Benefits and pitfalls of the use of intrapartum ultrasound

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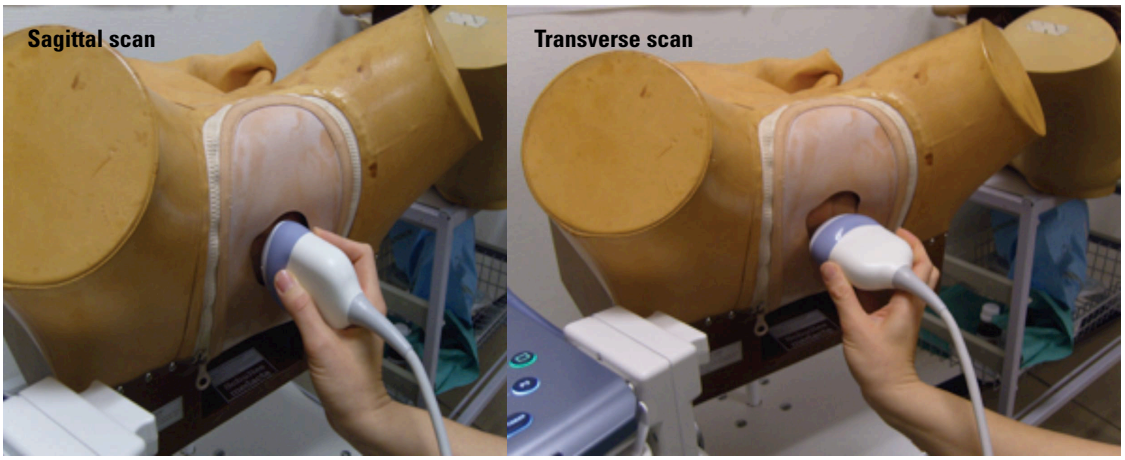

Figure 1: Transperineal Sagittal and Transverse application of 2D transducer.[20] The sagittal scan is used to obtain views of the maternal symphysis pubis and fetal skull. The transducer may be rotated 180 degrees (transverse application) in order to visualise the cervix and head-perineum distance.

Introduction

Ultrasound in labour (intrapartum ultrasound) has come to the fore in the last decade stemming from both an increased desire for a reliable method of labour assessment coupled with increased availability of ultrasound on the delivery suite. The use of ultrasound in the delivery suite currently is predominantly for presentation, amniotic fluid and fetal heart assessment, but there is a growing acknowledgement that ultrasound parameters could be used in assessing the progress of labour, and potentially in predicting labour outcome.[1]

The need for an objective method of assessing labour was first recognised as early as 1977 with the first known publication on intrapartum scanning.[2] A more comprehensive review of intrapartum ultrasound, incorporating some concepts that are standard in contemporary practice was described in a Russian PhD thesis from the mid-1990s.[3] There is the need, if not an alternative, then at least an adjunctive to digital vaginal examinations (VE). Digital VEs are associated with ascending infection to the fetus,[4] chorioamnionitis[5] and endometritis as well as reduced time to delivery in preterm labour.[5] The examination itself may also be an uncomfortable experience for the labouring woman.[6]

In some circumstances, digital vaginal examinations (VEs) are contraindicated, such as Placenta Praevia or Preterm Prelabour Rupture Of Membranes (PPROM). For some women with a fear of childbirth, previous sexual trauma or vaginismus, digital VEs are especially traumatic and for these women special arrangements are usually made to avoid examination except where absolutely necessary. Irrespective of these concerns, digital VE is a notoriously subjective technique and agreement between observers is frequently poor.[7,8]

Transabdominal ultrasound

Head position

Several studies have assessed the accuracy of transabdominal ultrasound in comparison with digital VE in determining fetal head position. These have concluded that ultrasound is superior to digital VE in identifying the correct fetal head position.[9–12] However, a recent large randomised controlled trial has shown no difference in obstetric or neonatal morbidity despite demonstrating increased accuracy of fetal position with ultrasound in the second stage of labour when used in assisted vaginal delivery.[13] In addition, in a recent large randomised study Popowski, *et al.* have shown increased obstetric intervention in the group where ultrasound was used in addition to vaginal examinations.[14]

