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Review

The importance of preoperative preparation of pediatric patients

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ABSTRACT

Preoperative preparation is a complex series of steps aimed at establishing the conditions for selecting an individualized perioperative plan, bringing the child to the best possible state of health state, stabilizing higher-risk patients and reducing them to a lower-risk stage, informing parents about the type of anesthesia planned and the potential risks and complications, and minimizing parental anxiety. However, anticipation and the route to surgery create preoperative anxiety in children and their parents. Under conditions of increased stress, the child's cooperativeness decreases, the requisite dosages of medications for premedication and induction increase, delirium may occur, and wound healing and recovery as a whole are prolonged. Sensitivity to pain also increases, leading to longer hospital stays and less satisfaction among patients and parents. Premedication is tailored to each patient based on age, body weight, health status, psychological profile, and the extent of the intervention. A thorough discussion with the anesthesiologist, a detailed examination, and an individualized anesthetic plan can minimize these effects. This paper describes pharmacological methods of preoperative preparation, provides recommended dosages, and draws attention to the potential side effects of the medications.

Keywords: preoperative preparation, anxiety, premedication, sedation

INTRODUCTION

Preoperative preparation is a complex series of steps that constitutes the anesthesiologist's daily routine. At the beginning of one's professional engagement, such preparation can seem confusing due to the numerous steps involved, but it gradually becomes routine. The importance of optimal preoperative preparation is only truly appreciated in its absence or during the management of emergencies. The goals of preoperative patient evaluation and preparation in the pediatric setting are to establish the conditions for selecting an individualized perioperative plan, to bring the child to the best possible state of health, to stabilize higher-risk patients and reduce them to a lower-risk stage, to inform parents about the type of anesthesia planned and the potential risks and complications, and to minimize parental anxiety so that all attention is focused on the child.[1] Increased anxiety levels in parents can cause heightened anxiety levels in their children.[2] Preoperative evaluation considers the unique physiological and psychological characteristics of each child, and tailored preoperative assessments are essential to ensure safe surgical outcomes and minimize risks. The key components of the pre-anesthetic visit include a review of the child's personal and family medical history, a clinical examination, laboratory analyses, and diagnostic procedures. Once sufficient data about the patient have been collected, the job of the anesthesiologist is to create an anesthetic plan for preoperative preparation, premedication, anesthetic technique, pain control, and possible treatment in the

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intensive care unit (ICU). Premedication is aimed at ensuring the safest possible conditions for administering anesthesia by using the advantages posed by behavioral preparation and pharmacological procedures. Each physical examination concludes with the signing of an informed consent form by the parents or the child, one which specifically focuses on anesthesia and the specific type of surgery.[3,4] Premedication is tailored to each patient based on age, body weight, health status, psychological profile, and the extent of the intervention. Premedication is essential for every patient, precisely because it acts on the blockade of vagal reflexes, reduces secretion in the respiratory system, ensures an accurate medical history, provides preemptive analgesia, and reduces the likelihood of postoperative delirium. This is especially important for patients with special needs, those undergoing complicated surgical interventions, and children with repeated surgical procedures.[5]

History-taking: The skill and art of the physician

In the context of the patient's personal history, it is important to obtain detailed information about the current surgical treatment since this can guide the anesthetic process. A surgical problem can lead to a range of symptoms in a child that will need to be addressed, such as hyperpyrexia, psychological distress, non-cooperation, dehydration due to excessive vomiting or diarrhea, recent consumption of large meals, or significant bleeding. If the patient is traumatized, information may even be collected from witnesses, parents, guardians, or members of the medical team. It is particularly important to determine the mechanism of injury and the circumstances surrounding it.

The next task is to elicit further information about the patient's previous illnesses, chronic conditions, previous surgeries, allergies, chronic therapies, reasons for previous hospitalizations, and potential complications. It is particularly important to focus on the highest-risk group of patients, namely prematurely born children and term infants who have been treated in neonatal intensive care units (NICUs). These patients represent a challenge for further anesthetic activity due to factors such as respiratory system immaturity, surfactant deficiency, nervous system immaturity, open fetal structures, and underdeveloped liver enzyme systems, as well as many other morphological, biochemical, and functional characteristics.

