Advances in the Care of Sick Neonates

Chap-Yung Yeung, MBBS, DCH, MRCP (Edin, Glasg), FRCP (Lond, Edin, Glasg, Ireland) FRCP(C), FRACP, FRCPCH

Paediatric medicine has a very short history compared with adult medicine. The history of neonatology is even shorter–most development of the discipline only occurred in the latter half of this century. Recognised specialists in neonatal medicine, or neonatologists, have been in existance for 30 years, although neonatal units have been around for a little longer.

This century has seen major technological advancement which has allowed dramatic improvement in the care of sick neonates and their outcomes.

NEW EQUIPMENT

The 'infant warmer' was probably the first innovation to considerably improve survival for low birth weight infants.[1] After the 2nd World War, many improvements in equipment allowed increasingly sophisticated care of sick neonates, especially those born prematurely. Ventilators and cardio-respiratory monitors began to be used for critically ill neonates during the 1960s.[2] Awareness of the importance of the retinopathy of prematurity, formerly known as 'retrolental fibroplasia' resulting from 'excessive oxygen exposure' led to the development of continuous transcutaneous blood gas monitoring in the early 1970s.[3] This was gradually replaced by continuous oxymetry in the 1980s. Other important innovations include the volume regulated infusion pump (which replaced intravascular gravitational drip sets), intracranial pressure monitoring devices and continuous EEG monitors.

THE CHANGING ROLE OF THE PAEDIATRICIAN

The recognition that individuals experience a 'continuum of development from conception to extra-uterine life' can also be considered a major breakthrough. The realisation that the paediatrician's role should start before conception came with the discovery that genetic materials in chromosomes were responsible for somatic manifestations of normality or abnormality in the 1950s.[4] Since then, there has been increasing interest in hereditary diseases and factors influencing foetal development.

PRENATAL DIAGNOSIS

Landmark innovations such as assessing the lecithin to sphingomyelin (L/S) ratio as an indication of foetal lung maturity by amniocentesis[5] and monitoring foetal heart changes, such as 'type II deceleration' following a uterine contraction, to identify perinatal distress[6] have revolutionised the management of potentially sick newborn infants.

SPECIALIST CENTRES

In the early 1970s regional perinatal centres were set up to offer comprehensive expert care for sick newborns.[7] Neonatal survival has now significantly improved as a consequence of concentrating expertise into one centre and running cost-effective perinatal programmes. Referring high-risk mothers to these centres is

encouraged and sometimes even legislated. A service to transport sick infants to these units and also stabilise their condition before arrival is also often provided. Regrettably, although rapidly developing regions like Hong Kong have been quick to assimilate new technology into their paediatric services, organised perinatal centres have still not been developed.

ANTIBIOTICS

Generations of highly potent antimicrobials to control infection have been important in improving neonatal survival, especially in developing communities.[8] Other measures to prevent infection have been equally important.

ASSISTED VENTILATION

In industrialised countries, progressive improvement in the control and prevention of respiratory failure, through assisted ventilation[9,10] and replenishment therapy with surfactants, has revolutionalised the management of very low birth weight and extremely low birth weight (ELBW) infants resulting in a dramatic reduction in neonatal deaths.[11] Following an incidental observation in sheep, antenatal steroids have also been administered to humans and found equally successful in reducing the risk of hyaline membrane disease (HMD) in premature babies.[13] In 1980 bovine surfactant was first used as replacement therapy and has dramatically improved HMD survival. Since then, a number of surfactant preparations have become available for prophylaxis or rescue therapy.

Concerns have recently been raised about the potential deleterious effects of perinatal steroid therapy. Although their use has achieved a significant reduction in deaths from HMD and intraventricular haemorrhages (IVH), potential long term side-effects are an increasing concern.

NUTRITION

There has been a tremendous amount of research in the last few decades into the nutritional needs of the growing infant. To provide optimal nutritional intake so that the infant outgrows the potentially severe complications of continued immaturity has become a primary objective of supportive care. A neutral thermo-environment to minimise metabolic wastage,[1] and supplemental and total intravenous alimentation for those unable to eat by mouth[15] has become standard practice in modern nurseries.

IMAGING TECHNIQUES

Although many imaging techniques[16-19] have been widely used in the management of adult patients for some time, their application in the study of foetal and neonatal anatomy and blood flow is still rather restricted. These new technologies are limited by the fear that they may damage developing organs, their bulkiness and the difficulty in transporting critically ill infants to investigatory laboratories.

However, portable ultrasonography machines already provide useful information in the accurate diagnosis of intracranial and cardiac lesions in neonates. These provide data relevant to many important clinical decisions: eg. whether further aggressive intervention therapies are needed when bilateral grade IV intraventricular haemorrhages have been identified in a tiny infant.

KERNICTERUS

A recent resurgence of kernicterus in term infants in North America has rekindled interest in the mechanism of bilirubin cytotoxicity and how it may be prevented.[20] The discovery of free bilirubin, which can cause brain damage,[21] highlights the importance of avoiding drugs that may affect bilirubin-protein binding and the need to enhance the metabolism of serum bilirubin by oral phenobarbitone and phototherapy in the jaundiced infant.[22] Traditional herbal medicines that could free the bilirubin from its protein binding[23] and infection-enhanced bilirubin toxicity[24] have

been cited as important causes for the large number of kernicteric infants seen in Southeast Asian communities. Aggressive health education on umbilical-cord care and avoidance of indiscriminate herbal medications appears to have been effective and cases of kernicterus have now disappeared in the region.[22]

THE FUTURE

Work is already in progress to identify ways in which brain damage may be prevented or limited. Data will probably soon be available on whether it is possible to manipulate various receptors of growth factors and cytokines to modify disease manifestations. Gene therapy involving stem cell transplantation will soon be available to treat various inborn metabolic disorders beyond the current treatment. The use of brain-cooling and various growth factors are currently being investigated and exciting results are expected.

More new technologies, including templates for automated medical records to be returned to the referring physician, have been promised.

Further developments should aim to improve the quality of life of infants whose severe medical problems can now be successfully treated or managed during the perinatal period.

A multidisciplinary approach to ensure the provision of long term holistic healthcare for the infant and psychosocial support for the parents is needed. In less developed communities such as Southeast Asia however, the priority must be to channel resources to suit the needs of society, rather than simply adopting the practices of more developed countries.

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About the Author

Professor C Y Yeung is Head of the Department of Paediatrics, The University of Hong Kong, Queen Mary Hospital, Hong Kong.