"An approach to procedural sedation and analgesia (PSA) for the obese child"

Why is this important? Procedural sedation and analgesia (PSA) refers to a technique (minimal, moderate or deep sedation) where sedatives, hypnotics, dissociative agents, with or without analgesics, are administered to patients to induce a sedative/hypnotic state. PSA also includes the use of nitrous oxide which could be an excellent option for sedation for the obese child. PSA allows the patient to tolerate unpleasant procedures while maintaining cardio-respiratory function. The drugs, doses and techniques used must not produce unconsciousness and a loss of protective airway reflexes e.g. coughing and swallowing.

The administration of drugs is a major adjunct for use with behavioural management techniques in 15-20% of paediatric dental patients[1]. Several hundred thousand children yearly receive oral sedation in the United States for dental procedures; similar numbers are administered parenteral sedation or receive general anaesthesia.

Benefits of sedation include the provision of comprehensive dental care to patients who would otherwise not receive it plus a reduction in "dental fear" that would potentially complicate future care. Loss of airway control and hypoxemia tend to occur mostly in patients with pre-existing conditions e.g. the obese that affect respiration – hence the importance of a pre-sedation history and examination. Patients should be classified as ASA 1 or 11 to qualify for sedation outside the operating theater.

Between 2004 and 2007 the data of a total of 49,836 propofol sedations/anaesthesia cases from thirty-seven different locations in the United States were submitted for a study to report on the incidence and nature of adverse events during procedures outside the operating room. The data indicated that propofol sedations/anaesthesia is unlikely to yield serious adverse outcomes in institutions with highly motivated and organised services. However, the safety of this practice is dependant on a system's ability, and the level of training of the staff, to manage less serious events[2].

Is obesity in children really a problem? The answer to this is yes when we consider the use of PSA for surgical procedures outside the operating theatre. Obesity is regarded as a systemic condition in which patients are considered to have chronic extrinsic restrictive lung disease as well as other compromised systems (e.g. cardiovascular and gastrointestinal), all of which can contribute to major adverse events during sedation. A recent survey highlighted the importance to improve training available for health care professionals in managing childhood obesity. There is an urgent need to develop integrated care pathways involving the essential multidisciplinary teams to manage this potentially modifiable condition[3].

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[1] Baker S, Yagiela JA. Obesity: A complicating factor for sedation in children. Pediatric dentistry 2006; 487-93.

[2] Joseph PC, et all. The incidence and nature of adverse events during pediatric sedation/anaesthesia with propofol for procedures outside the operating room: A report from the pediatric sedation research consortium. Pediatric anaesthesiology March 2009, 108:3:795.

[3] Tornton W, et all. Satisfaction, scopes and limitation for health professionals managing childhood obesity. Archives of Disease in Childhood 2010;95: A95-96.

In the United States, obesity can be described as a pandemic – yearly, it contributes to over 300 000 premature deaths, and over 100billion dollars in associated costs. Currently, almost one third of children and adolescents in the United States are either overweight or obese[4]. The population is distributed into higher weight categories with advancing age, as shown below:

- Overweight or obese (BMI≥85 percentile)

  21.2 percent of preschool children (2 to 5 years)

  35.5 percent of school-aged children (6 to 11 years)

  34.2 percent of adolescents (12 to 19 years)

- Obese (BMI≥95 percentile)

  10.4 percent of preschool children

  19.6 percent of school-aged children

  18.1 percent of adolescents

- Severe obesity (defined as a BMI≥97 percentile for these data)

