Special Considerations in the Perioperative Preparation of the Obese Child: An Evidence-Based Review

Mary Ellen Connolly, MSN, CPNP, and Andrea French, MS, CPNP

Recent statistics from the Centers for Disease Control and Prevention have identified 17% of American children between the ages of 2 and 19 years as obese. There are numerous consequences related to obesity in children and adolescents. Providers are faced with treating a variety of comorbidities never before present in the pediatric population. Providers should address the special needs of the obese child having routine surgery. During the perioperative course, the obese child requires close assessment and monitoring for complications such as airway compromise, pressure ulcers, wound complications, nonalcoholic fatty liver disease, prediabetic risks, and complete metabolic syndrome. Healthcare personnel need to be on the alert to anticipate the special needs of this high-risk pediatric population.

Introduction

Media attention, medical literature, and even political policy have focused on obesity in recent years. The Centers for Disease Control and Prevention (CDC) report that from the 2007–2008 National Health and Nutrition Examination Survey (NHANES) 17% of children between the ages of 2 and 19 years are obese. Over the last three decades, the prevalence of obesity in children has doubled in children and tripled in adolescents.1

Body mass index (BMI) is the most widely accepted measure to define the states of being overweight and obese. BMI calculates weight and height to classify weight status. According to the CDC, after a child’s BMI is calculated, it is plotted on the CDC BMI-for-age growth chart (gender appropriate) to obtain the child’s percentile ranking. Being overweight is defined as having a BMI at or above the 85th percentile but less than the 95th percentile. Being obese is defined as having a BMI at or above the 95th percentile. Research has confirmed these reference numbers accurately correlate to data related to morbidity and mortality in adults.2

There are numerous consequences associated with being overweight and obese in children and adolescents. Not only are some of these consequences immediate, but they may manifest into adulthood.3 Medical health risks are numerous and include cardiovascular disease, asthma, hepatic steatosis, obstructive sleep apnea, type 2 diabetes, musculoskeletal and orthopedic injuries, as well as the development of pediatric metabolic syndrome.

The rise in the prevalence of pediatric cases of being overweight and obese is evident in the current patient populations seen in acute care settings today. Medical providers are being faced with treating a variety of comorbidities historically not as prevalent in the pediatric population. Naturally, this transition is impacting the surgical world. In a 2005 review, Brenn noted the prevalence of obesity in children undergoing surgery had risen during the last 5 years.12 The review completed at A.I. DuPont Hospital for Children demonstrated that between 1999 and 2003 the overall prevalence of overweight in children over the age of 6 years increased from 13% to 16%. With an increase in the number of surgeries performed on overweight and obese children and adolescents, there are unique implications related to the evaluation and management of this population throughout the perioperative process. This evidence review will discuss current knowledge about caring for the obese pediatric patient during the preoperative, intraoperative, and postoperative period.

Preoperative Considerations

History taking

Along with the routine questions of a general history, the preoperative history of an overweight or obese child should focus on the known comorbidities associated with obesity. Additional time is necessary in order to allow for a thorough review. A detailed list of specialty providers, medications, or symptoms often leads to a more in-depth discussion of the child’s overall health status. This may warrant further investigation prior to the scheduling of surgery. A thorough physical examination, along with data collected from additional testing, completes the comprehensive risk assessment.

Division of Pediatric Surgery, University of Maryland Medical Center, Baltimore, Maryland.
**Respiratory considerations**

A history that elicits a description of nightly snoring is investigated more thoroughly to determine the necessity of further evaluation by a pulmonologist. An overnight polysomnography is the gold standard in the diagnosis of obstructive sleep apnea (OSA) in children. Physical examination focuses on comprehensive airway assessment, including overall muscle tone, nasal anatomy, ability to breathe through the nose, tonsillar size, and handling of oral secretions. 

OSA is present in 1–3% of children. Obesity is a risk factor for OSA. Throughout the night, children with OSA experience recurrent partial or complete episodes of airway obstruction. This results in hypoxemia, hypercapnia, and sleep disruption. Excess adipose tissue surrounding the upper airway causes physical compression of the soft tissue around the neck and jaw. This leads to an increase in upper airway narrowing. Smaller lung volumes during sleep, decreased oxygen stores, and increased risk of desaturation with obstructive events is potentiated by decreased chest wall compliance and upward displacement of the diaphragm by the obese abdomen when in the supine position.

