Pediatric Anesthesia

Anesthetic management

Preoperative Preparation

- All children should be visited preoperatively by the anesthetist responsible for caring for them in the perioperative period.
- There is an increased incidence of airway problems during anesthesia.
- children are more at risk of laryngeal spasm, breath-holding and bronchospasm in the postoperative period the chance of post-intubation croup is increased.
- It is extremely important that the child is weighed before arrival in theatre, because body weight is the simplest and most reliable guide to drug dosage.
- Veins suitable for insertion of a cannula should be identified.
- Morbidity and mortality caused by aspiration of gastric contents are extremely rare in children undergoing elective surgery.
- Prolonged periods of starvation in children, especially the very young infant, are harmful.
- These children, who have a rapid turnover of fluids and a high metabolic rate, are at risk of developing hypoglycemia and hypovolemia.
- Solids (including breast and formula milk) should not be given for at least 6 h before the anticipated start of induction.

 In the emergency setting, e.g. the child who has sustained trauma shortly after ingesting food, it is probably best (if possible) to wait 4 h before inducing anesthesia.

 If it is surgically possible to wait 4 h, an i.v. infusion of a glucose-containing solution such as 5% dextrose with 0.9% NaCl, must be commenced and, if necessary, appropriate fluid resuscitation undertaken.

Intravenous Induction

 The same induction sequence can be used as in adults: a rapid-acting barbiturate (e.g., thiopental, 3 mg/kg in neonates, 5–6 mg/kg in infants and children) or propofol (2–3 mg/kg) followed by a non-depolarizing muscle relaxant (e.g., rocuronium, cisatracurium, atracurium, mivacurium, or succinylcholine).
 Atropine should be given intravenously prior to succinylcholine.

 It is important that children are accompanied into the anesthetic room by someone with whom they are familiar.
 The appropriate monitoring should be applied as soon as possible after the start of anesthesia.
 When inhalational induction is planned, clear, scented plastic masks are much more acceptable to small children than the traditional **Rendell–Baker rubber masks**.
 Clear masks allow respiration and the presence of vomitus to be observed.
 An alternative to using a mask is cupping the hands over the face of the child while holding the T-piece, it is important to ensure that the flow of fresh gas is directed away from the child ‘s eyes because anesthetic gases may be irritant.
 When using a face mask, it is important that the soft tissue behind the chin is not pushed backwards by the fingers, thereby obstructing the airway. **The anesthetist’s fingers should rest only on the mandible.**








Airway Management

 The Jackson–Rees modification of the Ayre ‘s T-piece is the breathing system used traditionally for children under **20 kg** in weight.
 It has been designed to be **lightweight** with a **minimal** apparatus dead space. The apparatus may be used for both spontaneous and **controlled** ventilation
 The **open-ended** reservoir bag is used for manually controlled ventilation. This mode of ventilation is especially useful in the neonate and infant.
 Laryngeal mask airway (**LMA**) should be used only when it is planned that the child is to breathe spontaneously during surgery. It follows that **it is unwise** to use the device when neuromuscular blocking drugs are used.
 It is **mandatory** to intubate the trachea during **artificial** ventilation.
 Neonates with a tracheal tube must undergo artificial ventilation in order to reduce the work of breathing.
 Infants have a head which is large and a neck which is short relative to the size of the body. Instead of placing a pillow under the head, **it is usually necessary to place a small pad or pillow under the torso.**
 Tracheal intubation for children over 1 year:
 Appropriate tube ID sizes for preterm: <1500 g = 2.5 mm, 1500-3000 g = 3 mm, over 3000 g = 3.5 mm.

Laryngeal mask airway (LMA):

They are useful in short procedures with spontaneous ventilation. They have less resistance than endotracheal tubes and are of considerable use for insertion of fiberoptic bronchoscopes. Approximate sizes are:

- 1 for less than 6.5 kg.
- 2 for 6.5-20 kg.
- 2.5 for 20-30 kg.
- 3 for 30 kg and above.

 If too large a tube is selected, the tracheal mucosa is damaged and the child may develop **post-intubation croup**; if it is **too small**, excessive leak makes effective positive pressure ventilation impossible
 Generally, cuffed tubes are used only in children above the age of 8 years.
 In the case of an awake intubation in a neonate or young infant, adequate preoxygenation may help prevent hypoxemia.