  6.9 percent of preschool children

  14.5 percent of school-aged children

  12.5 percent of adolescents

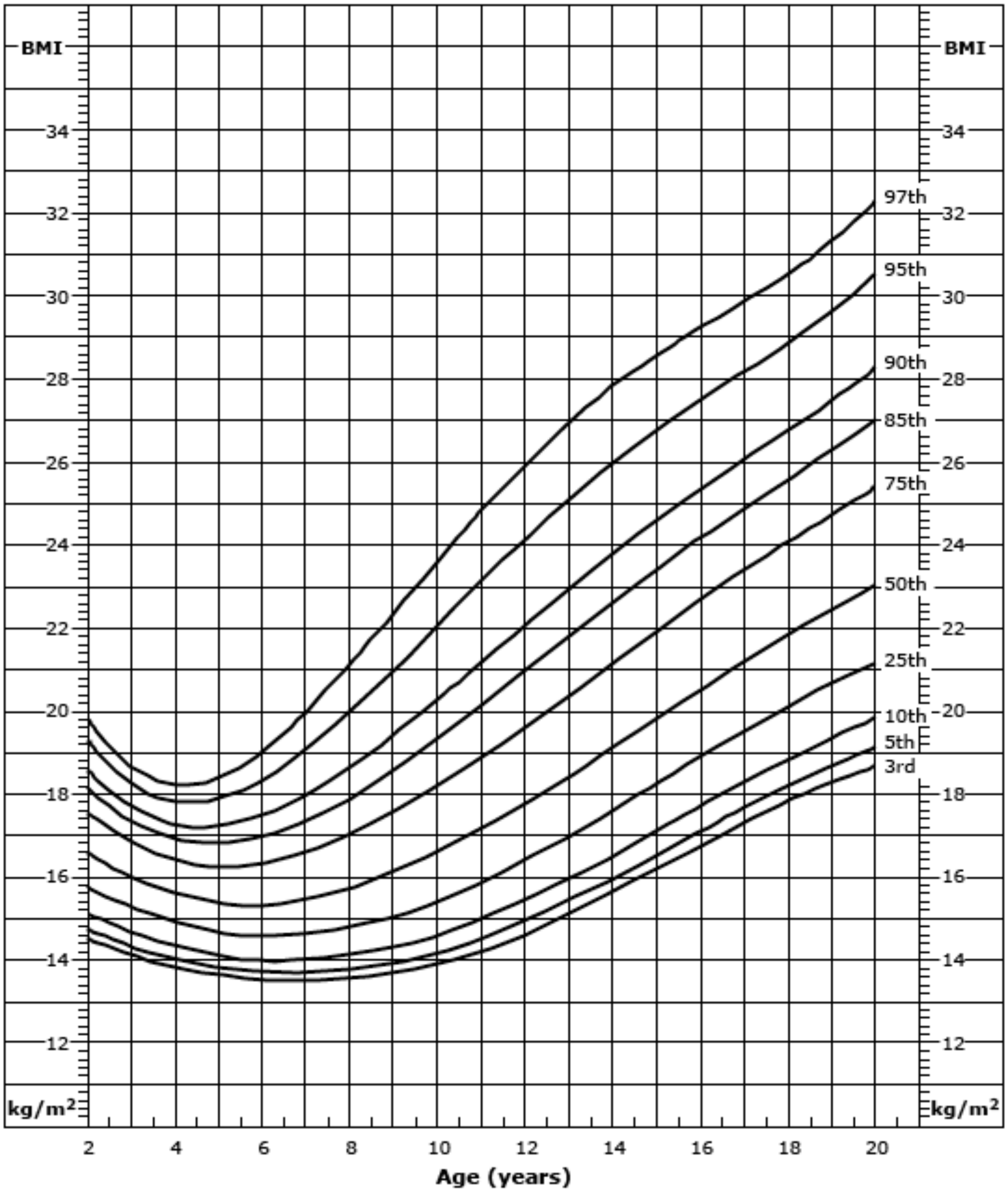
Definitions in this context "Overweight" technically refers to an excess of body weight, whereas "obesity" refers to an excess of fat. However, the methods used to directly measure body fat are not available in daily practice. For this reason, obesity is often assessed by means of indirect estimates of body fat (e.g. anthropometrics).

The body mass index (BMI) is the accepted standard measure of overweight and obesity for children two years of age and older. Body mass index provides a guideline for weight in relation to height and is equal to the body weight divided by the height squared. The BMI is also an acceptable tool when we have to decide as sedation practitioners whether we will sedate a patient outside the operating theater. In 2000, the National Center for Health Care Statistics and the Centers for Disease Control (CDC) published BMI reference standards for children between the ages of 2 and 20 years. See below the two charts for boys and girls included:

[4] Ogden CL, Carroll MD, Curtin LR, et al. Prevalence of high body mass index in US children and adolescents, 2007-2008. JAMA 2010; 303:242.

Chart 1:

