Neonatal Intensive Care and its application in Malta.

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In 1896 Dr. Couney exhibited premature infants Incubators at the World Expositions in Berlin and he also maintained an exhibition at the Chicago Century of Progress Exposition (1932-1933). These exhibitions stimulated public interest in the care of infants and awareness amongst doctors of the appalling mortality of premature infants led to the development of units specialising in the care of newborn infants. Between the 1940s and 1960s increasing knowledge was obtained in the optimum nursing and feeding techniques of sick and premature infants with a corresponding improvement in their outcome.

In recent years there has been a further remarkable improvement in the outcome of sick newborn infants especially for very premature infants. For example the infant mortality in England and Wales has fallen 47% between 1965 and 1985 (fig.1). This reduction in mortality is almost all due to reduced early neonatal mortality (deaths 0-6 days of age); late neonatal mortality and post neonatal mortality have remained the same. This improvement in outcome is largely attributed to the introduction of neonatal intensive care techniques.

NEONATAL INTENSIVE CARE TECHNIQUES

Although there has been increased knowledge and expertise in all aspects of neonatal intensive care, the following techniques have contributed to a revolution in the care of sick infants:

1 VENTILATION
2 NUTRITION
3 MONITORING
4 CEREBRAL ASSESSMENT

VENTILATION

During the late 1960s neonatologists attempted to treat respiratory failure, the leading cause of death in premature infants, usually due to hyaline membrane disease (HMD), by artificial ventilation; artificial ventilation was attempted only in very ill infants and results were poor, many infants dying as a result of barotrauma. Pioneering studies by Reynolds using a lamb model of HMD defined the optimal ventilator settings for infants with HMD. He showed that a relatively slow rate (30 breaths per minute) and a long inspiratory time (about 1 second) enabled ventilation at lower peak pressures thereby limiting risk of barotrauma (1). Many neonatal units adopted this style of ventilation and improved outcome for ventilated infants was observed. Ventilators were designed according to the specific needs for ventilating newborn infants; the ventilators commonly used are time cycled, pressure limited, have facilities for varying inspiratory and expiratory times and flow rate and end expiratory pressure. Figure 2 shows the increasing use and success of ventilation in infants in the Northern region of the U.K. Similar results have been noted elsewhere. Reynolds' studies defined the optimal ventilator setting for relatively mature infants (30-34 weeks gestation) with severe HMD. Recently it has been suggested that a faster rate (60-120 breaths per minute), lower peak pressure and short inspiratory times may be more appropriate in very immature infants. New ventilator techniques such as jet and osscillometric ventilation use very high frequency but are not yet established in neonatal care.

NUTRITION

A most significant advance in recent years has been the introduction of total parenteral nutrition (TPN) for very premature infants who are often unable to tolerate enteral nourishment. TPN provides adequate calories (usually about 85 CALS per KG per day) to enable infant growth. TPN may be administered by peripheral veins but extravasation and necrosis of tissue are common complications. Shaw showed that long term TPN could be administered via a fine silastic catheter introduced percutaneously and advanced to the right atrium (2). Scrupulous care to prevent sepsis is essential. Maintenance of nutrition in sick very premature infants is a very important aspect of neonatal intensive care.

MONITORING

Transcutaneous oxygen and carbon dioxide concentration can be monitored continuously by means of a polarographic electrode applied to the skin. The skin has to be heated to 44C to facilitate skin capillary flow and the electrode site therefore has to be changed 4 hourly to prevent skin burn. The transcutaneous O2 and CO2 concentration correlates very well with arterial concentration (figure 3) and a transcutaneous O2 concentration of 60 to 100 mmHg is considered optimal to reduce risk of retinal damage from hyperoxia. Transcutaneous monitors require frequent calibration and the electrode is delicate and expensive and often needs to be replaced. The measurement may also be unreliable if there is poor skin perfusion. Recently pulse oximeters, which measure blood oxygen saturation by infrared spectrophotometry of capillary pulsation, have become available allowing continuous monitoring of oxygen saturation. Pulse oximeters are very useful for detecting hypoxia, are not affected by poor skin perfusion but are subject to movement artifact and may not detect hyperoxia.

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CEREBRAL ASSESSMENT

Perhaps the most exciting development in recent years has been the introduction of noninvasive techniques of assessment of cerebral structure and function. These include cranial ultrasound, nuclear magnetic resonance spectroscopy (3), continuous EEG monitoring, brainstem evoked potentials and cortical electromagnetic stimulation (4).

Cranial ultrasound is routinely used in neonatal units to identify cerebral haemorrhage and hypoxic/ischaemic injury. Cranial ultrasound accurately identifies cerebral haemorrhage (5). Minor forms of cerebral haemorrhage are common in premature infants and are usually not significant but parenchymal haemorrhage may cause later neurodevelopmental disabilities. Periventricular leucomalacia (hypoxic/ischamic lesions in the periventricular white matter usually seen in premature infants) and subcortical porencephalic cysts may also be identified by cranial ultrasound. The prognosis of premature infants who require intensive care can be assessed by cranial ultrasound examination (6); Infants with a normal cranial ultrasound at discharge have a 90% chance of normal development whilst infants with parenchymal lesions or cerebral atrophy on discharge ultrasound examination have greater than 50% risk of later developing major disabilities.

NEONATAL INTENSIVE CARE IN MALTA

The special care baby unit (SCBU) admits newborn infants and also children up to 3 years of age who require special and intensive care. The unit is well equipped with ventilators and monitoring equipment but there is no facility for cranial or other ultrasound examination on the unit, despite there being suitable ultrasound machines in the Radiology department. Infants requiring ultrasound examination have to be transported to the Radiology department and this is not feasible in very small or sick infants. The SCBU has up to 4 intensive care cots and 11 special care cots (this is an approximate figure as in practice no infant needing special or intensive care will be refused admission to the SCBU) as well as 4 cubicles for nursing older infants. The total complement of nurses is 15 which is considerably less than the recommended staffing level (7).

Between 1st January 1989 and 31st August 1989 120 newborns (4% of total deliveries) were admitted to the SCBU. The diagnosis was classified into 5 groups as shown in table 1. 27 infants died (22.5%); prematurity and congenital malformations were the most important causes of death. Perhaps the best indicator of success of special care is the outcome for infants weighing between 1000 and 1500 grams at birth as these infants should have a good prognosis with modern intensive care. There were 18 babies in this category, 7 needing ventilation for respiratory failure, and 2 died (survival rate 89%). This is an excellent result. However in this period no infant with a birth weight less than 1000 grams (n=10) survived suggesting that further improvement in the service is possible.

CONCLUSION

The introduction of intensive care has been associated with improved outcome in very premature and sick infants. Facilities for intensive care are available and in use at the SCBU but there is an urgent need for more nurses and ancillary staff if further improvement in quality of intensive care is to be achieved.

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DIAGNOSTIC GROUP		
	NUMBER OF INFANTS	NUMBER DIED
PREMATURITY	47	13
CONGENITAL MALFORMATIONS	23	8
ASPHYXIA	16	4
INFECTION	4	0
OTHER	30	2
TOTAL	120	27