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Value of routine ultrasound examination at 35–37 weeks' gestation in diagnosis of non-cephalic presentation

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KEYWORDS: external cephalic version; labor; non-cephalic presentation; third trimester; ultrasound

CONTRIBUTION

What are the novel findings of this work?
This study reports the incidence of non-cephalic presentation at a routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation and subsequent management of such pregnancies.

What are the clinical implications of this work?
Routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation detects non-cephalic presentation in about 5% of pregnancies. Such diagnosis could potentially improve pregnancy outcome by preventing unexpected abnormal presentation in labor and, through external cephalic version, reducing the incidence of non-cephalic presentation.

ABSTRACT

Objective *Undiagnosed non-cephalic presentation in labor carries increased risks for both the mother and baby. Routine pregnancy care based on maternal abdominal palpation fails to detect the majority of cases of non-cephalic presentation. The aim of this study was to report the incidence of non-cephalic presentation at a routine scan at 35 + 0 to 36 + 6 weeks' gestation and the subsequent management of such pregnancies.*

Methods *This was a retrospective analysis of prospectively collected data in 45 847 singleton pregnancies that had undergone routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation. Patients with breech or transverse/oblique presentation were divided into two groups; first, those who would have elective Cesarean section for fetal or maternal indications other than the abnormal presentation, and, second, those who would potentially require external cephalic version (ECV). The latter group was reassessed after 1–2 weeks and, if there was persistence of abnormal presentation, the parents were offered the option of ECV or elective Cesarean section at 38–40 weeks' gestation. Multivariable logistic regression analysis was carried out to determine which of the factors from maternal and pregnancy characteristics provided a significant contribution in the prediction of, first, non-cephalic presentation at the 35 + 0 to 36 + 6-week scan, second, successful ECV from non-cephalic to cephalic presentation, and, third, spontaneous rotation from non-cephalic to cephalic presentation that persisted until delivery.*

Results *First, at 35 + 0 to 36 + 6 weeks, the fetal presentation was cephalic in 43 416 (94.7%) pregnancies, breech in 1987 (4.3%) and transverse or oblique in 444 (1.0%). Second, multivariable analysis demonstrated that the risk of non-cephalic presentation increased with increasing maternal age and weight, decreasing height and earlier gestational age at scan, was higher in the presence of placenta previa, oligohydramnios or polyhydramnios and in nulliparous than parous women, and was lower in women of South Asian or mixed racial origin than in white women. Third, 22% of cases of non-cephalic presentation were not eligible for ECV because of planned Cesarean section for indications other than the malpresentation. Fourth, of those eligible for ECV, only 48.5% (646/1332) agreed to the procedure, which was successful in 39.0% (252/646) of cases. Fifth, the chance of successful ECV increased with increasing maternal age and was lower in nulliparous than parous women. Sixth, in 33.9% (738/2179) of pregnancies with non-cephalic presentation in which successful ECV was not carried out, there was subsequent spontaneous rotation to cephalic presentation. Seventh, the chance of spontaneous rotation from non-cephalic to cephalic presentation increased with increasing interval between the scan and delivery, decreased with increasing birth-weight percentile, was higher in women of black than those of white racial*

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origin, if presentation was transverse or oblique rather than breech and if there was polyhydramnios, and was lower in nulliparous than parous women and in the presence of placenta previa. Eighth, in 109 (0.3%) cephalic presentations, there was subsequent rotation to non-cephalic presentation and, in 41% of these, the diagnosis was made during labor. Ninth, of the total 2431 cases of non-cephalic presentation at the time of the scan, presentation at birth was cephalic in 985 (40.5%); in 738 (74.9%) this was due to spontaneous rotation and in 247 (25.1%) this was due to successful ECV. Tenth, prediction of non-cephalic presentation at the 35 + 0 to 36 + 6-week scan and successful ECV from maternal and pregnancy factors was poor, but prediction of spontaneous rotation from non-cephalic to cephalic presentation that persisted until delivery was moderately good and this could be incorporated in the counseling of women prior to ECV.

