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MATERNO-FETAL MEDICINE

Is induced labour in the nullipara associated with more maternal and perinatal morbidity?

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Abstract
Purpose To ascertain any differences in foetomaternal outcomes in induced and spontaneous labour among nulliparous women delivering at term.
Methods A retrospective matched cohort study consisting of 403 nulliparous women induced at ≥292 days and 806 nulliparous women with spontaneous labour at 285–291 days.
Results Compared to those in spontaneous labour, women who had induction of labour were three times more likely to have a caesarean delivery (OR 3.1, 95% CI 2.4–4.1; $P < 0.001$). Women who had induction of labour were 2.2 times more likely to have oxytocin augmentation (OR 2.2, 95% CI 1.7–2.8; $P < 0.001$), 3.6 times more likely to have epidural anaesthesia (OR 3.6, 95% CI 2.8–4.6; $P < 0.001$), 1.7 times more likely to have uterine hyperstimulation (OR 1.7, 95% CI 1.1–2.6), 2 times more likely to have a suspicious foetal heart rate trace (OR 2.0, 95% CI 1.5–2.6), 4.1 times more likely to have blood loss over 500 ml (OR 4.1, 95% CI 2.9–5.5; $P < 0.001$), and 2.9 times more likely to stay in hospital beyond 5 days (OR 2.9, 95% CI 1.5–5.6; $P < 0.001$). Babies born to mothers who had induction of labour were significantly more likely to have an Apgar score of <5 at 5 min and an arterial cord pH of <7.0.
Conclusion Compared to those with spontaneous labour, nulliparous women with induced labours are more likely to have uterine hyperstimulation, caesarean delivery, and babies with low Apgar scores. Nulliparous women should be made aware of this, as well as potential risks of expectant management during counseling.

Keywords Induction of labour · Spontaneous labour · Caesarean section · Pregnancy complication · Neonatal outcome

Introduction

Induction of labour involves the artificial stimulation of uterine contractions with the aim of achieving vaginal delivery. The procedure is a common obstetric intervention, and is used in over 20% of deliveries in the UK [1]. Induction of labour is primarily employed when the benefits of delivery outweigh the risks of continuing the pregnancy. However, this intervention can have a significant impact on the birth experiences of women, such as an increased risk of emergency caesarean delivery [2].

Previous studies that compared induced to spontaneous labour in nulliparous women have shown conflicting results. For example, while some observational studies have consistently shown that the rate of caesarean delivery was increased approximately twofold in the induced labour group [3–9], other observational studies that compared induced to spontaneous labour, and some randomized controlled trials that compared elective induction of labour to expectant management of pregnancy, particularly at or beyond 41 weeks, have shown a similar or lower rate of caesarean delivery [10–13]. Furthermore, in some other studies, the magnitude of identified differences was not quantified [3, 14], and in some cases, the study samples were

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not homogeneous [15–17]. In addition, there is little or no data on this subject from the UK.

The aim of this study was to ascertain and quantify any difference in maternal and foetal outcome between induction of labour in a nulliparous woman at ≥292 days gestation and spontaneous labour in a nulliparous woman at a gestational age of 285–291 days in a secondary centre in the UK. It is hoped that the results of this study would add to the body of evidence on this subject.

Methods

The study sample consisted of nulliparous women with singleton term pregnancies who had elective induction of labour for post-term pregnancy (≥292 days) at the Chase Farm Hospital, North London, between July 1, 2007 and September 31, 2008. The cases were identified from the computer records and labour ward diaries. Data were extracted from computer records, and additional information was retrieved from clinical notes. Women with multiple pregnancies, previous uterine surgery, foetal anomaly, intrauterine growth restriction, oligohydramnios, premature rupture of membranes, non-vertex presentation, antepartum haemorrhage, pre-eclampsia or pre-existing maternal diseases were excluded. Using the same criteria, a control group was derived from patients who entered labour spontaneously at term (285–291 days) during the study period. This group consisted of women who had delivered just before or after each indexed case matched for age (up to a 5-year interval). Maternal and neonatal summary characteristics included maternal age, body mass index, augmentation of labour, abnormalities in foetal heart trace, mode of delivery, gestational age at delivery and birth weight. Maternal morbidity outcome variables included blood loss at delivery, need for blood transfusion, febrile morbidity during labour, and post delivery length of hospital stay. Neonatal morbidity outcome variables included Apgar score ≤ 5 at 5 min, arterial cord pH < 7.0, neonatal sepsis, birth asphyxia, neonatal trauma and neonatal intensive care admission.