 A **prominent occiput** tends to place the head in a **flexed position** prior to intubation. This is easily corrected by slightly elevating the shoulders with towels. **Straight** laryngoscope blades aid intubation of the anterior larynx in neonates, infants, and young children.
 Mucosal trauma from trying to force a tube through the cricoid cartilage can cause postoperative edema, stridor, croup, and airway obstruction.

Inhalational Induction

 Most children do not arrive in the operating room with an intravenous line in place.
 Modern potent volatile anesthetics can render small children unconscious within minutes. This is usually easier in children who have been **sedated** prior to entering the operating room and who are sleepy enough to be anesthetized without ever knowing what has happened (**steal induction**).
 Equipment appropriate for age and size should be selected.
Typically, the child is coaxed into breathing an odorless mixture of nitrous oxide (70%) and oxygen (30%). Sevoflurane is added to the anesthetic gas mixture in 0.5% increments every **three** to **five** breaths.
 Sevoflurane considers the agent of choice for inhalation induction. Single breath induction technique with sevoflurane (7–8% sevoflurane in 60% nitrous oxide) can be used to speed up induction.
 After an adequate depth of anesthesia has been achieved, an intravenous line can be started and a muscle relaxant administered.

Maintenance

 Ventilation is usually controlled during anesthesia of neonates and infants.
 During spontaneous ventilation, even the low resistance of a circle system can become a significant obstacle for a sick neonate to overcome.
 For patients weighing **less than 10 kg, it's** preferred to use the **Mapleson D** circuit or the **Bain system** because of their low resistance and light weight.
 The circle system can be safely used in patients of all ages if ventilation is controlled.
 Anesthesia can be maintained in pediatric patients with the same agents as in adults.
 Isoflurane Can be use following a **sevoflurane** induction to help **reduce** the likelihood of postoperative **delirium or agitation on emergence**.
 If **sevoflurane** is continued for maintenance, administration of an **opioid** (e.g., fentanyl 1–1.5 mg/kg) 15–20 min before the end of the procedure can reduce the incidence of emergence delirium and agitation.
 Nondepolarizing muscle relaxants are often required for optimal surgical conditions.

Perioperative Fluid Requirements

 Fluid therapy can be divided into ***maintenance***, ***deficit***, and ***replacement*** requirements.

❖ MAINTENANCE FLUID REQUIREMENTS:

Maintenance requirements for pediatric patients can be determined by the **4:2:1 rule**: 4 mL/kg/h for the first 10 kg of weight, 2 mL/kg/h for the second 10 kg, and 1 mL/kg/h for each remaining kilogram.

 The ideal maintenance solution is **0.18% saline** in **4% dextrose** with added **potassium chloride** (**KCl**) 20mmol.l-1 if required)

 Neonates require 3–5 mg/kg/min of a glucose infusion to maintain euglycemia; premature neonates require 5–6 mg/kg/min.

❖ DEFICITS

 In addition to a maintenance infusion, any preoperative fluid deficits must be replaced. Calculated as (**maintenance fluid x starvation hours**) For example, if a **5-kg** infant has not received oral or intravenous fluids for **4 h** prior to surgery, a deficit of 80 mL has accrued (5 kg x 4 mL/kg/h x 4 h).

 Preoperative fluid deficits are typically administered with hourly maintenance requirements in aliquots of **50%** in the **first hour** and **25**% in the **second** and **third** hours. In the example above, a total of 60 mL would be given in the first hour (**80/2** + **20**) and **40** mL in the second and third hours (80/4 + 20).

 Preoperative fluid deficits are usually replaced with a balanced salt solution (e.g., lactated Ringer's injection) or ½ normal saline.

❖ REPLACEMENT REQUIREMENTS

 Replacement can be subdivided into *blood loss* and *third-space loss*.

 Blood loss is typically replaced with non-glucose-containing crystalloid (e.g., 3 mL of lactated Ringer's injection for each milliliter of blood lost) or colloid solutions (e.g., 1 mL of 5% albumin for each milliliter of blood lost).