Chapter 32
Preparing the Child for Minimally Invasive Surgery and What Parents and Children Truly Remember

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Abstract Minimally invasive urological surgery in children is advancing and becoming the first choice in the management of elective urological procedures. Children are unique population that is different from adults in their anatomy, physiology, and response to the stress of surgery that also vary with the child's age and maturation. This must be remembered when planning surgical intervention in the pediatric population.

In this chapter we will discuss the process of patient selection, preparation, and patient/parents counseling before any minimally invasive pediatric urology surgery.

Keywords Minimally invasive • Consent • Preoperative evaluation

Growth and Maturation

After birth, important and rapid physiological changes take place in all the vital organs of the newborn that makes the pediatric patient unique, with different physiological response to the stress of anesthesia and surgery.

Growth

After birth the growth and development in children occurs at a rapid pace, especially in early childhood. A full-term newborn grows at a rate of 25–30 g/day

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over the first 6 months of life, leading to a doubling of the birth weight during this period. In the first 12 months of life, an infant's birth weight is typically tripled. By 3 years of age, birth weight is expected to quadruple, and by 10 years of age it will increase 20-fold from the birth weight. Body length increases by approximately 50 % in the first year of life and by threefold by 10 years of age [1]. Previously a 10 kg body weight was used as a cut point to perform laparoscopic/robotic surgery, but recently a successful robotic surgery was performed in 2.2 kg neonate to fix diaphragmatic hernia [2] and a series of laparoscopic robotic-assisted surgery was done in 45 patients less than 10 kg [3].

Cardiac Function

The neonatal and pediatric myocardium is stiffer and less compliant compared with the adult heart. This results in diminished preload capacity. In addition, infants and children have relatively higher resting heart rates. As a result, cardiac output in children is heart rate dependent, because the stroke volume is relatively fixed. Decreases in heart rate in infants and children will result in decreases in cardiac output to a greater extent than a similar decrease in heart rate in an adult patient. The pediatric heart is significantly less responsive to inotropic agents, because it has reduced intramyocardial calcium release [4, 5]. Patients with congenital heart disease will need careful evaluation by pediatric cardiologist and pediatric cardiac anesthesiologist before surgical urological procedure.

Respiratory Function

Lung development depends on intrauterine fluid dynamics, and processes such as oligohydramnios will result in pulmonary hypoplasia. In the postnatal period, lung development continues for 1 year after birth. This stage is characterized by maturation of the terminal saccules into alveoli. At birth, the lung contains approximately 20 million saccules, and at approximately 5 weeks postnatal, these begin to develop into the 300 million alveoli expected to be present by 8 years of age. The most robust development of the alveoli occurs before 4 years of age. After 8 years of age, lung volume increases because of increase in alveolar size, not from an increase in alveolar number [6, 7].

Renal Function

GFR and tubular function double by 1 month of age [8], and over the first 3 months of life, renovascular resistance continues to decrease, which results in further rises

in GFR. Following this relatively rapid rise, GFR continues to increase more slowly toward adult levels, which are reached by 12–24 months of life. The maturation of renal tubular function lags behind the maturation of glomerular function, and therefore the neonate can concentrate urine to only approximately 50 % of adult capability [9–11].

Immune Function

Neonates have increased susceptibility to bacterial infections, which is predominantly due to deficiencies in neonatal host defense mechanisms. Premature infants are at even higher risk. This susceptibility is due to several factors related to the immaturity of neonatal leukocytes, including neutrophils, monocytes, T and B lymphocytes, and NK cells, and also with deficiencies in the complement activation system. Although the neonatal period presents the highest risk of infection for children, the immune system is not fully competent until approximately 8 years of age [12, 13].

Preoperative Evaluation

The perioperative management of patients undergoing urologic surgery continues to evolve. It has become standard for patients undergoing even the most sophisticated and complex urologic procedures to be admitted on the same day of the surgery, and so the urologic surgeon is responsible that the patient has been fully evaluated by other physicians in the hospital and presents to the operating room in the most optimized medical condition, and this will result in improved patient safety and obviate the need for unnecessary cancelled surgeries due to the inadequacy of medical optimization.

Patient Selection

Urological surgical procedures are performed for a wide range of congenital and acquired pediatric urogenital disorders and this can be from day one of life. Important points in the patient's history to be considered when selecting patients for minimally invasive urological surgery:

1. Complete prenatal and neonatal history including any events during pregnancy and delivery should be discussed as these events may influence the child's current state of health. Infants with a history of prematurity and/or intrauterine growth retardation (IUGR) are at increased risk for surgical adverse events due to increased risk of pulmonary hypoplasia.