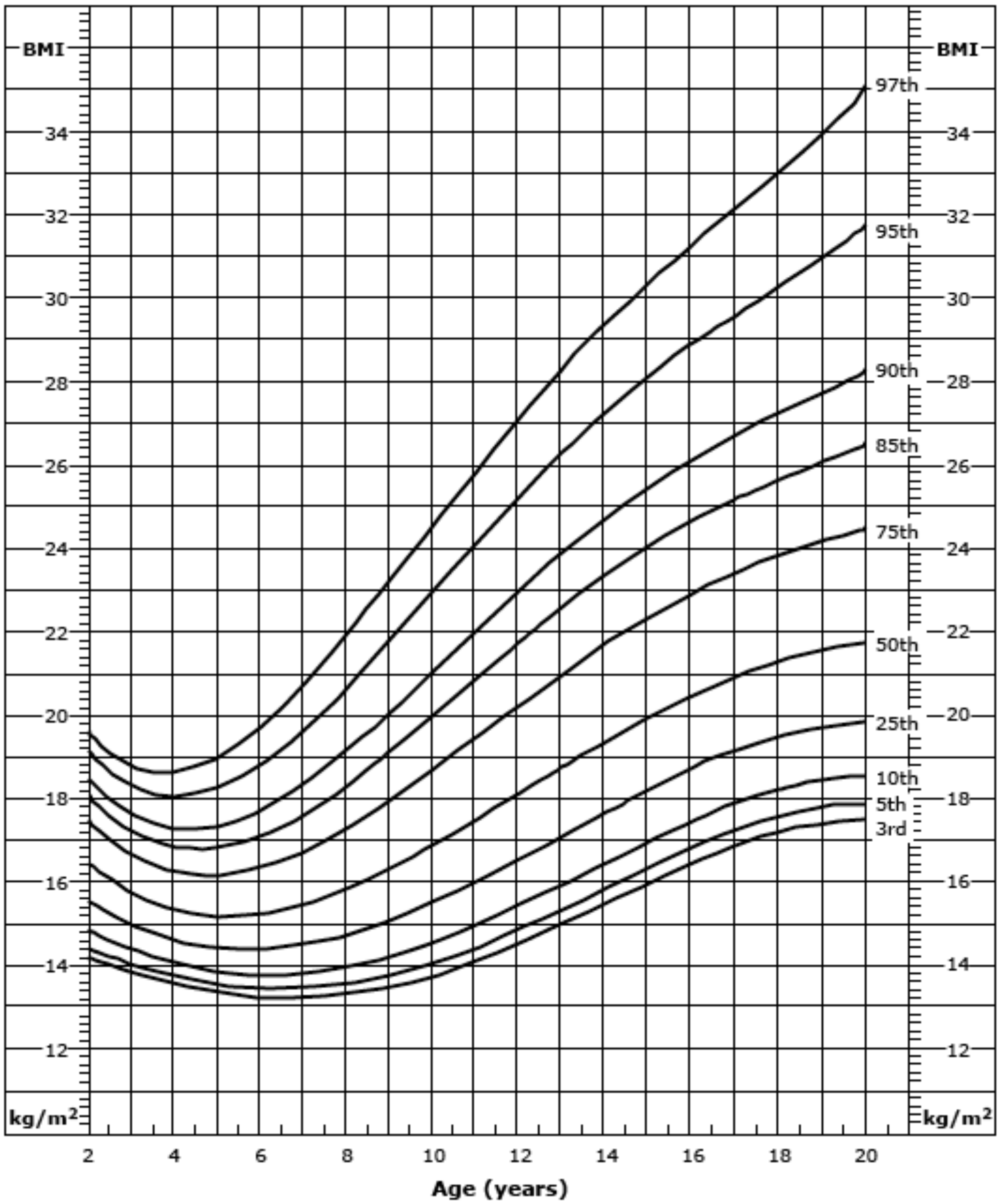
Body mass index-for-age percentiles, boys, 2 to 20 years, CDC growth charts: United States



Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

Chart 2:

Body mass index-for-age percentiles, girls, 2 to 20 years, CDC growth charts: United States



Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

A growing consensus of opinion supports the following definitions for obesity in children between 2 and 20 years of age

- **Underweight** — BMI <5th percentile for age and sex.
- **Normal weight** — BMI between the 5th and 85th percentile for age and sex.
- **Overweight** — BMI between the 85th and 95th percentile for age and sex.
- **Obese** — BMI ≥95th percentile for age and sex.
- **Severe obesity** — BMI ≥120 percent of the 95th percentile values, OR a BMI≥35.
  This corresponds to approximately the 99th percentile, or BMI z-score ≥2.33.

The definition of severe obesity in children and adolescents is not fully standardized. The above definition has been proposed because it is clinically practical, and the CDC growth standards are not sufficiently precise to use percentile curves at the extremes. At age 18 a BMI ≥120 percent of the 95th percentile corresponds approximately to the BMI threshold of 35 kg/m2, which defines Class II obesity in adults. This BMI threshold is extremely important for us as sedation practitioners as this gives an indication whether we can do a patient inside or outside the operating theater. There are however trainers in PSA that believe that this threshold should be 32 kg/m2.

Factors contributing to obesity in childhood Exogenous causes of obesity (hypothyroidism, Cushing's syndrome) are relatively rare but should be considered when the patient is seen before the sedation. Obesity is mostly caused by environmental factors: either a sedentary lifestyle or a caloric intake that is greater than needs. Increasing trends in glycemic index of foods, sugar-containing beverages, portion sizes for prepared foods, fast food service, diminishing family presence at meals, decreasing structured physical activity, increasing use of computer-oriented play activity and elements of the built environment (e.g. availability of sidewalks and playgrounds) have all been considered as causal influences on the rise in obesity.

Television viewing is perhaps the best-established environmental influence on the development of obesity during childhood. The amount of time spent in watching television is directly related to the prevalence of obesity in children and adolescents.

A number of drugs can cause weight gain, including psychoactive drugs (particularly olanzapine and risperidone), antiepileptic drugs, and glucocorticoids. Brief courses of glucocorticoids (e.g. several days for an exacerbation of asthma) are unlikely to have long-term effects on body weight unless they are prescribed frequently. Weight gain and hyperlipidemia induced by olanzapine, a psychotropic drug, may be particularly severe in adolescents as compared to adults.

There is increasing evidence that environmental and nutritional influences during critical periods in development, so called "metabolic programming" can have permanent effects on an individual's predisposition to obesity and metabolic disease. The precise mediators and mechanisms for these effects have not been established, but are the subject of ongoing investigations.

Anatomical problems caused by obesity and impacts on the airway

The impact of obesity on the airway is crucial for us to understand as sedation practitioners. If we do not understand this then we must not sedate obese children.

