The diagnostic and therapeutic role of ultrasound in obstetrics

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Abstract

Advances in ultrasound technology and new developments in the field of screening for pregnancy disorders have led to a change in the clinical application of ultrasound in the care of women with normal and complicated pregnancies. This review highlights the validated uses of ultrasound in obstetrics, such as pregnancy dating, screening for aneuploidy, diagnosis of foetal abnormality, placental localization, diagnosis of chorionicity in multiple pregnancy, assessment of foetal growth and well-being and foetal therapy. Knowledge of the scientific basis of the role of ultrasound means more appropriately timed intervention in pathological pregnancies.

Keywords dating; diagnosis; Down's; growth restriction; multiple pregnancy; placenta praevia; pre-eclampsia; pregnancy; preterm delivery; screening; ultrasound

Introduction

Improved knowledge of the scientific basis of the role of ultrasound and improvement in resolution has allowed better imaging of the foetus. This, together with new developments in the field of screening for pregnancy disorders, has led to a change in the clinical application of ultrasound in the care of pregnant women. Techniques such as pulsed wave and colour Doppler imaging have improved the monitoring of small for gestational age foetuses and helped to differentiate foetuses that are well, from those that are not. It has helped to distinguish normal from complicated pregnancy and directed subsequent management. The use of ultrasound in obstetrics can be elective or reactive, which helps to understand and differentiate elective ultrasound for scanning for potential problems and reactive use to help in the management of a clinical problem such as suspected foetal growth restriction (FGR).

Elective use of ultrasound

Pregnancy dating

The problems of calculating gestational age based on menstrual history can lead to an overestimation of gestational age and a much wider error margin compared with ultrasound. Gestational age is the strongest variable affecting foetal size, with the result that crown–rump length measurement is even more accurate (Figure 1). The UK National Institute for Clinical Excellence (NICE) guideline on antenatal care recommends that all pregnant women should be offered an early ultrasound examination to determine gestational age. This ensures consistency of gestational age assessments, improves the performance of screening for Down's syndrome, and reduces the need for induction of labour after 41 weeks.

Scans should ideally be performed at 10–13 weeks and use the crown–rump length measurement to determine the gestational age. When assessing gestation, a few days variation in either direction has an impact on the baby's chances of survival, especially in preterm delivery making pregnancy dating critical for decisions on clinical management. At the other end of the spectrum, as many as 70% of pregnancies presumed to be post-term (>294 days) by menstrual dates are not post-term by scan dates. This demonstrates that most inductions for post-term pregnancy could be avoided on the basis of ultrasound estimation of gestational age alone.

In terms of prenatal screening, both nuchal translucency and maternal biochemical test levels vary with gestational age. Erroneous dating therefore leads to incorrect risk assessment, unnecessary referrals/invasive testing and increased maternal anxiety.

Multiple pregnancy

The perinatal mortality rate in twins is around six times higher than in singletons, and is about 3–4 times higher in monochorionic than dichorionic twin pregnancies. Perinatal statistics (after 24 weeks) actually underestimate the importance of monochorionic placentation in foetal death, since the highest rate of mortality is before 24 weeks of gestation due to twin-to-twin transfusion syndrome (TTTS). Any effort to reduce this excess loss can be achieved only through early identification of monochorionic pregnancies by ultrasound examination in early pregnancy, appropriate surveillance and intervention during the second trimester. Chorionicity can be determined by ultrasonography and relies on the assessment of the characteristics of the inter-twin membrane, but may sometimes be aided by noting foetal sex and the number of placentas.

The best way to determine chorionicity is by an ultrasound examination at 6–9 weeks of gestation, when two separate amnions and chorions may be easily identified (Figure 2). After 9 weeks, the two amnions and chorions come together to form the inter-twin membrane, but it remains easy to identify at the base of the membrane as a triangular tissue projection known as the 'lambda sign' in dichorionic pregnancies. With the introduction of first-trimester scanning at 11–14 weeks, ultrasonographic examination of the base of the inter-twin membrane for the presence or absence of the 'lambda sign' provides a reliable distinction between dichorionic and monochorionic pregnancies (Figure 3).

