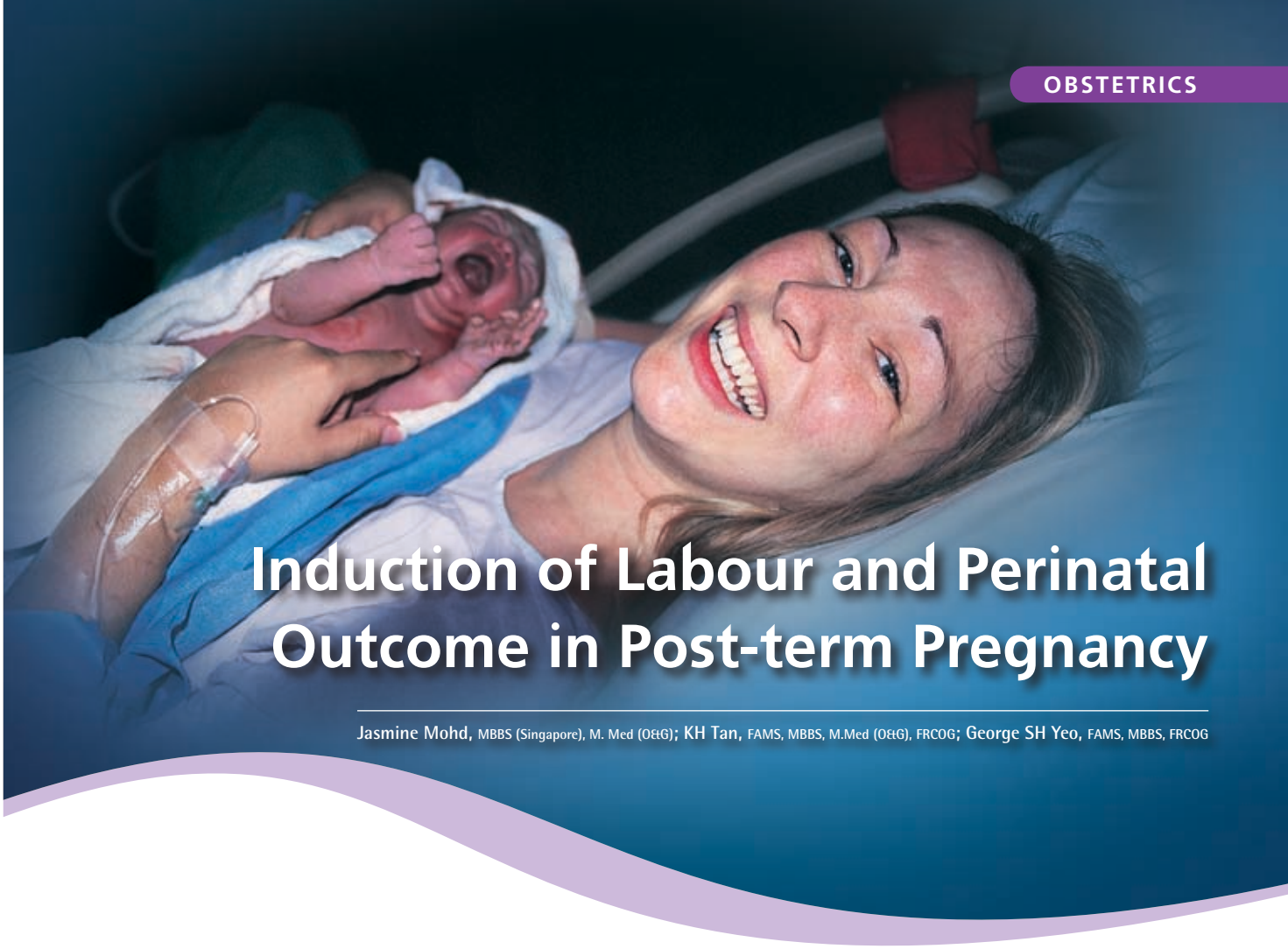

Induction of Labour and Perinatal Outcome in Post-term Pregnancy

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Stillbirth at term remains a relevant issue today despite advances in obstetric care. This article reviews the risks to the fetus in post-term pregnancy, the importance of accurate dating of gestational age with ultrasonography, the evidence to support induction of labour in post-term pregnancy, the risks of induction and methods of predicting a successful induction of labour.