The pharynx is the most collapsible part of the airway. Pharyngeal collapse usually occurs at the level of the epiglottis, uvula and tongue. This may lead to airway obstruction and hypoxaemia. Every sedation practitioner must then evaluate the airway carefully before PSA. There are various tools available to evaluate the airway. Sedation practitioners must always guard against possible airway obstruction. Drugs must always be titrated for PSA to achieve a desired effect.

Pharyngeal patency depends on the muscles preventing airway collapse (mostly genioglossus, tensor palatini and various hyoid muscles). Pharyngeal muscle tone may decrease during psychological sleep and with drugs used for sedation, leading to significant narrowing of the upper airway, turbulent airflow and snoring - in obese individuals, adipose tissue in the neck and pharynx already promote airway narrowing.

Other complications associated with obesity relevant for PSA include:

- Fat face with implications for rescue when necessary
- Short neck which may lead to obstruction
- Restricted mouth opening (mainly due to submental fat, fleshy cheeks and a larger tongue)
- Limited flexion and extension of the cervical spine and atlanto-axial joint

Of vital importance is any symptom reported by the parents that suggests airway obstruction or obstructive sleep apnoea (e.g. snoring, apnoea).

The assessment of the airway should also include range-of-motion testing of the atlanto-axial joint, cervical spine and jaw. Attention must also be paid to extension of the neck.

Under the following conditions it must be carefully considered whether a patient must not be done in a hospital setting[5]:

- Obstructive sleep apnoea (OSA)
- Large tonsils approaching the midline, or associated with loud snoring
- Children who cannot lie flat because of airway obstruction
- Stridor
- Retropharyngeal and neck masses
- Neck mobility: decreased range of movement
- Syndromic features (e.g. enlarged tongue, micrognathia, abnormal ears)

The Mallampati classification, for evaluation of the position of the uvula, is used during pre-operative assessment to evaluate patency of the airway, and gives an indication whether a patient can be done outside the operating theater or in a facility.

Figure 1 shows the position of the uvula. A patient with a Mallampati class 1 and/or 2 score qualifies for sedation outside the operating theater.

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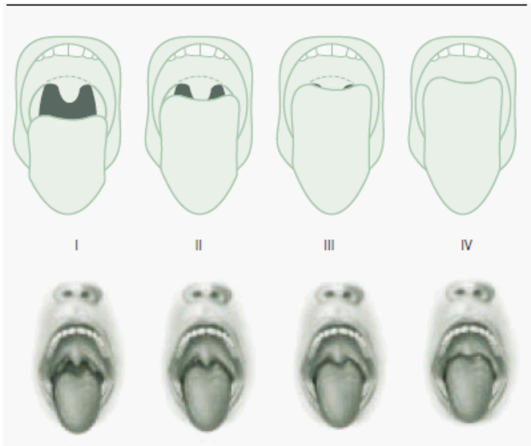
[5] "SAJAA Guidelines for the safe use of procedural sedation and analgesia for the diagnostic and therapeutic procedures in children: 2010".

Figure 1: Mallampati classification for prediction of difficult intubation
*Class 3 and 4 not for sedation outside the hospital setting



Obesity and the systemic physiological changes

The interrelationship between abnormal physiology and obesity is complex. Deranged physiology both at molecular (as mentioned earlier) and systemic level contributes to the development of obesity, and may determine the severity of its associated co-morbidities.

In turn, both obesity and the related co-morbidities results in physiological abnormalities, which can have a major impact in the peri-procedural period during PSA. Not all features of physiological derangement are seen in all patients as both environmental and genetic factors modify the development of abnormal physiology.

An approach to the different systems that may affect PSA:

1.Fat distribution

This distribution of fat can have a quite significant contribution to the presence of other physiological disturbances. Two major types exist:

Android obesity, the most common form in children, indicates fat is distributed primarily intra-abdominally. This is directly linked to increased oxygen consumption, cardiovascular risks and left ventricular dysfunction.
Gynaecoid obsity is the second type (most prevalent to women) where fat is mainly distributed in the buttocks and thighs. This form is associated with less metabolic complications and lower incidence of cardiovascular disease[6].

2.Respiratory system and obstructive sleep apnoea

All respiratory changes associated with obesity (including restrictive lung disease and obstructive sleep apnoea) can compromise breathing during sedation and the outcome of adverse events.

[6] Peiris AN, Sothmann MS, Hoffmann RG, Hennes MI, Wilon CR,Gustafson AB, Kissebah AH. Adiposity, fat distribution and cardiovascular risk. Ann Intern Med 1989; 64:369-73.

The various lung volumes and capacities are summarized in Figure 2 and Table 1 and a basic understanding thereof is of vital importance to the sedationist.

