

Manual of Newborn Care and the Practical Aspects of Neonatology

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SECTION VI

Essential Equipment and Instruments in Neonatal Practice

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34. Instruments

CHAPTER 34

Instruments

Lumbar puncture needle:

Parts ***(Figs. 1 and 2)***:

- Stillet
- Spinal needle

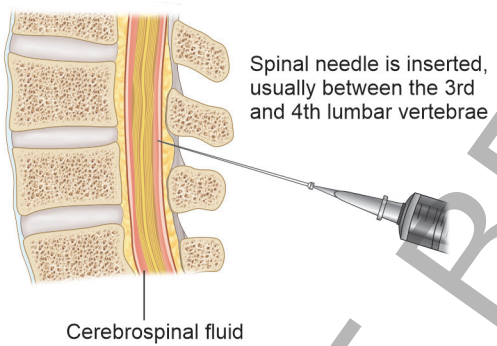

Fig. 1: Anatomy showing insertion of spinal needle between L3 and L4.

Sizes: 16–30 G

Site: L3–L4

Indications:

- *Therapeutic:*
  - Analgesia
  - Anesthesia
  - Antibiotics
  - Antineoplastics
- *Diagnostics:*
  - *Infectious:*
    - Meningitis
    - Encephalitis
  - *Inflammatory:*
    - Multiple sclerosis
    - Guillain–Barré syndrome
  - Oncology
  - Metabolic disorders



Figs. 2A and B: Needle used for lumbar puncture.

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- Spontaneous subarachnoid hemorrhage
- Study of CSF dynamics—CSF blocks

Contraindications:

- *Absolute contraindications:*
  - *Increased intracranial pressure:*
    - Cerebral herniation
    - Impending herniation
    - Hydrocephalus
  - Coagulopathy
  - Neck retractions
  - Prior lumbar surgery
  - 6th nerve palsy
  - Significant cardiopulmonary compromise
  - Papilledema
- *Relative contraindications:*
  - Thrombocytopenia
  - Infections of the skin overlying the LP site

Complications:

- Tonsillar herniation with sudden collapse and cardiopulmonary arrest
- Introducing infection into the CSF space
- Transient low back pain or thigh pain
- Post LP headaches which may last 3 days
- Traumatic tap and CSF leakage
- Epidermal cyst

Salah's bone marrow aspiration needle:

Parts ***(Fig. 3)***:

- Stillet/trocar
- Cannula
- Adjustable guard to prevent the deep penetration of trocar into the bone

Indications:

- *Diagnostic:*
  - Idiopathic thrombocytopenic purpura
  - Aplastic anemia
  - Leukemia
  - Megaloblastic anemia
  - Infections, e.g., kala azar



Fig. 3: Salah's bone marrow aspiration needle.

  - Storage disorders, e.g., Gaucher's disease
  - Myelofibrosis
- *Therapeutic:* Bone marrow transplantation

Contraindication:

- Hemorrhagic disorders—congenital coagulation factor deficiencies (hemophilia)
- Skin infection or recent radiation therapy at sampling site

Site ***(Fig. 4)***:

- *>1 year:* Iliac crest
- *<1 year:* Proximal tibia medial to tibial tuberosity
  - To prevent injury to pelvic sutures in infants

Complications:

- Local pain and swelling
- Hematoma
- Bleeding and infection

Infant feeding tube/nasogastric tube:

Parts ***(Fig. 5)***:

- Blunt end with lateral opening, radiopaque line, markings, external end with lid
- *How to measure:* Tip of the nose/angle of mouth to tragus to below xiphisternum

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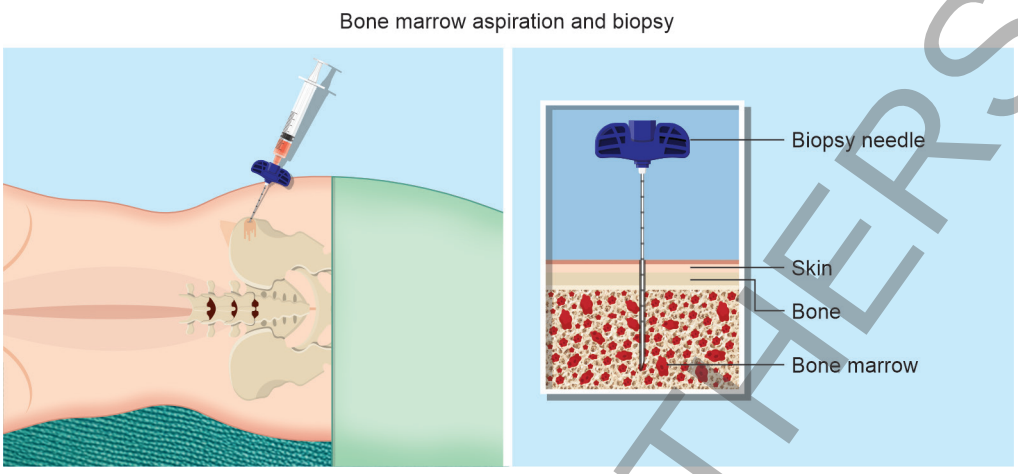

