Handling with care, Part 1

Neonatal treatment and transport

Sometimes the smallest of patients can require the greatest care. In the first of a two-part series on neonatal care, Debbie Legall explores the transportation of neonates between hospital facilities by air and associated treatment protocols

In any medical situation, ensuring that patients receive the care they need without delay is a prerequisite. This is particularly true of newborn babies where the quality of care and the timeliness of the treatment they receive can have a direct impact on their overall chances of survival and recovery. There are a number of challenges associated with the treatment of sick neonates, for example, the rapidity with which a disease can spread and take hold. While many larger hospital facilities may have neonatology teams (which deliver specialist care to newborn and premature babies) located alongside other specialist medical teams within the same building, if such expertise is not available or is in short supply, the only option is to transport neonates off-site to other hospitals – and for critically ill newborns, air transport offers the timeliest and the most appropriate solution.

> air transportation is an integral part of neonatal care in developed countries

The birth of neonatal transport

In the US, the care of neonates can be traced back to the 1930s, and in particular the 1933 World's Fair on technological innovations in Chicago – entitled 'A Century of Progress International Exposition' – which included public exhibits of premature infants in incubators. Such exhibits pre-dated the setting up of Neonatal Intensive Care Units (NICUs) nationally and the transportation of sick neonates. Once centres aimed at the treatment of critically ill newborns were established in the 1960s, the focus of attention soon shifted to the treatment of young babies who were born either at home or in settings where there was inadequate equipment. Infants born in such circumstances were originally transported by car using adapted incubators. With the transfer of wounded patients in World War II and in subsequent conflicts from the battlefield to treatment facilities, aeromedical transportation was born

– and developed. In 1976, the Committee on Perinatal Health proposed a system of regionalised perinatal care. A national model for neonatal referral centres was later developed, incorporating a neonatal transport system. Today, neonatal transport and care are highly-specialised areas requiring the skills of multi-disciplinary specialist teams using specially adapted high-tech equipment, but what are the challenges of infant air transport and how does it work?

Fixed or rotor-wing?

Air transportation is an integral part of neonatal care in developed countries, and referring medical facilities considering which type of air transport to use for the inter-hospital transfers can choose one of two options: fixed-wing aircraft or rotor-wing aircraft.

Michael Key, medical department manager and chief flight nurse for AirMed International LLC in the US, points out that there are advantages and disadvantages associated with both fixed-wing and rotor-wing modes of transport. Rotor-wing aircraft or helicopters, which are more suited to middle distance journeys of up to 150 miles, mean a 'quick departure of the team and time to patient, and decreased time 'out of hospital'' for the young patient. However, onboard there is 'restricted patient access for assessment and interventions due to cabin space and noise/ vibration'. Key explains that grounding due to bad weather conditions places further limitations on the extent to which such helicopters may be used. A further downside is the need for a landing zone close to the hospital.

USAF

A US Air Force team preparing to move a patient under ECMO, in this case an eight-month-old child. The tube feeding red, oxygenated blood to the child can be seen, along with the darker tube taking deoxygenated blood to the ECMO machine.

Key explains that fixed-wing aircraft (aeroplanes), used for transporting patients over longer distances – typically of more than 150 miles – have the advantage of size, and an 'interior space which allows for access to the patient for assessment and interventions'. Aeroplanes also come into their own on longer transfers in that they offer 'more efficient fuel costs and aircraft speed over longer distances'. On the downside, using fixed-wing aircraft means 'increased time to depart and time to the patient'. Longer overall journey times and more complicated arrangements can present a challenge because such aircraft require the use of an airport runway for take-off and landing, as well as an ambulance to transport the neonate to and from the hospital.

Before embarking on air transfers, however, medical staff must first consider whether such a journey should be undertaken, and, if so, ensure that the right preparations and conditions are in place.