Figure 2: Various lung volumes and capacities

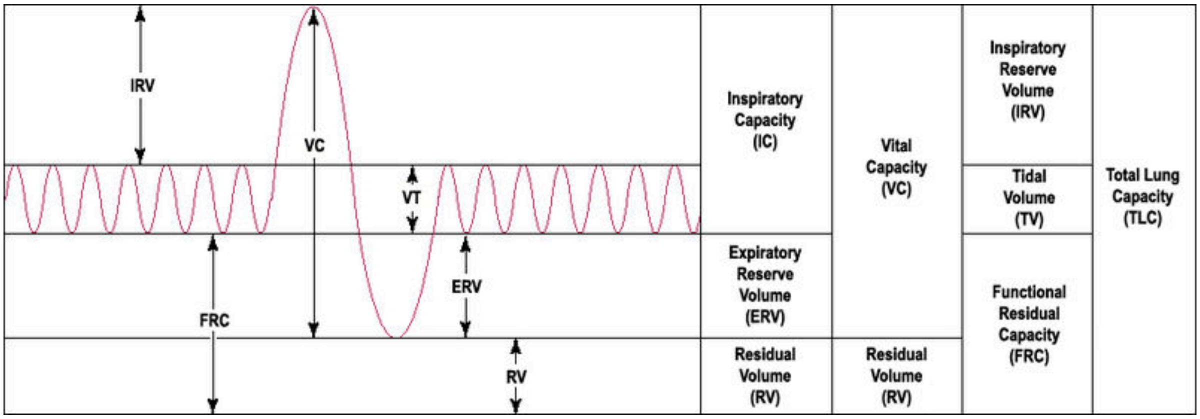


Table 1: The definitions of the various lung volumes and capacities

Lung volume/capacity	Definition
Tidal volume (TV)	The volume of air that moves in and out of the lungs during quiet/ normal respiration (6-7mls in children and adults)
Inspiratory reserve volume (IRV)	The maximal inspiration of air beyond the volume of a quiet inspiration
Expiratory reserve volume (ERV)	The maximal expiration of air beyond the volume of a quiet expiration
Residual volume (RV)	The amount of air that remains in the lung after forced maximal expiration
Inspiratory capacity (IC)	The largest volume of air that can be inspired after a passive expiration
Vital capacity (VC)	The maximum volume of air expired after maximal inspiration
Functional residual capacity (FRC)	The volume of gas remaining in the lungs at passive end expiration (25-35ml/kg in children, 30-40ml/kg in adults)
Total lung capacity (TLC)	The maximum amount of air the lungs can hold and the sum of the VC and RV (60-65ml/kg in children, 80-85ml/kg in adults)

As mentioned earlier – the effect of the excess thoracic weight and intra-abdominal pressure imposes a restrictive ventilatory problem in the obese patient. This may especially be so in dental sedation with the patient in the head down position. It may sometimes be necessary to do the procedure more in the upright position.

There is a well-known relation between increased body mass index (BMI) and respiratory dysfunction: as the BMI of a patient increases, the functional residual capacity (FRC) decreases. In young adults specifically, there is a progressive and steep reduction in the FRC. There is also a similar fall in the vital capacity and an increase in the alveolar oxygen tension gradient. There might be an increased shunt in deeply sedated obese patients usually more severe in those with an android fat distribution. This is due to the effects of an increase in intra-abdominal pressure (due to fat distribution) pushing upwards against the diaphragm and lung bases, together with the effect of a heavier chest wall compressing different areas off the lungs. The manifestation of this added weight and associated pressure on the diaphragm include decreases in the FRC, expiratory reserve volume (ERV), and in the morbidly obese the vital capacity (VC) and total lung capacity (TLC).

The FRC may be decreased to the closing capacity (CC), which is the point where small airway closure occurs and atelectasis ensues, with resulting ventilation-to-perfusion (V/Q) mismatching, right-to-left shunting and arterial hypoxemia, as mentioned earlier. Because of the drop in FRC, the oxygen reserves may be restricted during apnoeic episodes.

This may be further exacerbated by pre-existing airway collapse and atelectasis; especially in the patients with obstructive sleep apnoea (OSA) or where airway compression occurs while the patient is sedated.

Obstructive sleep apnea (OSA) is characterized by episodes of complete or partial upper airway obstruction during sleep, often resulting in gas exchange abnormalities and disrupted sleep. The condition exists in 2 to 5 percent of children and can occur at any age, but may be most common in children ages two to six years. It is thought that up to 10 percent of obese children suffer from OSA. Untreated OSA is associated with cardiovascular complications, impaired growth (including failure to thrive), learning problems and behavioral problems. Early diagnosis and treatment of OSA may decrease morbidity.

Obesity hypoventilation syndrome is the long-term consequence of sleep apnoea and with the development of this syndrome there is evidence of nocturnal alterations in the control of breathing manifestations as central apnoeic events[7]. These episodes of central apnoea cause desensitization of the respiratory centres to hypercarbia, and at its extreme, obesity hypoventilation syndrome spirals to the development of the "Pickwickian syndrome" which is characterized by gross obesity, somnolence, periodic breathing, hypercapnoea, hypoxemia, polycythemia and pulmonary hypertension.

Habitual snoring is an important clinical feature of OSA. Most children with OSA habitually snore, while lack of habitual snoring makes OSA less likely. All sedationists should be asking about snoring during routine presedation assessments. Any child who snores on most or all nights should undergo diagnostic evaluation, which includes a careful history, physical examination and polysomnography.

