NEONATAL ANAESTHESIA

Definitions

Conception Age (CA)	*Time elapsed between the day of conception and the day of delivery. *Gestational age is 2 weeks longer than conceptional age. *No longer used
Gestation Age (GA)	*Time elapsed between the first day of the last normal menstrual period and the day of delivery *Two weeks longer than conception age *For Assistive reproductive pregnancy, gestational age = 2 weeks + conceptional age
Post-natal age (PNA)/ Chronological age	Time elapsed after birth.
Post Conceptional Age (PCA)	Conceptional Age+ Post Natal Age
Corrected Gestational Age (CGA) (Preterm Babies)	*Gestation Age (weeks) + Post Natal age(weeks) *Calculate CGA for child up to 3 years *Corrected Gestational Age (CGA) influences the morbidity and mortality associated with preterm infants.
Neonates	Newborn up to the first 28 days of extrauterine life.
Preterm Infant	New-born of <37 weeks gestation
Term Neonate	New-born of 37–40 weeks gestation
Post term Neonate	New-born of more than 42 weeks gestation
Low Birth weight (LBW)	Weight at birth<2500 gms
Very Low Birth Weight (VLBW)	Weight at birth <2000 gms
Extremely Low Birth Weight (ELBW)	Weight at birth <1500 gms

Small for Gestation (SGA)	< 5 Percentile

Physiological Consideration – All the Systems are significantly immature.

System	Physiological Development	Clinical Implication
Central Nervous System	Fragile Cerebral vessels Impaired Cerebral Autoregulation	High Risk of Intraventricular hemorrhage (IVH) Neurocognitive outcomes depend on grade of IVH
	Ascending Pain pathways are developed but not the descending pathways.	Analgesia is important component of perioperative care
	Apnoea of prematurity	Increased risk of postoperative apnoea The incidence of postoperative apnoea is 11-37% for infants < 60/52 PMA. The risk of an infant <44/52 PMA developing postoperative apnoea is particularly high. Infants whose PMA is <45/52 should generally not be done as day cases as they will need postoperative apnoea monitoring.
Spinal Cord	Spinal cord extend up to L3	Sub arachnoid block(SAB) must be tried below L3
	Dura extends till S3-4	Increase incidence of dural puncture while giving caudal block
	Spinal surface area more and CSF production is more.	Turnover of CSF is faster and LA wears off faster.
	Myelination incomplete	Lower concentration of LA
CVS	Immature Heart	Stroke volume (SV) is heart rate (HR) dependent.

		ECF Calcium level should be maintained.
	Existence of shunts- PDA, ASD	Avoidance of triggers for transition to fetal circulation which may be difficult to reverse Presence of persistent fetal circulation in the ill neonate(Preterm)
GI	Immature liver function Glycogen storage limited. Total protein reduced, albumin reduced and alpha 1 glycoprotein limited. Coagulation factor low	Risk of hypoglycemia Drug doses have to be modified More free LA (More toxicity) Perioperative Vit K administration
Renal	GFR= 1/5 of adult GFR	Fluid management is challenging- poor tolerance of over/under hydration.
	Tubular function immature TBW =90-100%	Poor retention of sodium Poor clearance of drug/metabolites - delayed drug excretion
Respiratory	Hyaline Membrane disease (HMD), Chronic Lung Disease (CLD)	Arrange HDU care
Prematurity related challenges	Retinopathy of Prematurity(ROP)	Minimise FiO2 Careful selection of the Spo2 range Air:O2 blender for transportation
	Anemia of prematurity	Increased risk of postoperative apnoea

	Prone to coagulopathy due to immature liver function	Monitor coagulation

Anesthetic Considerations

- Gestation age or CGA is an independent factor affecting the outcome of the surgery
- Evaluation of the birth events and its relevance
- Identify the issues of prematurity
- Associated congenital abnormalities/syndromes
- Specific surgical needs
- Temperature maintenance in the perioperative period
- Fluid and electrolyte disturbances
- Immature immune system – high risk of infection and sepsis
- Transportation is challenging

Anesthesia in neonatal intensive care (NICU)

Critically ill, ELBW, or hemodynamic unstable neonates are operated in NICU as a sick neonate may decompensate on handling, therefore this should be kept to a minimum. The transport may be hazardous and result in hypothermia, haemodynamic instability and inconsistent ventilator therapy.

Common procedures include: PDA ligation, laparotomy, drain insertions for necrotising enterocolitis (NEC)

The decision to operate in the NICU can only be made after mutual agreement between the neonatologist, surgeon and anaesthetist.

The surgery can be done in the NICU OT or in the cubicle, "Open Care" or with the patient inside the incubator, after discussion with the surgical team.

Anaesthetic preparation for the operation in NICU

- Monitoring - Standard ASA and invasive monitoring according to the sickness and surgical intraoperative requirement. Extensions should be connected to the lines for easy access. The dead space must be counted in the total calculation of the fluids.
- Drugs - Both resuscitation and anaesthetic drugs must be available
- Suction - Functional suction for surgeons and anaesthetists must be available.

Maintenance of temperature

- Environment – Mobile Surgical Lights
- Drug Chart – Calculated doses of both anaesthetic and resuscitation drugs, fluid requirement, maximum allowable blood loss must be handy
- Sterility – Laminar flow for the ICU, sterility with the long lines (closed system must be maintained), peripheral access.
- Prophylactic antibiotics if indicated

Pre-anaesthesia Checklist

- Drugs
  - Resuscitation Drugs – O2: Air blender, O2 source for ventilation and T piece
  - Anaesthesia Drugs – NDMR, Opioids
- Labelling stickers or their alternatives
- ICU Ventilator which has more advanced modes, and unavailability of the inhalational gases. Request help from a neonatal respiratory therapist.

- Monitors and display screens - ECG, SaO_2, NIBP or arterial line, temperature, transcutaneous CO_2 $TcCO_2$ / $ETCO_2$ – displays easily seen.
- Blood and its products are available and stored appropriately
- Appropriate sized Equipment
- Lines with adequate extensions
- Calibrated ABG machine available
- Scrubs and sterile trays for various procedures
- Functional Suction
- Source of sufficient light

Anaesthetic Aims intraoperatively

Must Remember

- IV anesthetic technique is the only option as the NICU ventilators have no option for delivering the inhalational gas.
- Assess the patient, equipment before starting the procedure
- Monitor should be visible to both the anesthetic and surgical teams
- Meticulous record keeping
- Two anesthetists are needed
- Handing over to a neonatologist at the end of operation is important.

Table 3: Assessment of Dehydration in Pediatrics

Severity of Dehydration	% Dehydration		Symptoms
	Infant	Child	
Mild	5	3-4	Thirst. Mucous membranes moist, EJV visible in supine, CRT >2 sec, Urine sp gr >1.020
Moderate	10	6-8	Dry mucous membranes, ↑ HR, ↓ tears, Sunken fontanelle, Decreased skin turgor, CRT 2-4 sec, ↓Urine Output
Severe	15	10	Eye sunken, cool peripheries, apathy, somnolence, orthostatic to shock
Shock	>15	>10	Decompensation, Poor O_2 delivery, ↓BP