

Neonatal transport – the comfort zone

Neonatal transport creates many challenges for the neonatal nurse by the sheer nature of the isolation of the transport environment. Babies should be offered the same level of care during transport that can be expected from the NICU, including individual care assessment needs. This article will discuss the developmental care needs of the baby and how they have been incorporated into the North Trent Neonatal Transport Service.

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The North Trent Neonatal Transport Service (NTNTS) is a specialised service designed to make neonatal transport rapidly available to babies within the North Trent Neonatal Network (NTNN). Highly skilled nurses staff the team from 08.00-22.00hr seven days a week. Advanced Neonatal Nurse Practitioner (ANNP) and/or Specialist Registrar (SpR) cover is available when needed for transfer of the more seriously ill infant. In direct consultation with senior medical personnel at the Jessop Wing, the service deploys a neonatal intensive care team to assist in the treatment of critically ill babies both before and during transfer for specialist care. Telephone consultation, liaison with subspecialists and skilled inter-hospital transport are offered within one service.

Hospitals provide some intensive care facilities to sick babies however, if specialised intensive care and surgical care facilities are required these are provided by the two units in Sheffield. With the babies at the centre of the decision making process the objective of the NTNTS is to provide high quality, safe, efficient and comfortable transfers for all the babies requiring transfer.

Developmental care in neonatal transport

Little et al¹ suggested that developmental care interventions should be implemented with thought and consistency during neonatal transport as this may reduce and prevent neurodevelopmental complications. They also documented that neonatal transport teams are in a fundamental position to decrease complications and improve outcome in neonates. As experienced nurses the team are extremely cognisant of the importance of developmental care and have adopted various measures to ensure that babies are

positioned, contained, secured and feel safe during what can be a very stressful journey for them. This is done by encompassing the individual developmental care needs within the multidisciplinary care pathways for transport, which has a specific section relating to developmental care (FIGURE 1).

Through this tool the care team at the referring hospital can relay to the transport team the positions the infant has previously tolerated or favoured and the positioning aids that have been used. The tool also allows for information to be recorded about methods used for reducing light and noise. The transport team can facilitate ongoing developmental care throughout the transportation of the infant and then pass this information on to the receiving hospital to continue ongoing care.

Positioning, containment, reduction of vibration and patient safety

During transport the team provide a nested, contained environment for the infant using the Preemie nest set (CMS Medical Supplies) which enables the infant to lie in a range of supported positions. The Squishon gel filled mattresses (Children's Medical Ventures) (FIGURE 2) is also used on an existing foam mattress base to help reduce the adverse effects of vibration on both the baby and tubing². According to McNab et al³ healthy adults who have undergone transport have found the experience to be "very uncomfortable". The combination of the Squishon mattress and the Preemie nest together provides the baby with comfort, containment and flexed positioning, all aiding a reduction in stress⁴.

NTNTS use the TI500 Transport Incubator (Dräger Medical) and the Baby-Pod (Advanced Healthcare Technologies) for transporting babies between hospitals.

Keywords

positioning; comfort; pain assessment tool; restraints; noise; infant safety

Key points

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1. The North Trent Neonatal Transport Service (NTNTS) aims to provide high quality, safe, efficient and comfortable transfers for all babies.
2. NTNTS works towards meeting the developmental care needs of individual infants who are being transferred to and from hospitals.
3. During transport the team are able to facilitate a nested, contained environment, ensuring the babies feel safe and secure.

Nursed in incubator with pressure care mattress:	YES	NO	This baby has been nursed with an incubator cover to promote a shaded environment:	YES	NO
Nursed with positional aids:	YES	NO	This baby has been nursed in a cot with a crib canopy:	YES	NO
• Jelly wedges	YES	NO	This baby has had the following in or at the cot side:		
• Nest with supportive boundaries	YES	NO		• Toys	<input type="checkbox"/>
• Supported when side lying with a rolled sheet or towel	YES	NO		• Pictures	<input type="checkbox"/>
• Bendy Bumpers	YES	NO		• Bedding	<input type="checkbox"/>
• Freddie Frogs	YES	NO		• Religious items	<input type="checkbox"/>
			• A cloth that has been worn by mother	<input type="checkbox"/>	
This baby prefers the following positions:			This baby has been used to a quiet hour and is used to reduced noise levels:	YES	NO
• Side lying	<input type="checkbox"/>		The parents have been the primary care givers in the following areas of care:		
• Prone	<input type="checkbox"/>			• Mouth care	<input type="checkbox"/>
• Mid supine	<input type="checkbox"/>		• Nappy care	<input type="checkbox"/>	
• Left supine	<input type="checkbox"/>		• Lifting the baby for linen changes	<input type="checkbox"/>	
• Right supine	<input type="checkbox"/>		• Kangaroo care	<input type="checkbox"/>	
This baby tolerates the following positions for short periods of time:			• Supportive handling	<input type="checkbox"/>	
• Side lying	<input type="checkbox"/>		• Supportive positioning	<input type="checkbox"/>	
• Prone	<input type="checkbox"/>		The parents of this baby have been using a diary to communicate and keep a record of their baby's care and development:	YES	NO
• Mid supine	<input type="checkbox"/>				
• Left supine	<input type="checkbox"/>				
• Right supine	<input type="checkbox"/>				

FIGURE 1 Developmental care table.

