

Intrapartum fetal monitoring

Yesterday, today and tomorrow

Dr Wan Tinn Teh
RANZCOG Trainee

Dr Stephen Tong
FRANZCOG

During labour, the uterine contractions needed to expel the baby induce complete blood flow arrest, the consequence being progressive fetal hypoxia. The challenge for obstetricians is to find the balance between safe and timely delivery of the baby before irrevocable damage occurs and overly aggressive interventions to effect delivery.

Currently, intrapartum fetal monitoring is based on interpretation of the fetal cardiovascular response to stressors, where the obstetrician needs to judge whether the heart rate patterns could be consistent with a compromised fetus.

Traditional methods

Cardiotocograph

The most commonly used modality to monitor the fetus during labour is electronic fetal heart rate monitoring via cardiotocograph (CTG). CTG has a sensitivity of 85 per cent with a corresponding high negative predictive value in predicting the absence of fetal hypoxia, but is only 40 to 50 per cent specific with a poor predictive value.¹ While reassuring CTG patterns are reliable predictors of fetal wellbeing, the CTG is poor in accurately identifying fetal hypoxia. Non-reassuring CTG patterns are seen commonly in fetuses that are normoxic and entirely healthy. It has been shown that the use of routine CTG has only a minor beneficial effect on the incidence of neonatal seizures, but increases the number of assisted deliveries.² The main reason for the continued use of CTG is the lack of a better way to identify hypoxic fetuses in labour.

Fetal scalp sampling

Fetal scalp sampling was first described by Sailing in 1964.¹ By measuring the pH or lactate of blood obtained from fetal scalp capillaries, we can directly evaluate the fetus for acidosis. However, it requires invasive sampling of fetal blood by puncturing of the fetal scalp. Besides causing significant discomfort to the woman, the sample can also be technically difficult to acquire. Therefore, it can be difficult to perform serially on the same woman if the CTG continues to be non-reassuring.

Evolving modalities

Fetal pulse oximetry

Fetal pulse oximetry (FPO) is a relatively new technology. A sensor using far- and near-infrared wavelengths is placed transvaginally to measure oxygen saturation in the fetus. In contrast to fetal scalp sampling, this technology allows continuous monitoring of fetal oxygenation. The other proposed benefit of FPO is that it might improve the specificity of intrapartum surveillance. However, its clinical efficacy in reducing unnecessary operative deliveries is yet to be proven.³

Fetal electrocardiography

An alternative method of evaluating the fetus oxygenation status

during labour is to use the electrical signal emitted during the fetal cardiac contraction cycle and analyse its components. The ST segment waveform of the fetal ECG provides continuous information on the ability of the fetal heart muscle to respond to the stress of labour. Additional use of ST analysis of the fetal ECG has been shown to improve the specificity and positive predictive value of intrapartum CTG monitoring.⁴ However, it has also been recognised that some fetuses may not display ST changes on an ECG despite their hypoxic status, either because monitoring started after ST changes took place or because, for unknown reasons, the fetus simply does not display identifiable ST changes.⁵

Future technology

Dynamic transcriptional profiling of fetal hypoxic gene

Prevention of intrapartum hypoxic stress to the fetus so as to improve neonatal morbidity and mortality is an ongoing research aim for the obstetric community, as an improved, non-invasive test could substantially decrease the intervention rate.

It was recently reported that ribonucleic acid (RNA) of fetal origin circulates in the maternal blood and disappears around 15 minutes after delivery. This suggests that RNA from the placenta is released in a steady state. The implications are significant. It may be possible to develop a maternal blood test, measuring for the presence of hypoxic genes that directly suggest that the placenta is in fact deprived of oxygen and the fetus is in jeopardy. It could provide additional evidence to interpret, along with CTG findings, that would increase the clinician's ability to accurately determine which fetuses are truly hypoxic.

Hypoxia in any tissue is tightly regulated by a master regulator, the hypoxia inducible factor (HIF). When HIF is released, it binds to promoter sites and up-regulates a suite of genes to initiate a hypoxic response. Such genes include enzymes involved in the glycolytic pathway, induction of erythropoietin (to increased red cell production), induction of vascular endothelial growth factor, and vasodilators such as nitric oxide.⁷ To date, nearly 100 genes have been identified that are regulated by HIF and any of these could, in theory, be measured by a 'fetal distress' blood test.