In our unit, women are offered a membrane sweep at 280 days gestation and labour is induced if the woman does not go into spontaneous labour at ≤292 days. Induction of labour was defined as the use of prostaglandin E2 tablets to initiate labour in the absence of preceding uterine contractions. Women undergoing induction of labour are admitted on the morning of the procedure and receive vaginal prostaglandin E2 tablet according to the National Institute for Health and Clinical Excellence's (NICE) guidance [18]. The guideline "recommends induction of labour between 41+0 and 42+0 weeks, with the exact timing taking into account the woman's preferences and local circumstances. Vaginal PGE2 is the preferred method of induction of labour and the recommended regimens are one cycle of vaginal PGE2 tablets or gel: one dose, followed by a second dose after 6 h if labour is not established (up to a maximum of two doses)".

Although the definitions of failed induction vary widely [18, 19], in our unit, when induction fails after two doses of PGE2, the woman is counseled and given a maximum of two further doses. If there is no cervical response to this, the woman is delivered by caesarean section. This practice relies on NICE recommendations, which states that 'If induction fails, the subsequent management options include: a further attempt to induce labour (the timing should depend on the clinical situation and the woman's wishes) or caesarean section'.

Categorical data were compared using the χ^2 or Fisher's exact test where appropriate. Continuous variables between the groups were compared using the Student's t test or Mann–Whitney U test where appropriate and $P < 0.05$ was considered significant. Significant differences between the groups were quantified by calculating the odds ratios (OR) and 95% confidence intervals (CI). Statistical analyses were performed using Stata statistical software package (Stata Corp., Texas, version 7.0).

Results

During the study period, a total of 661 nulliparous women who had induction of labour were delivered in this hospital. Of these, 403 (60.9%) met the study criteria and were compared with 806 age-matched nulliparous women who delivered following spontaneous labour.

Maternal characteristics are summarized in Table 1. The two groups were comparable in age, ethnicity, BMI, and gestational age at delivery. Women who had induction of labour were significantly more likely to have caesarean delivery (39.9 vs. 17.5%, $P < 0.001$).

Table 2 shows some of the maternal outcomes. Compared to the spontaneous group, women in the induction group had a significantly higher oxytocin augmentation rate (60.8 vs. 35%, $P < 0.00$) as well as epidural analgesia rate (67 vs. 35.8%, $P < 0.00$). They also had a significantly higher proportion of uterine hyperstimulation (8.4 vs. 5.2%, $P = 0.03$), suspicious foetal heart rate trace (43.1 vs. 27%, $P < 0.00$), and an abnormal foetal heart rate trace associated with uterine hyperstimulation (20.5 vs. 9.5%, $P = 0.03$). There was no significant difference in the indications for caesarean delivery although in both groups, dystocia was the leading indication.

Among women that had vaginal delivery, the median duration of the first and second stages of labour was similar in both groups although a greater proportion of the induction group had primary postpartum haemorrhage

Table 1 Characteristics of nulliparous women with induced and spontaneous labours

	Induced ($n = 403$)	Spontaneous ($n = 806$)	P
Age (years)	27.9 ± 5.4	28.8 ± 5.5	0.62
BMI	25.6 ± 5.5	24.8 ± 3.9	0.09
Ethnicity			
White	222 (55.1)	447 (55.4)	0.90
Black	93 (23.1)	193 (24.0)	0.73
Asian	62 (15.4)	117 (14.5)	0.68
Other	28 (6.9)	49 (6.1)	0.56
Smoker	45 (11.2)	86 (10.7)	0.79
GA (days)	293 ± 1.1	290 ± 2.1	0.12
MOD			
SVD	156 (38.7)	496 (61.6)	<0.001
Instrumental	86 (21.3)	168 (20.8)	0.84
Caesarean	161 (39.9)	141 (17.5)	<0.001

Values are given as *n* (%) and mean (SD)

BMI body mass index, *GA* gestational age at delivery, *MOD* mode of delivery

(PPH) (EBL > 500 ml) and this was significant (55.3 vs. 23.3%, $P < 0.001$).

