Assessing antepartum fetal health

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Abstract

Most pregnancies lead to the delivery of a healthy baby, irrespective of risk factors. Some pregnancies, however, are complicated by differing pathologies that can lead to increased risk of perinatal morbidity and mortality. Fetal surveillance should be instituted, attempting to identify at-risk fetuses and reduce their chances of complications. Traditionally obstetricians have classified pregnancies into 'low-risk' or 'high-risk' and applied surveillance tools to the latter group. However, the majority of stillbirths occur in low-risk women. In this article we will evaluate the evidence behind the current tools used to assess antepartum fetal health in both high- and low-risk groups, and their ability to detect an at-risk fetus or improve outcome. This article does not address fetal surveillance during labour.

Keywords amniotic fluid index; biophysical profile; cardiotocography; Doppler; symphysis-fundal height; biometry

Classification of pregnancies into 'low-risk' or 'high-risk' takes place on the basis of the likelihood of an adverse outcome being less or greater than that of the general population. Currently the majority of stillbirths in this country occur in the low-risk group. Most pregnancies lead to the delivery of a healthy baby, irrespective of risk factors. Some pregnancies, however, are complicated by differing pathologies that can lead to increased risk of perinatal morbidity and mortality. Identification of these pregnancies will allow the initiation of appropriate assessment tools with the aim to improve the outcomes.

This article will focus on the tools available for assessment of antepartum fetal health and will exclude assessment in labour. The ability of each individual test to identify and improve outcome in an at-risk fetus will be investigated. Whilst each test alone may not be diagnostic of an at-risk fetus a combination of abnormal results or a change in trend with time favours the diagnosis. Reliability of certain tests depends upon accurate dating of the pregnancy. This is now done by a first trimester ultrasound scan between 10 and 13 + 6 weeks, as recommended by the National Institute of Clinical Excellence (NICE) Guideline on Antenatal Care. We will finally, briefly, look at management strategies for an at-risk fetus.

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Aims of assessing antepartum fetal health:

- To prevent the death of the fetus
- To optimize the timing of delivery, minimizing fetal and neonatal morbidity
- To avoid unnecessary intervention (e.g. pre-term delivery) if fetal health is confirmed.

Fetal movement monitoring

Maternal recognition of reduced fetal movements is associated with an increased likelihood of fetal death; however, meta-analysis of formal fetal movement monitoring has failed to show an improvement in the perinatal outcome. This may be related to the low positive predictive value for this assessment tool (2–7%) in a low-risk population; to prevent one fetal death, the policy of formal fetal movement monitoring would need to be performed in 1250 pregnancies. Furthermore, false reassurance or inappropriate interpretation of a CTG may be confounding factors in the failure of this formal monitoring method to reduce the number of stillbirths. However, current evidence does not support the recommendation for routine use of formal fetal monitoring; rather, women with reduced movements should be advised to contact their midwife or hospital for further assessment.

Symphysis-fundal height (SFH)

SFH measurement should be performed, at 2–3 weekly intervals, from 24 weeks onwards with the mother lying in a semi-recumbent position, legs extended and bladder empty. The uterine fundus is palpated and a non-elastic tape measure (scale markings on the underside) placed over this position. The distance from here to the upper edge of the symphysis pubis is recorded, in centimetres, on a growth chart. It is a NICE Guideline for Antenatal Care recommendation that all women should have SFH measured and plotted at each antenatal clinic visit. The advantage of this test is that it is readily available and simple, low in cost, and requires minimal equipment, training and time.

Palpation of the abdomen alone has a sensitivity of 21% and specificity of 96% for the detection of small for gestational age (SGA) fetuses. SFH measurement leads to very little improvement in prediction, with a sensitivity and specificity of 27% and 88% respectively, although there is a wide variation in the predictive accuracy depending upon the study quoted. Serial measurements, especially by the same person, however, may allow changes in the rate of growth to be observed and improve the sensitivity and specificity of this test.

One of the drawbacks of this test is that if the SFH measurement is less than expected it does not distinguish fetal growth restriction (FGR) from a constitutionally small fetus, which accounts for 50–70% of cases with a birth weight below the 10th centile. These fetuses are appropriate in size for parity, ethnicity and parental size, and do not have an increased risk of morbidity or mortality. FGR, by comparison, defined as a failure of the fetus to obtain its genetic growth potential due to a reduction in fetal growth, has increased risks of perinatal morbidity and mortality. It is illogical to expect SFH measurement to detect a fetus that is growth restricted but above the 10th centile.

Customized charts for SFH have been developed that are individualized according to maternal height, weight, parity and ethnic group and are recommended by the Royal College of Obstetricians and Gynaecologists, although the NICE Guidelines on Antenatal Care suggest that further prospective research is required into their diagnostic value and cost-effectiveness. Studies have shown an improvement in detection of both SGA, from 29% to 48%, and large for gestational age fetuses, from 24% to 46%. Although such charts have not been shown to improve perinatal outcome they do decrease the number of ultrasound scans requested for assessment of growth.