Conclusions *The problem of unexpected non-cephalic presentation in labor can, to a great extent, be overcome by a routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation. The incidence of non-cephalic presentation at the 35 + 0 to 36 + 6-week scan was about 5%, but, in about 40% of these cases, the presentation at birth was cephalic, mainly due to subsequent spontaneous rotation and, to a lesser extent, as a consequence of successful ECV. Copyright © 2019 ISUOG. Published by John Wiley & Sons Ltd.*

INTRODUCTION

Routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation is beneficial for the diagnosis of previously undetected fetal abnormalities[1], prediction of pre-eclampsia[2–4], prediction of small- and large-for-gestational-age neonates[5–12] and assessment of fetal oxygenation[13]. Another potential benefit of a routine scan at 35 + 0 to 36 + 6 weeks' gestation is the diagnosis of non-cephalic presentation. Undiagnosed non-cephalic presentation in labor is associated with increased risks for both the mother and baby[14]. A major trial reported that, in breech vaginal delivery, there is a higher rate of perinatal mortality and morbidity than in breech elective Cesarean section[15]. After publication of this trial, there was a shift toward elective Cesarean section when breech presentation was detected at term, from about 50% to more than 90%[16,17]. However, such a rise in the rate of Cesarean section is associated with increased risks of short- and long-term maternal and fetal complications[18–21]. Consequently, the Royal College of Obstetricians and Gynaecologists and the American College of Obstetricians and Gynecologists recommend that external cephalic version (ECV) should be offered to all eligible women diagnosed with breech presentation at term in order to reduce non-cephalic presentation at delivery and the rate of Cesarean section[22–24]. However, a high proportion of breech presentations at term are not detected by routine abdominal palpation and, therefore, the rate of potentially undiagnosed breech presentation in labor is relatively high[25–27].

The objectives of this study were to report the incidence of non-cephalic presentation at a routine scan at 35 + 0 to 36 + 6 weeks' gestation and the subsequent management of such pregnancies.

METHODS

This was a retrospective analysis of prospectively collected data in 45 847 singleton pregnancies that had undergone routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation at King's College Hospital, London or Medway Maritime Hospital, Gillingham, UK, between March 2014 and September 2018. During this visit, we recorded maternal demographic characteristics and medical history and carried out an ultrasound examination, which included fetal anatomy, fetal biometry for calculation of estimated fetal weight (EFW) using the formula of Hadlock *et al.*[28], fetal presentation (cephalic, breech and transverse or oblique), placental position, measurement of the deepest vertical pool of amniotic fluid and fetal Doppler. Gestational age was determined by the measurement of fetal crown–rump length at 11–14 weeks or fetal head circumference at 19–24 weeks[29,30]. The ultrasound examinations were carried out by examiners who had obtained The Fetal Medicine Foundation Certificate of Competence in ultrasound examination for fetal abnormalities. Women gave written informed consent to participate in the study, which was approved by the NHS Research Ethics Committee. The inclusion criterion for this study was singleton pregnancy delivering a non-malformed liveborn or stillborn neonate. We excluded pregnancies with aneuploidy or major fetal abnormality.

Patients with breech or transverse/oblique presentation were divided into two groups; first, those who would have elective Cesarean section for fetal or maternal indications other than the abnormal presentation, and, second, those who would potentially require ECV. The latter group was reassessed after 1–2 weeks and, if there was persistence of the abnormal presentation, the parents were offered the option of ECV or elective Cesarean section at 38–40 weeks' gestation. ECV was carried out by obstetricians or trained midwives at 37–38 weeks' gestation under ultrasound guidance and after the administration of terbutaline (0.25 mg subcutaneously).

Data on pregnancy outcome were collected from the hospital maternity records and included gestational age at delivery, mode of onset of labor and delivery, presentation at birth and birth weight. Birth-weight percentile was derived from The Fetal Medicine Foundation fetal and neonatal population weight charts[31].

Statistical analysis

Data were expressed as median and interquartile range (IQR) for continuous variables and *n* (%) for categorical variables. Mann–Whitney *U*-test and chi-square test or

Fisher's exact test, were used for comparing outcome groups for continuous and categorical data, respectively. Significance was assumed at 5%.