Overall, compared to the spontaneous group, a greater proportion of women in the induction group stayed in hospital beyond 5 days (5.2 vs. 1.9%, $P < 0.001$).

Table 3 summarizes the comparison of selected perinatal outcomes. Babies born to mothers who had induction of labour were significantly more likely to have an Apgar score of <5 at 5 min and an arterial cord pH of <7.0 irrespective of method of delivery. No difference in mean birth weight was observed between the two groups.

Discussion

In this study, there was a higher rate of oxytocin augmentation among women who had induction of labour. This is not unexpected as oxytocin is often required to stimulate uterine contractions following an amniotomy during the process of induction of labour [20]. Furthermore, oxytocin is also required to treat hypocontractility which is a common feature of the nulliparous uterus in established labour. The use of oxytocin is associated with the risk of uterine hyperstimulation. The hyperstimulation rate in both groups was comparable to the rate suggested by NICE (6%) and a small proportion of cases were associated with the abnormal foetal heart rate patterns. In this study, and as noted by Egarter et al. [21], uterine hyperstimulation was usually successfully managed with a reduction in the rate of oxytocin administration and/or administration of a tocolytic agent, particularly when hyperstimulation was associated with an abnormal foetal heart rate pattern.

Table 2 Labour and delivery outcomes of women with induced and spontaneous labours

	Induced ($n = 403$)	Spontaneous ($n = 806$)	OR (95% CI)	P
Syntocinon use	245 (60.8)	282 (35.0)	2.2 (1.7–2.8)	<0.001
Epidural	270 (67.0)	288 (35.8)	3.6 (2.8–4.6)	<0.001
Uterine hyperstimulation	34 (8.4)	42 (5.2)	1.7 (1.1–2.6)	0.03
Foetal heart trace				
Suspicious	174 (43.1)	218 (27.0)	2.0 (1.5–2.6)	<0.001
Pathological	42 (10.4)	59 (7.3)	1.5 (0.9–2.3)	0.06
Hyperstimulation with FHR anomaly	7 (20.5)	4 (9.5)	3.5 (1.0–12.1)	0.03
Meconium staining	76 (18.8)	177 (22.1)	0.7 (0.5–1.1)	0.2
Duration of labour				
Median (IQR)	7.6 (6–13)	7.9 (6–13)		0.17
Mean	9.7 ± 5.7	10.1 ± 6.02		0.28
Mode of delivery				
SVD	156 (38.7)	497 (61.6)	0.4 (0.3–0.5)	<0.001
Instrumental	86 (21.3)	168 (20.8)		0.84
Caesarean	161 (39.9)	141 (17.5)	3.1 (2.4–4.1)	<0.001
Indication for caesarean[a]				
Dystocia	85 (52.8)	83 (58.9)		0.2
Foetal distress	76 (47.2)	58 (41.1)		0.2
EBL > 500 ml	134 (55.3)	155 (23.3)	4.1 (2.9–5.5)	<0.001
Blood transfusion	9 (2.2)	10 (1.3)		0.19
LOS > 5 days	21 (5.2)	15 (1.9)	2.9 (1.5–5.6)	<0.001

Value are given as *n* (%)

IQR interquartile range, *SVD* spontaneous vaginal delivery, *EBL* estimated blood loss, *LOS* length of stay

[a] Of those that had caesarean section

Table 3 Foetal outcomes in women that had induced and spontaneous labour

	Induced ($n = 403$)	Spontaneous ($n = 806$)	OR (95% CI)	P
Apgar < 5@5	36 (8.9)	1 (0.1)	80 (10.1–588)	<0.001
Arterial cord pH < 7.0	35 (8.7)	6 (0.8)	11.1 (4.8–25.1)	<0.001
Neonatal admission	13 (3.2)	14 (1.7)	1.9 (0.8–4.2)	0.98
Neonatal trauma	1	0		0.82
Birth weight	3,416.4 ± 560	3,398.6 ± 437		0.72

Values are given as n (%)

Nevertheless, caesarean delivery was performed when the abnormal foetal heart rate pattern was persistent and a foetal blood sample was technically difficult to obtain because of the insufficient dilatation of the cervix.