OVERVIEW

The reported incidence of post-term or prolonged pregnancy is approximately 7% to 10%. Post-term pregnancy is defined as one that has extended beyond 42 weeks gestation (294 days from the last menstrual period). The most frequent cause of an apparently prolonged gestation is an error in dating.

Induction of labour is a very common aspect of obstetric practice. It is indicated when the risks of continuing the pregnancy outweigh the risks of induction.

RISKS TO THE FETUS IN POST-TERM PREGNANCY

Increased Perinatal Morbidity and Mortality

The main risk is that of increased perinatal morbidity and mortality, usually due to progressive uteroplacental insufficiency.

The traditional definition of a post-term pregnancy is one that extends beyond 42 completed weeks. However, multiple studies have shown that the risk of an adverse perinatal outcome increases when the pregnancy is beyond 41 completed weeks, or even earlier.

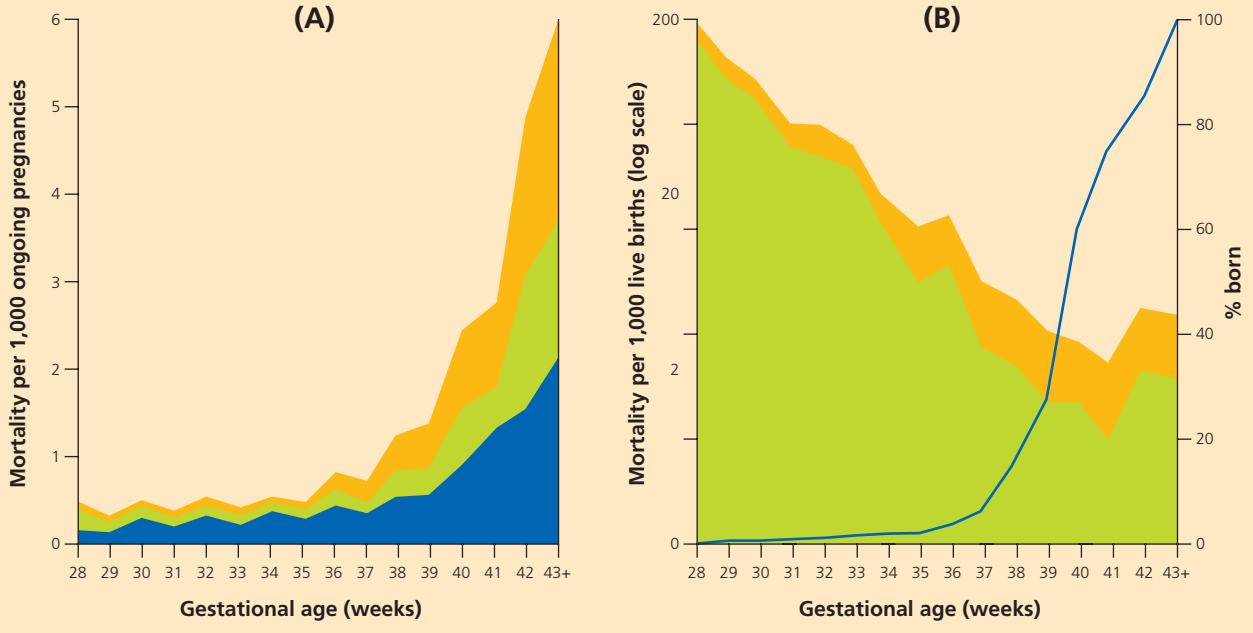
Stillbirth rate is usually calculated as the number of stillbirths per 1,000 livebirths and stillbirths. There is a statistically significant increase in fetal mortality from 41 weeks gestation and beyond; the odds ratios are 1.5, 1.8 and 2.9 at 41, 42 and 43 weeks, respectively.[1]

Reinterpretation of the statistical risk of stillbirth in post-term pregnancies showed that the risk is far higher than previously believed. The overall risk of pregnancy loss (stillbirth and infant mortality) increases eight-fold from 0.7 per 1,000 ongoing pregnancies at 37 weeks to 5.8 per 1,000 ongoing pregnancies at 43 weeks of gestation.[2] (Figure 1)

It has been demonstrated that the risk of fetal demise is significantly higher than the risk of neonatal death at 283 days or beyond (40+3 weeks gestation). This is the gestational age at which fetal mortality continues to increase without any benefit of a reduction in neonatal mortality. Fetal survival may be served best by considering a pregnancy at 40+3 weeks gestation as prolonged instead of the traditional definition of 42 weeks.[3]

