

Stabilization and Transportation guidelines for Neonates and infants with Heart disease:

Background: Referral Pediatric Cardiac Units, frequently receive neonates and infants referred and transported from Pediatric units, PICUs and NICUs from Kerala, neighboring states and overseas. These babies are referred with presumed or confirmed diagnosis of congenital heart diseases, most of them falling into the category of “critical” CHD requiring immediate/early intervention. Many of them are on mechanical ventilation / inotropes / Prostaglandin E1 infusions.

An increasing proportion of heart operations are now performed in infants and newborns. For example, nearly 55% of all patients undergoing pediatric heart surgeries at AIMS are infants (<1year age); 12% are neonates. Pediatric cardiac surgeries (encompassing the entire spectrum of lesions and procedures) are currently being accomplished at AIMS with an overall mortality rate of <2%, putting AIMS at par with the some of the best of centers in the world. This has been made possible through relentless efforts at improving expertise, technique, infrastructure, technology and establishing systems to improve outcomes and make pediatric heart surgery safe and affordable. It is also a credit to the pediatrician community in Kerala that CHD is suspected early and referred onwards for intervention.

An analysis of the outcomes of 1028 consecutive infants operated at AIMS published recently (*Preoperative Determinants of Outcomes of Infant Heart Surgery in a Limited-Resource Setting. Reddy NS, Kappanayil M, Balachandran R, Jenkins KJ, Sudhakar A, Sunil GS, Raj RB, Kumar RK.SeminThoracCardiovasc Surg. 2015 Autumn;27(3):331-8*) showed that the preoperative clinical condition of infants and neonates has profound impact on their eventual surgical outcomes. Preoperative sepsis, ICU stay, ventilation were shown to be significantly associated with postoperative mortality and morbidity. Therefore in order to further improve the outcomes after infant heart surgery, it is critical to ensure optimal clinical condition of these infants even prior to their going to surgery. In an ongoing study we find that majority of neonatal surgeries at AIMS are carried out on babies transferred to AIMS as emergencies, and transported in ambulances. Unfortunately systems for patient transport are not well organized. Systems for communication, transmission of vital clinical information, tracking the condition of the baby during transport – are virtually non-existent. Referrals often happen through direct personal communication between clinicians at either end, with inadequate documentation of the small details; transport most often happens through generic ambulance service providers with little or no attention to the specific needs of neonates/infants with heart disease. Majority of the babies are transported without an accompanying pediatrician or pediatric nurse with inadequate monitoring.

In order to ensure good outcomes for neonates and infants after cardiac surgery, it is important to address the following:

1. Ensuring clear communication, discussion and documentation of issues between referring and receiving clinical teams,
2. Optimizing the clinical status of the baby (as much as possible) prior to transport.
3. Ensuring safe, well-monitored transport.

4. Ensuring safe receipt of the baby followed by optimization of clinical state prior to surgery.

The purpose of this draft is to develop a guideline for referral and transport of sick babies to advanced centers

Step-wise approach

1.Suspecting CHD in the newborn or young infant

Nearly 250,000 children are born every year in India with CHD.

It is important to diagnose or suspect “critical” CHD as early as possible – most require urgent intervention. Nearly 100,000 children are born with critical CHD every year in India. These include: Duct-dependent pulmonary circulation (DDPC), duct-dependent systemic circulation (DDSC), total anomalous pulmonary venous connections (TAPVC), d-Transposition of great arteries (dTGA).

All neonates and young infants must be thoroughly assessed to rule out critical/major CHD. Assessment must include pulse oximetry, and a detailed clinical assessment. In babies with cyanosis/desaturation, Hyperoxia test helps differentiate cyanosis due to CHD from other causes.

CXR, ECG may provide additional evidence of the presence/absence of CHD.

Whenever available, echocardiogram should be done.

2. Once a major heart disease is suspected:

Understand underlying physiology.

- Decreased pulmonary blood flow
- Increased pulmonary blood flow
- Duct-dependency
- Transposition physiology
- Pulmonary venous obstruction
- Critical obstructive lesions (Pulmonary stenosis, Aortic stenosis, Coarctation)

Management will depend upon the underlying physiology.

Decide clinical priorities – need for stabilization, optimization, referral, surgical intervention

3.Optimise clinical condition in accordance with underlying physiology :

General measures:

- Intravenous access
- Temperature care
- Maintenance of fluid electrolyte balance
- Monitoring and maintenance of vital parameters
- Monitoring and optimization of metabolic parameters and end organ functions (blood sugar, LFT, RFT, lactates).
- Identification of sepsis and appropriate management

Reduced pulmonary blood flow

Duct dependent pulmonary circulation: All lesions that are accompanied by pulmonary atresia, or critically reduced pulmonary blood flow

- Ensure hydration
- Reliable vascular access
- PGE1 infusion: Start at 0.05 mcg/kg/min and titrate according to SO₂ (target SO₂ 80%-85%); this can often be brought down to 0.01 mcg/kg/hr after initial stabilization.