2. History of congenital heart disease, chronic lung disease, or other medical diseases that include, but not limited to, asthma, rheumatic heart disease, upper respiratory tract infection, diabetes mellitus, immune deficiency, hematological diseases, renal disease, neurological diseases, inborn errors of metabolism, cancer, chromosomal abnormality, and skin disease.
3. Current health status that include recent upper respiratory tract infection, urinary tract infection, recent hospitalization, diarrhea, and skin infection.
4. Nutritional history, acute or chronic gastrointestinal and liver disease.
5. Obesity.
6. History of allergies.
7. Current and past medications including use of steroids, anticoagulants, and chemotherapy.
8. Personal history of previous surgical intervention and previous anesthesia complications.
9. Family history of allergies, hematological diseases, and postoperative and anesthesia complications. Child of a Jehovah's Witness.
10. Social history like household smoking, adolescent smoking, use of drugs, and alcohol consumption.
11. Pregnancy and contraception in teenage girls.
12. Skeletal anomalies that include scoliosis, spina bifida, spinal injury, and any orthopedic surgery.

Contraindications for Minimally Invasive Urology Surgery

1. Absolute contraindications:
   - Poor cardiopulmonary reserve that will impair CO2 exchange
   - Active infection (UTI, intra-abdominal infection)
2. Relative contraindications:
   - Bowel adhesions due to previous abdominal surgery, peritoneal dialysis, or history of necrotizing enterocolitis (NEC)
   - Bleeding diathesis. Note: Laparoscopic and Robotic procedures are not contraindicated in children with ventriculoperitoneal (VP) shunts

Preoperative Preparation

Preoperative Information

Communication and information giving is vital in all aspects of heath care even more so for operative patients. Proven benefits of establishing a preoperative information program are increase in patient satisfaction, less demand for postoperative

analgesics, and decrease length in hospital stay [14]. Patients preferred mode of information about surgery includes direct contact with health care professional and printed literature (only 40 % of verbal info will be retained) [15]. Simplified language and simple drawings should be used to deliver information to the patient and his/her parents.

Informed Consent

Informed consent can reduce the risk of liability yet increase patient satisfaction. In the preoperative informed consent, be sure to include three additional comments that are to be initiated by the parent and witness: (1) that the parent/guardian understands the consent, (2) that all questions have been answered and there are none remaining, (3) and that all risks, benefits, and possibility of conversion to an open procedure and alternatives to the procedure are understood. When blood and/or other blood product transfusion is possible during surgery, written consent should be obtained. Jehovah's Witness refuse blood transfusions because of the belief that the "life force" resides in their blood. Most medical care providers agree that in an emergency it is unacceptable for a parent to make a conscious decision that could result in the loss of a minor child's life; in such cases, appropriate medical therapy, including transfusion of blood products, is administered against the wishes of the family [16]. It is therefore imperative that the surgical and anesthesia teams define a plan with the parents in the event that blood is required. Perioperative volume expanders, such as albumin and hemodilution, and blood banking are acceptable to some individuals, depending on their interpretation of biblical passages [17].

Preoperative Testing

When planning for a minimally invasive procedure such as straight laparoscopy or robotic-assisted laparoscopy, there are group of tests that should be done before subjecting the patient to pneumoperitoneum that includes prothrombin time (PT) and partial thromboplastin time (PTT), hemoglobin and hematocrit (H/H), and serum creatinine (SCr). Urine culture (UCx) should be done for high-risk patients or when opening the bladder is intended.

Preoperative Nothing by Mouth (NPO) Guidelines

Preoperative NPO instructions are crucial to avoid unnecessary respiratory complications during elective urological surgery and will prevent cancellations or delays. Simple instructions are given to the parents in the preoperative counseling and the day before surgery. For all the healthy children, 2-hour (h) fasting is required if

ingested clear liquids (like water, fruit juice without pulp, and clear tea), 4 HR fasting for breast milk, 6 HR for infant formula, 6 HR for nonhuman milk, and 6 HR for light meal (like toast and clear liquids). Fatty meals can delay gastric emptying. Both the amount and type of foods ingested must be considered when determining an appropriate fasting period [18].

Preoperative Fluid Management

Perioperative fluid therapy begins with an estimation of fluid deficit by the anesthesia team. The total requirement for maintenance fluids can be calculated using the Holliday-Segar formula as follows: for patients who weigh 0–10 kg the hourly replacement is 4 mL/kg/h (hr), patients who weigh 11–20 kg the hourly replacement is 40 mL/h + 2 mL/kg/h, and patients who weigh more than 20 kg the hourly replacement is 60 mL/h + 1 mL/kg/h [19].

