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Review Article

Organization of Neonatal Transport Service with Regional Perspective - Review Article

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Abstract

Neonatal transport system is primitive in India. High risk deliveries are not always anticipated. Many sick neonates are transferred to higher care centre by attendants on two wheelers, three wheelers, vans, buses, and ill-equipped general ambulances. As a result of which, these sick babies are prone to develop morbidities like hypothermia, hypoglycemia, hypoxaemia, hyper-carbia and multi organ dysfunction even when they reached higher care centre. This may result in higher morbidity and mortality leading to high infant mortality. Hence, there is an urgent necessity to establish dedicated neonatal transport service system in the country. Organized patient transport system always yields better health outcomes than self-transport system.

Keywords: High-Risk New-Born; Neonatal Transport Service; Organization

Abbreviations

ASHA: Accredited Social Health Activist; BP: Blood Pressure; CPAP: Continuous Positive Airway Pressure; EMRI: Emergency Management and Research Institute; IMR: Infant Mortality Rate; INR: Indian Rupee; MRI: Magnetic Resonance Imaging; NMR: Neonatal Mortality Rate; NTS: Neonatal Transport Service; NICU: Neonatal Intensive Care Unit; PDF: Portable Document Format

Introduction

India has got still high infant mortality rate (IMR) - 29/1000 live births in 2021, when compared to western countries (figure of < 6/1000 births). Neonatal deaths contribute to two thirds of the IMR and most neonates are dying during 1st week of life [1]. Neonatal mortality rate (NMR) in India is 20.4/1000 live birth in 2020, Unicef data (IMR 34/1000 in 2016) [2]. This reflects the existing perinatal care and services in the country. The figures are better in some states especially in south states. Delivery of high-risk pregnancies should occur at tertiary care hospital for better perinatal outcome. Anticipation of high-risk deliveries is not always possible like premature births. Hence, there is need of neonatal transfer from primary care centre to tertiary care centre through neonatal transport system (NTS).

Dedicated NTS does not exist in public sector at our place. Our main transport system is by road transport with 108 EMRI ambulances [3]. It is the one for all types of patients. Many babies are transferred by two wheelers (10-25 km), car, van, jeep and ill-equipped private ambulances. These high-risk babies are succumbing to develop hypothermia, hypoglycaemia, hypoxia and hypotension during neonatal transfer and contribute to significant neonatal morbidity and mortality even when they reached tertiary care centre. Organized transport showed better neonatal outcome than self-transport [4].

Our place is situated on national highway 62 with twin towns, Korutla and Metpally (Approximately 118,000 urban populations together) separated by 11km and approximately 180 surrounding villages spread in 40km radius. The population density at Metpally

and Korutla is 1900/Km^2 or 4900/sq.mi and 2900/Km^2 or 7500/sq.mi [5]. Ten to fifteen percent of villages are outreach (tribal Thandas) and not well connected with all seasonal roads.

Approximately > 5000 deliveries per annum are taking place in our area. Out of this, 60-65% deliveries taking place in two government regional area hospitals and the remaining 35-40% deliveries occurring in local maternity nursing homes. It is good to have a level 3 NICU for regional needs. There is a high scope and need for establishing a neonatal transport service (NTS), at least two. There is a necessity for creating public awareness and optimum utilization of NTS services.

There is regional shortcoming of resource deficiency - men, machines and money. The NTS should be patient friendly and cost effective.

- **Men**: Human resources are vital for running the NTS system. Specialized trained personnel like neonatal transport nurses, fellows, and respiratory therapist are deficit in number. Available personnel are reluctant to work in urban-rural India.
- **Machines**: Vehicles and transport equipment as in use in west/developed nations cannot be used in our locality due to high initial cost and maintenance. Indigenous cost-effective equipment is affordable.
- **Money**: Financial management is important for success of any organization. Funding can be partnership based- public and private, third party, charity or individual. It includes wages - daily and monthly, purchase and maintenance of vehicles and equipment, purchase of medication, insurance, administrative expenses, expenditure for continuing staff education and communication.

Types of neonatal transport: can be classified as follows

- Home to health care facility (home deliveries)
- Intra-hospital transport (delivery room/theatre to NICU)
- Inter-hospital transport-
- Transport for specialist care management like surgical, cardiac, neurological services etc.
- Retrieval from level 1 to level 3 NICU.
- Reverse transport - returning from level 3 care centre to level 1 care centre after management.
- Transfers in case of cot capacity issues.

Commonly available ambulance vehicles in India

Minivan

Affordable cost-effective vehicles for a journey upto 200 km. The disadvantage of these vehicles is lesser space available for placing transport incubator, neonatal equipment, patient attendants and performing procedures

- **Maruti omni ambulance:** Petrol variant with mileage of 16.8kmph, cost 3.06Lakhs INR (Indian rupee). This vehicle can be used for in-utero transfer of stable pregnant mother and attendants and transfer of stable infants for diagnostic evaluation, elective procedures and surgeries.
- **Maruti suzuki Eeco Ambulance:** Petrol variant with mileage 15.1kmph and costs 6,16,875/- INR. This vehicle from same Maruti automobile maker's but relatively more spacious than Omini variant.