One significant challenge involves patients receiving chronic therapy. Potential risks in these situations include disease relapse due to therapy exclusion, exacerbation of chronic conditions, allergic reactions, potentiation of adverse effects from the therapy, and interactions between those medications and anesthetics.

Medications that can be safely continued include diuretics (thiazides and furosemide), levothyroxine, immunosuppressants, hyperthyroidism medications, antiepileptics, antipsychotics, corticosteroids, inhalation medications for bronchial obstruction, alpha-blockers, hypnotics, and sedatives. A common scenario in pediatric practice involves patients with microcytic anemia who use iron supplements; the guidelines recommend discontinuing these seven days before surgery. Potassium-sparing diuretics should also be stopped on the day of surgery.

Antidepressants from the monoamine oxidase inhibitor group and anti-tumor necrosis factor (TNF) medications can be safely used up to two weeks before the procedure. In the case of adolescents, contraceptives should be discontinued four weeks in advance. Anticoagulants pose a significant dilemma. Warfarin is becoming increasingly less used in daily practice. However, discontinuation is recommended five days before surgery, with an INR <1.5. In such cases, anticoagulation is performed using bridging with low-molecular-weight heparin (LMWH) at prophylactic or therapeutic doses.

Oral vitamin K can be administered in cases requiring urgent treatment, its effect being expected within 12 hours. A more rapid effect, typically within 6-8 hours, can be expected with the intravenous administration of vitamin K. If the placement or removal of an epidural catheter is planned, LMWH should be paused 12 hours prior to the procedure. In that case, the subsequent dose of LMWH can be safely administered after 4-6 hours. Non-steroidal anti-inflammatory drugs should be discontinued seven days before surgery.

There are various forms of allergies. The most commonly encountered in daily practice include allergies to antibiotics (such as penicillin and cephalosporins), inhaled and nutritional allergens, anesthetics, and latex. It is important to consider mucosal hyperreactivity and the possible development of laryngospasm or bronchospasm during the induction of anesthesia, maintenance, or awakening.

The skilled examiner should also probe for details that parents or children may seek to avoid or dismiss as unimportant. These may include negative habits related to smoking, the use of electronic cigarettes, drug and alcohol consumption, and promiscuous behavior. Social behavior and academic success, as well as cooperation with

peers and the surrounding environment, provide useful insights into the child's intellectual, emotional, and social development.

In terms of hereditary diseases relevant to our assessment, we are interested in the presence of muscle disorders in the family, malignant hyperthermia, confirmed pseudocholinesterase deficiency, predisposition to bleeding or thrombosis, hemolytic anemia, allergies to anesthetics, infectious diseases transmitted through blood (HIV, CMV, hepatitis, etc.), whether either parent has experienced issues with anesthesia, the presence of malignant diseases, and any history of psychiatric problems. It is essential to note the time and type of the patient's last meal, as well as to assess the quantity and type of fluid intake.

Clinical examination and further examinations

The examination begins with observational methods from the first contact with the patient. Consciousness state, skin and mucosal coloration, nutritional status, and signs of dehydration are recorded. The external appearances of patients with some specific syndromes clearly predict the possibility of difficult intubation (such as Pierre-Robin syndrome, Dandy-Walker malformation, and Down syndrome), including visible deformities of the head, thorax, and extremities. It also includes the assessment of loose teeth that may dislocate during laryngoscopy and intubation, which should be noted and communicated to the parents. The remainder of the clinical examination is based on a detailed pediatric assessment tailored to the patient's age.