Transperineal (translabial) ultrasound

A novel non-invasive technique using standard transabdominal probes has been developed where an ultrasound transducer encased in a clean cover is placed in either transverse or sagittal plane on the mother's perineum (Figure 1) but not in the vagina.[15–17] Assessments of the descent of the presenting fetal part[18,19] and cervical dilatation[20](Figure 2) can be made within 1–2 minutes and without exerting undue pressure. Such a technique has the potential to reduce the frequency of intrusive internal examinations and associated infection and could be useful in allowing the assessment of women in whom digital VE is traumatic or contra-indicated.

However, similar to digital VEs, cervical dilatation is easier to assess at cervical dilatation of less than 9 cm and with rupture of membranes. Nonetheless it is a technique well tolerated by women[21–23] and caregivers.[24]

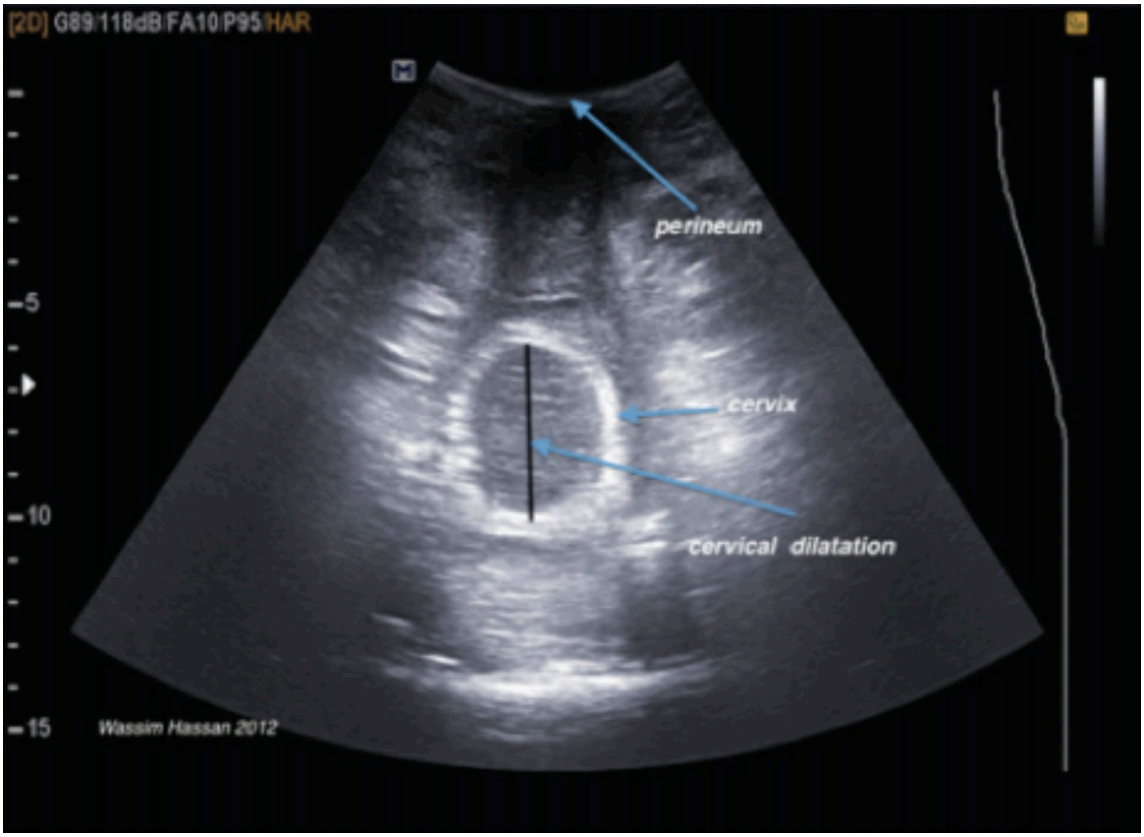

Figure 2: Cervical dilatation assessed by 2D transperineal ultrasound during labour.[20] The cervical dilatation is clearly visible at the centre with the vaginal wall hypoechogenic laterally to the cervix. At the top of the picture is the perineum where the transperineal probe is placed.