Minitruck

These vehicles have advantage over minivans like - more space available for staff, patients, equipment and performing procedures. A longer journey upto 300km or more can be done. Initial purchase cost is relatively high for these vehicles. Example -

- **Force trax ambulance:** Cost 14 - 24 lakhs INR, diesel variant, mileage 17 kmpl
- **Tata winger ambulance:** Diesel variant, 15 - 22.72 lakhs INR.
- **Mahendra bolero ambulance:** Diesel variant, mileage 12.5 kmpl, 6.87 - 8.89 lakhs INR.

The ambulance vehicles should pass and withstand 10G force in all directions. Ambulances are allowed to drive at higher speed than permissible road limits by NHS (but not more than 20kmph) [6]. The transport incubator trolley is positioned on offside for space management and well utilisation.

Neonatal transport team

Transport team leader is usually a neonatal physician. The other members include neonatal advanced nurse practitioner or neonatal transport coordinator, neonatal transport nurse, respiratory therapist and ambulance crew. Neonatal nurse/transport nurse/respiratory therapist is deficit in number and can be substituted with a trained neonatal transport nurse, male or female/midwife/

ASHA (Accredited Social Health Activist -by Government of India) worker from community and ambulance crew.

- The team leader and his members should exhibit the following qualities [7]
- Ability to work as a team member and as an individual.
- Possess and perform neonatal care skills (resuscitation and stabilisation) when required and ability to take complex decisions.
- Possess excellent communication skills.
- Ability to work in stressful conditions and possess and exhibit crisis management skills.
- Ability to perform clinical procedures.

Vehicle and equipment

A transport vehicle should be provided with specified weight, fixations, power and gas provisions (two cylinders that last for more than two hours). Power from two alternate modes like generator and inverter should be available to run the equipment. Ambulance should be fitted with cot rails and fixations, fastening belts for equipment, adequate power adapters, ambient environment with thermal control, permissible noise and vibration, infection control, safety measures and insurance coverage for all passengers [8].

Specific equipment

Transport incubators - cost effective, indigenously made ones are preferred -

- Medilap ICB 101 - costs INR 1.6 lakhs/unit.
- AKL surgical and medical equipment's -INR 1.05 lakhs/unit.
- Meditrin NT System - INR 55,000/unit.

Other essential equipment

- Portable CPAP/transport ventilator
- Multi-para monitor
- Non-invasive blood pressure monitor
- Resuscitation equipment
- Pulse -oximetry
- Syringe pumps
- Suction pump - battery operated slow suction and manual suction
- Oxygen-air blender
- Digital thermometer
- Glucometer with gluco-strips
- Blood gas analyser.

Other equipment

Power backup from alternate sources should be available like electric generator/inverter, electric adapters in sufficient number and minimum of two oxygen gas cylinders.

Medications

Normal saline, ringer lactate, 10% and 25% dextrose, calcium gluconate, phenobarbitone, adrenaline - prefilled syringe in 1:10,000 dilution, dopamine, dobutamine, midazolam, morphine, fentanyl, sodium bicarbonate and surfactant.

Maintenance of ambient ambulance atmosphere [9]

- Place the incubator trolley in offline for better space availability.
- Additional lighting, vibration and sound insulation. Driving the ambulance in a steady pace (prevention of acceleration and deceleration) during transport.
- Optimum stabilization of infant before transfer-surfactant administration, well securing endotracheal tube, initiation of ventilation and management of hypotension and shock.
- Anticipate clinical destabilization as in case of pneumothorax. Drain pneumothorax before transporting the baby.

Organization of neonatal transport

This can be achieved with following - a) training and assessment b) communication and documentation c) stabilization and care d) quality governance and e) legal issues.

Training and assessment

Training and education should be central theme for personnel involved in neonatal transfers. Training should include the following [9]

- Operation of transport equipment. Knowledge of transport physiology
- Inter-personnel and team co-ordination during transfer.
- Skills in neonatal resuscitation and stabilisation.

- Communication skills with individuals and higher authority.
- Continuous education on skills maturation - case scenarios, simulation-based training, equipment operation, Objective based structured clinical examinations.

Documentation

The supporting staff at referring and receiving units should prepare necessary documents/PDF files [10]

- Copies of ante-natal, intra-natal records.
- New-born case history and clinical findings at birth and later.
- Medications and procedural records. X-rays and lab records.
- Ultra-sound and MRI images and reports.
- Address maps and telephone and mobile numbers of parents, referring unit and receiving unit.
- Parents consent form and referral forms.
- Evidence of verbal and written documentation of hand-over.

Communication and handover

It is exchange of information between persons and parties - referring unit, receiving unit including transport team and patient's family. The success of NTS depends on effective communication between the referring and receiving units. This is specially important when transport is taking place from remote and rural place (11). A dedicated telephone line or mobile phone should be maintained for this purpose.