Further procedures in the investigation are determined by the conclusions reached in the previous two steps. Routine blood work is now a standard method. However, a complete blood count, emphasizing hemoglobin levels, is essential in evaluating children in whom significant intraoperative blood loss may be expected, especially in preterm infants and children with hemoglobinopathies, newborns, and infants up to six months of age. Coagulation status is also mandatory for such types of surgery. Gas analyses should be ordered in cases of suspicion of gas exchange disturbances. Additionally, biochemical analyses of blood and urine should be included depending on the patient's condition. Medication levels do not form part of routine practice. Imaging methods, such as chest X-rays, computed tomography (CT) scans, and magnetic resonance imaging (MRI), are also employed in exceptional cases. Supplementary techniques, including electroencephalography (EEG), electrocardiography (EKG), and evoked potentials (EP), can also be helpful. A rapid drug test, as well as a pregnancy test, may sometimes be required for adolescent patients. Every anesthesiologist is responsible for providing parents with instructions concerning preoperative fasting and explaining the importance of adhering to the dietary regimen before the planned elective procedure. Clear fluids should not be taken one hour before surgery, breast milk four hours before, infant formulas and light meals six hours before, and fatty meals eight hours before surgery.[6,7]

Premedication

Premedication involves a series of pharmacological procedures and behavioral preparation programs aimed at ensuring the safest possible conditions for administering anesthesia. Some 40-60% of children are estimated to exhibit significant stress and anxiety before surgical interventions.[8] This is conditioned by feelings of physical vulnerability, fear of separation from the parents, the hospital environment and staff, anesthesia and surgery, loss of personal integrity, and fear of death. The intensity of fear and anxiety is closely linked to the occurrence of delirium durıng awakening from anesthesia and in the early postoperative period, a time of nightmares, eating disturbances, increased feelings of pain, bedwetting, and separation problems. Significant amounts of stress hormones are released during these times, contributing to delayed wound healing, prolonged feelings of pain, susceptibility to infection, and consequently, slower recovery and longer hospitalization times. The at-risk group consists of children up to three years of age.[9] Preoperative preparation and discussions with the anesthesiologist, psychological support from parents, familiarization with the sequence of events involved, and premedication all contribute to greater patient satisfaction.[5,10] Relative contraindications for the use of premedication are presented in Table 1.[11]

Table 1. Relative contraindications for the use of premedication

Difficult airway	Sepsis	Cyanotic heart defects	Central or obstructive sleep apnea	Desaturation on room air	Neuromuscular diseases
Increased intracranial pressure	Liver or kidney insufficiency	Full stomach	Altered Glasgow Coma Scale score	Proven allergic reaction to premedication drugs	Trauma

These medications can be administered orally, nasally, intravenously (IV), intramuscularly (IM), and rarely rectally. If the medication is given orally, it can be mixed with a sweetened drink, although compounded medications are also available for this purpose. This method of administration should be applied 30 minutes before the planned induction of anesthesia. For nasal administration, special medication formulations with a nebulizer are used, and the doses are determined according to the number of spray puffs. Oral and nasal administration of premedication represents a good option for anxious patients in cases without established venous access. Premedication is administered in specialized rooms designated for that purpose, with essential supervision and monitoring of the premedicated patient and appropriate equipment and medications for resuscitation. Paradoxical reactions to the administered medications are not uncommon, during which an exacerbation of anxiety may be observed.

Medications for preoperative sedation:

1) Benzodiazepines are the most commonly used class of medication (Table 2).

- Midazolam is a short-acting medication with a half-life of approximately two hours. It has the advantage of producing anterograde amnesia. When administered nasally, the medication can irritate the mucous membranes and cause discomfort, and there are also concerns about neurotoxicity due to its direct effect on the olfactory nerve. A paradoxical reaction to midazolam may be expected in some children. In such cases, IV ketamine at a dose of 0.5 mg/kg or flumazenil can be given.
- Lorazepam has a slower onset of action but a longer effect duration. However, it should be avoided in neonates due to neurotoxicity.
- Diazepam is not a popular choice in children. It is mostly used in older children and is administered orally or, more commonly, rectally in the form of a suppository.

The antidote for benzodiazepines is flumazenil, which is used to reverse sedation caused by this class of medications at a dose of 0.01 mg/kg IV over 15 seconds (max 0.05 mg/kg).

