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Review article

Pediatric anesthesia – potential risks and their assessment: part II

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Metabolism

Obesity

Childhood obesity is increasing rapidly and affects up to one third of the pediatric population (1,2). In order to assess the degree of obesity, body mass index (BMI) is assessed using age and sex-related reference curves as BMI changes substantially with age. Obese children have nearly a twofold increase in perioperative adverse events compared with normal-weight children (2).

BHR, asthma, and respiratory tract infections are more common in obese than normal children (3–5) Additionally, functional residual capacity and forced vital capacity are reduced in obese children and the prevalence of OSAS is higher (2,6). Hypertension, noninsulin-dependent diabetes mellitus, gastroesophageal reflux and potentially delayed gastric emptying times are also more frequent (2).

Appropriate dosing regimes for obese children rarely exist and most drugs should be given according to lean body weight, which might be difficult to determine. In the perioperative period, an increased risk of respiratory depression and higher prevalence of OSAS should be taken into account and great care taken to avoid hypoxemia in this high-risk population.

Diabetes

The prevalence of diabetes mellitus in the pediatric population is increasing together with obesity. Ninety percent of diabetic children present with type 1 diabetes (insulin-dependent), 2–3% with type 2 diabetes (noninsulin-dependent) while the rest have other types e.g. maturity onset diabetes of youth, insulin resistance syndromes, genetic syndromes, pancreatic defects or secondary diabetes (7,8).

Anesthesia and surgery result in a typical metabolic stress response by an increased secretion of catabolic hormones (cortisol, catecholamines, glucagons, growth hormone) and the inhibition of insulin secretion (8). Therefore, intensive management of the diabetic child is essential to avoid major fluctuations in blood glucose levels and electrolyte imbalances.

It is useful to schedule surgery for the child early in the morning to avoid long fasting periods. Intravenous infusions of dextrose and insulin provide stable glycemic control in the perioperative period (9). Most patients require between 0.01 and 0.2 $U \cdot kg^{-1} \cdot h^{-1}$ of insulin and the amount of insulin should be adapted to the glucose level of the patient (8). Blood glucose, potassium, and acid-base estimations should be performed regularly in the perioperative period depending on the severity of surgery and the fasting times of the child.

Long-term steroids treatment

In spite of the lack of hard evidence, it is widely recommended to administer corticosteroids to patients who receive a long-term oral steroid therapy (>2 months) at a 'stress dose' level before surgery. The normal daily endogenous glucocorticoid secretion is estimated to be 5–10 $mg \cdot m^{-2}$ but can increase

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under stress to up to 100 mg·m^{-2} day^{-1}. Before surgery, children having long-term steroid therapy should receive their daily dose orally or parenterally and an additional 'stress dose' should be adapted dependent on the duration and the severity of surgery to prevent side-effects of unnecessary large doses of steroids (poor wound healing, inadequate glucose control, fluid retention, hypertension, electrolyte imbalance, immunosuppression, etc.) (10). The authors recommend their institutional regimen for steroid replacement: for minor surgery (endoscopy, punctures, etc.), hydrocortisone 50 mg·m^{-2} i.v. is recommended which should be followed by 12.5 mg·m^{-2} every 6 h on the day of surgery. For severe surgical stress, a dose of 100 mg·m^{-2} is recommended followed by 25 mg·m^{-2} every 6 h on the day of surgery, every 8 h on the first postoperative day and every 12 h on the second postoperative day. On the third postoperative day, the usual treatment dose should be administered. As the adrenal glands may take up to 1 year to recover completely following long-term steroid treatment, our endocrinologists recommend to substitute until 1 year following the discontinuation of corticoids. Patients with long-term inhaled steroids do not need a stress dose before surgery. The equivalent doses of the different corticosteroids are given in Table 1.

Other metabolic syndromes

There are numerous inborn metabolic diseases in childhood. Some might be recognized following newborn screening; some might only present later in life and then only be detected during an acute infection or other metabolic stress. For the anesthesiologist, therapy is mainly supportive including careful control of an adequate water-electrolyte balance as well as good blood sugar control. Treatment that is more specific depends on the particular disease and consulting a specialist for further treatment is highly advised prior to surgery.