Communication with the referring unit: Should include introduction of team leader and members, name and address of receiving unit, patient details in a structured form [11]

- S - Situation - main problem, reason for transfer.
- B - Background - maternal and new-born history.
- A - Assessment of clinical condition by examination and lab findings.
- R - Request/recommendations - advice for further stabilisation and evaluation.

Communication with family and parents: The following things should be discussed with parents

- Clinical status and severity of illness
- Time, type and mode of transport.
- Facilities and level of care at receiving centre
- Name, contact phone number and address of receiving centre.
- Care and procedures during transport.
- Cot availability and reservation at receiving centre.

Stabilization

Physiological stabilisation of sick infant should be carried out by the transport team at referring centre by structured protocols - 'TABCDE' or 'STABLE' (16). The aim is to restore physiological equilibrium like normothermia, euglycemia, management and prevention of hypoxia, acidosis and hypotension, surfactant administration, assisted ventilation and improving organ perfusion [12].

Clinical assessment

Infant should be assessed with STABLE or TABCDE protocol

- S - Sugar - blood glucose should be tested with Glucometer and treated if found hypoglycaemic with 10% 2.5ml/kg as bolus dose.
- T - Temperature - should be checked with digital thermometer, both core and peripheral. Normothermia should be maintained by available methods like transport incubator, phase gel mattress, Kangaroo mother care (KMC), plastic bag, thermocol box etc
- A - Assisted ventilation - check airway and breathing, keep neck in neutral position, suction, assess breathing and decide need for intubation and assisted ventilation.
- B - Blood pressure (BP) - record BP by invasive/non-invasive/Doppler mode. If found in hypotension, treat with normal saline bolus 10-20ml/kg and need for inotrope infusion.
- L - Lab workup - collect and send blood for quick lab reports - blood gas analysis etc
- E - Emotional support - to parents and family and keep ready equipment and ambulance for transfer.

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- T - Temperature
- A - Airway management
- B - Breathing - assessment and ventilation.
- C - Circulation - evaluates perfusion by capillary refill time, heart rate, BP, urine output, sensorium, spontaneous activity.

- D - Drugs - dextrose, dopamine, calcium gluconate, normal saline, surfactant, epinephrine, morphine, midazolam etc
- E - Emotional support

Preparation and plan

Handover - should be carried out in conducive atmosphere in presence of both teams (referring and receiving) and parents, initially with verbal consent at bedside and later with written consent.

While transferring the infant into the transport incubator, the following precautions should be taken

- Transfer should be done by two personnel by using tail lift secure with floor clamps.
- Prevent hypothermia by partially opening the port holes.
- Keep incubator on half side.
- Maximum visibility of infant and monitors.
- Properly secure all tube and catheters
- Secure baby with neo-restrains and equipment with fasten belts.

Communication during transport

The team leader should be available to referring, receiving units and parents throughout journey by mobile phone. He should update the clinical status of infant and communicate any emergency/ untoward incident to all the three groups.

Feedback communication and takeover

Once the infant reached the receiving centre, the team leader should communicate the clinical status of the infant, probable diagnosis, prognosis, hospital stay, finances, insurance, further management and probable date and time of reverse transport.

Parental concerns

Parents should be given an opportunity to see the baby. They should be given liberty to ask any questions and concerns regarding the status and care of the baby. They should be explained about the state of illness and need for further care and invited to accompany the transport team in the ambulance.

Family centred care (FCC)

FCC may not possible be in transport environment due to reasons like severity of sickness of infant and need for fast transfer to level 3 care unit. Invite parents to accompany the baby in ambulance.

Neonatal air transport

This is not a main transport system at our place but occasionally used for transporting babies with specific clinical conditions like infant cardiac surgeries at distant cities after initial road transport. Whereas neonatal air transport is an integral part of sick patient transport system in many developed countries especially Australia, USA and UK (Scotland, Wales and England). Both pressurized (fixed wing aircrafts) and unpressurized aircrafts (Helicopters) can be used for air transport. There are concerns need to be mentioned here specific to air transport like [13]

Air transport is costly

- At risk of high-altitude effects
- Noise issue (>125dB)
- Vibration
- Acceleration and deceleration effects on sick and tiny babies
- Space availability
- Gases - may expand at high altitudes and expansion of air leaks
- Thermal control in Helicopter transport
- If baby deteriorates, cannot immediately be landed but at nearby airport after approval for emergency landing.

Quality governance

In spite of optimum care during transport, emergency situation, infant death, accidents can occur [14]. These incidents should be reported and resolved with policy guidelines. Quality assurance and incident review should be submitted to state review bodies [15].

Legal issues

Medico-legal issues arise due to inadequate information and poor communication between the clients and care givers. Anticipate legal issues when baby dies during transport. When the baby is rapidly deteriorating during transport, ambulance should be taken to the nearest and highest care level hospital and stabilised or if baby dies, death certificate should be issued.

Conflicts of Interest

There are no conflicts of interest.

Sponsors

There are no sponsors for study article.

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