2) Barbiturates - these produce their effect by potentiating the inhibitory actions of GABA on the GABA (A) receptor. They are not commonly used for premedication in children since short-acting benzodiazepines have become available. A major disadvantage is hyperalgesia, which can induce agitation in children. Thiopental and methohexital are most commonly employed. Methohexital is the preferred agent for use in electroconvulsive therapy (ECT). However, it is also useful in procedural sedation for cardioversion, as an induction agent for intubation in neonates, and as a sedative in imaging procedures.[12,13] Methohexital is the sedative of choice in ECT since it both reduces the seizure threshold and prolongs seizure duration. The latter is an important consideration during ECT, since the duration of seizures is associated with improved efficacy of ECT[14] (Table 3).

Table 2. Benzodiazepines in premedication of children

Medication	Route of administration	Dose (mg/kg)	Onset of action (min)
Midazolam	Oral	0,5-0,75 (max 20 mg)	20-30
	Nasal	0,2-0,3	10-15
	Rectal	0,5-1	
	IV	0,1-0,2	Few
	IM	0,1-0,15	10-15
	Sublingual	0,2-0,3	10-15
	Nebulizer	0,2	Few
Lorazepam	Oral	0,025-0,05	60
Diazepam	Oral	0,1-0,5	
	Rectal	1	
Flumazenil (antidot)	IV	0,01	

Table 3. Barbiturates as agents for pediatric premedication		
Medication	**Route of administration**	**Dose (mg/kg)**
Thiopental	Rectal	20-40
Methohexital 10%	IV	0.5-2.0
	IM	10

Table 4. Opioids as agents for pediatric premedication		
Medication	**Route of administration**	**Dose (mg/kg)**
Morfin	IM	0,1-0,2 (max 5 mg)
	IV	0,05-0,1
	Oral	0,05-0,1
Fentanyl	Oral (lollipop)	10-15 (250 mcg)
	Nasal (after induction)	1-2
Sufentanil	Nasal	1-3 (max 50 mcg)
Meperidine	IM	1-2 (max 5 mg)
	Oral	1,5
Butorphanol	Nasal	0,025
Tramadol	Oral	1,5
	IV	1,5

3) Non-barbiturate sedatives are not recommended for neonates, since they have an unpleasant taste and can irritate the mucous membranes. These include chlorhydrate 10% (25-75 mg/kg orally at a total maximum dose of 2 g), triclofos sodium (25-100 mg/kg orally), and melatonin (0.25-0.5 mg/kg orally 60 min before the procedure). The pineal hormone melatonin performs several functions, including hypnosis, anxiolysis, sedation, and exhibiting anti-inflammatory activity. It produces a natural sleep and may reduce the incidence of emergence agitation.[15,16]

4) Opioids are rarely used for premedication. Instead, they are primarily employed for preemptive analgesia under strict supervision due to the potential for respiratory depression, nausea, vomiting, and pruritus.[17] Neonates are very sensitive to the respiratory depressant effects of opioids, and these are rarely used to premedicate this age group (Table 4).

5) Ketamine causes the central dissociation of the cortex from the limbic system, thus providing sedation and analgesia without causing respiratory depression while maintaining good cardiorespiratory stability. It also relaxes the smooth musculature of the airway stimulated by histamine and is used in case of a potential risk of bronchoconstriction. One significant advantage is that it can be administered to uncooperative children when an intravenous line has not been established. Expected side effects include hallucinations, sialorrhea, nystagmus, and nausea. Benzodiazepines and anticholinergics (such as atropine and glycopyrrolate) should be given prior to ketamine to mitigate some of these effects. However, even with such preparation, it should still be avoided in children with psychiatric disorders, epilepsy, or eye injuries[17] (Table 5).

