

## Perioperative Assessment of Paediatric Surgical Patients - A Review

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### ABSTRACT

Paediatric patients require special perioperative consideration because of differences in anatomy and physiology. Thus a standard perioperative assessment plays a crucial role for successful accomplishment of intraoperative and postoperative phase as well as to resist complications due to pre-existing conditions. Importance of past medical history and clinical examination has been emphasised and specific tests should be advised for paediatric patients who have significant past medical or family history. It was concluded that the goal of the preoperative evaluation of paediatric patients is to identify medical concerns and provide for the best efficacious perioperative treatment algorithm that shall minimize the patient morbidity.

**Keywords:** Perioperative, Paediatric, Surgery.

### INTRODUCTION

Preoperative evaluation is defined as the process of defining those features of a patient's general condition that may affect the course of surgery adversely and includes: - extremities of age, contracted blood volume, debilitation and malnutrition, dehydration, electrolyte imbalance, decrease cardiac reserve, diminished pulmonary reserve, renal insufficiency, infections, and coagulation defects. <sup>[1]</sup> These medical conditions might be present in any patient and may lead to increased morbidity and mortality. <sup>[1,2]</sup>

Preoperative evaluation of surgical patients and decision regarding choosing the appropriate and specific presurgical laboratory tests can be challenging task at times. Appropriate preoperative evaluation not only provides a successful intra-operative and postoperative management of

the effects of anesthesia and surgery but it's also necessary for combating complications that may result from preexisting disease. <sup>[3]</sup> Thus Preoperative assessment standardization is warranted to assure that all relevant measures are considered. <sup>[2,3]</sup>

Paediatric anatomy and physiology differ significantly from those of adults and therefore require special considerations in evaluation and preoperative management. <sup>[4]</sup> Most of oral and maxillofacial surgeons devote their focus to their techniques and skills, giving minimal attention to the bi-psychological factors in patient's perspective which has significant impact on their healing and recovery. <sup>[5]</sup>

The rationale behind the review is to facilitate the Oral and Maxillofacial Surgeons to identify medical concerns and provide the best evaluation and diagnostic

measures that shall help minimize the patient morbidity.<sup>[2]</sup>

## DISCUSSION

Past medical history and physical examination constitute the two most important tools in oral and maxillofacial surgery armamentarium for the preoperative evaluation of paediatric patients and subsequent treatment.<sup>[5]</sup>

The history includes information regarding maternal habits during gestation such as drinking and smoking. Maternal perinatal history and vaccinations should be reviewed when evaluating neonates and infant patients. Gestational age at birth, birth height, weight and APGAR (Appearance, Pulse, Grimace, Activity, and Respiration) scores should be obtained from parents or patient's pediatrician. Family medical history is also important for the history of present illness in pediatric patients. It reveals medical details that can make physicians suspicious for particular medical problems. Anesthetic complications, allergic reactions to specific medications, bleeding problems and genetic antecedents should be considered and investigated further to rule in or out conditions such as malignant hyperthermia and blood dyscrasias.<sup>[5]</sup>

Vital signs should be recorded on the first appointment and before any surgical procedure. Weight and height should be recorded routinely and patient values are estimated to evaluate the growth chart corresponding to the patient's sex and age group. Cultural and environmental causes such as the consumption of high-caloric diets and sedentary life-style account for some of the common causes of high Basal metabolic index in pediatric patients. A dose dependent relationship is found between the development of childhood obesity and maternal smoking.

Routine laboratory tests usually are not required for healthy children. Specific tests should be ordered for children who have significant past medical or family medical history or positive findings on examination.