Table 1
Steroids and their equivalent doses

Steroid	*Equivalent dose (mg)*	*Duration of action (h)*
Cortisol	20	8–12
Cortisone	25	8–36
Prednisolone	5	12–36
Prednisone	5	18–36
Methylprednisolone	4	12–36
Betamethasone	0.75	36–54
Dexamethasone	0.75	36–54

Chronic renal failure

In children with known chronic renal failure, the preoperative assessment must particularly focus on the presence of cardiorespiratory function, hypertension, hypo/hypervolemia, electrolyte imbalances and/or coagulation disorders (11).

Congenital syndromes

It is out of the scope of this review to discuss the numerous congenital syndromes found in children. However, the presence of any congenital malformation should alert the anesthesiologist, as it is often associated with malformations of other organs. Particularly important for the anesthesiologist are the associations of numerous syndromes with cardiac malformations (Table 2).

Down's syndrome – trisomy 21

Down's syndrome is the most commonly found chromosome related disorder and is found in approximately 1 in 650 neonates. It is easily recognized from the characteristic flat face, protruding tongue, inner canthal folds, up-slanting palpebral fissures, hypotonia and hyperflexible joints. It is also associated with mental retardation. More than half the children present with an associated congenital cardiac malformations (mostly endocardial cushion defects or ventricular septal defects). Anesthesiologists should be aware of the difficult airway management in these children and should be especially careful with regard to a potential atlantooccipital subluxation.

Allergies

A thorough history of known medical and environmental allergies should be obtained for all children and the allergenic agents avoided. Special care must be taken in children with a latex allergy. The highest risk for anaphylaxis from latex is found in children with spina bifida, urinary tract malformations and a history of atopy or previous repeated exposures to latex. Fifty-five percent of children are sensitized to latex following an average of 7.7 operations

Table 2
Syndromic associations with cardiovascular diseases

Congenital heart disease
Apert's syndrome
DiGeorge syndrome
Down Syndrome (trisomy 21)
Edwards' syndrome (trisomy 18)
Goldenhar's syndrome
Marfan syndrome
Meckel's syndrome
Patau's syndrome (trisomy 13)
Polysplenia
Rubinstein's syndrome
Sebaceous nevi syndrome
TAR syndrome (thrombocytopenia, absent radius syndrome)
VACTERL (vertebral, anal, cardiac, tracheal, esophageal, renal, limb) association
Williams syndrome
Syndromes associated with cardiomyopathy
Duchenne's muscular dystrophy
Farber's disease
Friedreich's ataxia
Hunter's syndrome
Hurler's syndrome
Myotonic dystrophy
McArdle's disease
Stevens–Johnson syndrome
Syndromes associated with arrhythmias or autonomic dysfunction
Albright's osteodystrophy
Guillain–Barré syndrome
Shy–Drager syndrome
Wolff–Parkinson–White syndrome
Syndromes associated with ischemic heart disease or thromboses
Ehlers–Danlos syndrome
Fabry's disease
Grönblad–Stranberg syndrome
Homocystinuria
Tangier disease
Werner's syndrome

independent of their underlying diseases (12). Only the strict avoidance of latex-containing products can help to minimize a child's risk of latex associated anaphylaxis, as the often recommended chemoprophylaxis consisting of H_1/H_2 receptor antagonists is ineffective (13).

Vaccinations and infectious diseases

This discussion refers only to elective cases, which can be postponed without medically adverse events for the child. Vaccinations can be followed by local swelling, pain, fever, headache, rash, malaise, and myalgia, all of which can last between 1 day and 3 weeks (14). The anesthetic implications of a recent vaccination have not been well studied. Many countries have routine immunization schemes, which include several vaccinations (mostly polyvaccines that differ in their contents between countries) within the first year of life. Many anesthetic procedures are performed in this age group without apparent sequelae. It is probably sensible to postpone elective surgery for at least 3 days following a vaccination with killed organisms (pertussis vaccine) or inactivated toxins (tetanus and diphtheria toxoids) and 2 weeks following attenuated live organisms (measles, mumps, rubella, and poliovirus vaccines) to reduce the coincidence of the peak systemic reactions to the vaccine with surgery (14).

Anesthesia, stress and trauma are known suppressors of the immune system. Therefore elective surgery should be postponed in the case of an active disease or following a direct contact with another child with an active disease (14,15). This measure also helps to reduce the number of hospital-acquired infections with children's diseases.