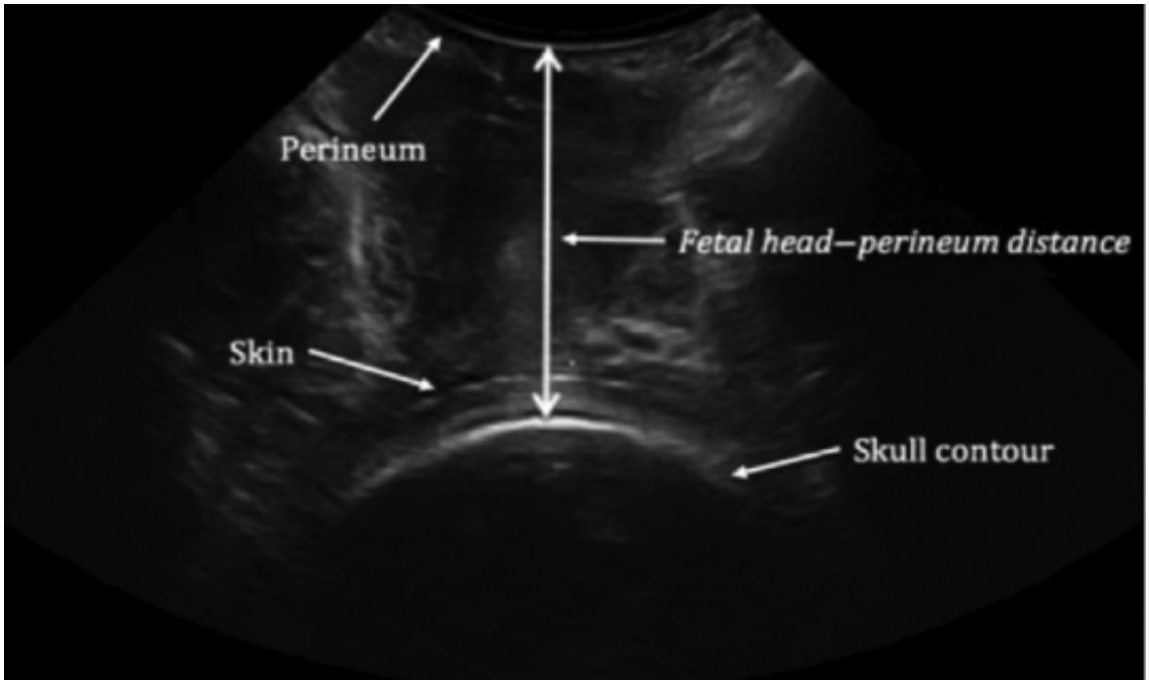

Figure 3: Head-perineum distance measured as the outer bony limit of the fetal skull and the perineum. Printed with permission.[28]

Head descent

The conventional assessment of head engagement and station in relation to the pelvic brim and the ischial spines respectively is subject to great intra-observer variability and the presence of caput and moulding[25] makes this even more difficult. Thus, much interest in the use of intrapartum ultrasound has centered around head descent.

Initial studies focused on Angle of Progression (AoP) in labour[15,18,26] in the prediction of the likelihood of spontaneous vaginal delivery. With the probe placed in the sagittal plane, a line is drawn between the tangent on the deepest bony part of the fetal head together with the long axis of the pubic symphysis, this tangent defining the 'angle of descent' or 'angle of progression', more commonly known as the AoP. This is a difficult measurement to obtain at very high and very low stations and should ideally be restricted to the late first and early second stages of labour.