Univariable and multivariable logistic regression analysis was carried out to determine which of the factors from maternal and pregnancy characteristics provided a significant contribution in the prediction of, first, non-cephalic presentation at the 35 + 0 to 36 + 6-week scan, second, successful ECV from non-cephalic to cephalic presentation, and, third, spontaneous rotation from non-cephalic to cephalic presentation that persisted until delivery. Prior to the regression analysis, the continuous variables, such as age, weight and height, were centered by subtracting the arithmetic mean from each value. Multiple categorical variables were dummy coded as binary variables to estimate the independent effect of each category. Predicted probabilities from logistic regression analysis were used to construct receiver-operating-characteristics (ROC) curves to assess the performance of screening for each of the three outcomes.

The statistical package SPSS version 24.0 for Windows (IBM Corp., Armonk, NY, USA) was used for data analyses.

RESULTS

Patient characteristics

The study population of 45 847 singleton pregnancies included 43 416 (94.7%) in which presentation was cephalic at the 35 + 0 to 36 + 6-week ultrasound examination, 1987 (4.3%) with breech presentation and 444 (1.0%) with transverse or oblique presentation (Table 1). In the group with breech presentation, compared to those with cephalic presentation, median maternal age was higher, there was a lower prevalence of women of black, South Asian and mixed racial origin and those with anterior or posterior placental location, and a higher prevalence of nulliparous women, pregnancies conceived by *in-vitro* fertilization and those with lateral or fundal placental location. In the group with transverse or oblique presentation, compared to those with cephalic presentation, median maternal age and EFW percentile were higher, maternal height was lower, and there was a higher prevalence of parous women, women of black racial origin, those with pre-existing or gestational diabetes mellitus, placentas with a lateral, fundal or previa location, and polyhydramnios.

Table 1 Maternal and pregnancy characteristics in 45 847 singleton pregnancies, according to fetal presentation at 35 + 0 to 36 + 6 weeks' gestation

	Fetal presentation		
Variable	*Cephalic* (n = *43 416*)	*Breech* (n = *1987*)	*Transverse* (n = *444*)
Age (years)	31.5 (27.2–35.3)	32.8 (28.9–36.3)**	35.2 (30.4–35.3)**
Weight (kg)	79 (70–90)	79 (71–91)	82 (73–92)**
Height (cm)	165 (160–169)	165 (161–169)	163 (159–168)**
Racial origin			
White	32 307 (74.4)	1602 (80.6)	249 (56.1)
Black	6811 (15.7)	244 (12.3)**	141 (31.8)**
South Asian	2089 (4.8)	68 (3.4)**	30 (6.8)
East Asian	892 (2.1)	34 (1.7)	13 (2.9)
Mixed	1317 (3.0)	39 (2.0)**	11 (2.5)
Parity			
Nulliparous	19 671 (45.3)	1073 (54.0)**	109 (24.5)**
Parous	23 745 (54.7)	914 (46.0)	335 (75.5)
Conception			
Natural	41 972 (96.7)	1876 (94.4)	425 (95.7)
In-vitro fertilization	1207 (2.8)	95 (4.8)**	16 (3.6)
Ovulation drugs	237 (0.5)	16 (0.8)	3 (0.7)
Diabetes mellitus			
Pre-existing	447 (1.0)	23 (1.2)	10 (2.3)*
Gestational	1800 (4.1)	80 (4.0)	39 (8.8)**
GA (weeks)	36.1 (35.9–36.4)	36.1 (35.9–36.4)	36.1 (35.9–36.4)
EFW percentile	52.7 (27.7–76.2)	53.0 (27.3–79.1)	68.7 (40.7–86.6)**
Placental position			
Anterior	19 710 (45.4)	819 (41.2)**	196 (44.1)
Posterior	18 698 (43.1)	783 (39.4)**	127 (28.6)**
Lateral	2984 (6.9)	187 (9.4)**	50 (11.3)**
Fundal	1839 (4.2)	185 (9.3)**	41 (9.2)**
Previa	185 (0.4)	13 (0.7)	30 (6.8)**
Amniotic fluid deepest pool			
< 2 cm	40 (0.1)	5 (0.3)	1 (0.2)
2–7 cm	42 879 (98.8)	1956 (98.4)	416 (93.7)
≥ 8 cm	497 (1.1)	26 (1.3)	27 (6.1)**

Data are given as median (interquartile range) or *n* (%). Compared with cephalic group, Bonferroni adjusted significance value: $^{**}P < 0.01$; $^{*}P < 0.025$. EFW, estimated fetal weight; GA, gestational age.