Herbal medicine

A significant and increasing proportion of the pediatric population (approximately 16% in children presenting for ambulatory surgery) receives or has received herbal preparations (16). For example in Australia, approximately 29% of children with asthma receive herbal medicine for their condition (17). The literature shows several case reports highlighting the potential dangers of herbal medicine (18,19). Although there is little possibility of interaction between conventional and herbal medicines in children (20), the potential for interaction with anesthesia drugs exists.

A major concern is that 70% of the patients taking herbal medications do not report this at the preoperative assessment for a variety of reasons (19,21). Many herbal remedies decrease platelet aggregation (e.g. bilberry, bromelain, dong quoi, feverfew, fish oil, flax seed oil, garlic, ginger, ginkgo bilboa, grape seed extract) or inhibit clotting (e.g. chamomile, dandelion root, dong quoi, horse chestnut) (21). The long-term use of echinacea, which is thought to reduce the duration and severity of URTI, can result in immunosuppression that might potentially increase the risk of wound infection (22). Furthermore, it has the potential for anaphylaxis as well as for

hepatotoxicity if used in combination with other hepatotoxic agents (21). Other herbs (e.g. hops, kava kava, passion flower) can potentiate central nervous system depression in the perioperative period.

Ma huang (*Ephedra sinica*) is used for the treatment of a variety of symptoms. This ephedrine-containing drug is a cardiovascular stimulant by acting as an alpha and beta adrenergic agonist, a potent bronchodilator and an agent promoted for weight loss because it increases the metabolic rate (21). It has been associated with numerous fatalities (21). Ephedra can potentially interact with volatile anesthetic agents and promote arrhythmias. Furthermore, there can be profound intraoperative hypotension resulting from ephedra in patients who have used it on a long-term basis (21).

A report of the World Health Organization Monitoring Center with nearly 5000 cases of adverse events associated with herbal medications before 1996 included approximately 100 events in children below10 years (21,23). Furthermore, these adverse events are most likely underreported because of no central mechanism for mandatory reporting and nonrecognition of the association of the adverse event with herbal medication (19).

As a result, all children and families should be evaluated for possible intake of herbal medication. Furthermore, patients taking herbal medications are more likely to avoid seeking conventional diagnosis and therapy and rather would use self-medication (24). Therefore, special care should be used to detect an undiagnosed, underlying disorder causing symptoms treated with herbal medicine (19,24). As the impact of the different herbal medications cannot be quantified at present, it is recommended by the American Society of Anesthesiologists to discontinue them 2–3 weeks before surgery in spite of the fact that withdrawal of conventional medication is associated with increased morbidity and mortality after surgery (25,26). Whether this increased morbidity and mortality also occurs following the discontinuation of herbal medicine is unknown.

Fasting times?

The purpose of preoperative fasting times is to avoid stomach contents being vomited and aspirated, especially during induction of anesthesia. The intake of clear liquids, defined as anything that print can be seen through (e.g. tea, water, apple juice) up to 2 h before anesthesia neither significantly increases the fluid content of the stomach nor alters the pH of the stomach contents, which would increase the risk of aspiration pneumonitis. Furthermore, clear fluids help the child to tolerate fasting and also avoids perioperative hypoglycemia (27–29). For solids and milk, longer fasting periods should be set: 4 h for breast milk or formula milk in young infants (<6 months) and 6 h for solids and milk in older infants and children (30–33).

Inpatient or outpatient procedure?

The decision whether a surgical procedure should be performed on an outpatient or inpatient basis includes several factors: minimally or well-controlled physiological alterations, a procedure associated with a low percentage of surgical or anesthetic complications, a short duration of anesthesia and easily controlled postoperative pain (34). The large majority of cases in the pediatric population can be easily performed as outpatient surgery (35).

Prematurely born infants should reach 60 weeks postconceptional age to be eligible for outpatient surgery because of the higher rate of postoperative apneas, periodic breathing, and/or bradycardia in this population (36). Otherwise, they should be admitted to the hospital and monitored for 24 h after anesthesia. A summary of the criteria for outpatient procedures is given in Table 3.

What should the minimal clinical assessment include?

Safety is the prime consideration for each anesthetized child. But what do we really need to know and

Table 3
Selection criteria for day care

Peripheral procedures
Not entering a body cavity
Limited duration
Minimal/moderate postoperative pain which can be managed with oral/rectal medication
No major physiologic disturbances
No major blood loss
No postoperative fasting necessary
No expremature babies (<36 weeks and up to 60 weeks postconceptional age)
Significant (as opposed to mild) OSA

do to be safe? The preoperative assessment is an evaluation of all issues that are relevant to safe anesthesia and performance throughout the perioperative period. A detailed medical history and physical examination by any other health care professional cannot 'clear a patient for anesthesia'. It can only provide additional, important information to the anesthesiologist to aid a decision whether a child is fit for anesthesia.