Stillbirth of unknown cause at term continues to remain a significant problem. With reference to the Confidential Inquiry into Stillbirths and Deaths in Infancy (CESDI) 5th annual report in 1998, the unexpected loss of a baby at term or weighing above 2.5 kg prior to labour accounts for nearly an eighth of all fetal deaths.[4] The underlying cause of many of these deaths is unknown. A pilot study of antepartum term stillbirths commissioned by the CESDI revealed that no explanation or associated condition was found in 27 out of 86 cases (31%). The most commonly associated condition was isolated intrauterine growth restriction (22%).

Figure 1. Risk of pregnancy loss and likelihood of delivery in post-term pregnancy



The summed mortality at each gestation for the rate of stillbirth(■), neonatal death (■) and post-neonatal death (■) expressed as **(A)** per 1,000 ongoing pregnancies, and **(B)** per 1,000 live births. The likelihood of delivery (–; cumulative percentage born) at each gestation is also shown in **(B)**.

Reproduced with permission from reference 2.[2]

In the United Kingdom, perinatal mortality rates have been falling since the 1950's, but throughout this period, stillbirths remain the largest contributor, accounting for nearly 70% of all perinatal deaths in 2004. Over a half of stillbirths are still "unexplained" according to the Extended Wigglesworth Classification.[5] (Figure 2) The role of intrauterine growth restriction in stillbirths needs further study, especially with respect to accurate antenatal diagnosis and at postmortem examination.

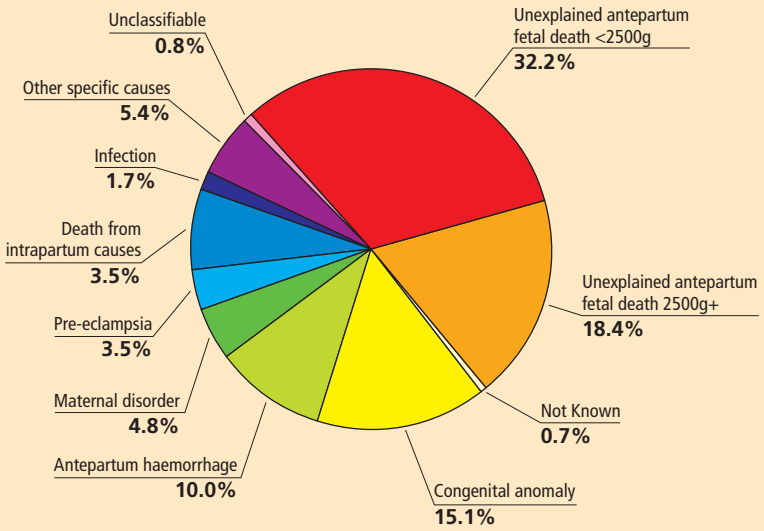
In the authors' hospital, a major tertiary centre in Singapore, perinatal mortality rates have been reduced by the systematic organization of perinatal care. There is provision for high-risk consultations, a birth defect clinic, a fetal medicine clinic, an outpatient day-care centre and an obstetric medical disorders clinic. However, whilst neonatal mortality rates have decreased and remained very low for the past 10 years, stillbirth remains a pressing issue.

Figure 3 illustrates that stillbirth rates have not fallen significantly despite introduction of the systematic organization of perinatal care in our hospital. This is in contrast to the more marked reduction in neonatal deaths.

Local data in the authors' hospital were examined by Tan et al in a confidential panel enquiry into suboptimal factors relating to stillbirths.[6] All 270 stillbirths in the years 1995 to 1999 were studied. The incidence of stillbirth was 3.48 per 1,000 births. The stillbirths were classified according to their gestation. (Table 1) Approximately 44% of stillbirths occurred after 36 completed weeks of gestation, showing that term stillbirths still account for a sizable proportion of the total. The stillbirths were also classified according to the birthweight of the fetuses, with 48.9% weighing 2,500 g or more. The majority of deaths in these 'good-sized' babies was caused by abruption or cord accident, or were unexplained.