European Air Ambulance

European Air Ambulance

Being prepared

According to the University of Washington's Division of Neonatology NICU online resource, there are a wide range of diseases and conditions that could result in a neonate being transported to another medical facility. These include respiratory distress, low birth weight, suspected congenital heart disease, significant birth complications, neonatal seizures, suspected infection and recurring hypoglycaemia. The website emphasises that an important aspect

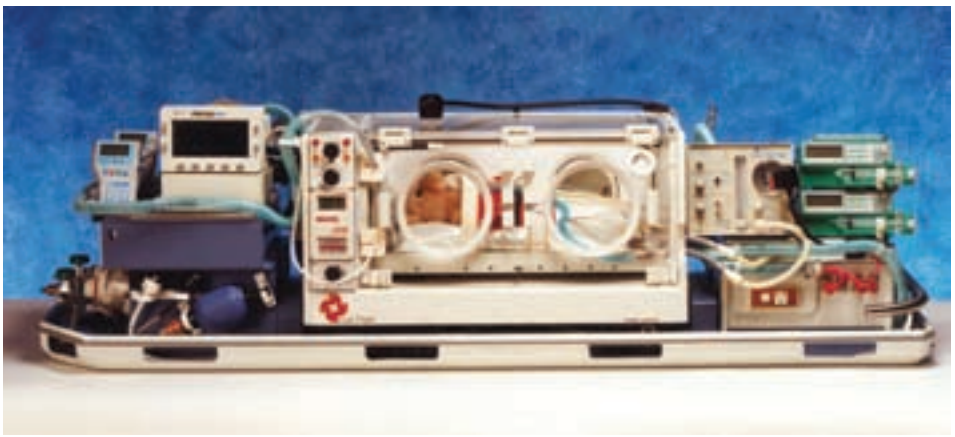
numerous complications can develop in neonatal patients during an air transfer

of pre-flight preparedness is the need for the newborn patient to be in a stable condition before flying. Among the recommendations made are: adequate ventilation, a heart rate of 120-160 beats per minute, an axillary temperature of 36.5°C to 37°C, and the correction of any metabolic problems.

In addition, there are, potentially, numerous complications that can develop in neonatal patients during an air transfer. These can range from neurological complications to haemorrhagic, cardiac, pulmonary, renal, gastrointestinal tract and metabolic complications, as well as complications resulting from infection and sepsis. Key considerations for neonatal transfer teams, therefore, are: ensuring that the correct range of supportive measures has been established, that the correct equipment is in place and that teams of staff with the required spread of medical skills are present in order to cope with the needs of the patient being transferred.

Special considerations

Sick infants require a variety of supportive measures, such as temperature control, ventilation, and intravenous fluids and drugs. Caring for such patients in an intensive care setting is often difficult, but these difficulties are compounded when treatment has to take place in the air.



Life Flight

Didier Dandrifosse, head of Luxembourg Air Rescue (Member of European Air Ambulance) medical department, agrees that neonatal air transport provides a unique set of challenges to both air ambulance and rescue helicopter crews. He commented: "The medical skills and equipment necessary to maintain the health and continuous care of the patient, in addition to the complex logistics involved, require the utmost professionalism and faultless organisation of the team." To illustrate the point, Dandrifosse highlights that premature babies, who are already in a fragile state while still on the ground, are, compared to adults, even more sensitive to environmental elements once in the air. Infants become much more sensitised to everything that is taking place while airborne – such as the vibration of the aircraft, temperature changes and changes in air pressure, including noise. And all of these factors can cause stress to a small body and destabilise it.

Critically ill babies present further challenges to air crew. Key explained: "Neonates that are seriously ill usually also have immature skin and have difficulty with thermoregulation, and insensible fluid loss." Key points out that because neonates also have low fat stores, they can be extremely vulnerable to hypothermia and dehydration.

He highlights the challenges associated with air transport. Whereas in the NICU patients are managed using incubators and isolettes, in transport 'this becomes more difficult due to weather, cabin conditions, high altitude, winds and length of transports'. However, Key concedes that equipment such as special transport incubators or isolettes, as well as polyethylene bags or 'space blankets' can provide protection from the environment as well as help to maintain body temperature.

both cannulation and anticoagulation carry significant risk of morbidity

In addition, treatment innovations can present challenges of their own to neonatal air transfers.