The portable incubator is used to transport all categories of babies whereas NTNTS only use the baby-pod for transporting those babies above 1.5 kg who are capable of maintaining their temperature. This is based on local experience as the company is unable to provide evidence to support gestational age or weight use, other than maximum weight of 6kg and six months of age.

At present, within the UK many infants are transferred without any form of restraint inside the incubator, the argument being that there is a risk of injury to the infant by the restraint itself. The use of any restraint is a risk reduction exercise which will involve some compromise between the risk of injury to the baby by the restraint and the risk of injury to the baby and the wider environment if no restraint is used. The securing straps provided with both pieces of equipment secure the infant using four soft foam straps attached at the sides of the mattress and are fastened diagonally across the baby to form a cross (FIGURE 3). The restraints are of a fairly lightweight construction, obviously in consideration of the fragility of the baby being transported however, the concern is that they will not provide sufficient restraint in a collision, possibly leading to unnecessary injury to the baby and also to other passengers



FIGURE 2 Squishon mattress (Children's Medical Ventures).

travelling in the ambulance. NTNTS are currently investigating what other harnesses are commercially available. Two other manufacturers, one in the UK (Paraid Medical Systems) and one in America (Kerton Medical) are in the process of developing new restraints and the team are aware of one method which would appear to improve upon the existing system.

Noise and its prevention

Noise is measured in decibels (dB). Human sound sensitivity levels start at 0 dB, and the pain threshold of sensitivity occurs when noise levels reach 120 dB⁵. During neonatal transport noise levels may be higher than that recommended for a neonatal intensive care unit. Macnab³ has suggested that noise levels should not exceed 60dB and the American Academy of Pediatrics⁶ recommends that noise levels

above 45dB should be avoided.

There are four types of adverse noise-induced health effects on preterm babies that need to be considered⁷:

1. Hearing impairment – due to constant high levels of background noise.
2. Sleep disturbance – caused by loud or sharp noises which can lead to unnecessary stress and loss of sleep time.
3. Somatic effects – noise can cause fluctuations in arterial oxygen tension, blood pressure and intracranial pressure and may contribute to hypoxic brain damage.
4. Auditory perception and emotional development – external noise may mask the mother's voice impairing the emotional development of the baby.

Wherever possible, staff minimise the noise infants are exposed to. At the start of a transfer staff routinely set their phones to vibration mode and on arrival at a referring hospital handover of the infant is taken away from the cot side.

The team, who are highly skilled nurses, know that most transfers do not necessitate the use of ambulance lights and sirens although the infant may be subjected to the noise of sirens if the need arises. Unfortunately the infant will always be subjected to other general noise generated by ambulances and road surfaces. Buckland et al⁸ documented that high

levels of noise are related to road surface, speed of travel and the type of road being travelled upon. These factors are out of the control of the NTNTS but preventative measures can be taken to reduce noise. The use of incubator covers has been shown to significantly reduce noise levels inside the incubator⁹ (FIGURE 4). By using an incubator cover the infant also has some privacy whilst being transported between hospital departments and the ambulance. Whilst in transit to the ambulance the baby is continuously monitored, once loaded securely into the ambulance the cover is lifted for the duration of the journey so the baby can be observed.

Saunders⁹ found that neonatal ear mini-muffs, (Natus)(FIGURE 5) reduce noise levels by 7 to 12dB, therefore every baby that travels with NTNTS is fitted with a pair of these. Furthermore it is suggested by Zahr¹⁰ and Purdy¹¹ that infants wearing earmuffs demonstrate improved, more stable oxygen saturation levels and their sleeping periods are increased. The mini-muffs are made of soft foam secured around the ear with hydrogel and they are easily removed when the baby reaches the destination hospital.

Noise can also be transmitted via other means – nasal continued positive airway pressure (CPAP) ventilation causes noise intensities in the post-nasal space with levels reaching up to 102 dB at some frequencies and increasing with higher flow rates¹². The post nasal space is proximal to the inner ear and transmitted noise could be considerably detrimental and may cause cochlear damage and hearing loss.

Temperature management

Maintaining a thermal neutral environment for the infant during neonatal transport can be a challenge. However provision of a thermal neutral environment is essential in the immediate and subsequent management of the infant and failure to provide such an environment may result in cold stress or hyperthermia, which may create metabolic effects¹³. Carmichael et al¹⁴ identified that infants undergoing neonatal transport will undoubtedly undergo a degree of thermal stress, which NTNTS aim to minimise at all times.