Findings at 35 + 0 to 36 + 6-week scan and subsequent pregnancy management

Of the 43 416 pregnancies with cephalic presentation at the 35 + 0 to 36 + 6-week scan (Table 2), 43 307 (99.7%) remained cephalic at birth. In 109 (0.3%), there was subsequent spontaneous rotation to non-cephalic presentation, including 45 (41.3%) in which the diagnosis was made during labor and 64 (58.7%) in which the diagnosis was made before labor. In the latter group, ECV was attempted in nine (14.1%), ECV was declined in 35 (54.7%) and no ECV was attempted because of planned Cesarean section for reasons other than the malpresentation in 20 (31.3%).

Table 2 Fetal presentation at 35 + 0 to 36 + 6 weeks' gestation and subsequent management in 45 847 singleton pregnancies

Variable	*All*	*CS**
Cephalic presentation	43 416 (94.7)	10 277 (23.7)
Remained cephalic at birth	43 307 (99.7)	10 168 (23.5)
Spontaneous rotation to breech/transverse	109 (0.3)	109 (100)
Diagnosed in labor	45 (41.3)	45 (100)
Diagnosed before labor	64 (58.7)	64 (100)
ECV attempted	9 (14.1)	9 (100)
Successful	0 (0)	—
Failed	9 (100)	9 (100)
ECV declined	35 (54.7)	35 (100)
No ECV due to planned CS for other indication	20 (31.3)	20 (100)
Breech presentation	1987 (4.3)	1467 (73.8)
Spontaneous rotation to cephalic	327 (16.5)	76 (23.2)
Remained cephalic	323 (98.8)	72 (22.3)
Spontaneous rotation to breech	4 (1.2)	4 (100)
ECV attempted	620 (31.2)	436 (70.3)
Successful	239 (38.5)	65 (27.2)
Remained cephalic	234 (97.9)	60 (25.6)
Spontaneous rotation to breech	5 (2.1)	5 (100)
Failed	381 (61.5)	371 (97.4)
Remained breech	379 (99.5)	371 (97.9)
Spontaneous rotation to cephalic	2 (0.5)	0 (0)
ECV declined	611 (30.7)	530 (86.7)
Remained non-cephalic	498 (81.5)	492 (98.8)
Spontaneous rotation to cephalic	113 (18.5)	38 (33.6)
No ECV		
Onset of labor before planned ECV	50 (2.5)	47 (94.0)
Planned CS for other indication	379 (19.1)	378 (99.7)
Remained breech	348 (91.8)	347 (99.7)
Spontaneous rotation to cephalic	31 (8.2)	31 (100)
Transverse/oblique presentation	444 (1.0)	267 (60.1)
Spontaneous rotation to cephalic	180 (40.5)	38 (21.1)
ECV attempted	26 (5.9)	18 (69.2)
Successful	13 (50.0)	5 (38.5)
Failed	13 (50.0)	13 (100)
ECV declined	75 (16.9)	48 (64.0)
Remained non-cephalic	27 (36.0)	27 (100)
Spontaneous rotation to cephalic	48 (64.0)	21 (43.8)
No ECV		
Onset of labor before planned ECV	5 (1.1)	5 (100)
Planned CS for other indication	158 (35.6)	158 (100)
Remained non-cephalic	117 (74.1)	117 (100)
Spontaneous rotation to cephalic	41 (25.9)	41 (100)

Data are given as *n* (%). *Percentages calculated using *n* in 'All' column as denominator. CS, Cesarean section; ECV, external cephalic version.

