NTS Clinical Guideline

Title:	Preterm Neonate Transfer		
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Key Points

Prior to departure

1. Obtain essentials of history, and advise referring unit on achievable objectives, which will expedite the stabilisation of the infant.
2. Ensure you have all preterm-specific equipment with you

On arrival and on transfer

3. Obtain thorough **handover**
4. **Ventilation**
   - Assess infant's stability on current ventilatory support mode
   - Ensure optimal ETT position (T1-2)
   - Ensure appropriate surfactant administration (minimum 100mg/kg, distributed symmetrically)
   - As soon as practicable, place baby onto transport ventilator, and assess continued stability prior to transfer
     - beware hypo/hypercapnia (minimise volutrauma)
5. **Cardiovascular**
   - Assess immediate need for invasive BP monitoring, or central access
   - Establish two points of intravenous access as a minimum
6. **Fluids**
   - Assess fluid and glucose delivery requirements
     - Be mindful of increased risk of water loss in extreme preterms
   - Assess need for treatment of metabolic or electrolyte derangement
7. **Infection**
   - Ensure intravenous antibiotics given prior to departure
8. **Haematology**
   - Assess need for support with blood components at point of referral
     - address early , as it may take time to obtain components
9. **Neurological**
   - Ensure adequate sedation for transfer
     - this may exceed their sedation on the referring unit
10. **Environment**
    - Ensure appropriate temperature within the incubator
    - Ensure humidity maintained around the infant, through use of plastic bag/wrap
11. **Family**
    - Ensure parents updated regarding transfer process
      - Offer Parent Pack + Accepting Unit Information Sheet

Background

The most common reason for NTS referral over the last decade has been for the 'uplift' of preterm neonates who have unexpectedly delivered at units not suited to the level of care which they require. Antenatal transfer of these infants is the ideal management, but this is not always possible.
Preterm infants often require the full range of support the transport team can offer, and thus a systematic approach is required to ensure all their needs are met. Additionally, preterm infants are disproportionally susceptible to the adverse effects of transport, and especial attention must be given to their care.
A balance must be reached between the benefits of instituting increasing levels of treatment/monitoring, against the inevitable risks from time delays that ensue: '*the aim should be to stabilise the baby and achieve the optimal condition, whilst recognising the limitations of the transport setting and the underlying condition*' [NTS Stabilisation and Preparation for Transfer Guideline]. This decision should be made in consultation with the consultant on-call, and will vary on a case-by-case basis, depending on individual patient requirements, referring location and expected duration of transfer[1].

Pre-departure Preparation

Communication

- The unexpected delivery of preterm babies at units unused to looking after them can be a very difficult event for all involved parties: parents, baby, referring team and transport team.
- Upon receiving a referral, it is important to cover the key points of the clinical situation, and provide helpful, achievable advice and support until you can arrive on site. Initial conversations should focus on establishing the current physiological and management status, and initiating simple interventions to improve the situation (if necessary) and ease the transition of the baby to your care.
- Upon arrival, a thorough handover can be conducted, and the feasibility and suitability of the patient for transfer can be assessed.

Equipment

- Specific equipment is required for the transport of preterm infants: ensure you have the ability to deliver humidified gases (*i.e.* ventilator water-bottle, rigid reusable tubing), appropriate-sized restraints, plastic wrapping to maintain humidity around the infant, and Transwarmer.

Systematic Review of Management

Airway Maintenance

- Depending on the degree of prematurity and condition of the infant, the referring unit may have stabilised on non-invasive (*i.e.* CPAP), or invasive ventilation (*i.e.* endotracheal tube [ETT]).

- Before transferring on non-invasive ventilation, stability must be ensured, and consideration given to expected duration of transfer. CPAP has been shown to be safe for the transfer of preterm babies[2], but should doubt persist, intubation for transfer may be the safest course.
- If transferring intubated, prime consideration should be given to maintenance of airway security. ETTs should be positioned and fixed securely (as per NTS guidelines), and supported within the transport incubator to allow minimal movement. It has been demonstrated that motion during transport may induce sufficient mechanical forces to result in extubation[3], and the decreased 'cords-to-carina' distance in low-birthweight or preterm neonates exacerbates this risk.
- If not already done so, a nasogastric tube should be inserted, and gastric contents emptied, to reduce the risk of aspiration during the course of transfer.

Breathing/Ventilatory Support

- Depending on the time since delivery and any subsequent interventions, preterm infants may still be in a period of physiological transition at the time of transfer. Additionally, if surfactant has recently been administered, lung compliance may be undergoing quite profound changes[4]. These factors should be considered when changing from the referring unit's ventilator settings to those of the (necessarily limited) transport ventilator, and it is advisable to ensure a blood gas is repeated prior to departure, to ensure continued stability on the new equipment.
  The implied risk is of *over*-ventilation during transport, leading to hypocarbia, associated with later development of PVL and BPD, (although conversely *hyper*carbia may be associated with increasing rates of IVH); and also the more immediate concern of the development of a pneumothorax. Reassuringly, evidence from the literature suggests this risk of over-ventilation (pCO_2 < 4kPa) is mild (~3%), *although disproportionately seen in extreme preterm infants*, and pneumothorax rates are comparable to the non-transported cohort[5].
- The process of transfer (*i.e.* change in equipment, handling, motion) places the preterm infant at an increased risk of respiratory instability. Whilst deterioration should be guarded against, over-compensation should be also be avoided, with studies showing elevated rates of hyperoxia (associated with ROP) during transport[6]. Careful attention to pre-transfer stabilisation may help to reduce the need for acute intra-transport interventions.
- Specific equipment must be utilised in the ventilation of preterm infants. The delivery of non-humidified gas to the preterm infant can exacerbate insensible water loss, and worsen ventilator–induced lung injury. Consequently, a humidifier must be attached to the ventilator circuit, and the rigid ventilator tubing used.

