

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).