The preoperative assessment, where the anesthesia team meets the child and family for the first time, often takes place only shortly before surgery. As the perioperative period is a very stressful time for most children and families, any additional stress should be avoided. It is therefore of crucial importance that any evaluations, tests and consultations should not be performed for routine reasons but only if there is a reasonable expectation that they will result in a benefit, such as change in the proceedings, the timing of the anesthesia or perioperative resource utilization that will improve the safety and effectiveness of an anesthetic procedure. Additionally, the potential benefits should be carefully weighed against any potentially adverse effects including interventions that result in injury, discomfort, inconvenience, delay of surgery or increased costs that are not commensurate with the anticipated benefits.

The preoperative visit offers the anesthesiologist an excellent opportunity to interact with the child and family or guardians in order to gain their confidence while at the same time investigating the child's illness and physical limitations. Just by observing the child from a distance while talking to the parents, important information can be collected, e.g. normal exercise tolerance, cyanosis, breathing difficulties, runny nose or cough, basic neurologic development and nutritional status?

The information obtained from the interview and the records should start during gestation and include a description of current diagnoses, treatments including medications (including over-the-counter-medications), recent vaccinations, allergies, recent laboratory tests and a determination of the patient's past and present medical conditions. Furthermore, the family history can be helpful in identifying children with a susceptibility to MH, at a high risk of an atypical pseudocholinesterase, an unknown bleeding disorder or muscular dystrophy. The basic physical examination should include an airway examination (congenital or acquired craniofacial deformities) as well as evaluation of the cardiopulmonary system (37). It is important that this preoperative assessment precedes the ordering or performance of specific tests to avoid unnecessary testing (37).

The timing of the interview and physical examination varies considerably between centers. It certainly depends on the level of surgical invasiveness and also on the practice environment and geography of the area and should be adapted to local conditions. We consider it appropriate to see the child as close in time to the surgery as possible, but preferably not on the same day. This strategy helps to avoid cancellation of surgery if further tests are required. It is increasingly important, for medicolegal reasons to see the child and parents more than 24 h before elective surgery to give them sufficient time to consider different options and potential risks involved. However, if a child has been examined some time before surgery, a new, short evaluation of the child's health must be made on the day of surgery to detect any interim changes e.g. a newly developed respiratory tract infection.

What additional investigations might be warranted?

Preoperative hemoglobin testing

In spite of a lack of evidence that routine preoperative blood testing in healthy children is warranted, this practice is still common in some centers. Routine preoperative blood testing in healthy children reveals approximately 2.5–10% abnormal results but rarely has impact on the scheduled surgery (38–40). The most commonly found abnormality is mild anemia. Although mild anemia is not reliably detected by history taking and examining the child, it is not associated with an increased perioperative morbidity (39,41,42). Furthermore, the presence of mild anemia does not change the anesthesia management and is therefore not warranted in most cases. Nevertheless, in children of African origin, hemoglobin level testing might be warranted because of a higher risk of sickle cell disease and its major implications for perioperative management (43,44). We recommend that the child and family are informed of both positive or negative test results and

we provide them with a card stating the test result which helps to reduce repeated unnecessary future testing.

As many clinically relevant anomalies can be predicted by careful preoperative assessment (40), routine preoperative laboratory testing for all patients regardless of clinical evidence of disease, is not indicated in children (38–40,45–48). However, a strategy to perform laboratory tests is justified only when clinical doubt is present. This approach also significantly reduces the costs, patient discomfort and even risk, that might derive from a large number of false-positive results (postponing surgery while tests are repeated, further diagnostic assessments are made, or even treatment of the patient based on these results) and from false-negative results that lead to the omission of the usual measures of caution (38,47).

Preoperative evaluation should not be used for routine health-care screening of children because follow-up of an abnormal preoperative test result is normally poor and could create medicolegal issues for the physician (49).

Preoperative coagulation testing

Coagulation studies are often thought to be useful, especially in children undergoing adenoidectomy and/or tonsillectomy, despite the clear evidence that preoperative coagulation studies have a very low positive predictive value in detecting occult bleeding disorders or an increased risk for perioperative hemorrhage (50–53). The American Academy of Otolarnygology – Head and Neck surgery therefore recommends screening only for patients with a clear medical indication based on the history or a physical examination that might indicate potential coagulation problems (54).

