored by two verbal descriptors - one for each symptom extreme - "No pain" and "Worst pain" Pain intensity is rated on a ten-point numeric scale. "0" represents "No pain", whereas "10" represents "Worst possible pain"

expressions describing the pain is used in pre-school and school children (3–8 years) [Table 2]. Children older than 8 years of age can easily describe their pain on Visual Analogue Scale (VAS) and Verbal Numeric Pain Rating Scale [Table 2].

Approach to pain relief in children
Non-pharmacological pain management
Evidence on the effectiveness of the addition of non-pharmacological interventions like hypnosis, transcutaneous electric nerve stimulation, acupuncture, cold therapy, localised heat, warm insufflation, and immobilization with a multimodal approach to perioperative pain management in children is limited and does not clearly show beneficial effects in the management of postoperative pain.

Pharmacological pain management
Multimodal analgesia, using a combination of opioid, NSAIDs, and local anaesthetics is superior to any modality alone. Adjuvant medications have been shown to reduce opioid requirements and concerns regarding NSAIDs use in children.

(a) Non-opioid analgesics
(i) Paracetomol
Paracetamol is most commonly used in neonates and infants for mild to moderate pain. IV paracetamol loading dose in term neonates and infants is 20 mg/Kg (2 ml/Kg) followed with a maintenance dose of 10 mg/Kg (1 ml/Kg) every 6 hr. In older infants and children, the dose is 15 mg/Kg (1.5 ml/Kg) every 6 hr. The oral dose is 15–20 mg/kg, 4 hourly and 30–45 mg/kg is given rectally. The maximum dose per day is 75 mg/kg in children, 60 mg/kg in neonates, and 45 mg/kg for premature infants. The full-term neonates and children produce large quantities of glutathione, to which oxidised metabolite of acetaminophen is bound; this makes them protected against its hepatotoxicity.[11]

(ii) Non-steroidal anti-inflammatory drugs
In children younger than 3 years, the safety and efficacy of non-steroidal anti-inflammatory drugs (NSAIDs) have not been established. Ibuprofen given orally for moderate postoperative pain is equally efficacious as paracetamol. Diclofenac is a more potent anti-inflammatory drug than ibuprofen or paracetamol. The oral dose is 1–1.5 mg/kg, 12 hourly. Ketorolac a potent NSAID given in a dose of 0.25–0.5 mg/kg intravenously 6 hourly provides excellent postoperative pain relief. The common side-effects of NSAID's are nephrotoxicity, thrombocytopenia, precipitation of asthma, gastrointestinal ulceration, and hepatotoxicity.

(b) Narcotic analgesics
Codeine, a weak analgesic is given orally and is considered to be safe among children above 3 years of age (0.5–1 mg/kg, every 4–6 hr). It is metabolised to morphine which causes analgesia. Intravenous (IV) opioids like morphine and fentanyl are preferred in severe postoperative pain. IV morphine doses are 25 to 50 µg/Kg every 6 hr in neonates and 100 µg/Kg every four to 6 hr in children. IV fentanyl doses are 1–2 µg/Kg every 4 hr. Even small doses of opioids can cause apnoea and periodic breathing among neonates and infants; therefore, strict cardio-respiratory monitoring is recommended in such patients.

Patient controlled analgesia (PCA)
It is efficacious with acceptable rates of adverse events in a variety of postoperative settings (abdominal, laparoscopic, thoracic, orthopaedic surgery) and with a variety of opioid choices (fentanyl, morphine) [Table 3].[12] The incidence of respiratory depression is 0–1.1% with its use.[13] Various factors such as age, weight, pain severity, risk factors should be considered for calculating bolus and infusion doses. Though basal/continuous infusions result in improved sleep quality, they may cause episodes of hypoventilation and hypoxia. In very young children, PCA has also been used; however, pain relief is not always satisfactory because of poor patient understanding. In these patients, Nurse or Parent Controlled Analgesia (NCA/PCA) represents a more suitable modality of drug administration. Potential adverse effects of PCA therapy include respiratory depression, nausea, vomiting, and pruritus. They can be prevented or controlled by the use of adjuvant drugs and careful titration. A combination of PCA bolus with regular administration of NSAIDs or paracetamol may decrease respiratory adverse effects. Monitoring is mandatory and involves measurements of respiratory rate, level of sedation, and oxygen saturation. Efficacy of PCA therapy is assessed by self-reporting, VASs, faces pain scales, and usage pattern.