Fig. 4: Anatomical site of insertion of bone marrow aspiration needle.

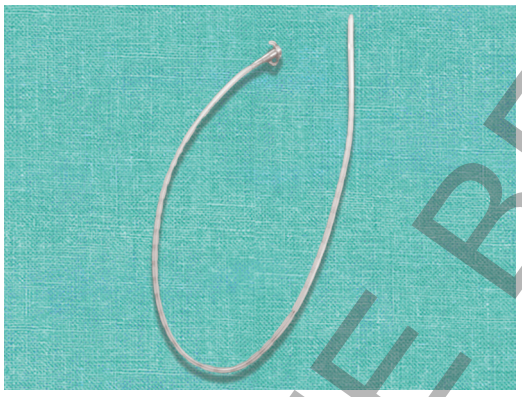

Fig. 5: Infant feeding tube/nasogastric tube.

Indications:
Diagnostic:
- Diagnosis of tracheoesophageal fistula, choanal atresia
- Aspiration of gastric content in children for CBNAAT

Sizes:
- *Preterm:* 5
- *Term:* 5–8
- *Therapeutic:*
  - Nasogastric feeds
  - Decompress the stomach
  - Stomach wash for meconium-stained amniotic fluid
  - Management of poisoning
  - Endotracheal suctioning
- *Other uses:*
  - As an oxygen catheter
  - For nasal, endotracheal, and tracheostomy suction

Complications:
- Trauma to nose and pharynx
- Placement of tube in trachea
- Vomiting with aspirations during the procedure
- Ulceration or infection of nasal mucosa

Endotracheal tube (Table 1):
Two types:
1. Uncuffed for <8 years (preferred because of reduced incidence of tracheal stenosis)
2. Cuffed for >8 years

Parts ***(Fig. 6)****:*
- Proximal part—adapter—to fix to bag or ventilator
- Central portion—vocal cord tube—should be at the opening of glottis

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TABLE 1: Age-based endotracheal (ET) tube size selection.

Age group	*ET tube size*
Preterm	2–2.5
Full term	3–3.5
2–24 weeks	4–4.5
6–12 months	4.5–5

TABLE 2: Age-based selection of laryngoscope blades.

Age group	*Size*
Preterm	0
Term	1
Children 2–10 years	2
Children >10 years	3

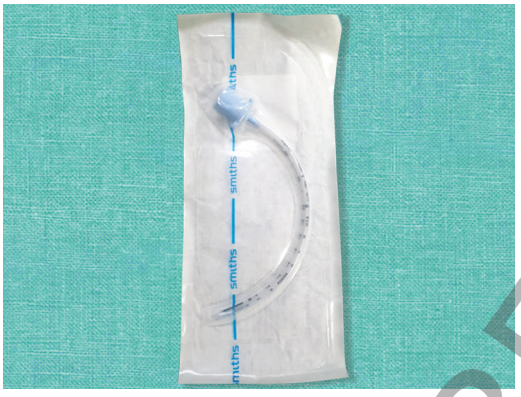

Fig. 6: Endotracheal tube used for intubation.



Fig. 7: Laryngoscope with Miller's and Mackintosh laryngeal blade.