The effect of drugs on the mechanics of the respiratory system, as described above, must be carefully considered by the sedation practitioner. Drugs must be carefully selected and titrated to effect.

3.Cardiovascular changes and the right heart

Hypertension is the most common co-morbidity associated with obesity. Children with obesity are three times more likely to have hypertension than non-obese children. Ambulatory blood pressure monitoring detects hypertension in about 50 percent of children and adolescents with obesity. More than 50 percent of obese children have lipid abnormalities as measured by a fasting lipid profile. The typical pattern is one of elevated concentration of serum low-density lipoprotein (LDL)-cholesterol and triglycerides and decreased concentration of high-density-lipoprotein (HDL)-cholesterol. Childhood obesity also predisposes to a number of

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[7] Adams JP, Murphy PG. Obesity in anaesthesia and intensive care. British Journal of Anaesthesia 2009;85:979-82.

other risk factors for atherosclerosis. These include endothelial dysfunction, carotid intimal thickening, the development of early aortic and coronary arterial fatty streaks and fibrous plaques, decreased arterial distensibility and increased left atrial diameter. Cardiovascular complications are generally rare in young, healthy ASA 1 and 11 sedated patients, but have to be considered in the obese paediatric population. Dysrhythmias in this group may be precipitated by arterial hypoxemia, hypercarbia, ischemic heart disease, obese hypoventilation syndrome or fatty infiltration of the cardiac conduction system. Pediatric OSA may be associated with systemic hypertension, pulmonary hypertension/cor pulmonale, and left or right ventricular hypertrophy. With respect to pulmonary hypertension in children with OSA, the prevalence of symptomatic disease is low, and the overall prevalence is unknown.

4.Gastrointestinal changes

Increased intra-abdominal pressure and hiatus hernias are more likely in obese patients. In the obese paediatric population the fasting gastric volume is approximately 0.4ml/kg with a pH of less than 2,5. This is generally accepted as an indication for a high risk of aspiration pneumonitis should this fluid reach the lungs[8]. Sedation practitioners must always see that the paediatric patients are fasted as stipulated by all international sedation guidelines. About 40 percent of obese children have a fatty liver, with a prevalence that varies by ethnicity, independent of obesity status. Approximately 10 percent of obese children and adolescents have mildly elevated serum aminotransferase concentrations, which are usually caused by non-alcoholic fatty liver disease (NAFLD). Weight loss is the only established treatment for NAFLD.

5.Endocrine changes

The reported prevalence of impaired glucose tolerance among obese children and adolescents ranges from 7 to 25 percent, and the prevalence of type 2 diabetes ranges from 0.5 to 4 percent.
The metabolic syndrome describes the clustering of abdominal obesity, hyperglycemia, dyslipidemia and hypertension, which are risk factors for type 2 diabetes and atherosclerotic cardiovascular disease (as mentioned under cardiovascular). Adolescent girls with obesity are at increased risk of hyperandrogenism and early onset polycystic ovary syndrome (PCOS). PCOS can include a variety of clinical abnormalities, including hirsutism, menstrual irregularities, acanthosis nigricans, premature pubarche, acne and seborrhea.

The sedation practitioner must always enquire as to the blood glucose levels of obese children.

6.Psychosocial

Psychosocial consequences of childhood obesity are common, and include poor self-esteem, distorted body image, anxiety and depression. The risk of psychosocial morbidity increases with increasing age and is greater among girls than boys. The obese children may be extremely anxious; behavioural management techniques will play an important role in preparing them for a sedation procedure.

Drugs and pharmacokinetics

[8] Vaughan RW, Bauer S, Wise L. Voluma and pH of gastric juice in obese patients. Anaesthesiology 1975;43:686-9

Drug absorption, distribution, metabolism and excretion are all affected by an increase in the BMI. Hydrophilic drugs (e.g. aminoglycosides) exhibit no significant differences in peak blood concentrations between obese and normal-weight patients when dosed on the lean body mass (LBM)[9].

LBM includes all tissue other than fat and is usually determined by measuring skin fold thickness, bioelectrical impedance, hydrostatic weighing or dual-energy x ray absorptiometry, but can be estimated by the method of James[10] as follows:

- Males = $[1.10 \times weight] - [128 \times (weight^2/height^2)]$
- Females = $[1.07 \times weight] - [148 \times (weight^2/height^2)]$

(Weight in kg and height in cm)

Lipophilic drugs on the other hand, including most agents used for sedation (e.g. midazolam, fentanyl), act differently. Intravenous bolus doses of drugs such as propofol calculated on lean body mass tend to produce similar initial effects irrespective of obesity. However, the duration of the clinical effect is shortened by increased redistribution to body fat. Repeated doses also show less early accumulation of effect in the obese because the excess fat increases the ability to sequester drugs away from the brain. Upon cessation of drug administration, the fat-sequestered drug will slowly return to the systemic circulation, resulting in a longer elimination half-life. Thus, while initial recovery from sedation may tend to be faster in the obese, complete recovery is likely to be delayed[11].