Table 3: Patient controlled analgesia (PCA) regimen for morphine and fentanyl				
Drug	Bolus dose (µg/kg)	Continuous rate (µg/kg/h)	Lock out interval (min)	4h limit (µg/kg)
Morphine	20	4-15	5	300
Fentanyl	0.25	0.15	5	4

(c) Alpha 2 agonists

Recent meta-analysis has demonstrated that premedication with oral clonidine (4 µg/kg) leads to decreased postoperative pain. Dexmedetomidine (1 µg/kg) has analgesic, sedative, and anxiolytic properties.[14] It causes postoperative analgesia with the same efficacy as opioids with less risk of respiratory depression. It also maintains haemodynamic stability and reduces the requirement of opioids both intraoperatively and postoperatively when given with volatile anaesthetic agents.[15]

(d) Corticosteroids

Dexamethasone in a dose of 0.25 mg/kg is widely employed as an adjuvant in the treatment of postoperative pain and prevention of PONV in children for some time. Studies have demonstrated improved pain control and reduced agitation with intravenous or intramuscular dexamethasone.[16] It prolongs the duration of regional anaesthesia also.

(e) Regional anaesthesia

Placement of a block prior to the start of surgery provides excellent analgesia, reduces intraoperative anaesthetic drug requirements, ensures pain-free rapid emergence from anaesthesia, decreases stress response, and avoids deleterious adverse effects of narcotic drugs. Ultrasonographic guidance for regional blocks allows visualisation of anatomic structures and of injected local anaesthetic solution and, thus, helps to establish analgesia with the low volume of drugs. It is also useful in guiding caudal and epidural blocks in infants as the ossification of sacrum and vertebrae are not complete in them.[7] The various regional techniques are topical anaesthesia, infiltration, regional nerve blocks, and neuraxial analgesia. They are either used independently or along with general anaesthesia.

(i) Neuraxial analgesia

It includes caudal, epidural, and spinal blocks. Epidural and caudal catheters can be easily inserted with the help of ultrasound to extend the duration of perioperative analgesia or the height

of the block. The suggested maximum doses of local anaesthetics bupivacaine, ropivacaine and levobupivacaine recommended for neonates and children are similar [Table 4]. Various additives like clonidine (mean 10 hr), dexmedetomidine (mean 10 hr), morphine (mean 15 hr), fentanyl (mean 6 hr), and sufentanil (mean 3 hr)[8-10] when added to local anaesthetics prolong the duration of analgesia. Epidural opioids when given alone result in postoperative analgesia without motor and sensory block but their routine use as additives is associated with the risk of respiratory depression, itching, nausea and vomiting, urinary retention, and decrease gastrointestinal motility.

(ii) Peripheral nerve block

Commonly used blocks such as brachial plexus block, lumbar plexus block, femoral nerve block, sciatic nerve block, fascia iliaca block, penile block, and peribulbar block provide excellent postoperative analgesia.

EMERGENCE DELIRIUM

Emergence agitation seen in postoperative period is characterised by hyperactive psychomotor and aberrant cognitive behaviours following general anaesthesia. It should be documented as a 'vital sign' in postoperative records. Patients anxiety, temperament, and behaviour are some of the important factors predicting ED.

Eckenhoff and colleagues first described ED in 1960. It is a disturbance in a child's awareness or attention to his/her environment with disorientation and perceptual alterations including hypersensitivity to stimuli and hyperactive motor behaviour in the immediate postanaesthesia period.[17] Its onset is within first 15 to 30 min after surgery.[18] These children have 1.43 times greater risk of developing maladaptive behavioural change and physical aggression resulting in self-extubation and infliction, accidental removal of intravenous catheters, and parental distress.[19]

Incidence of ED is 3 to 8 times higher in children less than 5 years of age. Its incidence ranges from 20 to 80% in all paediatric cases. When pain and other confounders are adequately controlled, the incidence is probably around 20–30%.[18] Patients exposed to short-acting volatile anaesthetics like sevoflurane show a higher incidence of ED.[20] Rapid emergence, young age (≤5 yrs) postoperative pain,[21] surgical procedures such as oral, ophthalmological, and otorhinological