- Radiopaque marker—visualization in X-ray
- Distance indicator
- *Distal end:* Murphy's eye, to prevent blockage

Indications:
- For mechanical ventilation
- During resuscitation
- Direct suctioning of trachea in meconium aspiration
- For maintaining unstable airway

Complications:
- Mechanical trauma to tongue, teeth, palate, pharynx, and larynx during intubation procedure
- Stimulation of posterior pharyngeal wall leading to coughing, vomiting, or vasovagal episode with resultant hypoxia and bradycardia
- Prolonged intubation may cause pressure necrosis of laryngeal structures leading to persistent hoarseness, subglottic stenosis
- Pneumothorax

Laryngoscope (Table 2):

Types:
- Miller's (straight blade) is used for children because of shorter and straighter larynx **(Fig. 7)**.
- Mackintosh (curved blade) preferred for adolescents

Indications:
- *In infants:*
  Prior to endotracheal intubation in:
  - Neonatal asphyxia

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- Meconium aspiration
- Respiratory distress syndrome
- Tracheoesophageal fistula
- Mechanical ventilation

- Respiratory failure of any cause

Contraindications: Diseases or injuries of cervical spine.

Complications:

- *Mechanical injury:* Injury to local tissues like tongue, teeth, palate
- Stimulation of posterior pharyngeal wall may cause vasovagal episode leading to hypoxia and bradycardia
- Hyperextension of neck may cause damage to cervical spine

Ambu bag:

Parts ***(Fig. 8)***:

- Patient outlet (to which face mask is attached)
- One-way valve unit (just proximal to patient outlet)
- Pressure release valve (pop off valve)
- Oxygen inlet—to attach oxygen source
- Air inlet—to attach reservoir bag

Indications:

- *Neonatal resuscitation:*
  - Any baby not breathing
  - Sedated baby
  - Nonresponsive baby
- For giving intermittent positive pressure ventilation



Fig. 8: Self inflating Ambu bag, mask, and reservoir attached.

Types:

- Uncushioned—used in neonates
- Cushioned

Contraindications: Congenital diaphragmatic hernia (entry of air into the stomach distends it further and compromises the lung expansion)

Mechanism of ventilation with Ambu bag:

- In the resting stage, the Ambu bag is filled with air (or oxygen).
- On squeezing the bag to initiate ventilation, the one-way valve proximal to the patient outlet opens resulting in the release of air (or oxygen) stored in the bag to the patient.
- On releasing the pressure, the bag gets reinflated with air (or oxygen depending on whether the oxygen inlet is left open or connected to an oxygen source)
- The patient's exhaled air cannot re-enter the bag due to the one-way mechanism of the valve at the patient outlet
- Check if—oxygen is connected, oxygen reservoir is connected.

Uses of reservoir:

- Increase the FiO_2 of the oxygen delivered to the patient by means of an Ambu bag from 40% to more than 90%.
- Right size of face mask covers the nose and mouth.
- *Uses:* To deliver intermittent positive pressure ventilation by means of an Ambu bag.

Suction catheter: Used for removal of secretions from the endotracheal tube and upper airway secretions by applying a negative pressure to maintain airway patency and reduce the risk of aspiration **(Fig. 9)**.

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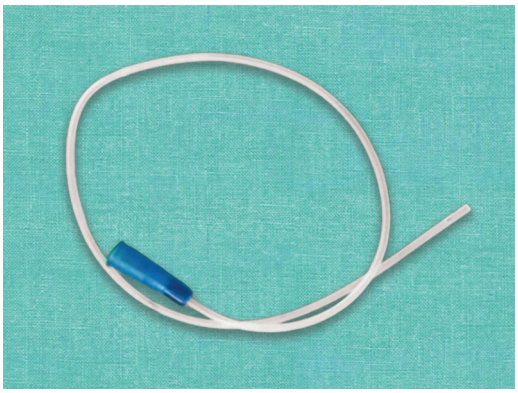

Fig. 9: Suction catheter.

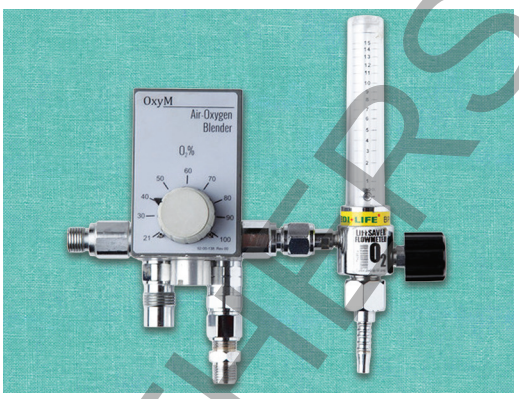

Fig. 10: Oxygen blender.