Of the 1987 pregnancies with breech presentation at the 35 + 0 to 36 + 6-week scan (Table 2), ultrasound examination 1–2 weeks later demonstrated spontaneous rotation to cephalic presentation in 327 (16.5%). In 620 (31.2%) cases, ECV was attempted, which was successful in 239 (38.5%). In 611 (30.7%) cases, ECV was declined, but in 113 (18.5%) of these, there was subsequent spontaneous rotation to cephalic presentation. In 50 (2.5%) cases, there was spontaneous onset of labor before planned ECV. In 379 (19.1%) cases, no ECV was attempted because of planned Cesarean section for reasons other than malpresentation, and in 31 (8.2%) of these, there was subsequent spontaneous rotation to cephalic presentation.

Of the 444 pregnancies with transverse or oblique presentation at the 35 + 0 to 36 + 6-week scan (Table 2), ultrasound examination 1–2 weeks later demonstrated spontaneous rotation to cephalic presentation in 180 (40.5%). In 26 (5.9%) cases, ECV was attempted, and this was successful in 13 (50.0%). In 75 (16.9%) cases, ECV was declined, but in 48 (64.0%) of these, there was subsequent spontaneous rotation to cephalic presentation. In five (1.1%) cases, there was spontaneous onset of labor before planned ECV. In 158 (35.6%) cases, no ECV was attempted because of planned Cesarean section for reasons other than malpresentation, and in 41 (25.9%) of these, there was subsequent spontaneous rotation to cephalic presentation.

Therefore, in our population, first, the incidence of non-cephalic presentation at 35 + 0 to 36 + 6 weeks' gestation was 5.3% (2431/45 847), second, 22.1% of cases of non-cephalic presentation (379 breech and 158 transverse or oblique) were not eligible for ECV because of planned Cesarean section for indications other than malpresentation, third, of those eligible for ECV (1231 breech and 101 transverse or oblique) only 48.5% (646/1332) agreed to the procedure, and this was successful in 39.0% (252/646) of cases, fourth, in 33.9% (738/2179) of pregnancies with non-cephalic presentation in which successful ECV was not carried out, there was subsequent spontaneous rotation to cephalic presentation.

In the total of 2431 cases of non-cephalic presentation at the time of the scan (1987 breech and 444 transverse or oblique), presentation at birth was cephalic in 985 (40.5%); in 738 (74.9%) this was due to spontaneous rotation and in 247 (25.1%) this was due to successful ECV.

Prediction of non-cephalic presentation at 35 + 0 to 36 + 6 weeks

In the total population of 45 847 pregnancies, logistic regression analysis was carried out to determine which of the factors from maternal and pregnancy characteristics provided a significant contribution in the prediction of non-cephalic presentation at the 35 + 0 to 36 + 6-week

Table 3 Fitted regression model with maternal and pregnancy characteristics for prediction of non-cephalic presentation at 35 + 0 to 36 + 6 weeks' gestation

	Univariable		*Multivariable*	
Characteristic	*OR (95% CI)*	P	*OR (95% CI)*	P
Maternal age – 30 (in years)	1.05 (1.04–1.06)	< 0.001	1.06 (1.05–1.07)	< 0.001
Maternal weight – 82 (in kg)	1.005 (1.002–1.007)	< 0.001	1.006 (1.004–1.009)	< 0.001
Maternal height – 165 (in cm)	0.99 (0.99–1.00)	0.731	0.99 (0.98–0.99)	0.001
Racial origin				
White	1.00 (reference)			
Black	0.99 (0.88–1.10)	0.815	—	—
South Asian	0.82 (0.67–1.01)	0.059	0.79 (0.64–0.98)	0.028
East Asian	0.92 (0.68–1.24)	0.580	—	—
Mixed	0.66 (0.50–0.88)	0.005	0.69 (0.52–0.91)	0.010
Nulliparous	1.14 (1.05–1.24)	0.001	1.32 (1.22–1.44)	< 0.001
Conception				
Natural	1.00 (reference)			
In-vitro fertilization	1.68 (1.38–2.05)	< 0.001	—	—
Ovulation drugs	1.46 (0.92–2.34)	0.112	—	—
Diabetes mellitus				
Pre-existing	1.32 (0.93–1.89)	0.123	—	—
Gestational	1.19 (0.98–1.44)	0.073	—	—
Gestational age (in weeks)	0.86 (0.78–0.94)	0.001	0.84 (0.77–0.92)	< 0.001
Estimated fetal weight percentile	1.003 (1.002–1.004)	< 0.001	—	—
Placental position				
Non-previa	1.00 (reference)			
Previa	4.21 (3.01–5.88)	< 0.001	3.60 (2.56–5.04)	< 0.001
Amniotic fluid deepest pool				
2–7 cm	1.00 (reference)			
< 2 cm	2.71 (1.15–6.40)	0.023	2.65 (1.12–6.31)	0.027
≥ 8 cm	1.93 (1.45–2.57)	< 0.001	1.72 (1.29–2.30)	< 0.001