Table 4: Suggested maximum doses of bupivacaine, levobupivacaine and ropivacaine in neonates and children are similar	
Single bolus injection	**Maximum dose**
Neonates	2 mg/Kg
Children	2.5 mg/Kg
Continuous postoperative infusion	**Maximum dose**
Neonates	0.2 mg/Kg/hr
Children	0.4 mg/Kg/hr

surgeries[18] are associated with ED. Use of laryngeal mask airway during paediatric surgery is associated with a lower incidence of ED as compared to tracheal intubation.[22]

Many hypotheses have been proposed to explain the pathophysiology of ED. An imbalance between excitatory and inhibitory pathways and differential effects of hypnotic agents on cortical and subcortical networks has been postulated. Volatile anaesthetics may affect brain activity by interfering with the balance between neuronal synaptic inhibition and excitation in the central nervous system.[23] Postoperative disorientation and agitation may be caused due to pain, hypoxia, hypotension, hypocarbia, hypercarbia, hypoglycaemia, hypothermia, full bladder, and raised intracranial pressure.[17] Clinically, ED is characterised with the presence of no eye contact, no purposeful action, and no awareness of surroundings.[24]

Many scales have been designed to recognise the severity of ED. In Paediatric Anaesthesia Emergence Delirium (PAED) scale, the scores for each of the five listed behaviours (eye contact, purposeful movements, awareness of surroundings, restlessness, and inconsolability) are added to achieve a total score (maximum score of 20). Score ≥10 has 64% sensitivity and 86% specificity, and score >12 has 100% sensitivity and 94.5% specificity for diagnosing ED.[17]

The preventive strategy for ED should involve the selection of appropriate technique of anaesthesia, premedication, intraoperative administration of propofol, midazolam, fentanyl, dexmedetomidine, clonidine, and multimodal analgesics to reduce postoperative pain. Some non-pharmacological measures such as parental presence at induction and recovery, interactive games, anxiety reduction, etc., are also beneficial.[25] A recent meta-analysis showed that propofol, ketamine, alpha 2 adrenoreceptor agonists, and fentanyl are effective in decreasing the risk of ED.[26]

Pharmacological techniques to reduce ED
The incidence of ED can be reduced by modifying the anaesthesia technique. This includes the addition of drugs like perioperative analgesics and regional anaesthetic techniques and reducing/avoiding exposure to volatile agents like sevoflurane and desflurane. Their low blood gas solubility coefficients result in rapid washout and emergence from anaesthesia which is detrimental in children

with high risk. Different strategies opted to reduce the incidence of ED are total intravenous anaesthesia, single dose of propofol 1 mg/kg at the end of sevoflurane anaesthesia,[27] premedication with midazolam 10–45 min before induction,[28] opioids (fentanyl 2 μg/kg or alfentanil 10 μg/kg) administered at induction and intraoperatively,[29] remifentanil infusion (0.5 μg/kg/min) intraoperatively,[30] dexmedetomidine 0.3 μg/kg at the end of surgery,[16] premedication with a single-dose intranasal ketamine 2 mg/kg,[29] intravenous ketamine 0.25 mg/kg 10 min before end of surgery,[29] magnesium sulphate 30 mg/kg followed by 10 mg/kg infusion,[25] and premedication with dexamethasone 0.2 mg/kg.[25]

Treatment of ED includes supportive measures and pharmacotherapy to reduce postoperative pain. PAED scale should be used to identify and quantify the severity of ED. Pharmacotherapy with propofol 0.5−1 mg/kg, fentanyl 1−2 μg/kg, or midazolam 0.1 mg/kg intravenously is effective in reducing ED.[29]

POSTOPERATIVE NAUSEA AND VOMITING IN CHILDREN (PONV)

PONV is characteristically used to describe nausea and/or vomiting or retching in the postanaesthesia care unit or in the immediate 24 postoperative hours.

