A Decision Support System for Interpretation of the Cardiotocogram.

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There is growing public and political attention focused on medical error which is increasingly recognised to be a consequence of human fallibility (BMJ March 2000). In obstetrics interpretation of the cardiotocogram (CTG) in the management of labour is the major problem. The 1997 UK Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI) found that 75% of deaths of healthy babies during birth were avoidable. Most errors were related to interpretation of the CTG, a continuing theme in the 1998 and 1999 CESDI Reports. Death is not the only outcome - a study in the Trent region of the UK (report,1999) found similar findings for babies with neonatal hypoxic-ischaemic encephalopathy, a known risk factor for later cerebral palsy. Obstetrics accounts for some 60% of the medical litigation bill and much of this is related to CTG interpretation. Not surprisingly, the Chief Medical Officer in his recent report ('An organisation with a memory', 2000) has set a target of a 25% reduction in obstetric mishaps by 2005.

Such data emphasise that CTG instruments are merely recorders of the fetal heart rate and uterine activity; the clinicians remain the monitors. This requires experience, knowledge, expertise and attention to detail. The use of conventional computer techniques to improve interpretation has not proved successful for these provide little more than feature extraction with novel presentation of data. This information still requires interpretation by an experienced clinician in the context of the particular labour. In contrast, expert systems can process and interpret the data 'intelligently'.

In Plymouth, we have been working on the use of 'intelligent systems' as decision support tools for the management of labour over the past 12 years.

The knowledge base and inference engine have been carefully validated in 3 separate studies
1. In comparison with Plymouth clinical practice and 17 externally nominated experts on 50 cases with 10 normal, 25 abnormal and 15 intermediate CTGs.
2. In comparison with widespread clinical practice and 3 of the best experts from the first study on 500 cases weighted to poor outcome (perinatal mortality 64/1000; cord artery acidosis pH< 7.05 - 300/1000).
3. In comparison with clinical practice on 900 serially collected cases from our labour ward

These studies have demonstrated that the decision support system
- performed better than clinical practice. It identified more cases that went onto have a poor outcome and substantially pre-empted clinical decision making.
- performed as well as expert obstetricians in management of labour using the CTG.
- intervened in the stillbirth group on average six hours sooner than clinical practice and more than two hours before the experts. It would be reasonable to expect that a number of these deaths would have been prevented.
- in all other poor outcome groups intervened much earlier than clinical practice and at a similar time as the experts
- in the 500 study missed one case of perinatal mortality (stillbirth and neonatal death) whereas the experts and clinical practice missed several. In contrast the system performed two caesarean sections with a normal outcome whereas the experts performed none.
- in the 900 study identified more cases of abnormality than clinical practice and was very much quicker to act.
- the system's interventions in the 900 study were more discriminatory than clinical practice with a highly significant shift in cord artery blood gas values.

The system is now in the final stage of integration into delivery ward work practice prior to a UK multicentre randomised control trial funded by the MRC scheduled to commence this Autumn.