Cardiovascular Stability and Vascular Access

- Cardiovascular instability is similarly a feature of the preterm neonate, and may be exacerbated through transfer.
- Establishment of central venous access and invasive blood pressure monitoring is not essential in the stabilisation and transfer of a preterm neonate. However, if there are concerns regarding cardiovascular stability, or the duration of transfer means continuation of stability cannot be confidently assured, then establishment of umbilical access may be advised (see NTS Guideline on

Umbilical Catheter Insertion). Generally, a 'stable' preterm will have a mean NIBP >gestational age, F_iO_2 <0.3 and evidence of adequate perfusion (normal CRT, acceptable lactate). Regardless, a minimum of two points of venous access is required.

- Hypotension should be treated in line with NTS Guideline on Management of Hypotension
- Where invasive arterial access has been achieved, this should be monitored in line with NTS Guideline on Monitoring of Arterial Lines, and accurately and regularly documented.

Fluids and Metabolic

- As a matter of course, preterms should be transferred on plain 10% dextrose. Infusion rates will be related to gestational age, age at transfer, and clinical impression of fluid requirements. Extremely preterm infants are at high risk of becoming fluid deplete through a number of mechanisms; therefore, an assessment encompassing clinical examination, and consideration of physiological and biochemical parameters should occur at stabilisation to assess fluid requirements.
- Extremely preterm infants may require up to 90-120ml/kg/day in the first 24 hours, and may additionally require boluses of 0.9% saline (10ml/kg), if they have evidence of having become fluid deplete.
- Electrolyte derangement is common in extremely preterm infant (*e.g.* hypernatremia from fluid depletion; hyperkalaemia from haemolysis, if extensive bruising has occurred). Treatment of electrolyte derangement may occasionally be required before safe transfer can occur, although the benefits of this should be balanced against the risks of delaying transfer.
- Extremely preterm infants are similarly at risk of acid-base disturbance, although this usually becomes more of a problem after a few days, so is less likely to impact upon transfer. Again, treatment of severe acid-base imbalance may be indicated, but should not unnecessarily delay transfer.
- Extreme preterm infants are also at risk from hypoglycaemia. Their stability at their current rate of glucose delivery should be assessed at arrival, and fluids adjusted accordingly. Boluses of 10% dextrose (2.5ml/kg) may be required in severe hypoglycaemia.

Infections

- Antibiotics should not feature prominently in the stabilisation period, as they are likely to have already been given by the referring unit. However, do ensure this is the case, and, if not, they should be given, as per local protocol, prior to departure.

Haematology

- By virtue of perinatal events, extremely preterm infants may be at-risk of adverse haematological status (*i.e.* anaemia, deranged clotting). Additionally, this may be a dynamic process, which may worsen during stabilisation/transfer. It is thus advisable to address haematological abnormalities prior to departure.

- Identify the potential need for blood products as soon as possible, as there may be a significant delay in obtaining these. This may include at the point of referral.
- Packed RBCs, FFP, cryoprecipitate and platelets may all be given *during* transfer. The extended duration of infusion for these products means that commencement of transfer should not generally be delayed for their completion. If there is doubt, discuss with the consultant on-call.

Neurology and Sedation

- The mechanical forces which impact upon cardio-respiratory stability may also impact upon neurological stability.
- The use of sedation is sometimes required in ventilated preterm infants, and the increased stimuli that the transport process generates should be considered. The impact of motion-induced forces, noise and light have been shown to provoke discomfort in neonates (preterm neonates demonstrating the greatest response), with a significant number (~20%) displaying evidence of at least 'moderate pain'[8].
  It may be considered that sedation be provided at a level above that of standard sedation of a non-transported preterm baby, to account for this extra discomfort, and that non-pharmacological measures (*i.e.* gel mattresses, nesting, incubator covers) be employed[9]. Attention to patient comfort may have a multi-systemic impact, through improved physiological stability.

Environment

- One of the most common adverse events noted during neonatal transportation is hypothermia[6], and the susceptibility of preterm neonates to hypothermia in any situation (though a high surface area:volume ratio, and poor skin integrity) means they are at risk of experiencing this complication disproportionally. Similarly, their decreased skin integrity similarly places them at increased risk of trans-epidermal water loss.
- Establishing an isothermic, humid environment within a transport setting is difficult. Use of humidified gases (see above) is helpful. The incubator and Transwarmer will provide an isothermic environment with in the incubator, but any disruption of the incubator micro-environment (*i.e.* opening incubator doors, procedural interventions) will negate this. Within the incubator, a humid micro-environment can be maintained through keeping baby within a plastic bag/wrap, to lessen trans-epidermal water loss. Maintenance of an isothermic environment within the incubator can be assisted by reducing the temperature gradient between the inside and outside of the incubator (*i.e.* maintaining an adequate temperature within the ambulance).

References

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