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Annotations

Is neonatal cerebral ultrasound just for the voyeur?

Few neonatal intensive care units consider themselves well equipped unless high quality 'real-time' ultrasound facilities are available round the clock. Looking inside an infant's head is an interesting occupation and as a research tool has considerably advanced our understanding of lesions due to vascular compromise, but what is its clinical role? Should Doppler ultrasound be introduced for clinical purposes, and what is the value of information obtained by these methods? The answer to these questions today may be considered by some to be self evident, but in the post-Griffith era an attempt to justify the cost of this relatively expensive piece of equipment is perhaps of some value.

What are we seeing?

Real time ultrasound was first used in a neonatal intensive care unit to detect intraventricular haemorrhage in 1978[1]; and gradually the number of conditions diagnosed by this technique has increased.[2] In recent years, and with the use of higher frequency transducers, periventricular leucomalacia has been recognised as a particularly important abnormality in premature infants. In addition, frequent scanning permits the early detection of increasing ventricular size or extension of haemorrhagic lesions.

Real time ultrasound of the infant's brain has been widely adopted because the manufacturers of ultrasound equipment have developed machines that produce, by means of sound, an image which appears to resemble the structure of the brain. We interpret echoes by reference to anatomical slices produced by pathologists and believe that the image gives us the same information, but this may be misleading. We now know that extensive echodensity within the brain may be associated with a macroscopically normal brain at necropsy[3] and, conversely, pathological features within or around the brain may not be detected by ultrasound. There is a need for accepted definitions on which to base diagnoses, but to date there are few such agreed descriptions of pathological appearances.

The problem of diagnostic criteria exists for all imaging techniques; indeed, real time ultrasound is better evaluated in this respect than computed tomography, as scanning normal babies by ultrasound is more acceptable. The value of any imaging technique may be judged by measurement of its positive and negative predictive value, and its use in detecting abnormalities may be assessed by its sensitivity and specificity for each particular lesion. Several studies are now available that report the accuracy of ultrasound in the diagnosis of periventricular haemorrhage, but correlation of appearances with other conditions is unfortunately limited.

What does it mean?

Ultrasound was rapidly accepted into the neonatal unit because it showed abnormalities not easily detectable by any other means. Germinal matrix haemorrhage and intraventricular clot produce striking appearances, and these lesions were initially thought to be associated with the adverse outcome of some infants. Research often lagged behind clinical use and much anxiety was generated among neonatal unit staff and the infant's parents when these lesions were diagnosed. It was only some years later when it was realised that uncomplicated haemorrhage confined to the ventricles was a benign condition.[4 5]

The potential clinical value of real time ultrasound can be divided into two separate categories: intervention and prognosis. Ventricular dilatation occurs in a large proportion of premature infants after intracranial haemorrhage, and some go on to develop hydrocephalus. It is in this group that intervention may be important. Regular ultrasound assessment will give the first indication of enlargement of the ventricles, but to date no clear guidelines exist as to when to intervene in the management of these infants. The outcome in such infants may be modified by the early detection and management of posthaemorrhagic hydrocephalus, and research is continuing. At present there is little evidence that knowledge of progressive ventricular enlargement aids the clinician, and the clinical role of ultrasound in this context is still uncertain.

Reliable prognostic information based on ultrasound scans is just becoming available but there is still considerable confusion in this area. There is now evidence that cavitating periventricular leucomalacia is a sinister lesion in terms of prognosis and

further variables such as the size, extent, and position of the cavities are important in more accurately predicting both cerebral palsy and developmental delay.[5 6] Babies can survive massive haemorrhage with fairly minor neurological deficit,[7] and there are no studies reporting the outcome of a large group of unselected babies prospectively scanned with ultrasound and found to have cystic periventricular leucomalacia. The most worrying occurrence is the withdrawal of intensive care because of ultrasound findings alone, a practice which I believe is common (at least in the United Kingdom) in many neonatal units that have ultrasound facilities, but no consensus as to the criteria for termination of assisted ventilation. Thus ultrasound scanning for either diagnostic or prognostic reasons is a somewhat tenuous justification for its routine use. It is, however, true that consistently normal scans are associated with a low risk of adverse neurodevelopmental outcome and as such are reassuring to parents and nursery staff.[4 5]

Who should scan the infants?

Radiologists and neonatologists most commonly undertake ultrasound brain scanning in the neonatal unit and this largely depends on who owns the machine. In my view the person with the most experience and interest is the one who is most appropriate, but unfortunately it may be a fairly junior doctor (or perhaps radiographer) who performs the routine scans.

The clinical value of ultrasound scans has been discussed above, and major therapeutic or management decisions may be based on interpretations performed by these personnel. It is alarming that no recognised course, diploma, or formal period of training is necessary before anyone can pick up an ultrasound transducer. The distinction between experience and inexperience is blurred; this happens in few other fields of medicine with quite the same implications.

What use is Doppler?

Doppler ultrasound has been used to detect flow in the anterior cerebral artery in neonates since 1979,[8] and there are now many reports of its use. Fairly inexpensive equipment, together with ease of obtaining signals, has made this technique attractive to a number of observers.[9] It is, however, unfortunate that many studies have been performed without appropriate methodological care and with poor instruments. The practical value of Doppler ultrasound is still not clear. We have recently reported its value in predicting outcome after intrapartum asphyxia, but before this technique becomes clinically useful further prospective studies will be necessary.[10]

Conclusion

Ultrasonography has made a major contribution to neonatal neurology and increased understanding of the variety of cerebral lesions which affect the perinatal brain; it is easy to believe that this valuable research tool also has a clear role in clinical neonatology. Ultrasonography has become a ubiquitous technique for investigating the neonatal brain for all the reasons discussed above, but it is difficult to assemble a convincing argument in favour of buying high resolution equipment solely for brain scanning. The role of real time ultrasound can be better justified for the diagnosis of neonatal cardiac or renal abnormalities than for cerebral lesions, because there the therapeutic implications for a large variety of abnormalities are much more clear cut. It is considerably easier to justify a multipurpose machine dedicated for use in a neonatal unit, thereby fulfilling the dual aims of clinical utility as well as more esoteric voyeurism.

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