In critically ill neonates, for example, those who have suffered lung or heart failure, newer and more invasive methods of treatment, such as extracorporeal membrane oxygenation (ECMO), in which a machine outside of the body is used to supply oxygen to the blood, may be required. The procedure, which may be life saving, requires cannulation – the use of tubes which are inserted into the body – and anticoagulation – where anticoagulant drugs such as heparin are administered to prevent the blood from clotting. Both cannulation and anticoagulation carry significant risk of morbidity. However, according

to the medical journal, Chest, ECMO 'is often the only option for short-term cardiac support while waiting for either native heart recovery or as a bridge to transplantation'. Such treatments can, explains Louise Burton, a flight nurse for the Brisbane Base Royal Flying Doctor Service (RFDS), create difficulties for medical staff during air transfers, due to the weight of the equipment and the number of staff needed to accompany such patients. RFDS is one of many facilities that are aiming to meet these new challenges and has plans to use ECMO during neonatal transfers. Similarly, Key of AirMed International is involved in an inter-state programme with Hanuola, the ECMO programme of Hawaii, to develop an ECMO transport system for critically ill paediatric patients.

RFDS has plans to use ECMO during neonatal transfers

A Helicopters Otago crew transporting a neonate Helicopters Otago Ltd NZ

Skilled for the job

Dandrifosse said he believes that quality is the overriding priority: "As a general rule, in the transport of newborn and/or premature babies, quality is more important than speed." In other words, he explains, experience in the transportation of patients by air around the world, professional teams and high quality equipment are the key ingredients for delivering optimum levels of care.

Billy Hutchison, a registered respiratory therapist at Texas Children's Hospital, US, echoes some of the views expressed by Dandrifosse: "We feel having a dedicated transport staff properly trained in neonatal transports gives us the ability to handle any situation arising on transport."

Neonatal air transport teams comprise a number of specialist functions. Hutchison explains that his team uses neonatal trained registered nurses and registered respiratory therapists: "We have a two-person crew on most transports. Both are trained in all areas of intervention and care of the neonate." In cases involving extremely critical transports, the team also takes a neonatal nurse practitioner on flights.

In recent years neonatal care requirements have helped to shape and change practitioner roles, particularly in the area of nursing. In New Zealand, for example, a neonatal nurse practitioner role has been developed. This new advanced practice nursing role is a model of how the nursing culture has changed to incorporate elements of other roles that were historically undertaken by other medical professionals. In the US, programmes of study are available for nurses who wish to become advanced practice nurses – in order to take on roles as neonatal nurse practitioners. Courses, which can be attended on a full-time or part-time basis, have individually designed study plans.

METI's BabySIM represents a six-month-old infant Photo Courtesy of METI © 2009

"in the transport of newborn and/or premature babies, quality is more important than speed"

In addition to attending courses, nurses can gain advanced nursing practice skills in the care of high-risk infants in primary and community care settings. Still further opportunities for neonatal nurses have grown out of skills shortages, with neonatal nurses being introduced into tertiary level neonatal care units in the US, Canada and the UK – in response to the increased survival rates of extremely low birth weight infants, a shortage of physicians and a growing emphasis within the nursing profession on the development of advanced nursing practice roles.

Other examples of training – and its importance in the care and transport of neonatal patients – abound. The SSM Cardinal Glennon Medical Center, the first neonatal transport team in St Louis, Missouri, US, is responsible for stabilising and transporting thousands of critically ill neonates and small infants each year. The team, which has a core staff of 16 registered nurses and 16 respiratory therapists, includes a registered nurse and respiratory therapist who have undergone advanced training in stabilising and treating neonates.

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There is also evidence that ongoing training in particular is being prioritised by neonatal services. At SSM Cardinal Glennon Medical Center, in addition to classroom-based training and mentor training, ongoing training modules are offered, which include neonatal resuscitation techniques. Hutchison also highlights the importance of ongoing training for neonatal air transfer teams at Texas Children's Hospital: "We have a simulation lab where we are trained to handle all scenarios. This ongoing training keeps us prepared."

Next issue: in part 2 of *Handling with care*, Debbie Legall examines the types of equipment used for the intra-hospital air transfer of neonate patients

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