Eggebo, *et al*. devised a simple method of assessing head

ITU Head station (cm)	Angle of progression (°)	HPD (mm)	HSD (mm)
-3	84	54	*
-2	95	48	48
-1	106	42	41
0	116	36	34
1	127	31	27
2	138	*	*
3	148	*	*
4	159	*	*
5	170	*	*

*Conversion to HPD and HSD was only calculated for values supported by data from this study. ITU, intrapartum and transperineal ultrasound

Table 1: Conversion table for ultrasound methods to assess fetal head descent, using head–perineum distance (HPD) and head–symphysis distance (HSD) data versus data for Angle of Progression (AoP). Printed with permission.[1]

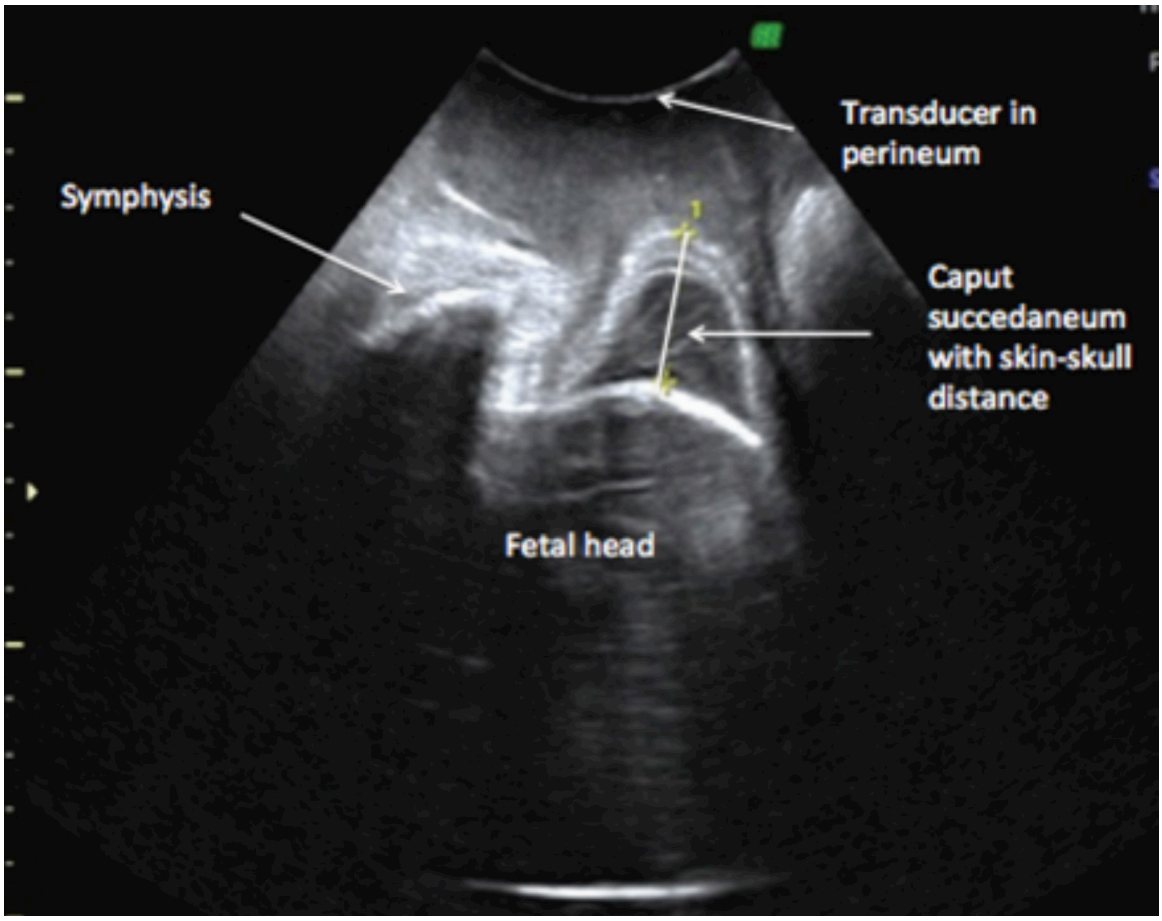

Figure 4: Caput succedaneum obtained on the sagittal view of the fetal skull.[30]

descent initially in a subset of women with prelabour rupture of membranes[27] using a novel parameter that he called the Head-Perineum Distance (HPD), this being the shortest distance from the outer bony limit of the fetal skull to the skin surface of the perineum (Figure 3). The HPD was then replicated in a group of 110 women in prolonged labour[28] and found to have a high degree of correlation with AoP in the assessment of head station, though with large confidence intervals.