Increased pulmonary blood flow/congestive heart failure

Large left-to-right shunt lesions: Truncus Arteriosus, AP window, VSD with coarctation

Single ventricle lesions without PS

- Restricted fluid intake (2/3rd restriction)
- Decongestive medications as needed
 - Digoxin
 - Lasix bolus/infusion
 - Afterload reducing agents – Dobutamine / milrinone / Enalapril
- If ventilated: Room air or low FiO₂, with permissive hypercapnia (Arterial PCO₂ 35-45mmHg): this is done deliberately to avoid pulmonary over-circulation.

Parallel circulation with poor mixing

- Maintain good hydration for adequate circulatory volumes
- PGE1 infusion if SO₂ poor (<70%)
- Mechanical ventilation if required

Duct-dependent systemic circulation (DDSC)

- Start PGE1 infusion @ 0.1 mcg/kg/min with monitoring of lower limb pulses and perfusion, renal/liver/gut functions.
- If ventilated: Room air/low FIO₂, with permissive hypercapnia (Arterial PCO₂ 35-45mmHg)

Obstructed TAPVC

- Restricted fluid (50%-75%)
- If ventilated: Room air/low FIO₂.

Special instructions

- In a baby expected to need a cardiac intervention, avoid femoral arterial / venous punctures
- Preserve and maintain vascular access sites.
- Ventilation / fluid management should ALWAYS be customized to the physiology (as detailed above).

4. Arranging a transfer to Referral Center :

i). Initial communication

Pediatric Cardiac Unit at referral hospital should be informed as soon as a decision for transport is made.

ii). A clinical summary of the patient may be transmitted through fax/email/whatsapp.

Essential information to be provided:

Demographics and basic information

- Name
- Age
- Sex
- Gestational age
- Birth Weight
- Current Weight
- Neonatal resuscitation score (APGAR) (if subnormal)
- Presumed or confirmed cardiac diagnosis
- Parents' educational status

Cardiac and hemodynamic status

- HR
- BP
- Pulses
- Temperature
- Respiration
- SO₂
- Heart sounds / murmurs

Co-morbidities

- Sepsis: Blood counts, CRP, Blood Culture
- Organ functions: CNS, Hepatic, Renal, Respiratory
- Genetic syndromes / dysmorphism
- Others

Ongoing medications (with dose / route / frequency / duration)

- Decongestives
- Antibiotics
- Inotropes
- Prostaglandin E1
- Other major medications

Ventilation

- Spontaneous
- Mechanical ventilation: Mode, Rate, FIO₂, PIP, PEEP
- ABG/VBG: pH, PO₂, PCO₂, lactate.

Once above information is transmitted to the referral Pediatric Cardiac Unit should respond back with the following information:

- Suitability for transfer to referral for further management.

- Need, and approximate time required for ensuring availability of ICU bed to receive the baby
- Approximate financial details of the intended surgery / management
- Overall outlook for the lesion and its future outcomes

Referring team must share above information with the parents / caregivers of the patient, and obtain their willingness for transfer to referral pediatric cardiac center

4.Organizing transport:

Transport may be arranged through on of the following three means:

- Ambulance services of the referring hospital.
- Ambulance services of the receiving hospital
- Other ambulance service providers.

5.The process of Transport

The following information must be recorded and documented at *initiation* of transport (***in addition*** to the previously mentioned checklist)

- *Personnel accompanying*: doctor / nurse / paramedic / parent.
- *Vitals*: HR, BP, Pulses, Temperature, S_O2.
- *Metabolic parameters*: Lactate, Blood sugar
- *Vascular access sites*: location and functioning
- *I/v drugs on flow*: route, dose, dilution, rate of flow
- *Endotracheal tube*: size
- *Ventilator settings*
- ***Checklist of parameters to be recorded in transit, with frequency***:
 - E.g., HR continuous, NIBP every 30 minutes, temperature every 30 minutes, random blood sugar every 60 minutes, etc.

Inform the team at AIMS once the transport begins from the referring institution
If possible, continue contact with the transporting team.

6.Post Transport

- Once the baby is received at referral hospital, the team should stabilize and do a detailed assessment of the referred patient. A detailed feedback should be provided to the referring unit as soon as possible.
- As per the clinical condition of the baby, the referring team will be provided periodic updates on the further treatment and outcomes of the referred patient.