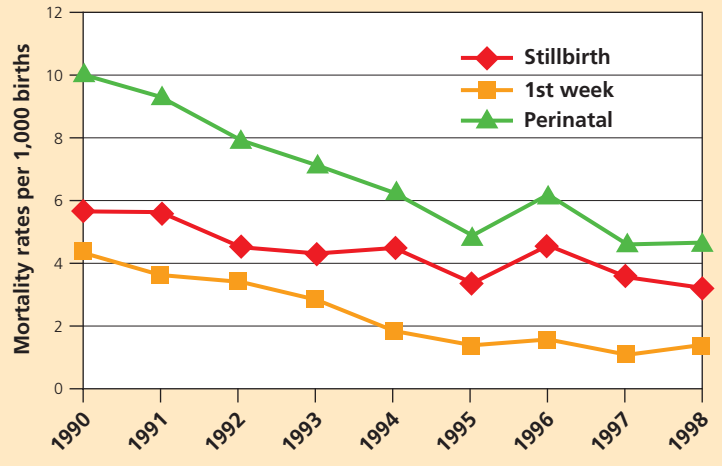
These acute events cannot be easily anticipated. Therefore, despite advances in neonatal care in salvaging very preterm infants, the rates of sudden fetal demise due to acute events such as abruption or cord accident remain almost constant over the years. (Figure 4) Many of these near-term stillbirths may be prevented if delivered before the pregnancy continues to a prolonged gestation. (Figure 5) Undiagnosed causes

Figure 2. Causes of stillbirth by Wigglesworth and Obstetric Classifications, 2004



Source: Confidential Enquiry into Maternal and Child Health

Figure 3. Mortality rates per 1,000 births at KK Women's and Children's Hospital



Data from Department of Maternal-Fetal Medicine, KK Women's and Children's Hospital.

such as placental insufficiency probably constitute a proportion of these unexplained stillbirths, and they might be avoided by induction of labour.

Concerns regarding cord prolapse, hyperstimulation and subsequent fetal heart rate abnormalities as a consequence of induction can be alleviated by the organization of delivery suites and provision of a safe set-up for 'crash' caesarean sections. Confidential Enquiry into Maternal and Child Health (CEMACH) and its predecessor organizations, Confidential Inquiry into Stillbirths and Deaths in Infancy (CESDI) and Confidential Enquiry into Maternal Deaths (CEMD), have both emphasized the need for a fresh look at the organization of labour wards.[5] Meanwhile, the absence of an organized system of labour ward processes should not prevent the timely induction of labour in a post-term pregnancy.The audit at the authors' hospital from February 2003 to February 2004 looked at 98 cases of crash caesarean section and found the mean decision-to-delivery-interval (DDI) was 7.6 minutes, with all deliveries made within 17 minutes.[7-9] (Figure 6) This reduction in DDI has tremendously enhanced safety for our patients in labour and their babies, showing that induction of labour can be safely undertaken.

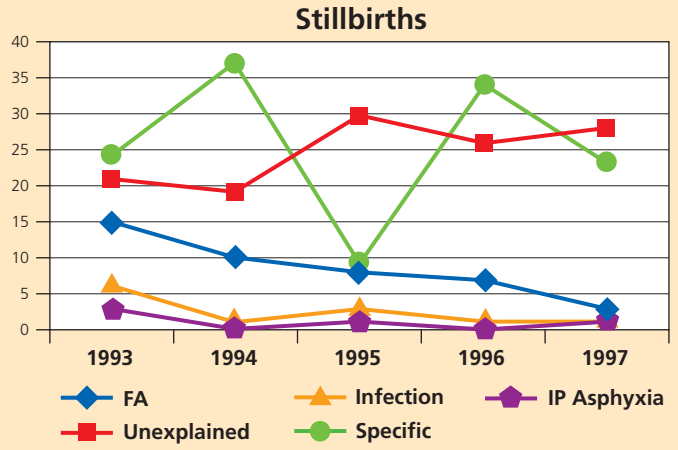
Table 1. Classification of stillbirths according to gestational age

Gestational age (weeks)	Frequency	Percent (%)
28-33	106	39.3
34-35	45	16.7
36-39	97	35.9
≥40	22	8.1
Total	**270**	**100.0**

Table 2. Classification of stillbirths according to fetal birthweight

Birth weight (grams)	Frequency	Percent (%)
<1,000	48	17.8
1,000-1,499	45	16.7
1,500-1,999	45	16.7
2,000-2,499	54	20.0
2,500-2,999	37	13.7
3,000-3,499	28	10.4
≥3,500	13	4.8
Total	**270**	**100.0**