Head-Symphysis Distance (HSD) has recently been described as another ultrasound marker to assess head descent. It is measured as the distance between the lower edge of the pubic symphysis and the nearest point of the fetal skull along the infrapubic line.[29]

It has since been shown that all these parameters for head descent are comparable[1] (Table 1) but HPD is now emerging as the preferred method for assessment due to its simplicity of use and reproducibility even at high stations and both stages of labour.

Caput Succedaneum

Using the transperineal scanning method, the identification of caput has been demonstrated by obtaining a sagittal view of the fetal skull.[15] In 122 women, Hassan found an association between digital assessment of caput and ultrasound assessment of caput (Figure 4).[30] Additionally, there was a relationship between ultrasound measured caput and the likelihood of vaginal delivery.

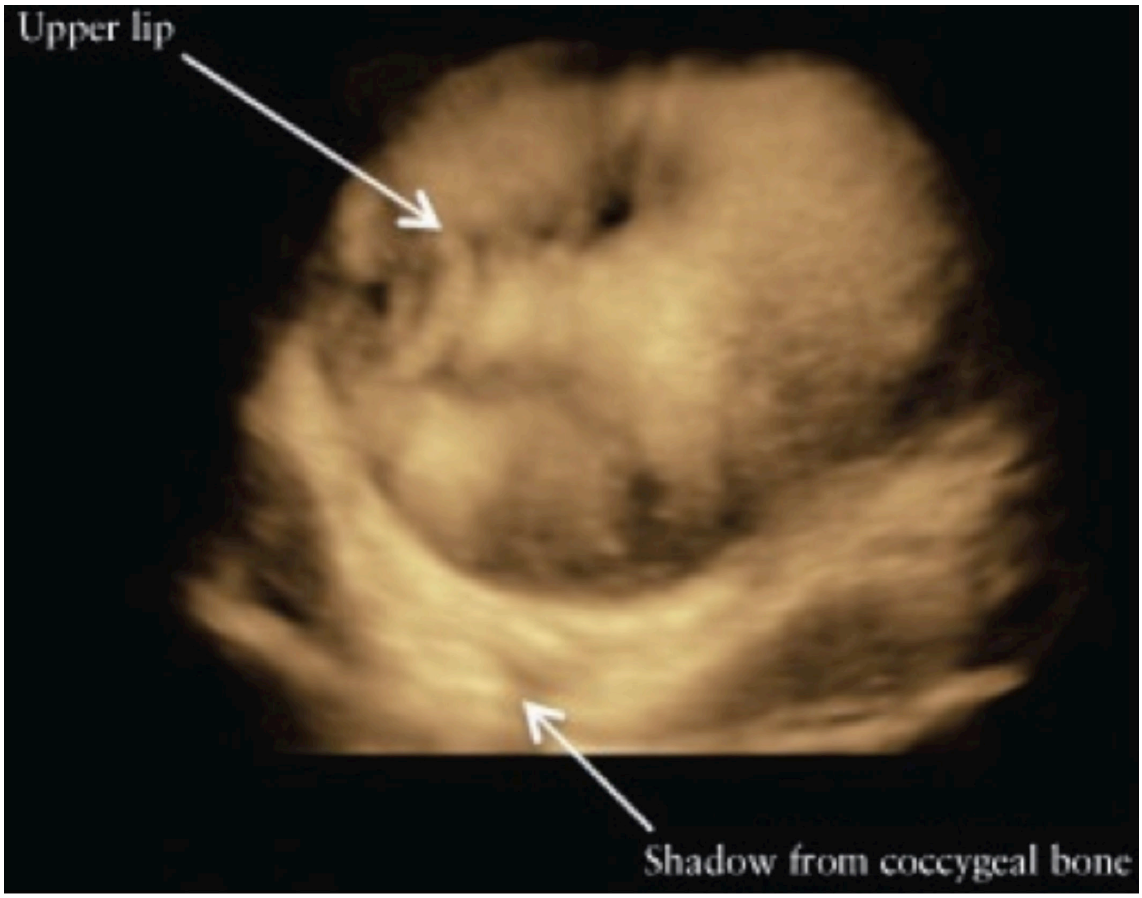

Figure 5: Face presentation diagnosed on 3D ultrasound. Printed with permission.[39]

The role of Fetal Doppler

Emergency Caesarean delivery rates are rising[31] and the primary method of fetal monitoring, the cardiotocograph, is acknowledged to have limitations in predicting perinatal adverse outcome.[32] There is clearly a need to better predict emergency Caesarean deliveries for adequate resource provision and reduction of intra-partum events causing hypoxic-ischaemic encephalopathy.

Cerebro-umbilical ratio

Fetal Doppler examination demonstrating cerebral redistribution (low cerebro-umbilical [C/U: MCA/PI] ratio) may predict emergency Caesarean deliveries.[33] Cerebral redistribution is a marker for hypoxia and there is currently controversy over whether it is physiological[34] or pathological. In either case it is logically consistent to consider that a fetus that is relatively hypoxic at the start of labour is more likely to require emergency delivery due to hypoxia and abnormal fetal heart rate monitoring.

Ductus Venosus (DV) Doppler