**System specific pediatric- related conditions**<sup>[5]</sup>

### Respiratory infections

Children presenting with respiratory infections are at increased risk for anesthetic and post anesthetic complications. This risk may continue for weeks after acute symptoms have abated. The intraoperative problems that occur usually are laryngospasm and bronchospasm causing hypoxic events. Upper respiratory infections elicit response which causes airway edema and increases airway secretions and decreased mucociliary clearance. The net effect decreases the airway lumen diameter. Airway reactivity also increases leading to bronchospasm and laryngospasm. Airway hyperactivity can remain for upto 6 weeks after upper respiratory infection. It is recommended to delay elective procedures 4 to 6 weeks post upper respiratory infection. Patients who have severe lower respiratory tract infections present a greater risk. Children having infections such as pneumonia accompanied with fever, productive cough or positive findings on radiograph should have procedures delayed at least 6 weeks after convalescence. In contrast, mild symptoms seen in patients who have allergic rhinitis usually are not a contraindication to anesthesia.<sup>[6,7]</sup>

### Asthma

Asthma is a common childhood illness. In children, diagnosis is not straightforward. Once identified, medical treatment should be maximized before any procedure requiring anesthesia. Achieving optimal control is paramount in avoiding perioperative complications. Before surgery, patients who have asthma should be asymptomatic by controlling medications and environmental factors. Medications should be continued and not held before the procedure. Factors that increase risk in patients who have asthma include emergency department or hospitalization for acute attack within prior year, history of intubation and prior treatment with systemic steroids. Patients who have more serious disease who are on steroids may need

additional steroid support at the time of surgery. Steroids decrease edema and airway reactivity. Prednisone 1mg/kg given at 24 hours and 12 hours before surgery may be used in these cases. Elective surgery should be delayed for children who are wheezing actively. [4]

### **Cystic fibrosis**

Cystic fibrosis is a fatal autosomal recessive disease resulting from an inborn error of metabolism causing dysfunction of all exocrine glands leading to thickened gland secretions. Although many systems are affected, 90% of the related morbidity is pulmonary. The lungs eventually become progressively hyper inflated and mucus secretions become thick. This predisposes to infection and ultimately bronchiectasis. In addition to the increased anesthetic risk resulting from the pulmonary problems, perioperative problems can be complicated further by malabsorption secondary to pancreatic insufficiency which leads to nutritional problems and electrolyte imbalances. [8]

In general, patients who have cystic fibrosis are not candidates for office anesthesia techniques. Careful preoperative evaluation is necessary to avoid complications. Preoperative pulmonary function testing may be a useful predictor for postoperative mechanical ventilation in these patients. Preoperative management includes eradicating acute infections and treating bronchospasm with bronchodilators and steroids. Patients who have pulmonary-related heart failure need to be optimized with digoxin, diuretics and drugs that decrease pulmonary vascular resistance.

### **Cardiovascular system** [4]

The depressant effects of most anesthetic agents combined with the diminished ability of the pediatric cardiovascular system to compensate stressful situations makes preoperative evaluation extremely important for children.

### **Murmurs**

Murmurs are common in the pediatric population. Murmurs can be innocent or pathologic. Innocent murmurs

arise from cardiovascular structures in the absence of anatomic abnormalities. More than 30% of children have an innocent murmur at one time in their lives. Innocent murmurs are accentuated during high-output states such as fever, infection and anxiety. Patients having these types of murmur who are asymptomatic and have a normal exercise tolerance typically do not have increased anesthetic risk. Pathologic murmurs include those that are diastolic, pansystolic, harsh, located at the left sternal border and associated with an early or midsystolic click or an abnormal second heart sound. Physical findings such as cyanosis, weak pulses and abnormal cardiac size on radiograph often are associated with pathologic murmurs. Children having these types of murmurs should be evaluated further as they may be manifestations of a congenital heart defect or underlying cardiac disease. Previously undiagnosed murmurs in children also should be evaluated in the preoperative period. Besides a thorough physical examination and an echocardiogram usually is essential in working up these murmurs. [9]

### **Mitral valve prolapsed (MVP)** [4]

The incidence of mitral valve prolapsed (MVP) is approximately 2% to 3%. In the pediatric population this condition occurs in older children and adolescent. It is the result of myxomatous degeneration of the valve leaflets and chordae tendineae allowing redundant mitral valve leaflets to bulge into the annulus.