Figure 4. Aetiology of stillbirths in KK Women's and Children's Hospital



Macrosomia

Another risk to the fetus in post-term pregnancy is that of macrosomia. Post-term infants are larger in size, with a higher incidence of macrosomia (2.5% to 10% vs 0.8% to 1% in term infants).[10] Analysis of our local data on birthweight indicates that 4 kg represents the 98th centile of our birth population. (Table 3)

Macrosomia is associated with increased complications in labour, including prolonged labour, dystocia, increased caesarean section rate and shoulder dystocia with its attendant risks of neurological injury and fractures. In particular, shoulder dystocia has been shown to increase with increasing birthweight >3.6 kg.[11] (Figure 7) There is therefore a case for delivery of these infants before significant macrosomia occurs, even though rates of shoulder dystocia have not been shown to decrease with induction of labour.

Umbilical pH Levels and Apgar Scores

Post-term pregnancy is an independent risk factor for low umbilical pH level at delivery and low 5-minute

Apgar scores. Cord blood metabolic acidosis causes an increased risk of developing subsequent motor and cognitive defects in a compromised neonate. There is a significant negative correlation between gestational age at delivery and umbilical-cord-artery pH – mean pH was 7.26 at 37 weeks, and 7.22 at 42 weeks.[12]

Risk of Postmaturity Syndrome

Twenty percent of postdates infants have post-maturity syndrome.[13] This is associated with a risk of cord compression from oligohydramnios, meconium aspiration, short-term neonatal complications (eg, hypoglycaemia and respiratory insufficiency), and poorer fetal status in both the antenatal and intra-partum periods. There is evidence of placental abnormality on histopathology and ultrasound, and by the presence of placental DNA degradation products in maternal serum. Yet, in practice, little of this information is actually conveyed to the patient during counselling in post-term pregnancy.

Meconium Aspiration Syndrome

The risk of meconium aspiration syndrome (MAS) increases with advancing gestational age. Meconium aspiration syndrome affects up to 5% of infants born with meconium-stained amniotic fluid. It is the leading cause of respiratory failure in term infants, and is associated with significant morbidity and prolonged neonatal intensive care. Reduction of post-term pregnancy is an important factor in reducing MAS: a reduction in post-term births after 41 weeks has been shown to be associated with a four-fold decrease in the incidence of MAS.[14]

EVIDENCE FOR INDUCTION OR EXPECTANT MANAGEMENT IN POST-TERM PATIENTS

The largest trial to look at this issue showed that elective induction resulted in a lower caesarean section rate (21.2% vs 24.5%). This was primarily due to fewer caesarean sections being performed for non-reassuring fetal status. Patient satisfaction was higher in the induction group.[15]

A recent Cochrane review concluded that a policy of labour induction at 41 weeks or beyond was associated with fewer perinatal deaths (relative risk 0.30). There was no evidence of a statistically significant difference in the risk of caesarean section for women induced at 41 and 42 completed weeks of gestation. Women between 37 and 40 weeks of gestation were more likely to have a caesarean section with expectant management than those in the labour induction group (relative risk 0.58). There were also fewer babies with MAS in the induction group.[16]

Figure 5. Rates of stillbirth by gestation

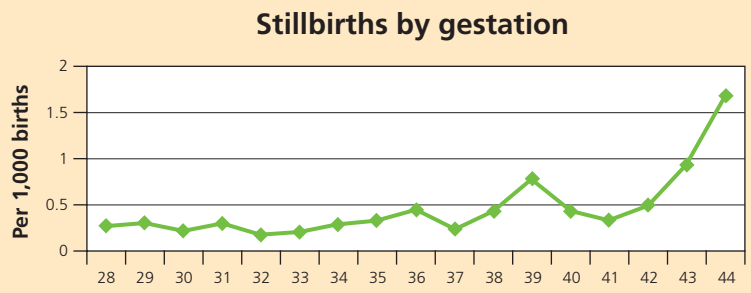
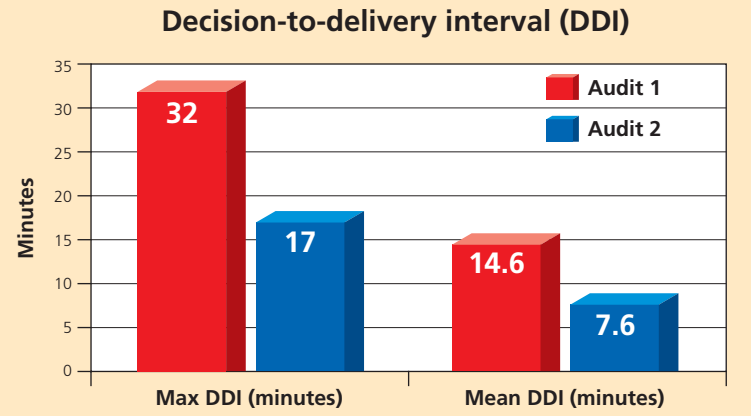