**Cardiac**

During the preoperative evaluation of the overweight or obese child, blood pressure measurement using an appropriate-sized cuff is an essential assessment. Primary care providers may be able to offer data on readings taken during routine visits, indicating the extent of the hypertension. Working with the primary care provider, adjustments to the therapy may be made as necessary.

Hypertension is defined as an average systolic or diastolic blood pressure measurement greater than or equal to the 95th percentile, when these measurements are taken at three or more separate office visits, at least 1 week apart. Blood pressure measurements are taken by the primary care provider routinely beginning at the age of 3. These systolic and diastolic measurements are compared to a gender-specific chart for blood pressure based on age and height at the 5th, 50th, and 95th percentiles. Hypertension is three to five times more prevalent in obese children compared to nonobese children. Patients with OSA confirmed by polysomnography have a significantly higher diastolic blood pressure. The extent of the hypertension positively correlates to the degree of the OSA, as well as BMI. The exact mechanism for hypertension is unknown, but it is theorized that the sympathetic nervous system is activated due to arousal, hypoxemia, and changes in cardiac output caused by fluctuations in intrathoracic pressure.

Hypertension is just one factor to consider when performing a preoperative physical. The practitioner should screen the obese child for metabolic syndrome (MetS). MetS is a collection of cardiovascular risk factors related to insulin resistance, waist adiposity, glucose dysregulation, hypertension, elevated triglycerides, and low levels of HDL-C. Children with obesity and MetS are more likely to develop type 2 diabetes in adulthood. The screening can be easily accomplished with fasting glucose studies, routine lab work, and waist circumference measurements. These measurements can be obtained during the physical exam and preoperative laboratory workup.

**Gastrointestinal and hepatic considerations**

A history described by a patient and their family to include a sedentary lifestyle and consumption of calorically dense foods coupled with the risk of being overweight or obese suggests further exploration. Laboratory blood work to assess the level of aspartate aminotransferase (AST) or alanine aminotransferase (ALT) may be warranted to identify those at risk for nonalcoholic fatty liver disease (NAFLD). The physical exam includes a skin assessment to evaluate for jaundice and a thorough abdominal assessment to palpate for hepatomegaly, although this may be difficult with an overweight or obese child.

The increase in childhood obesity has been directly correlated to the increased incidence of NAFLD in the pediatric population. This excessive degree of hepatic fat ranges from fat accumulation alone to a more severe histologic finding of steatohepatitis. This is often unrecognized, as patients are asymptomatic until laboratory abnormalities are detected when routine screening is performed. Lerret and Skelton report the most frequent clinical finding is hepatomegaly, particularly when coupled with obesity and acanthosis nigricans. Although a definitive pathogenesis is unclear, Lerret and Skelton describe how the increase in adipose tissue throughout the body also increases the fat deposition in the liver. The result of increased fat deposition in the liver is the creation of a reactive oxygen species. This excessive oxidative stress results in the release of cytokines that give rise to inflammation and fibrosis.

NAFLD is the most common form of chronic liver disease in the pediatric population. NAFLD has emerged as an independent risk factor for cardiovascular disease over the last 5 years. Observations in several studies note increased carotid intima-media thickness and carotid plaques, even in the pediatric population. As childhood obesity rates have increased, so has the incidence of NAFLD. Diagnosis is frequently made upon routine laboratory blood work (elevated ALT) or detection of hepatomegaly on physical exam. Findings such as these that are indicative of decreased liver function need to be evaluated with the anesthesia team to determine if any modifications are necessary with regard to drug selection and dosing. Definitive diagnosis can be made by liver biopsy. Pathology results will demonstrate inflammation, steatosis, cellular injury, and fibrosis. Biopsy is invasive and is generally not employed. Most frequently, elevated liver enzymes, liver ultrasound, and physical exam make this diagnosis.