Antimicrobial Prophylaxis

The Centers for Disease Control and Prevention (CDC) provided guidelines for surgical antimicrobial prophylaxis (SAP) [20], but these were broad and general and did not specifically address urologic surgery. The CDC surgical wound classification system of clean (class I), clean-contaminated (class II), contaminated (class III), and dirty/infected (class IV) can be applied to pediatric urologic procedures [21]. SAP is recommended for (1) all surgery in neonates less than 72 h of age because of possible exposure to maternal pathogens and, particularly, compromised immunologic capacity; (2) major class II surgery; and (3) all class III and IV surgical procedures [21]. Antibiotic use in class I and minor class II operations has not been studied and remains based on surgeon's preference. Recommendations for SAP are provided in Table 32.1 [22]. The timing of SAP administration is critically important, and the first dose should be given 30 min to 3 h prior to incision to achieve bactericidal levels of the antibiotic at the site of incision.

Preoperative Bowel Preparation

The use of mechanical bowel preparation is standard practice before urological procedures such as cystoplasty was based on observational data. This preparation was popularized beginning in 1966 and became routine practice by the early 1970s. Antibiotics were subsequently added to decrease the bacterial load [23]. The aim of mechanical bowel preparation with or without antibiotics is to decrease the intestinal content and the intraluminal bacterial content, which it has been

Table 32.1 Recommendations for SAP

Operation	Preoperative dose
Neonatal (<72 h old) surgery	50 mg/kg ampicillin and 2.5–3 mg/kg gentamicin
Class I	Cefazolin 25 mg/kg
	Vancomycin (if MRSA or MRSE likely) 10 mg/kg
Class II	Cefazolin 25 mg/kg
	Ampicillin 50 mg/kg
	Gentamicin 2.5–3 mg/kg
Class III	Cefoxitin 40 mg/kg
	Cefotetan 40 mg/kg
Class IV	Cefoxitin 40 mg/kg
	Cefotetan 40 mg/kg ± 2 mg/kg gentamicin
	Gentamicin 2 mg/kg + 10 mg/kg clindamycin

Source: Data from McInerny [22]
MRSA methicillin-resistant Staphylococcus aureus, *MRSE* methicillin-resistant Staphylococcus epidermidis

postulated will reduce complications. Recent studies in adult colorectal surgery have shown an increased risk of abdominal septic complications, including anastomotic leakage, with bowel preparation [24]. The incidence of postoperative complications did not differ between children with or without preoperative bowel preparation. Those who did not receive bowel preparation had a significantly shorter hospital stay and avoided the unpleasant procedures [23]. Known side effects of bowel preparation are due to dehydration and electrolyte disturbances such as hypokalemia and hyperphosphatemia. Caution in patients with renal and/or cardiac impairment. The use of preoperative bowel preparation usually is by surgeon's preference.

What Parents and Children Remember

The urologist should assume that parents and older children will remember everything good and bad. The statement that "Technical excellence will provide patient satisfaction" is false. Memories whether positive or negative will be imprinted from the time in the clinic or emergency room up until surgery and the postoperative period.

It is well known that significant preoperative anxiety is associated with a difficult and often prolonged anesthetic induction [25, 26]. If the child is not treated in an *age-appropriate manner*, the entire perioperative experience will likely be compromised. Conversely, if the psychological and emotional aspects of a child's condition distract caregivers from the primary medical and surgical concerns, a successful outcome may be compromised [27]. There is consensus among anesthesiologists regarding the need for the treatment of a child's anxiety before surgery [28] because for a lot of children, the immediate postoperative course reflects their experience during induction.

Table 32.2 Responses to anesthesia and surgery by age and some ways to ameliorate their anxiety

Age	Response	Solution
Infant	Fear of separation from parents and exhibit stranger anxiety	Parental involvement in the perioperative experience
Toddler	Fear of loss of control	Enable the child to make choices, such as asking if the child has a color preference for his or her hospital gown
Preschool	Fear injury and they tend to think in concrete terms and therefore may take statements literally	Caution when choosing the language used with this age group
School	Fears that he or she may not meet the expectations of adults	Clearly explained the expectations from them
Adolescent	Fear of death and not understanding their body function	Reassurance without prompting

Table 32.2 [27] shows how the age of the child will affect his/her responses to anesthesia and surgery and some ways to ameliorate their anxiety.

Summary

In the process of preparing a child for minimally invasive urological surgery, we should take in consideration their unique anatomy, physiology, and psychological needs. Collaboration with other physicians will help to optimize the condition of high-risk patients and minimize the chance of cancelling the surgery. Preoperative information and consent will help the parents and old children to understand the procedure and lower the postoperative anxiety and lower the chance of liability. Use of bowel preparation before surgery depends on the surgeon's preference. Perioperative anxiety is different with age.

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