Figure 6. Crash caesarian sections in KK Women's and Children's Hospital



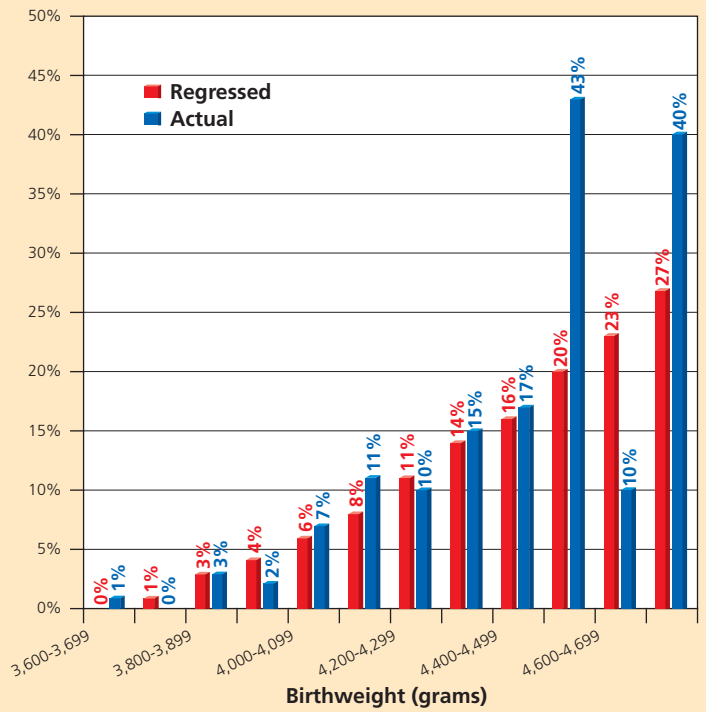
Importance of Ultrasound Dating

Menstrual dates have been found to systematically overestimate gestational age at term compared to ultrasound dating.[17,18] The lowest incidences of the diagnosis of post-term pregnancies are in populations which routinely use ultrasound for dating.[19] A Cochrane meta-analysis found that rates of induction of labour for post-term pregnancy were lower in women who had routine ultrasound dating of pregnancy before 24 weeks.[20]

Table 3. Incidence of birthweight above 4 kg by gestational age at delivery

Gestational age (weeks)	Percentage of infants with birthweight >4 kg
36 to 36+6	0.9
37 to 37+6	0.9
38 to 38+6	1.5
39 to 39+6	2.5
40 to 40+6	3.7
41 to 41+6	4.0
42 to 42+6	4.3
>43	3.1

Figure 7. Rate of shoulder dystocia with increasing birthweight



Reproduced with permission from reference 11.

Induction Before 41 Weeks

A major concern regarding induction of labour is that of iatrogenic prematurity. Respiratory problems can result from inadvertent delivery of a premature infant, or transient tachypnoea may occur after caesarean section for failed induction. However, as most pregnancies today are dated sonographically, the likelihood of delivering a premature infant is low.

A recent trial demonstrated that respiratory distress still occurs at term.[21] Betamethasone, given immediately before elective caesarean section at term, reduces respiratory distress syndrome and admission to a special care baby unit, as does delaying delivery until 39 weeks. The rate of such admissions was 0.050 in the control group, and 0.024 in the group receiving antenatal steroid. This rate falls with increasing gestation, supporting the recommendation to delay elective caesarean section until the 39th week. Additionally, the benefits of antenatal steroids persist until 39 weeks.