**Psychosocial implications**

Psychosocial risks of obesity may have a profound effect on a child’s emotional well-being. At an early age, the overweight or obese child may be subjected to social discrimination and ridicule by classmates and peers. Puhl and Latner reported evidence that suggests children with excess weight are more likely to demonstrate low self-esteem. The CDC has documented that decreased self-esteem can negatively affect academic and social functioning.

It is imperative that the healthcare team is aware of the impact their interactions may have on this individual. Beginning with the initial presurgical evaluation, care should be taken to avoid derogatory terminology when referencing the patient’s size. Discretion and privacy should be maintained when gathering necessary equipment, such as a larger blood pressure cuff or gown. Addressing the patient’s weight and health status
is necessary and should be accomplished in a nonjudgmental, professional manner. Preoperative height and weight should be obtained in a private area and away from parents if appropriate. Puhl and Latner report parents are frequently a source of negative feedback for overweight children.\textsuperscript{11}

**Intraoperative Considerations**

**Intravenous (IV) access**

Obtaining IV access preoperatively on the obese child can be challenging. As a result, many obese children will require central access. IV premedication is commonly administered by the pediatric anesthesiologist to aid in separation of the child from the parent. Without IV access, this is not possible. Induction of anesthesia via inhalation provides an alternative. However, the obese child will likely require a longer period of induction secondary to ventilation-perfusion mismatch and intermittent airway obstruction.\textsuperscript{12}

**Equipment**

Incorporation of the right equipment into patient care is an opportunity to help the obese child and family feel more comfortable in the hospital setting. Obese children are more likely to report feeling different from their peers and anxious in general. Several studies have demonstrated that obese children are frequently the target of bullies and schoolyard teasing.\textsuperscript{11} In fact, Warschburger reports that obese children demonstrate poorer psychosocial functioning than other children with chronic illnesses.\textsuperscript{13} The hospitalized obese child is more likely to exhibit signs of anxiety than other children hospitalized with chronic illnesses. Providing a safe and comfortable environment may help to alleviate this anxiety. The pediatric perioperative acute care units and inpatient pediatric units should be evaluated to ensure furniture, beds, operating table, scales (weight capacity that exceeds 300 lbs), door width, wheelchairs, and stretchers are large enough to accommodate the obese child.\textsuperscript{14} Anticipating family members’ needs and providing chairs that are comfortable for large-sized visitors will also aid in decreasing anxiety.

Bag-valve-mask ventilation is difficult in the obese child. Therefore it is important to ensure that the appropriately sized ambu bag and mask are available for the large pediatric patient. Difficulty with bag-valve-mask ventilation is related to decreased chest wall compliance secondary to adipose tissue distribution. Obese children have an increased incidence of asthma coupled with a decrease in functional residual capacity.\textsuperscript{12} Upper airway collapse is secondary to increased tissue deposition around the pharynx, which leads to pharyngeal wall collapse.\textsuperscript{15} Due to these physiological concerns, the supine position should be avoided as much as possible. The supine position results in increased venous return, increased pulmonary blood flow and increased cardiac output, and increased blood pressure. Additionally the supine position will result in decreased diaphragmatic excursion secondary to abdominal contents pressing on the diaphragm. The prone, lateral decubitus or head-up positions are safer options for the obese child during the intraoperative and postoperative periods.\textsuperscript{12}

**Monitoring**

During the intraoperative and postoperative periods, obese children require increased diligence of monitoring and planning for anesthesia. Routine intraoperative and postoperative monitoring may be difficult when caring for the obese child. Excess tissue can make pulse oximetry and cardiac monitor tracings unreliable. Hospital personnel should be alert to ensure appropriate-sized blood pressure cuffs and pulse oximetry probes are available for large-sized pediatric patients in the operating suite and the recovery area.