Sizes:
- *Preterm:* 5 F
- *Term:* 6 F

Types of suctioning:
- Oropharyngeal suctioning
- Nasopharyngeal suctioning
- Endotracheal suctioning

Complications:
- Hypoxia
- Tissue trauma
- Bronchospasm
- Cardiac dysrhythmias

Oxygen blender:
- The blender is a light weight compact air-oxygen blender that allows precise mixing of medical grade air and oxygen.
- It combines compressed medical air and oxygen to deliver blended pressurized gas at a precise oxygen concentration.
- These blenders **(Fig. 10)** are suitable for number of respiratory applications including routine therapy, ventilator gas supply, and bubble cap.

Infusion pump: Infusion pumps **(Fig. 11)** are devices that are used to deliver therapeutic fluids which can be either medications or nutrients at a predetermined rate.



Fig. 11: Infusion pump.

Principle:
- It uses pumping action to infuse fluids medications or nutrients to the patient.
- It is suitable for intravenous subcutaneous enteral and epidural infusions.
- *There are two types of infusion pumps:*
  1. Syringe pumps
  2. Volumetric pumps

Uses:
- Chemotherapy
- Pain management
- Total parenteral nutrition
- Anesthesia/sedation

End-tidal carbon dioxide:
Capnography:
- Capnography is the process of measuring the partial pressure of end-tidal CO_2 in each expired breath **(Fig. 12)**.

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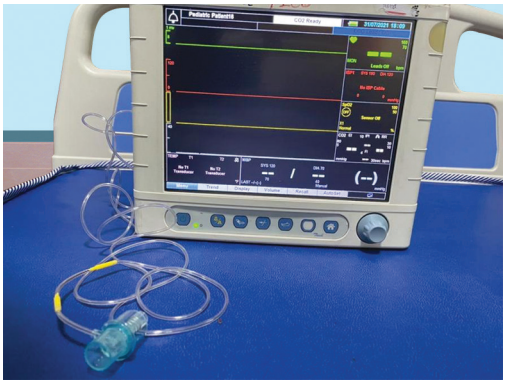

Fig. 12: Instrument to measure $ETCO_2$.

- Providers measure the value of $ETCO_2$ in each exhaled breath with a very thin tube inserted into the breathing circuit or the patients oxygen mask or nasal prongs.
- The waveform (capnogram) that you then see on the capnography monitor provides a real time recording of the patient's respiratory rate, pattern and depth of breathing, and the value of CO_2 exhaled.
- *Normal $ETCO_2$* is 35–45 mm Hg, and a normal waveform is rectangular shaped.

Uses: These measurements help the provider evaluate adequacy of ventilation.

Radiant warmer:

- Also called an open care system was developed to ensure ready access to the baby.
- They are used to maintain the body temperature of newborn infants **(Fig. 13)**.
- The major advantage of the radiant warmer is the easy access it provides to critically ill infants without disturbing the thermal environment.
- Its major disadvantage is the increase in insensible water loss produced by the radiant warmer.

Principle: The overhead quartz heating element produces heat which is reflected by the parabolic reflector on to the baby on the bassinet.



Fig. 13: Radiant warmer.

It has two modes:

Manual mode:

- When anticipating the arrival of a baby requiring care under a radiant warmer
- Manual mode is used
- Before baby has arrived, keep warmer on with 100% heater output which then drops to 60% after a particular time.

Servo mode:

- Once the baby is placed, servo mode is used.
- A temperature probe is connected to the baby.
- Heater provides output according to baby's current temperature and set temperature.

T-piece resuscitator: It is a mechanical device that uses valve to regulate the flow of compressed gas directed toward patient **(Fig. 14)**.

Parts:

- Oxygen/air (gas) supply tubing/inlet
- Gas outlet and tubing (to patient)
- Circuit pressure dial

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Fig. 14: T-piece resuscitator.

- Maximum pressure release knob
- PIP knob

Indication:

- If baby is not breathing (apneic) or
- If baby is gasping or
- If baby's heart rate is <100 bpm

Capable of providing peak inspiratory pressure and positive end expiratory pressure for manual ventilation.

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Manual of Newborn Care and the Practical Aspects of Neonatology

Salient Features

- Useful resource for clinical assessment of newborns
- Useful for neonatal intensive care calculations done in Level IV NICU
- Important procedures done in Level IV NICU
- Includes drug dosages and routes which are frequently used in NICU
- Describes uses of few instruments in NICU.



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