MVP is asymptomatic. Some patients report nonexertional chest pain and rarely syncope. Echocardiogram examination is common to confirm the diagnosis. Surgical management concerns mostly are for prevention of subacute bacterial endocarditis (SBE).

Preoperative antibiotic prophylaxis for subacute bacterial endocarditis (SBE) [4]

Children who have any form of valvular heart disease, intracardiac ventricular septal or atrial septal defects or intravascular shunts are the patients for SBE prophylaxis when scheduled for a surgical

procedure that may cause a transient bacteremia. These procedures include dental or oral surgical, sinus, genitourinary and gastrointestinal operations. Oral intubation is not an indication for SBE prophylaxis; however, nasal intubation is associated with a transient bacteremia and requires preoperative antibiotics.

### **Neuromuscular disorders**

Children who have neuromuscular disorder require special consideration when planning a surgical procedure. Anesthetics may add to preexisting muscle weakness requiring postoperative ventilatory support. Additionally, diminished airway reflexes and delayed gastric emptying increase the chance of aspiration and postoperative pulmonary sequelae. A common group of neuromuscular disorders affecting children is the muscular dystrophies.<sup>[4]</sup>

Muscular dystrophy is a group of skeletal muscle disorders. These diseases are progressive and usually manifest symptoms anywhere between infancy and adulthood. A thorough history should be taken in all children including questions concerning delayed walking and speech and other developmental issues.

Duchenne's muscular dystrophy is one of the more common genetic diseases. The disease begins in early childhood. Patients do not live much past the second decade. It is characterized by severe proximal muscle weakness, progressive degeneration and fat infiltration of muscle. This causes a gradual deterioration of motor function. Patients also manifest kyphoscoliosis and restricted pulmonary disease. These features combined with sensitivity to non-depolarizing muscle relaxants put these patients at risk for postoperative respiratory compromise and possible need for ventilator support. Rhabdomyolysis with hyperkalemia during general anesthesia is another concern in patients diagnosed with Duchenne's muscular dystrophy. Succinylcholine and some inhalational anesthetics can promote massive rhabdomyolysis. One of the most serious potential complications facing

children with muscular dystrophy and have general anesthesia is malignant hyperthermia. Anesthesia should be approached with caution in these patients. A history of delayed motor function even in female patients may indicate an undiagnosed neuromuscular disease. Children who have history and symptoms consistent with a neuromuscular disease should undergo genetic testing for malignant hyperthermia associated mutations. In vitro halothane-caffeine contracture testing of a muscle biopsy specimen also may be able to identify patients at risk.

### **Psychologic Considerations in Pediatric Perioperative Management**

#### **Preoperative anxiety**

Patients experience preoperative anxiety approximately 1 week before surgery. Anxiety can cause an increased induction time and an increase in the amount of medication needed for induction. Children may display preoperative anxiety in a variety of ways, ranging from subtle changes in behavior to exceeding evident displays.<sup>[4]</sup>

There are many factors that have a bearing on preoperative anxiety including age, temperament of the child, previous medical experiences and the level of parental anxiety. Children between ages 1 and 5 have the highest risk for preoperative anxiety. Some patients who have developmental delays may have higher risks for anxiety beyond these ages.

The level of parental anxiety is a contributing factor in children's level of apprehension. The parental effect is not limited to just the preoperative experience. It also can heighten postoperative anxiety in children.

The type and quality of the preoperative preparation by surgeons and the anesthesiologists can have a significant effect on the level of preoperative anxiety experienced by children. Many institutions have programs to prepare children for surgical, anesthesia and hospital experiences. These programs take many

forms including tours of the operating room area and hospital children's floors and videotaped instruction with teaching sessions of coping skills. Parents usually are included in these programs which also can help diminish the parental effect of children's anxiety.<sup>[10]</sup>

#### **Parental presence in the operating room**

One method for reducing preoperative anxiety is having a parent present in the operating room for the anesthesia induction. The efficacy of this technique is controversial. This technique seems to work best when there already is a low level of parental anxiety and children are less than 4 years old. Medicolegal aspects of having a parent present during induction also should be considered. Hospitals and practitioners may be held responsible for parents who are injured secondary to syncope.