Morbidly obese patients have a significantly higher pseudocholinesterase activity than non-obese patients. This might be of some benefit when using topical ester local anaesthetics. Obesity is not associated with phase 1 metabolism (oxidation, reduction, and hydrolysis); although drugs eliminated through phase 2 metabolism (e.g. glucoronidation) appeared to be cleared faster in the obese. Both glomerular filtration and tubular secretion are also increased in the obese, and renally excreted drugs (e.g. amoxicillin, gentamycin) may need more frequent dosing.

The use of nitrous oxide ($\leq$50%) is a good option for paediatric sedation because of its rapid onset, minimal respiratory depression and easy reversibility. Benzodiazepines, such as midazolam in doses up to 0.6mg/kg, and titrated to effect, are also suitable.

Chloralhydrate and opioids, especially in large doses, should be avoided because of their greater likelihood of producing excessive sedation and respiratory depression (in an obese patient there is an existing potential of fast developing hypoxemia).

Choose your patient well

PSA must provide a safe environment for the patient, and the result must be effective control of pain, anxiety

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[9] Ogunnaike BO, Whitten CW. Anaesthesia and obesity. Clinical Anaesthesia. 5th ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 2006.

[10] James WPT. Research on obesity: A report of the DHSS/MRC Group. London, UK: Her majesty's Stationary Office; 1976.

[11] Blouin RA, Kolpek JH, Mann HJ. Influence of obesity on drug disposition. Clinical pharmacology 1987;6:706-14.

and movement in children undergoing procedures. Decreased awareness and amnesia are added advantages[12].

Identification of those children unsuitable for PSA is crucial, and many of the sedation techniques utilized in adults are not recommended for paediatric practice. The American Society of Anesthesiologists (ASA) Physical Status Classification System is tabulated below:

Table 2: ASA classification

ASA class	Definition
1	A normally healthy patient
2	A patient with mild systemic disease and no functional incapacity
3	A patient with severe systemic disease that limits activity, but is not incapacitating
4	A patient with severe systemic disease that is a constant threat to life
5	A moribund patient not expected to survive 24 hours with or without an operation

The letter E following the class number denotes E- An emergency procedure

ASA class I and II patients are usually good candidates for sedation. The following patients should preferably be sedated in a hospital setting:

- Age < 1 year
- Prematurity with residual pulmonary, cardiovascular, gastrointestinal or neurological problems or significant anaemia
- Children with congenital syndromes
- Obesity (> 95th percentile BMI for age)
- Children who need an advanced sedation technique
- A previous failed sedation
- A previous over sedation (unintentional deep sedation or general anaesthesia)
- Any known adverse effect (hyperactive or paradoxical response) or allergy to any of the sedation drugs
- Any child who, following airway assessment is suspected of having airway problems
- Children with respiratory problems, including an active URTI, low oxygen saturation, and a weak cough or cry
- Asthmatic children who are clinically wheezing or whose regular treatment includes more than inhalational short acting B2 –agonists and inhalational steroids
- Children with cardiac problems, including congenital cardiac disease, cyanosis, congestive heart failure and undiagnosed murmurs
- Neurological conditions, including poorly controlled seizures, neuromuscular disease, central apnoea or an unstable cervical spine
- Increased intracranial pressure
- Severe behavioural problems
- Uncontrolled gastro-oesophageal reflux or other conditions predisposing to reflux
- Active vomiting
- Haematological conditions, including coagulation disorders and sickle cell disease
- ASA class III and IV
- Parental reluctance
- Children with malignancies

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[12] "SAJAA Guidelines for the safe use of procedural sedation and analgesia for the diagnostic and therapeutic procedures in children: 2010"

In other patients, the sedationist should be more cautious and have a low threshold for referring the patient to a more suitable institution, if he or she does not feel comfortable performing the sedation. In these patients, even simple sedation may be problematic:

- Age < 5 years
- Acute or chronic altered mental state
- Head injury
- Communication problems
- Severely delayed physical or mental milestones
- Children on psychotropic drugs, including methylphenidate
- Epilepsy
- Controlled gastro-oesophageal reflux (i.e. GORD on treatment)

Follow the guidelines[13]

This is the most effective strategy to reduce the incidence of adverse events. Evaluation of risk before sedation should ideally be performed by the sedationist him/herself, alternatively by an appropriately trained practitioner and reviewed if necessary. This provides an opportunity to identify specific risk factors, and may warrant additional consultation before sedation[14].

Pre-sedation evaluation should include:

- Obtaining age and weight
- Full medical history, including relevant diseases, physical abnormalities, congenital syndromes, behavioural problems, hyperactivity and mental retardation. History of sedation or general anesthesia and any complications, including previous failed sedation. Allergies and previous allergic or adverse drug reactions is important as well as current medication (e.g. anti-epileptic drugs, antiretroviral)
- Performing a review of all organ systems (in obese children special attention should be given to the cardiovascular and respiratory systems)
- Recording of the vital signs (for some noncooperative children this might be impossible; however this occurrence should be documented)
- Physical examination, including a focused evaluation of the airway to determine any risk for obstruction (see section under "Anatomical problems caused by obesity")
- Classify the child according to the ASA classification

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[13] "SAJAA Guidelines for the safe use of procedural sedation and analgesia for the diagnostic and therapeutic procedures in children: 2010"

[14] Ramaiah R, Bhananker S. Paediatric procedural sedation and analgesia outside the operating room: anticipating, avoiding and managing complication. www.expert-reviews.com 10.1586/ERN.11.52.