Table 5. Ketamine as an agent for pediatric premedication			
Medication	**Route of administration**	**Dose (mg/kg)**	**Onset of action (min)**
Ketamine	Oral	3-6	12
	Nebulizer	2	
	Rectal	5-10	30
	IM	1-10	2-4
	IV	0,25-0,5	<1

Table 6. Alpha-2 agonists as agents for pediatric premedication			
Medication	**Route of administration**	**Dose (mcg/kg)**	**Onset of action (min)**
Clonidine	Oral	3-4	60-90
	Nasal	2	30-60
	IM	2-4	30-60
	Rectal		50
Dexmedetomidine	Oral	2-4	20-30
	Nebulizer	1-3	45

6) Alpha-2 agonists induce dose-dependent sedation through their mechanism of action on the locus cereleus. The use of dexmedetomidine has increased in recent years due to the drug's safety profile since it does not cause respiratory depression or nausea and vomiting. However, it can result in bradycardia and hypotension at higher doses. Clonidine is used in sedation in pediatric intensive care units (PACUs)[18,19] (Table 6).

7) Antihistamines are less frequently used, but exhibit sedative, antiemetic, antihistaminic, and antispasmodic effects. These include hydroxyzine (0.5-1 mg/kg IM) and diphenhydramine hydrochloride (1.5-2 mg/kg orally/IV/IM).

Other medications are used to optimize various cholinergic functions, control pain, manage postoperative nausea and vomiting (PONV), control bacterial infections, and prevent thromboembolic events:

1) Anticholinergic medications include atropine, scopolamine, and glycopyrrolate. These drugs are used

to prevent or treat bradycardia caused by manipulations such as intubation or surgical vagal stimulation. They are often administered in combination with ketamine for their anxiolytic effect, although this can lead to tachycardia and skin flushing. Other significant side effects include dry mucous membranes, hyperthermia, and central nervous system excitation. One representative of this group is atropine (0.01-0.02 mg/kg IV), while glycopyrrolate (0.01 mg/kg), which does not cross the blood-brain barrier, is used in cases of atropine allergy and when a targeted reduction of salivation is desired.[13]

2) Topical anesthetics include EMLA cream, Lidocaine iontophoresis, Ametop, S-Kain patch, and Ela Max.

3) Antiemetics are used when assessment indicates risk factors for PONV, such as a history of PONV, significant blood loss, prolonged surgical interventions, inhalation anesthesia, and specific types of surgeries (e.g., tonsillectomy, strabismus, inner ear surgery, and abdominal or urological operations). If a child has one or two risk factors, a single dose of a 5-HT agonist is administered, while both a 5-HT agonist and dexamethasone are given in the presence of more than three risk factors.

4) Antacids and H_2 receptor antagonists are given to patients with an increased risk of aspiration of gastric contents. This includes patients with trauma, ileus, gastroesophageal reflux, hiatal hernia, or esophageal diseases, obese patients, and children with altered airways.

5) Analgesics: The most commonly used medication for preemptive analgesia is acetaminophen (paracetamol). Dosing varies based on the child's age: neonates: 7.5 mg/kg every 6-8 hours IV; max 30 mg/kg/24 hours, infants up to two years: 10 mg/kg every four hours IV; max 60 mg/kg/24 hours, children up to 15 years: 10-15 mg/kg every six hours IV/orally; max 100 mg/kg/24 hours.

6) Antibiotic prophylaxis: The first dose of antibiotics should be administered 30-60 minutes before incision. A second dose should be repeated during surgeries in which the duration exceeds twice the half-life of the chosen antibiotic or if intraoperative blood loss is estimated to exceed 15% of the patient's blood volume.

7) Prevention of thromboembolic events (TBEs): It is important to assess the risk percentage for each individual patient, including both pharmacological and physical prophylaxis for TBE.[11,20]

CONCLUSION

Preoperative preparation reduces preoperative anxiety, which is frequently observed in pediatric patients and can adversely impact their overall experience. By alleviating anxiety, premedication can lead to smoother inductions and improved outcomes. Additionally, it enhances pain management and minimizes the physiological stress response associated with surgery or invasive procedures. It also contributes to faster recovery times and a lower incidence of postoperative complications. Moreover, premedication can facilitate better communication and cooperation between healthcare providers and young patients, creating a more positive environment for both the child and the family.

Author contribution

Review conception and design: DS; literature review: DK, KS; draft manuscript preparation: IB, IP. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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