While taking a coagulation history of a child, a history of 'excessive bruising' is very subjective and frequently reported in children with and without bleeding abnormalities (55). Large bruises, hematomas, simultaneous bruising of several parts of the body or unusual forms of bleeding (e.g. frequent and prolonged epistaxis, unusual bleeding after minor trauma) are more suggestive of a clotting disorder than bruising itself (55,56).

Even with a careful history, mild forms of von Willebrand's disease, mild platelet dysfunction or factor deficiencies (e.g. factor XI) can be missed but would not change management for minor surgery (57). Thus, normal coagulation values, even in the presence of an insignificant history, do not completely rule out a coagulation disorder (51). Not all children exhibiting preoperative abnormalities in coagulation tests will have bleeding problems in the perioperative period and vice versa (58,59). The commonly used prothrombin time only examines the extrinsic coagulation pathway while its sensitivity to detect inherited defects is minimal. In contrast, the partial thromboplastin time examines the intrinsic pathway and is therefore more useful in detecting inherited diseases, although it can be normal even in the presence of disease (59,60).

Arterial blood gases vs noninvasive methods

Preoperative arterial blood gases are rarely indicated in children. In addition, they are invasive and difficult to perform in an awake child prior to surgery and do not improve the quality of risk assessment or risk stratification (61). In contrast with arterial blood gases, pulse oximetry is a noninvasive, cost-effective, commonly available method, which gives important supplemental information on baseline oxygenation especially when performed under ambient air conditions. In case of OSAS, an overnight recording might be useful to stratify the risk and the postoperative monitoring. Additionally, transcutaneous carbon dioxide measurements or capillary blood gases can be used especially in young infants to further characterize impairment of respiratory function.

Further preoperative blood testing

Further preoperative blood testing (e.g. for electrolyte imbalance) is only warranted for children with a history suggesting an underlying disease (e.g. renal impairment) or who take medication which might influence the water/electrolyte balance, renal or hepatic function.

Preoperative urine analysis

The rationale for performing routine urine analysis prior to surgery is the detection and treatment of children with unsuspected renal disease and/or urinary tract infection. The collection of a clean,

uncontaminated specimen can be very difficult and time-consuming to collect from children; a preoperative urine analysis does not add significant information to a thorough clinical assessment and can therefore be omitted in most cases (40).

In contrast, a pregnancy test in teenagers might be warranted as the incidence of a positive pregnancy test preoperatively varies between 0.5% and 1.3% in spite of a negative history. This rate of unknown pregnancies increases to 2.4% in patients 15 years and older (62). Furthermore, detection of an unknown pregnancy has major implications for anesthesia management and might lead to long-term cancellation of elective surgery (62,63). The American Society of Anesthesiologists therefore recommends offering pregnancy testing to any female patient of childbearing age (37).

In conclusion, any preoperative laboratory testing should only be performed in the presence of a positive finding in the history and/or physical examination or if there is a clear need for baseline values because of anticipation of significant changes resulting from surgery or other medical intervention (e.g. chemotherapy) (64).

Preoperative chest X-ray

In the 1970s, a chest X-ray was a routine preoperative requirement even in children. After several studies demonstrated that chest X-rays rarely reveal clinically important abnormalities which were not already suggested by a thorough history and physical examination, the American Academy of Pediatrics now recommends, in order to minimize radiation exposure in children, no chest X-ray unless there is a clear indication that it will have significant impact on the perioperative period (65,66).

Preoperative chest X-rays are, however, important for children who have cervical lymph node biopsies for suspected lymphomas. These children can present with no or only few symptoms in spite of an extremely fast growing mass in the anterior mediastinum, which has major implications for anesthesia management.

Pulmonary function testing

For some time, studies suggested that it was not necessary to perform preoperative laboratory evaluation of pulmonary function (e.g. spirometry) (67). However, several studies in adults suggest that clinical identification of preexisting chronic lung disease is inadequate for the purposes of risk assessment. Clinical identification of lung disease was thought to be comparable with spirometry to assess the risk of a respiratory adverse event (68,69). Some asthmatic patients, especially children, are unaware of significant changes in lung function, and therefore it is unreliable to use their symptoms to assess disease severity and potential optimization of respiratory function (70). In such circumstances, respiratory function tests (e.g. assessing peak flow or forced expiratory volume in 1 s) are noninvasive, easily performed and inexpensive tests that can help to quantify the severity of respiratory impairment, detect the response to therapeutic interventions and document the time course of respiratory impairment. In this context, the measurement of maximum expiratory flow-volume curves is a valuable clinical test but is limited to children above the age of 5 years, as active cooperation of the patient is required.