Small prospective studies[35,36] have been carried out demonstrating that although technically feasible, there is significant operator variation in ductus venosus waveform patterns as well as differences during and in between contractions in labour. The authors[37] conclude that although perinatal Doppler examination of the DV is possible; it is time-consuming, technically not always possible and requires experience. In difficult cases they recommend 'off-line' analysis of recorded patterns. Without a clear protocol on its use and role in prediction of perinatal events, the routine use of DV Doppler on the delivery unit is currently neither recommended nor feasible.

3Dimensional (3D) ultrasound

3D has been compared to 2D in various studies and found to be comparable[19,38] in assessing fetal head descent in the first stage of labour. There are several advantages of 3D versus 2D image acquisition including standardisation of measurements, the possibility of storing volumes in order to perform later analyses, even in planes other than that used for acquisition and multiplanar alignment. The need for a larger, more expensive probe and specialist training make its use unwieldy on the delivery suite. However, 3D transperineal images can be used to identify mal-presentation[39] and thus improve the counselling of labouring women and their partners with a visual ultrasound image (Figure 5).

Sonopartogram

In 1954, Friedman first described the use of standardised curves[40] in the management of labour. Philpott, *et al*.[41] in 1972 first brought the concept of the partogram into clinical practice. However, a Cochrane review[42] in 2009 concluded that its use made no overall difference to obstetric and neonatal morbidity and thus the routine use of the partogram in standard labour management could not be advocated. Hassan[43] developed the concept of a sonopartogram (Figure 6), an ultrasound based partogram, as an objective tool for the prediction of labour based on ultrasound. Subsequently,