By using a Transwarmer mattress (Prism Healthcare) it is possible to reduce thermal stress in transport if the maximum incubator temperature is not sufficient or in the event of a power supply failure to

the incubator². Transwarmer mattresses are used by NTNTS when required for use in the Baby-Pod, which has no internal heat source but can be used to transfer preterm infants according to Advanced Healthcare Technology Ltd¹⁵. The Transwarmer mattress is a disposable mattress filled with sodium acetate gel which is a food grade. Within the mattress there is a metal disc which, when activated, triggers a chemical reaction leading to the generation of heat. The mattress will heat to an operating temperature of 38°C¹⁴ and will continue to function and supply heat for approximately two hours. It is important to stress that safe use of the gel mattress is critically dependent on gel temperature at the time of activation and the warming of a hypothermic neonate without running any risk of burns does depend on the mattress being activated with a gel temperature between 19°C and 28°C¹⁶. Thus the ambient temperature at which mattresses are stored needs to be controlled and the manufacturer's instructions carefully followed. The mattress also assists in reducing vibration in neonatal transport when placed under the baby.

Pain and pain relief during transport

Infants often appear distressed and experience discomfort during transport but by using the above mentioned developmental care methods some of this discomfort can be eliminated. Until twenty years ago it was believed that neonates did not experience any pain¹⁷. Due to the fact that they are unable to verbalise their pain they depend on others to recognise, assess and manage it. Whitfield¹⁸ identified that there is no doubt that pain causes stress in infants and this in turn may adversely affect long term neurodevelopmental outcome of the infant.

Methods of pain relief used at present by NTNTS include the use of pacifiers, sucrose and opiate analgesia. The use of a pacifier has been shown to reduce distress and has a synergistic effect when combined



FIGURE 3 Restraints used in the Baby-Pod and Dräger TI500 incubator.

with sucrose¹⁹. However, use of a pacifier should be restricted to infants above 28 weeks' gestation due to the possible lack of a well developed sucking reflex.

Sucrose has been shown to have a good analgesic effect during painful procedures, including insertion of cannulas and heel prick sampling procedures that the NTNTS may have to perform on the infant during stabilisation prior to transfer. Evidence supports the sucrose having a good effect on preterm infants below 30 weeks' gestation despite poorly developed taste sensation or suck^{20,21}. Sucrose needs to be administered into the infant's mouth to be effective, it causes a release of endogenous opiates which produce pain relief for the infant. Again it has to be remembered sucrose can only be used once the infant has developed a suck response to avoid the risk of aspiration. Other contraindications for using sucrose include infants who have not established feeding, all those infants who are at high risk of necrotising enterocolitis (NEC) and those recovering from recent gut problems¹⁹. Macrae²² suggests opiate analgesia provides very safe and effective pain relief, but due to the side effects of respiratory depression these infants may require respiratory support during transport. Administration by a continuous infusion provides steady levels of effective analgesia for the baby.

To achieve a high standard of pain relief



FIGURE 4 Portable incubator cover designed and made by NTNTS.



FIGURE 5 Mini-muffs.

for the infants during transport it has been decided by NTNTS that a pain assessment tool specific to transport needs to be developed in the near future. Various existing pain assessment tools are being reviewed to devise an eclectic tool that would be effective and combine all the needs of the infants during transfer. Sparshott has recommended that the assessment tool should consider gestational age, physical condition and state of consciousness of the infant²³.

Involving parents

The understanding and involvement of service users is important to the NTNTS. A specially designed parent information pack is available that explains who the team are and what they do. There is an individually designed web page www.northtrentneonatal.nhs.uk/index.php on the network web site. Currently the team are developing a short information film for parents to watch on one of two portable DVD players which are carried at all times. This will hopefully go towards relieving some of the anxiety and stress at such a difficult time. A parent questionnaire enables audit of the team's performance as well as giving valuable knowledge from a parent's perspective on how to improve the service NTNTS provide. Recent parent feedback on the developmental care provided during

transport is very positive. Babies tend to snuggle in and settle very well inside the incubator and parents feel that their babies appear 'cosy and snug'.

Conclusion

The NTNTS makes every attempt to ensure that the individual comfort and developmental needs of each infant are met, whilst maintaining a high standard of clinical care and patient safety during transfer. The incubators are always set up with a mattress and supporting aids in place, so that, in the event of a time critical transfer babies are not compromised by delaying transfer, yet still receive some degree of benefit from developmental care options. Unfortunately due to the nature of the way babies are transported noise is always encountered by the baby and team during transfer; but every attempt is made to minimise the level of noise the infant is subjected to.

As well as the challenge of trying to find a better harness system in terms of risk reduction the team would also like to find a harness that would permit and promote interventions such as self comforting or prone positioning.

Performance is measured through questionnaires of service users and audit of all the clinical information and timings of transfers, which are stored on a comprehensive computer database. This information is then used to implement improvements in service. NTNTS constitute part of a benchmark group for neonatal care and are also involved with the national neonatal data set, which is developing guidelines for the care of neonates during transport. There is continuous networking with other units, enabling information to be gained and shared, leading to the implementation of best practice. The transport team in North Trent are constantly working towards improving standards and ensuring that possibly one of the most traumatic journeys that the baby will make is not compromised by lack of confinement, support and comfort.

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