Spirometry is particularly useful when there is uncertainty about the presence of lung impairment, as this has a profound effect on anesthesia and provides the opportunity to optimize lung function preoperatively (61). Although spirometry can enhance the diagnosis of impaired respiratory function, it does not quantify perioperative risk. Spirometry should not be used indiscriminately but only where its use could provide further information which would change perioperative management or improve risk stratification (61).

Cardiac evaluation

A cardiac evaluation is recommended in all patients with symptoms suggesting cardiac disease (e.g. failure to thrive, low exercise tolerance, recurrent respiratory tract infection). Furthermore, it should be performed in all asymptomatic patients with a clinical assessment indicating the potential for underlying cardiac disease including all patients during or shortly after chemotherapy. An echocardiogram is also helpful in identifying any arrhythmias or conduction defects (e.g. prolonged QT times).

Patients with neuromuscular disease (e.g. Duchenne's muscular dystrophy) also have a high

incidence of cardiac pathology and can present with rhythm disturbances, mitral valve prolapse and ventricular wall hypokinesia. The ECG may show right axis deviation, atrioventricular, or intraventricular conduction defects.

In conclusion, preoperative assessment is an extremely important component for ensuring optimal preparation of a child prior to surgery; physiologically and psychologically. While a major improvement in pediatric anesthesia mortality has been seen during the last two decades, the incidence of perioperative morbidity remains high. Advances in this field require targeting anesthesia management to the risks encountered in children. Thus, a broad knowledge of potential risks is mandatory during preoperative assessment before applying the preventative tools to improve outcome. The anesthesiologist should primarily focus on a detailed medical history starting from the prenatal period and while talking to the parents observe the child closely before carrying out a systematic physical examination. Table 4 summarizes commonly found

Table 4
Symptoms encountered at the preoperative assessment, their potentially underlying disease as well as a suggestion for the action to be taken prior to surgery

Symptom	*Potential underlying disease*	*Action to be taken*
Prolonged exhalation Chronic nocturnal cough Wheezing or recurrent wheeze with URTI Passive smoking Runny nose, cough	Bronchial hyperreactivity Asthma URTI	Optimize respiratory function before surgery Optimize treatment Beta-2-agonist preoperatively Oral steroids if current wheezing
Snoring Nocturnal apnea Preferred mouth breathing	Obstructive sleep apnea syndrome	Organize postoperative monitoring for 24 h Consider cardiac evaluation and/or sleep study prior to surgery depending on severity of symptoms and surgery
Expremature baby mechanically ventilated after birth	Bronchopulmonary dysplasia	Optimize respiratory function before surgery Optimize treatment Beta-2-agonists Evaluate cardiac function Assessment of electrolytes if treated with diuretics
Murmur No change with change in position >2/6 Diastolic or pansystolic component Children <1 year Abnormal exercise tolerance Cyanosis Differences between upper and lower limb blood pressures Enlarged liver	Cardiac malformation	Cardiology consult ECG Echocardiography Chest X-ray
Large bruises, hematomas Simulataneous bruising of several parts of the body Petechiae Unusual forms of bleeding Unexplained epistaxis	Coagulation disorder	Coagulation studies, possibly hematologic consult
Enlarged liver and/or spleen Neurologic deficits	Metabolic disease	Consult specialist for interdisciplinary perioperative care if necessary
Several pervious operations Spina bifida	Latex allergy	Latex free environment
Urinary malformations	Latex allergy	Latex free environment
Death in family during anesthesia	Malignant hyperthermia	Trigger-free anesthesia
Prolonged mechanical ventilation in family	Pseudocholinesterase deficiency	No succinylcholine

symptoms in the pediatric population and potential underlying medical conditions as well as suggestions for actions to be taken prior to surgery. Following a thorough assessment, tests should only be performed that have a direct impact on perioperative management or are needed to obtain baseline values because of anticipated significant changes in these parameters. The treatment of any underlying disease should be optimized and if needed discussed in an interdisciplinary forum to minimize perioperative adverse events.

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