Five principal neurotransmitter receptors responsible for causing nausea and vomiting are muscarinic M1, dopamine D2, histamine H1 5-hydroxytryptamine (HT)-3 serotonin, neurokinin 1 (NK1), and substance P.[31] Nausea and vomiting may be induced through a variety of central and peripheral mechanisms.

Central mechanism
Vomiting is caused by the noxious stimulation of the vomiting centre directly or indirectly via one or more of four additional sites: the gastrointestinal (GI) tract ($5\text{-}HT_3$), the vestibular system (H_1, M_1),[32] chemoreceptor trigger zone (mu, kappa, DA_2, NK_1), and higher centres in the cortex and thalamus (anxiety, Pain). Once receptors are activated, neural pathways lead to the vomiting centre, where emesis is initiated. Neural traffic originating in GI tract travels along afferent fibres of glossopharyngeal and vagus nerves. Antiemetic targets for drug interventions are predicated on their ability to block the receptors sites.

Peripheral mechanism

Direct gastric stimulation from gastric trauma, blood, or toxins induces the release of substance *P* and serotonin from enterochromaffin cells. This activates the vagal and splanchnic nerve afferents which terminate in the nucleus tractus solitarius in the brain stem, near or within the area postrema (also called the chemoreceptor trigger zone). The 5-HT$_3$ receptors also constitute the peripheral mechanism of PONV.[33]

Risk factors for PONV

The incidence of PONV varies from 13 to 42% in children and adults without prophylaxis.[34] Incidence of PONV varies with different anaesthetic options, from patient to patient, and operating procedure [Table 5].

Scoring system for PONV

It is done by Eberhart classification to facilitate decision making for postoperative vomiting (POV) prophylaxis. It includes four risk factors: age more than 3 years, duration of surgery more than 30 min, strabismus surgery, and previous history of PONV. The incidence of PONV with the presence of 0, 1, 2, 3, and 4 risk factors is about 10%, 20%, 40%, 60%, and 80%, respectively.[39]

Preventive measures

Preventive measures include a multimodal and opioid-sparing approach with regional anaesthesia, NSAIDs, and other non-opioids for postoperative analgesia and adequate hydration.

A. Anti-emetics for prevention and reduction of POV

(a) Serotonin receptor antagonists

Ondansetron, granisetron, ramosetron, and dolasetron are efficacious for PONV at equipotent doses. All these drugs have the potential to prolong electrocardiogram intervals, particularly QT interval and should be avoided for patients at risk for QTc prolongation.

Table 5: Risk factors for PONV

	Risk factors
Patients factors	Age >3 years until puberty
	History of POV or PONV in a parent or sibling
Anaesthetic factors	Use of general anaesthesia[35]
	Administration of volatile anaesthetics
	Longer anaesthesia with volatile anaesthetics
	Administration of Nitrous Oxide (N2O) in high-risk patients[36]
	Postoperative opioid administration
	Anticholinesterases[37]
	Less use of perioperative fluids[38]
Surgical factors	Strabismus surgery
	Adenotonsillectomy
	Laparoscopic procedures

A dose of ondansetron is 0.1 mg/kg with a maximum dose of 4 mg and that of granisetron is 40 µg/kg with a maximum of 0.6 mg. Newer serotonin antagonist like palonosetron has higher receptor binding capacity with a longer half-life and has a similar efficacy for the prevention of PONV. Palonosetron is effective for the prevention of late or postdischarge nausea and vomiting (PDNV) because of its prolonged action. It does not affect QT interval.

(b) Glucocorticoids

Dexamethasone has analgesic as well as antiemetic effect. It is used in a dose of 0.15 mg/Kg up to a maximum dose of 4 mg in children

(c) Anticholinergics

Transdermal scopolamine is available as a long-acting sustained release patch to be applied at least several hours prior to anaesthesia. Side effects include dry mouth, blurring of vision, confusion, and agitation.

(d) Butyrophenones

Low doses of droperidol and haloperidol are as effective as serotonin receptor antagonists for PONV prophylaxis. Droperidol in a dose of 25 µg/kg is used for both prophylaxis and treatment of PONV, as a second drug. They should be avoided in patients with QT prolongation.

(e) Antihistamines

Dimenhydrinate and diphenhydramine are administered in a dose of 0.5 mg/kg in children for PONV. Their common side effects include dry mouth, dizziness, and urinary retention.