TTTS is thought to occur in about 15% of monochorionic twins as a consequence of unequal sharing of placental blood through inter-twin vascular anastomoses. Ultrasound features in the donor include foetal growth restriction, an empty bladder and anhydramnios. In contrast, the recipient usually has normal

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Figure 1 First trimester ultrasound showing measurement of the crown–rump length.

growth velocity, a large bladder, polyhydramnios and, when TTTS is severe, hydrops. Untreated severe TTTS before 26 weeks is associated with perinatal mortality of up to 90% and a high risk of disability in the survivors. A large, multi-centre randomized study has shown that foetoscopic laser coagulation of inter-twin anastomoses is a more effective first-line treatment than serial amnioreduction in cases of severe TTTS at less than 26 weeks.

Placental site

The routine use of ultrasound has changed the classification of placenta praevia from typing (I–IV) to 'minor' and 'major' (Figure 4). A minor placenta praevia (low-lying placenta) in the third trimester is one that lies in the lower uterine segment, but is more than 2 cm from the internal os. A major placenta praevia occurs when the placental edge overlaps or is within 2 cm of the internal cervical os in late pregnancy. If the placenta is overlapping or reaching the internal cervical os at the time of the anomaly scan, repeat ultrasonography should be arranged in late pregnancy to exclude placenta praevia. A caesarean section should be performed for a major praevia at term, while an attempt at vaginal delivery is appropriate for a minor placenta

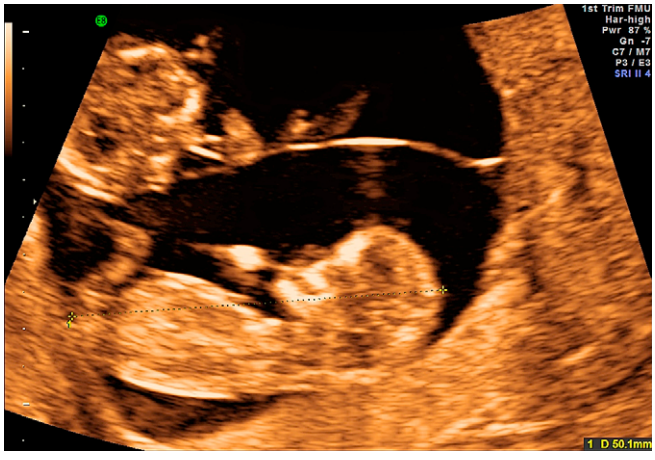

Figure 2 'T' sign in a monochorionic twin pregnancy.

Figure 3 'Lambda' sign in a dichorionic twin pregnancy.

praevia but appropriate precautions should be taken to manage the potential for excessive bleeding.

Placenta accreta

Placenta accreta refers to the abnormally firm attachment of placental villi to the uterine wall with absence of the normal intervening decidua basalis and fibrinoid layer. In the most common form, placenta accreta is attached directly to the myometrium. The main risk factors for placenta accreta include placenta praevia and previous uterine surgery (myomectomy, caesarean section, etc). The risk of placenta accreta in patients with one caesarean section is 8-fold higher compared with an unscarred uterus and is further increased 4-fold with two or more caesarean sections. Placenta accreta is associated with a high maternal mortality rate as well as significant morbidity from haemorrhage,

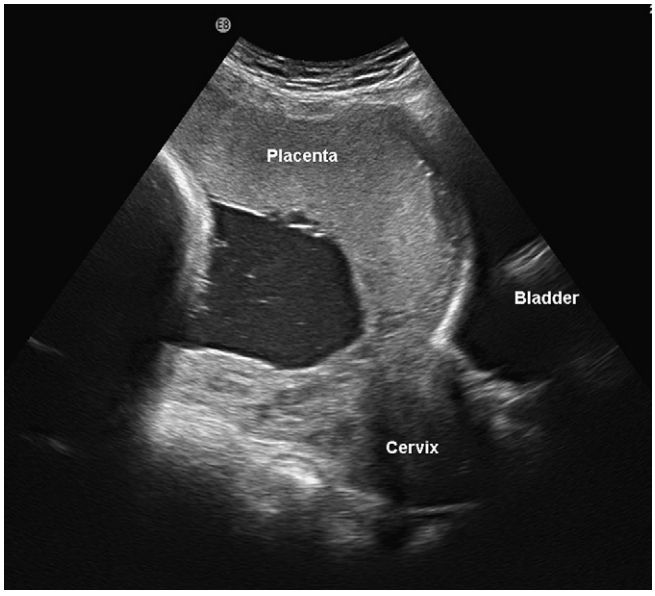

Figure 4 Ultrasound showing the placenta in the lower segment of the uterus and the placental edge encroaching to the internal cervical os.

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