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Anesthesia for pediatrics and geriatrics..

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Pediatric anesthesia..

Definitions:

*Neonate = less than 28 days old.

*Infant = 28 days to 1 year old.

*Child = 1 year to 16 years old.

Anatomical differences of pediatrics than the adults:

1) Larger head, shorter neck and larger tongue.

2) Glottis inlet is higher, epiglottis is longer and curved.

3) The narrowest part of the larynx is the cricoid ring.

4) Ribs are more horizontal and breathing is diaphragmatic rather than intercostal.

Anatomy	PEDIATRIC	ADULT
Tongue	Large	Normal
Eiglottis Shape	Floppy, omega shaped	Firm, flatter
Epiglottis Level	Level of C3 - C4	Level of C5 - C6
Trachea	Smaller, shorter	Wider, longer
Larynx Shape	Funnel shaped	Column
Larynx Position	Angles posteriorly away from glottis	Straight up and down
Narrowest Point	Sub-glottic region	At level of Vocal cords
Lung Volume	250ml at birth	6000 ml as adult

Physiological differences in pediatrics than the adults:

1) Functional residual volume (FRC) lies close to the closing volume (CV) in the infants and the reduction in FRC with anesthesia or disease can lead to atelectasis and segmental collapse unless positive end-expiratory pressure (PEEP) is applied.

2) In infants, alveolar ventilation and oxygen demand are much higher than in the adults, but the FRC/VA (alveolar ventilation) is much lower (half), so the reserves of oxygen in the lung of the infant are lower.

3) Unlike in adults, mild hypoxia in the neonate causes hypoventilation leading to apnea.

4) Basal metabolic rate, caloric requirements and O2 uptake is are higher.

5) Glycogen stores are relatively low, but brain and myocardium are more glucose dependent.

6) Cardiac output average (relative to body weight) and heart rate are greater.

7) The neonate has limited responses to cold (vasoconstriction rather than shivering) and there is an increased propensity to bradycardia.

8) In general, infants have larger volumes of distribution for most drugs, and even susceptible infants may require larger initial doses of drugs to achieve adequate plasma concentrations.

Normal respiratory rate and heart rate according to age:

Age group	Heart rate Beat/ min	Respiratory rate Breath/ min
Less than 1 year	160 - 110	60 - 30
1 to 3 years	150 - 100	40 - 24
3 to 6 years	140 - 95	34 - 22
6 to 12 years	120 - 80	30 - 18
12 to 18 years	100 - 60	16 - 12

Practical conducts for general anesthesia:

*Fasting guidelines:

a) Solids- morning case, no solid food overnight; afternoon case, light food at breakfast; no solid food for 6 hours before surgery.

b) Milk- up to 4 hours before surgery for bottled milk, up to 3 hours before surgery for breast milk.

c) Clear liquids- up to 2 hours before surgery.

*Children with major organ dysfunctions, or those actually ill with infection or trauma, should be treated as though they had a full stomach regardless of fasting interval because these conditions are associated with delayed gastric emptying. Small infants 3 should be scheduled first on an operating list to improve planning, but it may still be necessary to commence intravenous fluids.

*Premedication:

a)Local anesthetic creams.

b)Sedative drug required.e.x. oral midazolam or oral ketamine.

c)An ant sialagogue (e.g. atropine) should be added to prevent excess salivation.

d)Rectal administration of induction agents has been used (such as thiopental)

*Induction of anesthesia:

a)All the necessary monitoring devices placed on the child before induction.

*an appropriately sized pulse oximetry probe on a digit.

*allow the placement of precordial stethoscope.

b)When inhalational induction is planned, clear scented plastic masks are much more acceptable to little children. Clear masks allow respiration and the presence of vomitus to be observed.

c)Gas induction has become increasingly preferred since the introduction of sevoflurane. It is usually elected from the outset together with nitrous oxide and oxygen.

d)Intravenous induction depends on child's preference

e.g., required propofol dose is 2.5-5mg/ kg while it is in adults 1-2.5 mg/ kg). The pain on induction with propofol can be reduced by adding 20 mg lidocaine to 200 mg propofol. Thiopental provides a smooth induction but can delay postoperative recovery.

*Endotracheal tubes& LMA.

Table 34.15 Paediatric quick reference guide

Age	Approximate weight (kg)	Body surface area (m^2)	Percentage of adult drug dose (approximate)	ETT size (mm)	ETT length (cm)	LMA size
Term	3.5	0.23	12.5 (1/8th)	3.5	9	1
1 month	4.2	0.26	14.5	3.5	10	1
3 months	6	0.33	15	3.5	10	1.5
6 months	7.5	0.38	22	3.5/4.0	11	1.5
1yr	10	0.47	25 (1/4)	4.0	12	1.5/2
2yr	12	0.53	30	4.5	13	2
3yr	14	0.61	33	4.5/5	13/14	2
5yr	18	0.73	40	5.0/5.5	14.5	2.5
7yr	22	0.86	50 (1/2)	6.0	15.5	2.5
10yr	30	1.10	60	6.5 cuffed	17	3
12yr	38	1.30	75 (3/4)	7.0 cuffed	18	3 or 4

Note: weights are approximations only. Patients should be weighed accurately.

*Maintenance:

Most simple short procedures require only spontaneous ventilation under a volatile or intravenous anesthetic agent and analgesia that will extend into the postoperative period. Neonates are usually intubated and ventilated for surgical procedures to ensure adequate gas exchange, and are given local anesthetic blockade where possible to limit CNS depressant drug usage. In complex procedures where postoperative ventilation is planned, high-dose opioid techniques are often used to minimize stress responses.