(f) Phenothiazines

They are the most effective antiemetics but their use is limited in children because of sedation and extrapyramidal side effects at high doses.

(g) Propofol

It has antiemetic action when administered during induction, maintenance, and for sedation.

(h) Metoclopramide

It is a weak antiemetic with extrapyramidal side effects so used as second-line therapy for PONV prophylaxis in children. The total daily dose should not exceed 0.5 mg/kg.

(i) Combination therapy

In children at high risk (scheduled for adenotonsillectomy or strabismus surgery) of PONV,

a combination therapy of intravenous ondansetron 150 μg/kg and dexamethasone 150 μg/kg is recommended.

B. Anti-emetics for treating established POV

IV Ondansetron 0.15 mg/kg should be used to treat established POV in children. If already been given prophylactically, then a second antiemetic from another class should be given, such as IV dexamethasone 0.15 mg/kg or IV droperidol 25 μg/kg injected slowly.

Some non-pharmacologic techniques such as acupuncture have been tried but they are less effective than standard antiemetics.

OTHER POSTOPERATIVE COMPLICATIONS IN CHILDREN

(a) Airway related complications

Their incidence is 60% of all anaesthesia-related complications. The common causes of postoperative hypoxaemia are residual effect of anaesthetics, inadequate reversal, respiratory depression, airway obstruction, laryngospasm, bronchospasm, and postoperative stridor. The acceptable lower limit of PaO2 is 80–100 mmHg in the recovery room, and it corresponds to spO2 93–97%. Oxygen therapy with a face mask should be initiated when oxygen saturation falls below 93%. It is dangerous to delay treatment of laryngospasm as it can lead to postobstructive pulmonary oedema, hypoxic sequelae, respiratory insufficiency, and cardiac arrest. The airway obstruction seen postextubation can be relieved with neck extension, jaw thrust, and by placing the child in a lateral position. Laryngospasm can be managed by, administration of 100% oxygen, continuous positive airway pressure, and suppressing the laryngeal reflex with subhypnotic dose of propofol (0.8 mg/kg). Gold standard is administration of IV succinylcholine 1 mg/kg with atropine 0.2 mg/kg in the presence of bradycardia. Magnesium sulphate is another alternative medication for bronchospasm, before or after the administration of other drugs, it helps to relax the bronchial musculature. Upper airway obstruction should be treated with high flow nebulised oxygen with racemic epinephrine (0.5 ml of 2% solution diluted to 2–4 ml given every 4 hr). It produces vasoconstriction and minimises tissue oedema. Racemic epinephrine is the choice due to its few side effects than the laevorotatory form of adrenaline but it is not available in India at present. Dexamethasone 0.5 mg/kg 6 hourly for 4–6 doses is commonly used. Some cases might need intubation and ventilation.

Respiratory insufficiency may be caused due to opioid overdose (morphine), prematurity or postoperative apnoea in a child with obstructive sleep apnoea. Naloxone 0.01 mg/kg repeated every 2–3 min is effective in reversing respiratory depression. Caffeine in a dose of 10 mg/kg is an effective treatment for apnoea. Postoperative pulmonary oedema can be easily managed with positive pressure ventilation with PEEP, diuretics, and fluid restriction.

(b) Cardiovascular instability

Hypoxia, fentanyl, or anticholinesterases can cause bradycardia. It is managed by the removal of the cause and administration of anticholinergics. Pain, anxiety, and fluid deficit can cause tachycardia. Hypotension may be treated with optimization of volume status and control of bleeding.

(c) Hypothermia

Children are more prone to hypothermia because of the lack of fat insulation, excessive heat loss due to the increased surface area to weight ratio, and the presence of few brown fat cells. Preventive measures are warming the operation theatre up to 26°C, using a radiant heater at induction and recovery, covering the babies with cotton pads, and infusion of warm fluids.

SUMMARY

Postoperative pain, ED, and PONV are common postoperative complications of paediatric anaesthesia despite improvements in anaesthetic and surgical techniques. Therefore, a pre-emptive, multimodal opioid-sparing anaesthetic plan should be tailored according to individual and surgical needs.

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