Indication for referral for ultrasound on the basis of customized growth charts:

- The first symphysis-fundal height measurement is below the 10th centile on the customized chart.
- Growth is static or slow compared to the slope of the curves on the chart on consecutive measurements.
- Growth is excessively steep compared to the slope of the curves on the chart on consecutive measurements.

(The first measurement above the 90th centile is not an indication for referral for large for dates unless there are other clinical concerns).

Assessment of fetal heart sounds and rate

There is no predictive value for future health in auscultation of the fetal heart; it merely confirms that the baby is alive. Routine fetal heart auscultation is therefore not a NICE recommendation although NICE guidelines state that it may be performed for reassurance of the mother, on her request. Similarly, no studies on hand-held Doppler assessment of the fetal heart have shown an improvement in outcome. Routine auscultation or Doppler assessment could, in theory, detect a fetal arrhythmia and initiate further investigation. Arrhythmias are rare, however, and require documentation of the actual fetal heart rate, which is not routinely done.

Cardiotocography (CTG) and computerised CTG

Intrinsic cardiac activity and autonomic reflex changes are determinants of the fetal heart rate, which can be recorded using cardiotocography (CTG). The normal baseline fetal heart rate is between 110 and 160 beats per min (bpm) with fluctuation around this baseline, or variability, of 5–25 bpm. Two accelerations in a 20 min trace are considered reactive in a term pregnancy; accelerations can be more difficult to identify in pre-term fetuses, especially less than 28 weeks. CTG changes occur very late in the disease process of FGR, much later than Doppler abnormalities, making their use in the antepartum assessment of fetal health of limited value. Interpretation of antepartum CTGs within and between observers can also display poor reliability and scoring systems have failed to help.

There are no trials looking at the role of antepartum CTG in low-risk women and very few in the high-risk group. The Cochrane collaboration review of Randomized Controlled Trials (RCT) found that antepartum CTG in a high-risk group had no significant effect on perinatal morbidity or mortality (RR [relative risk] 2.05; 95% confidence interval 0.95–4.42) although the meta-analysis was underpowered to assess this outcome ($n = 1627$). Therefore current evidence does not support the routine use of antepartum CTG.

Computerized CTG has been developed to aid interpretation of CTGs. They have a better accuracy than clinicians, particularly in the determination of short-term variability (<3.5 ms) in fetal heart rate and in predicting fetal acidaemia, hypercarbia and low Apgars. Comparison with traditional CTG in a small group of women ($n = 469$) has shown a significant reduction in perinatal mortality (RR 0.20; 95% confidence interval 0.04–0.88) but further studies focusing on the use of computerized CTGs in high-risk women is warranted.

Ultrasound biometry and estimated fetal weight

Placental dysfunction results in a reduction in the nutrient supply to the fetus. Whilst the blood supply to the vital organs of the heart and brain are maintained, adaptation occurs with mobilization of glycogen stores from the liver and a reduction in blood flow to, and growth of, non-vital organs like the gut, liver and kidneys. The most sensitive biometric measurements in predicting FGR is a reduced abdominal circumference or estimated fetal weight (EFW) on USS. As growth is a dynamic process, serial measurements further improve prediction; growth is reduced in FGR but maintained in SGA. The presence of abnormal umbilical Doppler and reduced amniotic fluid index increases the detection of FGR to 66.7%, from a positive predictive value of 38.1% with reduced abdominal circumference alone.

Formulae have been devised, which measure parameters including biparietal diameter, femur length, head and abdominal circumference, to calculate an EFW. Shepard and Aoki's formulae were found to have the best correlation with birth weight. Validation of these formulae has been achieved at birth weights of 2080–4430 g; accuracy outside these ranges is unknown. Customized ultrasound EFW charts are also available with better sensitivities for detecting FGR and lower false positive rates; they are also predictive of poor perinatal outcomes. In a low-risk population, systematic review does not support the use of routine ultrasound after 24 weeks, as this fails to achieve an improvement in perinatal mortality.

Amniotic fluid volume

Amniotic fluid production is a reflection of fetal renal perfusion secondary to its relation to urine production. Decreased blood flow to the fetal kidney in FGR leads to a reduction in amniotic fluid production. Oligohydramnios occurs when the largest vertical pocket of amniotic fluid is less than 2 cm or the amniotic fluid index (AFI- defined as the sum from each quadrant of the vertical amniotic pool depth) is less than 5 cm. There is a poor correlation between both these measurements and true amniotic fluid volume. Furthermore, oligohydramnios may be caused by factors other than growth restriction (e.g. ruptured membranes). There is no evidence that one method (deepest vertical pocket or AFI) is superior to the other in the prevention of perinatal morbidity or mortality. The use of AFI, however, is associated with significantly more cases being diagnosed and subsequently