**Postoperative Considerations**

**Care in the postanesthesia care unit**

Postoperatively, the obese child requires close monitoring with particular attention given to pulse oximetry readings. In a 2010 study of 49 children undergoing adenotonsillectomy for sleep-disordered breathing, 37 of the 49 children were identified as obese.\textsuperscript{16} Almost half of the obese children developed upper airway obstruction postoperatively. Approximately 75% of the obese children required supplemental oxygen and experienced episodes of coughing. These complications were more likely to occur during the first postoperative night. Moreover, it is suggested that respiratory complications in the immediate postoperative period may be indicative of other untoward events that occur later in the recovery course.\textsuperscript{16} Nafie et al. reported that obese children who underwent routine adenotonsillectomy were more likely to require overnight stay compared to nonobese children.\textsuperscript{17} In this study, the authors reported that overnight stay was precipitated by upper airway obstruction in the recovery area, multiple attempts at laryngoscopy, difficult bag-valve-mask ventilation, and increased intraoperative desaturation events.

In a 2008 study of 2,025 children having elective non-cardiac surgery, 294 children were identified as obese. The obese children demonstrated an increased incidence of difficult mask ventilation, airway obstruction, bronchospasm, and oxygen desaturation than the nonobese population.\textsuperscript{18} A retrospective chart review of 1,133 children who underwent outpatient dental procedures revealed an increased incidence of oxygen desaturation requiring supplemental oxygen and unplanned overnight stay in obese children postoperatively.\textsuperscript{19} These studies demonstrate the increased risk of respiratory compromise that may be seen in the postsurgical obese pediatric patient, and suggest that overnight stays are indicated to assure postoperative surveillance of the potential of these adverse events.

Respiratory complications may be increased by the use of postoperative narcotics. When dosing narcotic medication in the child with excessive adipose tissue, Veyckemans\textsuperscript{20} and Brem\textsuperscript{12} recommend that the initial PCA dosing should be based on ideal body weight (IBW) not total body weight (TBW). The PCA dose is then reduced by 25% of the child’s IBW and titrated to effect. Theoretically, lipophilic drugs, such as barbiturates and certain benzodiazepines have a greater volume of distribution in the obese child versus the nonobese child. Thiopental and midazolam are lipophilic medications that demonstrate an increased volume of distribution and should be administered based on the patient’s TBW.

**Wound infection**

It has long been recognized that obese patients are more likely to develop wound complications postoperatively. The obese child and family will require extra attention to
postoperative wound care. The child with a large amount of adipose tissue is more likely to develop a wound infection and wound dehiscence. This is thought to be secondary to decreased perfusion of adipose tissue, as well as increased tension on the wound edges. Postoperative teaching and instructions should stress the importance of local wound care and recognition of infection in this high-risk population. A thorough skin check prior to discharge home is also recommended. The obese child is at risk for development of pressure ulcers secondary to intraoperative positioning.\(^22\)

**Venous thromboembolism and mobility**

Deep venous thrombosis (DVT) is a rare event in children. However, obesity increases the risk for postoperative development of a DVT. At-risk children should be managed with anticoagulation therapy per hospital protocol.\(^23\) Any delay in early ambulation increases the risk of postoperative DVT. Additionally, since many pediatric bariatric surgery centers require the placement of compression stockings during the operative procedure to reduce the incidence of DVT development, the use of sequential compression devices should be implemented as part of the postoperative management of all obese children who are not ambulatory. Staff should become familiar with available specialty equipment to assist in early postoperative lifting and ambulation of the obese child. Specially designed equipment to assist in the lifting of obese patients can improve quality of care and reduce patient length of stay, as well as avoid hospital personnel injury.\(^13,24\)

**Conclusion**

The epidemic of pediatric obesity has a profound impact across the healthcare spectrum. All hospital personnel should familiarize themselves with the obesity risks and comorbidities present in children, particularly those undergoing surgery that is often considered “routine.” Anticipation of obesity risk factors, especially those associated with anesthesia, allows for a more safe passage of these children through the perioperative process. Risk is minimized and patient comfort is enhanced when staff familiarizes themselves with specialty equipment and anticipate the needs of the obese child and family.

**Disclosure Statement**

No competing financial interests exist.

**References**


Address correspondence to: Mary Ellen Connolly, MSN, CPNP Division of Pediatric Surgery, Department of Surgery University of Maryland Medical Center 22 S Greene Street Baltimore, MD 21201 E-mail: mconnolly@smail.umaryland.edu