OR, odds ratio.

scan. The following variables were examined: maternal age, weight, height, racial origin (white, black, South Asian, East Asian or mixed), parity (nulliparous or parous), method of conception (natural, *in-vitro* fertilization or use of ovulation induction drugs), diabetes mellitus (gestational, pre-existing or none), gestational age at scan, EFW percentile, placental position (previa or non-previa) and amniotic fluid deepest pool.

On multivariable analysis, significant prediction of non-cephalic presentation was provided by maternal age, weight, height, South Asian and mixed racial origin, parity, gestational age at scan, placenta previa and amniotic fluid deepest pool ($R^2 = 0.022$; $P < 0.0001$) (Table 3). The area under the ROC curve for prediction of non-cephalic presentation from maternal and pregnancy factors was 0.601 (95% CI, 0.590–0.613) with a detection rate of 18.4% for a false-positive rate of 10% (Figure 1).

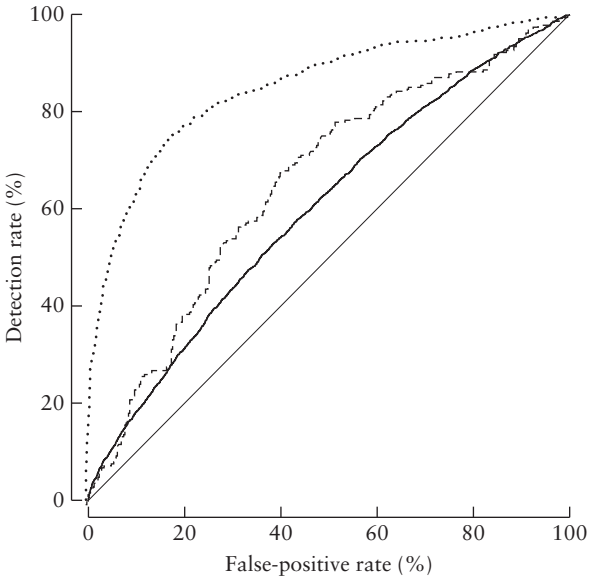

Figure 1 Receiver-operating-characteristics curves for prediction from maternal and pregnancy factors of non-cephalic presentation at 35 + 0 to 36 + 6-week scan (——), successful external cephalic version (– – –) and spontaneous rotation from non-cephalic to cephalic presentation that persisted until delivery (· · · ·).

Successful ECV from non-cephalic to cephalic presentation

In the 646 pregnancies with non-cephalic presentation in which ECV was attempted, logistic regression analysis was carried out to determine which of the factors from maternal and pregnancy characteristics provided a significant contribution in the prediction of successful ECV. The following variables were examined: maternal age, weight, height, racial origin, parity, method of conception, diabetes mellitus, non-cephalic presentation (breech or transverse/oblique), EFW percentile, placental position (anterior, posterior, lateral or fundal) and amniotic fluid deepest pool.