- Obtaining contact information of the parent / guardian
- Signed consent

Preparation and setup for sedation and analgesia should follow acknowledge pre-procedural checklists and guidelines. A commonly used acronym that is useful in planning and preparation for a procedure is "SOAPME" (see table 3).

Table 3: SOAPME check-list

S (suction)	Size-appropriate catheters and a functioning suction device
O (oxygen)	Adequate oxygen supply, flow meters and other devices to allow O2 delivery
A (airway)	Age-appropriate airway equipment
P (pharmacy)	Basic drugs for life-support and antagonists
M (monitors)	Functioning monitors with size-appropriate probes
E (equipment)	Special equipment for paediatric patients, e.g. pediatric defibrillator paddles

During the sedation, the use of monitoring and close observation remains the key to detect ventilatory problems early on. The SASA guidelines also recommend the standard use of pulse oximeter, blood pressure cuff and cardiac leads. Capnography is a very important way of monitoring, although not yet compulsory.

In the recovery period, hypoxemia is a major complication that occurs commonly with the sedated obese patient. These patients should continue to be monitored post-operatively with a pulse oximeter until fully awake. This can also be minimised by putting the patient in recovery position. Avoid post-operative opioid analgesia.

Anticipate, avoid and manage complications early…safety is a realistic end-point!

An approach to your sedation would be based on a thorough medical evaluation to identify signs and symptoms indicative of significant respiratory disease as well as any history of a difficult airway during previous sedation/ anaesthesia. Certain conditions compromising their respiratory systems (sleep apnoea, hypoventilation syndrome, restrictive lung disease) have to be considered before sedating the paediatric patient due to the increased risk of intra-operative complications. Although obesity associated cardiovascular disorders are unlikely in young subjects, obese adolescents may have systemic conditions such as diabetes or hypertension that can increase their treatment risk.

Think again about your drug cocktail to be used and how much of each drug – usually drug dosages are calculated according to the total body weight, keep in mind that it is recommended to use the lean body weight for obese patients, as re-distribution of drugs will prolong the duration of recovery form sedation. The accumulative side effects of sedative agents with local anaesthetic, nitrous oxide and particularly opioids must also be considered in selecting an oral sedative regime[15]. The selection of sedative agents for an obese patient should have minimal to none respiratory depression effects.

The prophylactic administration of agents against aspiration pneumonitis (e.g. H_2-receptor antagonists, gastric prokinetics and soluble antacids) should be considered for patients with a history of aspiration or vomiting during sedation but this is usually an indication to refer the patient to a hospital setting.

The position of the sedated patient is of vital importance. The supine position, especially during sedation, is commonly used in paediatric sedation. Unfortunately, this position compromises the obese child's ability to ventilate and maintain adequate oxygenation, and a semi-sitting position is recommended. In the upright position, ERV and FRC are reduced such that the tidal ventilation falls within the range of the CC, with ensuing V/Q abnormalities and a trend towards hypoxemia. In the supine and Trendelenburg positions, the FRC falls even further and well below the CC, worsening the hypoxemia. Obese patients tolerate exercise poorly, with any increase in the cardiac output achieved by increasing the heart rate and/or stroke volume. When these patients are positioned supinely they already tend to have an increased cardiac output and given the decreased peri-sedation tissue oxygenation associated with obesity and the increased cardiac workload, the likelihood for myocardial hypoxemia is enhanced.

No more KFC.

An easy pneumonic to remember is "NO MORE KFC" and would remind you of the most important end-point when planning your sedation.

N- Never completely supine or in Trendelenburg position

O- OSA and snoring is a dead-end

M- More drugs needed? Remember more recovery will be needed

O- Obesity is a systemic illness

R- Respiratory complications is your worst enemy

E- Emesis and aspiration history? = Refer!

K- Know your own limitations

F- Fetch your guidelines when in doubt

C- Calculate the BMI – guessing games doesn't always work with children

Challenges to the sedationist

Be vigilant, and remember**:** In this rapidly developing sedation market we should continuously be on the look out for newly published articles on new outcomes and new drugs used. On October 27, 2010 the BMJ published their first online article on the use of intra-nasal lignocaine and midazolam for procedural sedation in

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children. This article proved that both were effective ways to sedate children for painful procedures. In this study 46 children were used and none had any serious or respiratory side effects such as desaturation, bradicardia, hypotension or apnoea despite using relatively high doses of midazolam (0.5mg/kg). This proved to be a simple, non-invasive alternative approach for children needing sedation[16].

If in doubt, refer to a hospital with a surgical centre and anaesthetic department to have the procedure done. If the obesity is such that serious systematic complications are likely, it is also advisable to refer to bigger centres[17]. Of all patients receiving sedations for diagnostic or therapeutic procedures, the paediatric population is the subgroup at the highest risk level with the lowest tolerance for error.

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