A longitudinal cohort study is being performed at Monash Medical Centre, Clayton, to examine whether RNA coding hypoxic regulated genes obtained from maternal blood could be used to non-invasively identify which babies are already genuinely distressed from hypoxia, or to predict which ones will become distressed soon.

We are recruiting pregnant nulliparous women with a singleton pregnancy, who are having induction of labour. Maternal blood samples are being collected from these women throughout their labour via a second IV cannulae. Timepoints of interest are: just before induction (no hypoxic genes should be present as there have been no uterine contractions); one sample during active labour; and a final sample at the moment of delivery (a number will be hypoxic). Whether the baby was in fact hypoxic will be determined by umbilical cord lactate levels measured immediately after delivery.

RNA molecules are being isolated from these samples in the laboratory. We are using PCR-based platforms that specifically measure genes belonging to the hypoxia pathway. The results are being analysed in conjunction with other information collected, including CTG findings, fetal scalp sampling results if performed, apgar scores at birth and cord lactate results. Preliminary results have been promising, showing that multiple hypoxic genes are increased in expression in cases where fetal distress occurred, but are not increased in the control group.

The ultimate goal of our study is to develop a minimally invasive novel bedside test in delivery suite that better reflects hypoxic status in fetuses than the CTG. Such a test will allow us to reserve operative delivery for fetuses that truly need it and decrease the intervention rates for women.

References

1. Schwartz N, *et al.* Intrapartum fetal monitoring today. *Journal of Perinatal Medicine* 2006; 34:99-107.
2. Thacker SB, Stroup D, Chang M. Continuous electronic heart rate monitoring for fetal assessment during labor. *Cochrane Database of Systematic Review* 2001; (2):CD000063.
3. East CE, Chan FY, Colditz PB, Begg L. Fetal pulse oximetry for fetal assessment in labour. *Cochrane Database of Systematic Reviews* 2007; 2:CD004075.
4. Neilson JP. Fetal electrocardiogram (ECG) for fetal monitoring during labour. *Cochrane Database of Systematic Reviews* 2006; 3:CD000116.
5. Rosen KG. Fetal electrocardiogram waveform analysis in labour. *Current Opinion in Obstetrics and Gynecology* 2005; 17:147-50.
6. Ng EK, Tsui NBY, Lau TK, Leung TN, Chiu RWK, Panesar NS, *et al.* mRNA of placental origin is readily detectable in maternal plasma. *Proceedings of the National Academy of Sciences* 2003;100(8):4748-53.
7. Schumacker PT. Hypoxia-inducible factor-1. *Critical Care Medicine* 2005; 33(12):S423-5.

'A midwife's perspective on homebirth in New Zealand' continued from page 35.

In addition, oxytocics are stored in the fridge, either before the labour commences or when the LMC arrives, to ensure that it is available for active management of the third stage if required or for treatment in the case of a postpartum haemorrhage. A birth pack and resuscitation equipment for the mother and the baby are part of the homebirth kit.

In addition to all the equipment, homebirth midwives maintain their knowledge of dealing with unexpected emergencies, such as shoulder dystocia, breech birth (unplanned), neonatal resuscitation, postpartum haemorrhage and cord prolapse. Awareness of ambulance calls and who might be needed for support is also vital when planning a homebirth, as well as good preparation of the family.

Conclusion

Homebirth is different from hospital birth. As stated by Justine Caines from Homebirth Australia, 'Women make decisions about their care. They invite a midwife into their home, rather than be forced to meet the needs of practitioners and organisational convenience, which happens when giving birth in a hospital.' The people to consult about homebirth are the women and the midwives who work with them.

References

1. De Jonge A, van der Goes BY, Ravelli ACJ, Amelink-Verburg MP, Mol BW, Nijhuis JG, Bennebroek Gravenhorst J, Buitendijk SE. Perinatal mortality and morbidity in a nationwide cohort of 529 688 low-risk planned home and hospital births. *BJOG* 2009; 116, 1177-1184.
2. Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician. *CMAJ* 2009; September 15, 181(6-7), 377-383.
3. Primary Maternity Services Notice 2007. Notice pursuant to Section 88 of the New Zealand Public Health and Disability Act 2000. Supplement to New Zealand Gazette, 41.

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