*I.V fluids:

Crystalloids: Intraoperative hypoglycemia can occur in neonates, but is unusual owing to the effects of the stress response on glycolysis and gluconeogenesis. In contrast, excessive perioperative administration of glucose solutions can lead to hyponatremia, water intoxication and cerebral edema. Hartmann's solution (Ringer's lactate solution) can be given as a sole agent during surgery, but it is wise to measure blood glucose hourly during prolonged cases, alternatively, a fixed maintenance infusion of a glucose-containing solution should be continued throughout, with additional fluid replacement of Hartmann's given independently. A recognized formula for maintenance fluid hourly rates is:

- 1-10 kg = 4 ml/ kg
- 11-20 kg = 40 + 2 ml/ kg
- over 20 kg = 60 + 1 ml/ kg

It has been shown that a mixture of glucose 2.5% in Ringer's lactate can maintain normal glucose while avoiding hyponatremia. Increased replacement fluids may be required if the gut remain exposed.

Colloids and blood: The threshold for transfusion will vary the child's overall condition and associated pathologies. For otherwise healthy children it is acceptable to let Hb drop to 8-9 g/dl, but neonates and children with cardiac or pulmonary conditions may benefit from a Hb raised to 10-13 g/dl. A volume formula for transfusion is: • (Hb required – Hb actual) × (body weight in kg) × 5 = volume of red cells required (using resuspended SAGM blood). Fresh frozen plasma and platelets may need replacing earlier than in adults to prevent coagulopathy. These colloids contain citrate and will require additional calcium administration to prevent significant hypocalcaemia if infused quickly.

*Breathing systems:

Common breathing systems used in pediatric practice include Ayer's T-piece (Maple son E), Jackson-Rees modification (Mapleson F), Bain systems and circle. The Mapleson F system remains the mainstay of pediatric anesthesia. It is compact and light, with low dead space and airway resistance. It can function in spontaneous and controlled ventilation with or without manual continuous positive airway pressure (CPAP). The Bain system behaves like a Mapleson E or F circuit and has been used in all age groups. The circle system is has become preferred for controlled ventilation in pediatrics because of heat and moisture conversation as well as cost efficiencies.

Geriatric anesthesia

People above 65 years are defined as old ages, Ageing is characterized by degenerative changes in structure and function of organs and tissues, there is gradual loss of skeletal tissue mass, increase in body fat, reduction in total body water, and reduce in albumin levels. Decreased skin elasticity increases the risk of injury from the use of various adhesive tapes. Adding a thin layer of cotton batting wrap before applying the noninvasive blood pressure cuff may be a simple but effective maneuver for the prevention of neurovascular complication. Thinner layer of subcutaneous fat, which predisposes elderly patients to the potential for pressure sores. Protecting elderly patient's bony prominences, padding with pillows and arm-support devices should be ensured.

Drugs: Old aged patients are very sensitive to anesthetic agents. Lower concentration of drug is required to achieve a desired effect and effect is usually prolonged. Gradual titration of drug to dosage effect is usually required, boluses must always be avoided. One must be cautious of hemodynamic surges. Intravenous drugs may have longer circulation time and delayed onset of effect. Elderly patients display a lower dose requirement for propofol, etomidate, barbiturates, opioids, and benzodiazepines. Administration of a given volume of epidural local anesthetic tends to result in more extensive spread in elderly patients. A longer duration of action should be expected from a spinal anesthetic. Prolonged circulation time delays the onset of intravenous drugs, but speeds induction with inhalational agents. Elderly requires lesser dosage of opioid agents. Sufentanyl, fentanyl and alfentanil are twice potent in elderly as compared to adult population owing to altered sensitivity of brain to opioids. As the central compartment is reduced in geriatrics infusion rates should be reduced and titrated to effect. Metabolism of neuromuscular blockade agents (skeletal muscle relaxants) which depend on liver and renal blood flow is reduced, thereby prolonging the duration of effect. Metabolism of atracurium and cis-atracurium is unaffected by age, as they are metabolized by Hoffman degradation (spontaneous degradation in plasma and tissue at normal body PH and temperature).

Airway management:

They have limited neck mobility, because of arthritic changes. They have difficult mask ventilation due to the absence of multiple teeth. Goal of pre-oxygenation may not be reached because of that. They are tending to sleep apnea due to reduction in upper airway consistency that placing them at increased risk of pulmonary complications. Intubation should be rapid, gentle and traumatic.

Notable benefits of regional anesthesia in old age:

1) Decreased incidence of deep venous thrombosis.

2) Blood flow improved.

3) Provide adequate pain relief.

4) Maintain spontaneous airway.

5) Pulmonary functions are intact depending on the level of blockade.

Other physiological notes about old age:

1) Increased vagal tone and decreased sensitivity of adrenergic receptors lead to a decrease in heart rate

2) Decreased elasticity of lung tissue, allowing over distention of alveoli and collapse of small airways. Residual volume and the functional residual capacity increased. Airway collapse increases residual volume and closing capacity.

3) Impairment of Na+ handling, concentrating ability, and diluting capacity predispose elderly patients to both dehydration and fluid overload.

4) Liver mass and hepatic blood flow reduced with aging. Hepatic function declines in proportion to the decrease in liver mass.

5) Aging produces both pharmacokinetic and pharmacodynamic changes.