RISKS OF INDUCTION

Hyperstimulation

Hyperstimulation is easily managed in a safe set-up for induction. The fetus usually recovers with measures such as removing the prostaglandin pessary, cessation of oxytocin infusion or the administration of intravenous tocolytic agents. If the fetal heart rate fails to recover, intervention in the form of emergency or crash caesarean section usually leads to delivery of the baby in a good condition.

Failed Induction and Higher Caesarean Rates

Hannah demonstrated a lower caesarean section rate in the induction group, primarily due to fewer sections

being performed for non-reassuring fetal status.[15] The Cochrane meta-analysis found that routine induction after 41 weeks was not associated with an increased caesarean section rate.[16]

Another large meta-analysis concluded that the caesarean delivery rate was lower in women whose labour was routinely induced after 41 weeks, regardless of their baseline Bishop score. Fewer caesarean deliveries for fetal heart rate abnormalities accounted for much of the overall reduction in caesarean delivery associated with labour induction.[22]

PREDICTION OF A SUCCESSFUL INDUCTION

Bishop Score

The assessment of the cervix has been used as a predictor of vaginal delivery. The Bishop score is most commonly used in clinical practice. (Table 4) Bishop observed that multiparous women undergoing induction of labour with a cervical score >8 had the same likelihood of vaginal delivery as women who were in spontaneous labour.[23]

Transvaginal Ultrasound

Transvaginal ultrasound measurement of cervical length has been shown to be useful in the prediction of preterm labour.[24] Similarly, it has been studied to predict successful outcome in induction of labour; it is more reproducible and quantitative compared to subjective assessment of cervical effacement between different observers.

Both cervical length and Bishop score were linearly correlated with duration of labour. Women with cervical length <3.0 cm had shorter labours ($p<0.001$) and were more likely to deliver vaginally ($p<0.001$).[25]

Ultrasound features such as preinduction sonographic assessment of cervical length, posterior cervical angle and occipital position are superior to the Bishop score in predicting the outcome of labour.[26]

Table 4. Bishop score for elective induction

	0	1	2	3
Dilation (cm)	Closed	1 to 2	3 to 4	5 to 6
Effacement (%)	0 to 30	40 to 50	60 to 70	>80
Station	−3	−2	−1 to 0	+1, +2
Cervical consistency	Firm	Medium	Soft	
Position of cervix	Posterior	Midposition	Anterior	

Adapted from reference 23.

The posterior cervical angle is the angle between the posterior uterine wall and the cervical canal. It has been proposed as a more accurate indication of the position of the cervix. Clinical studies and observation show that the likelihood of caesarean section is higher in occiput-posterior rather than occiput-anterior positions.

Fetal Fibronectin

Fetal fibronectin (fFN) in cervicovaginal secretions has been used to predict uterine readiness for induction. It is an independent predictor for success of induction of labour, with positive fFN correlating with lower caesarean section rates, and shorter intervals to delivery.[27]

To date, the routine use of ultrasound measurement of cervical length and fFN in predicting the success of induction of labour is uncertain. More data, including that from cost-benefit analysis, is needed before these tests can be recommended for the selection of patients for induction.

Sweeping of Membranes

Sweeping of membranes has the potential to initiate labour by increasing local production of prostaglandins. In women who wish to avoid using agents for cervical ripening, a trial has shown that routine sweeping of the membranes substantially reduces the risk of post-term pregnancies.[28] A Cochrane review of membrane sweeping showed that if performed as a general policy in women at term, it was associated with reduced duration of pregnancy and reduced frequency of pregnancy

continuing beyond 41 weeks (relative risk 0.59) and 42 weeks (relative risk 0.28). To avoid one formal induction of labour, sweeping of membranes must be performed in eight women.[29]

CONCLUSION

Stillbirth at term remains a pressing issue despite advances in obstetric surveillance. Induction of labour should be performed when necessary at term. With accurate dating of gestation, delivery by 41 completed weeks of gestation is a reasonable aim. Women can be assured that induction of labour at this gestation does not increase the risk of caesarean delivery, and it reduces the risk of perinatal death.

Delivery suites should have prompt and appropriate response measures for emergencies (eg, shoulder dystocia and hyperstimulation), such as a set-up for crash caesarean section. The absence of a good system with organized processes for safe induction should not prevent appropriate induction of labour in a post-term pregnancy. Indeed, such a system should be implemented in the delivery suite if it were not already in place. In addition, processes must be in place in any obstetric unit for accurate dating of gestation by ultrasound in order to avoid prolonged pregnancy.

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