#### **Attention deficit disorders/ Attention deficit hyperactivity disorder<sup>[4]</sup>**

Attention deficit disorders are conditions characterized by an attention span that is less than expected for a person's age. There can be age related inappropriate hyperactivity and impulsive behavior. The disorder affects 3% to 5% of all school-aged children and is 3 to 10 times more common in men than women. A good baseline evaluation and documentation of patient's behavior and level of function are helpful before planning a surgical procedure. Associated conditions such as depression should be identified during the preoperative assessment. Preoperative consultation with patient's mental health therapists may be important especially in children who might need increased postoperative support or modification in their treatment regimen. These consultations also may be useful particularly in aiding in the selection of preoperative anxiolytic medication and postoperative analgesics as some sedative medications may not be effective or may produce an idiosyncratic reaction in children who have behavior disorders. In addition to these behavioral management concerns, there are anesthetic

matters that must be considered in children who have attention deficit disorders.<sup>[4]</sup>

#### **Fluid and Electrolyte Management**

Many organ systems are not fully mature at birth or even during the first months of infancy. Among them is renal function, which is decreased, compared with adults. Lower glomerular filtration and decreased capability to concentrate urine are the most important physiologic differences in infants up to age 1. In addition, patients scheduled for any surgical procedure under sedation or general anesthesia present with a degree of fluid deficit as a result of nothing-by-mouth restrictions.

Fluid therapy should be oriented to replace water losses that are measurable and not measurable and to maintain the daily renal water requirements. Urine output accounts for 60% of the total measurable water losses. In neonates and infant patients, water diffusion through the skin accounts for the most significant source of insensible water loss because of immature stratum corneum on the epithelium. The most reliable measurement to assess appropriate hydration in pediatric patients is urine output.

Isotonic IV solutions with osmolalities approximately 285 to 295 mOsm are the ideal choice for fluid replacement. IV infusion of hypotonic solutions induces red blood cell lysis by mobilization of water intracellularly. One-quarter or one-half percent normal saline and dextrose 5% can be administered IV as replacement solution. The addition of 10 to 20 mEq/L of potassium chloride provides the daily potassium requirements.

#### **Preoperative Fasting Guidelines**

The American Society of Anesthesiologists and its task force developed a series of recommendations for preoperative fasting and the use of pharmacologic agents to reduce the risk for pulmonary aspiration.

These guidelines are intended for healthy patients undergoing elective procedures. They may not apply or may

need to be modified in patients who have pathologic conditions that affect gastric emptying and also in those cases when a difficulty of airway is identified. According to these recommendations, clear liquid may be consumed upto 2 hours before the scheduled surgical procedure. The volume of the liquids ingested is not as important as the type. Breast milk is allowed upto 4 hours preoperatively for neonates and infants. Fasting for 6 hours is recommended for milk formula, nonhuman milk and solids. Fried and fatty foods may decrease gastric emptying.

### **PEDIATRIC DRUG DOSAGES**

Many physiologic factors found in different stages of growing children may affect the pharmacodynamics, pharmacokinetics and therefore, the dosage of medication.

Two of the most widely used formulas based on children's weight or age are:

**Clark's rule:** dose= (adult dose x weight in pounds)/ 150 lb and young's rule: dose= (adult dose x age)/ (age + 12).

The most accurate but the same time, most cumbersome method for calculating the medication dosage for pediatric patients is based on BSA. Multiple equations can be used to calculate the BSA based on patient's height in cm and weight in kg. The BSA formula to calculate children's drug dosages is:  $([BSA \text{ of child}] / 1.73m^2) \times \text{adult dose}$ .<sup>[11]</sup>

### **CONCLUSION**

The ultimate goal of the preoperative evaluation and its management is to identify medical concerns and provide for the best efficacious perioperative treatment algorithm that minimizes patient morbidity.

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