Table 4 Fitted regression model with maternal and pregnancy characteristics for prediction of successful external cephalic version from non-cephalic to cephalic presentation

	Univariable		*Multivariable*	
Characteristic	*OR (95% CI)*	P	*OR (95% CI)*	P
Maternal age – 30 (in years)	1.06 (1.02–1.09)	0.001	1.04 (1.01–1.07)	0.022
Maternal weight – 82 (in kg)	1.00 (0.99–1.01)	0.988	—	—
Maternal height – 165 (in cm)	1.00 (0.98–1.03)	0.807	—	—
Racial origin				
White	1.00 (reference)			
Black	1.66 (1.04–2.64)	0.034	—	—
South Asian	1.70 (0.75–3.86)	0.206	—	—
East Asian	0.85 (0.29–2.52)	0.769	—	—
Mixed	0.94 (0.31–2.86)	0.92	—	—
Nulliparous	0.36 (0.26–0.50)	< 0.001	0.39 (0.28–0.54)	< 0.001
Conception				
Natural	1.00 (reference)			
In-vitro fertilization	1.09 (0.46–2.57)	0.852	—	—
Ovulation drugs	1.05 (0.17–6.30)	0.961	—	—
Diabetes mellitus				
Pre-existing	1.57 (0.39–6.35)	0.525	—	—
Gestational	1.14 (0.55–2.36)	0.732	—	—
Non-cephalic presentation				
Breech	1.00 (reference)			
Transverse/oblique	1.59 (0.73–3.50)	0.245	—	—
Estimated fetal weight percentile	1.01 (1.00–1.01)	0.076	—	—
Placental position				
Posterior	1.00 (reference)			
Anterior	0.95 (0.67–1.36)	0.790	—	—
Lateral	0.73 (0.42–1.27)	0.261	—	—
Fundal	1.28 (0.73–2.26)	0.392	—	—
Amniotic fluid deepest pool				
2–7 cm	1.00 (reference)			
< 2 cm	—	—	—	—
≥ 8 cm	0.31 (0.04–2.67)	0.286	—	—

OR, odds ratio.

On multivariable analysis, significant prediction of successful ECV was provided by maternal age and parity ($R^2 = 0.087$; $P < 0.0001$) (Table 4). The area under the ROC curve for prediction of successful ECV from maternal and pregnancy factors was 0.653 (95% CI, 0.610–0.696) with a detection rate of 22.2% for a false-positive rate of 10% (Figure 1).

Spontaneous rotation from non-cephalic to cephalic presentation

In the 2179 pregnancies with non-cephalic presentation at the 35 + 0 to 36 + 6-week scan in which successful ECV was not carried out, logistic regression analysis was performed to determine which of the factors from maternal and pregnancy characteristics provided a significant contribution in the prediction of spontaneous rotation to cephalic presentation that persisted until delivery. The following variables were examined: maternal age, weight, height, racial origin, parity, method of conception, diabetes mellitus, non-cephalic presentation (breech or transverse/oblique), placental position (previa or non-previa), amniotic fluid deepest pool, interval to delivery, EFW percentile and birth-weight percentile.

On multivariable analysis, significant prediction of spontaneous rotation to cephalic presentation that persisted until delivery was provided by black racial origin, parity, transverse fetal lie, placental previa, polyhydramnios, interval from scan to delivery and birth-weight percentile ($R^2 = 0.481$; $P < 0.0001$) (Table 5). The area under the ROC curve for prediction of spontaneous rotation to cephalic presentation from maternal and pregnancy factors was 0.852 (95% CI, 0.834–0.870) with a detection rate of 62.4% for a false-positive rate of 10% (Figure 1).

DISCUSSION

Main findings

First, at 35 + 0 to 36 + 6 weeks, the fetal presentation was non-cephalic in about 5% of pregnancies. Second, the chance of non-cephalic presentation increased with increasing maternal age and weight, decreasing height and earlier gestational age at scan, was higher in the presence of placenta previa, oligohydramnios or polyhydramnios and in nulliparous than parous women, and was lower in women of South Asian or mixed racial origin than in white women. Third, about 20% of cases of non-cephalic presentation were not eligible for ECV

Table 5 Fitted regression model with maternal and pregnancy characteristics for prediction of spontaneous rotation from non-cephalic to cephalic presentation that persisted until delivery