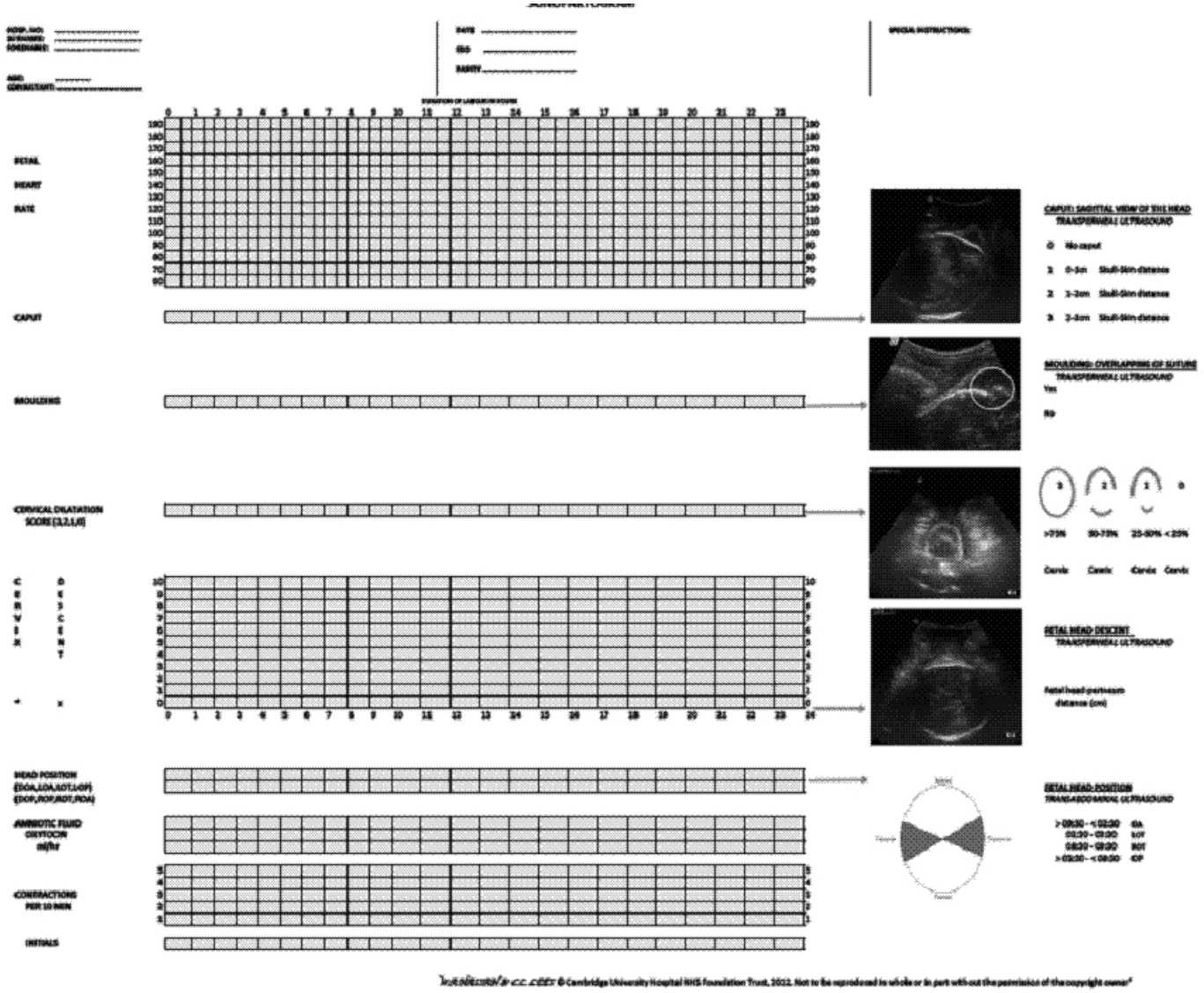

Figure 6: The Sonopartogram.[43]

combining various ultrasound parameters of the progress of labour including Head-Perineum Distance ≤ 40 mm[44] and Caput< 10 mm[30] a 'proof of principle' predictive model for vaginal birth in nulliparous labour has been constructed.[45]

Conclusion

Ultrasound in the delivery room is nowadays ubiquitous but the use of this technology has both its proponents and opponents. A major concern is that advances in intrapartum ultrasound will mean that the art of Obstetrics is lost as over-reliance on technology develops. Certainly without large prospective studies on the subject, the evidence for routine use of transperineal ultrasound remains under scrutiny.[46] As prediction models based on intrapartum ultrasound parameters are developed,[44,45,47] real-time assessment of labour progress is likely to enhance the objectivity of recording the progress of labour, making it a future tool in active labour.[48] This technology in both the developed and developing worlds could provide information that would allow better planning both for place and mode of delivery thus improving both safety and choice for women.

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