In this study, women in the induction group had a higher rate of epidural analgesia. This rate (>60%) was also higher than the hospital's (20%) and the UK's national rate (24%). The association between induction of labour and high epidural rate has been noted by the previous researchers [22, 23]. The high epidural rate among women undergoing induction of labour relates to the fact that these women experience higher levels of pain on account of a higher level of oxytocin augmentation [24]. However, a woman's choice of analgesia is ultimately dependent on the various factors, including a perception of the anticipated severity of pain.

The study also showed that the induction group had a higher caesarean section rate. This is in sharp contrast to some observational studies and randomized controlled trials that showed a similar or lower rate of caesarean delivery among women undergoing induction [10–13]. In this study, failure to progress in the first stage of labour was a leading indication for caesarean section although there was a significant contribution from presumed foetal compromise. It could be argued that the need for induction of labour in this group of women indicates an intrinsic predisposition to poor uterine action, and this is not readily corrected by oxytocin. The large contribution from presumed foetal compromise may be related to the inability to confirm foetal well-being due to technical difficulties in obtaining foetal blood samples from a narrow cervical os when there was a suspicious foetal heart rate trace. However, it is worth noting that the incidence of failed induction in this study was low.

Among women who delivered vaginally, the rate of primary PPH was significantly higher in the induction group when compared to the spontaneous group. Active management of the third stage of labour is routinely practiced in our unit, and the groups had similar instrumental delivery rates. Thus, the same argument regarding an intrinsic predisposition to poor uterine contractility can be advanced to account for the higher PPH rate in the induction group.

Not surprisingly, women in the induction group were noted to be more likely to have a long hospital stay. Two factors may have contributed to this. Firstly, women planned for induction of labour are admitted into hospital on the day of the procedure. This leads to increased in-hospital pre-delivery time. Secondly, caesarean delivery, the rate of which was higher in the induction group, is associated with a longer post delivery length of stay [1]. The economic impact of length of stay has been studied and it is thought to contribute to the higher costs associated with the induction of labour [17].

Although both groups had similar neonatal admission rate, contrary to the findings of other authors [11, 15], the rate of adverse neonatal outcome (poor Apgar score and low arterial cord pH) was higher in the induction group, and conceivably, this may be related in part to uterine hyperstimulation.

The strength of this study lies in the fact that the study sample was homogenous in terms of parity and age. Furthermore, there was quantification of significant differences that were identified between the groups. Nevertheless, in a study of this nature, confounding variables tend to remain.

Finally, it is worth noting that some authors [11, 24] believe that there are difficulties associated with the comparison between elective induction and spontaneous labour. For example, Caughey [11] opines that "because the actual choice faced by clinicians and their patients is induction of labour or expectant management of the pregnancy, the comparison of induction of labour with spontaneous labour as a methodological approach to evaluating elective induction of labour does not produce results that are clinically relevant or that can be used to counsel women prospectively."

Conflict of interest There are no conflicts of interest to disclose.

References

1. Government Statistical Service for the Department of Health (2009) NHS maternity statistics, England: 2007–2008
2. National Institute for Clinical Excellence (2001) Clinical guideline D: induction of labor. National Institute for Clinical Excellence, London

3. Cammu H, Martens G, Ruyssinck G, Amy JJ (2002) Outcome after elective labor induction in nulliparous women: a matched cohort study. Am J Obstet Gynecol 186(2):240–244
4. Seyb ST, Berka RJ, Socol ML, Dooley SL (1999) Risk of caesarean delivery with elective induction of labour at term in nulliparous women. Obstet Gynecol 94(4):600–607
5. Luthy DA, Malmgren JA, Zingheim RW (2004) Caesarean delivery after elective induction in nulliparous women: the physician effect. Am J Obstet Gynecol 191(5):1511–1515
6. Vrouenraets FP, Roumen FJ, Dehing CJ, van den Akker ES, Aarts MJ, Scheve EJ (2005) Bishop score and risk of caesarean delivery after induction of labour in nulliparous women. Obstet Gynecol 105(4):690–697
7. Vahratian A, Zhang J, Troendle JF, Sciscione AC, Hoffman MK (2005) Labour progression and risk of caesarean delivery in electively induced nulliparas. Obstet Gynecol 105(4):698–704
8. Yeast JD, Jones A, Poskin M (1999) Induction of labour and the relationship to caesarean delivery: a review of 7001 consecutive inductions. Am J Obstet Gynecol 180(3 Pt 1):628–633
9. Prysak M, Castronova FC (1998) Elective induction versus spontaneous labour: a case control analysis of safety and efficacy. Obstet Gynecol 92(1):47–52
10. Gülmezoglu AM (2006) Induction of labour for improving birth outcomes for women at or beyond term. Cochrane Database Syst Rev 18(4):CD004945
11. Caughey AB, Sundaram V, Kaimal AJ, Gienger A, Cheng YW, McDonald KM, Shaffer BL, Owens DK, Bravata DM (2009) Systematic review: elective induction of labor versus expectant management of pregnancy. Ann Intern Med 151(4):252–263 W53–W63 (review)
12. Sanchez-Ramos L, Olivier F, Delke I, Kaunitz AM (2003) Labor induction versus expectant management for postterm pregnancies: a systematic review with meta-analysis. Obstet Gynecol 101(6):1312–1318
13. Hannah ME, Hannah WJ, Hellmann J, Hewson S, Milner R, Willan A (1992) Induction of labor as compared with serial antenatal monitoring in post-term pregnancy. A randomized controlled trial. The Canadian Multicenter Post-term Pregnancy Trial Group. N Engl J Med 326(24):1587–1592 (Erratum in: N Engl J Med 30;327)
14. Bodner-Adler B, Bodner K, Pateisky N, Kimberger O, Chalubinski K, Mayerhofer K, Husslein P (2005) Influence of labor induction on obstetric outcomes in patients with prolonged pregnancy: a comparison between elective labor induction and spontaneous onset of labor beyond term. Wien Klin Wochenschr 117(7–8):287–292
15. Glantz JC (2005) Elective induction vs. spontaneous labor associations and outcomes. J Reprod Med 50(4):235–240
16. Beebe L, Beaty C, Rayburn W (2007) Immediate neonatal outcomes after elective induction of labor. J Reprod Med 52(3):173–175
17. Maslow AS, Sweeny AL (2000) Elective induction of labor as a risk factor for cesarean delivery among low-risk women at term. Obstet Gynecol 95(6 Pt 1):917–922
18. National Institute for Health and Clinical Excellence (2008) Clinical guideline D: induction of labor. National Institute for Health and Clinical Excellence, London
19. Lin MG, Rouse DJ (2006) Clinical obstetrics and gynaecology 49(3):585–593
20. Selo-Ojeme D, Pisal P, Lawal O, Rogers C, Shah A, Sinha S (2009) A randomised controlled trial of amniotomy and immediate oxytocin infusion versus amniotomy and delayed oxytocin infusion for induction of labor at term. Arch Gynaecol Obstet 276(6):813–820
21. Egarter CH, Husslein PW, Rayburn WF (1990) Uterine hyperstimulation after low dose prostaglandin E2 therapy: tocolytic treatment in 181 cases. Am J Obstet Gynecol 63(3):794–796
22. van Gemund N, Hardeman A, Scherjon SA, Kanhai HH (2003) Intervention rates after elective induction of labor compared to labor with a spontaneous onset. A matched cohort study. Gynecol Obstet Invest 56(3):133–138
23. Svärdby K, Nordström L, Sellström E (2007) Primiparas with or without oxytocin augmentation: a prospective descriptive study. J Clin Nurs 16(1):179–184
24. Macones GA (2009) Elective induction of labour: waking a sleeping dogma? Ann Intern Med 151:281–282