	Univariable		*Multivariable*	
Characteristic	*OR (95% CI)*	P	*OR (95% CI)*	P
Maternal age – 30 (in years)	1.01 (1.00–1.03)	0.129	—	—
Maternal weight – 82 (in kg)	1.007 (1.002–1.012)	0.011	—	—
Maternal height – 165 (in cm)	1.00 (0.99–1.01)	0.934	—	—
Racial origin				
White	1.00 (reference)			
Black	2.37 (1.88–3.00)	< 0.001	1.69 (1.24–2.26)	0.001
South Asian	1.28 (0.81–2.01)	0.290	—	—
East Asian	0.91 (0.46–1.78)	0.775	—	—
Mixed	0.82 (0.42–1.61)	0.569	—	—
Nulliparous	0.32 (0.27–0.39)	< 0.001	0.35 (0.28–0.44)	< 0.001
Conception				
Natural	1.00 (reference)			
In-vitro fertilization	0.71 (0.46–1.12)	0.143	—	—
Ovulation drugs	1.71 (0.66–4.45)	0.272	—	—
Diabetes mellitus				
Pre-existing	0.48 (0.20–1.18)	0.111	—	—
Gestational	0.86 (0.57–1.31)	0.483	—	—
Non-cephalic presentation				
Breech	1.00 (reference)			
Transverse/oblique	4.49 (3.60–5.61)	< 0.001	4.44 (3.32–5.94)	< 0.001
Placental position				
Non-previa	1.00 (reference)			
Previa	0.20 (0.07–0.55)	0.002	0.22 (0.07–0.66)	0.014
Amniotic fluid deepest pool				
2–7 cm	1.00 (reference)			
< 2 cm	0.39 (0.05–3.36)	0.393	—	—
≥ 8 cm	1.56 (0.89–2.71)	0.119	2.11 (1.03–4.35)	0.042
Interval from scan to delivery (in weeks)	2.95 (2.65–3.29)	< 0.001	3.17 (2.81–3.57)	< 0.001
Estimated fetal weight percentile	1.005 (1.002–1.008)	0.001	—	—
Birth-weight percentile	1.002 (0.999–1.005)	0.136	0.99 (0.98–0.99)	0.002

OR, odds ratio.

because of planned Cesarean section for indications other than the malpresentation. Fourth, in our hospitals, only half of women with non-cephalic presentation agreed to ECV and, when this was carried out, it was successful in only 39% of cases. Fifth, the chance of successful ECV increased with increasing maternal age and was lower in nulliparous than parous women. Sixth, in one-third of pregnancies with non-cephalic presentation in which successful ECV was not carried out, there was subsequent spontaneous rotation to cephalic presentation. Seventh, the chance of spontaneous rotation from non-cephalic to cephalic presentation increased with increasing interval between the scan and delivery, decreased with increasing birth-weight percentile, was higher in women of black than white racial origin, if presentation was transverse or oblique rather than breech and if there was polyhydramnios, and was lower in nulliparous than parous women and in the presence of placenta previa. Eighth, in 0.3% of cephalic presentations, there was subsequent rotation to non-cephalic presentation, and in 41% of these, the diagnosis was made during labor. Ninth, in 41% of cases of non-cephalic presentation at the time of the scan, the presentation at birth was cephalic, mainly due to spontaneous rotation (75%) and to a lesser extent due to successful ECV (25%). Tenth, prediction of non-cephalic presentation at the 35 + 0 to 36 + 6-week scan and successful ECV from maternal and pregnancy factors was poor, but prediction of spontaneous rotation from non-cephalic to cephalic presentation that persisted until delivery was moderately good and this could be incorporated in the counseling of women prior to ECV.

Comparison with findings from previous studies

A previous study of routine ultrasound examination at 36 weeks' gestation in 3879 singleton pregnancies in nulliparous women reported that the incidence of breech presentation was 4.6%; in the group with breech, compared to those with cephalic, presentation, there was higher maternal age but no significant difference in body mass index or birth-weight percentile[27]. In our considerably larger study, which included both nulliparous and parous women, the incidence of non-cephalic presentation was similar but, in addition to increased maternal age, significant contributors to such presentation were increased weight and decreased height, as well as several other maternal and pregnancy characteristics.

In our study, we did not record the findings from routine clinical examination before the ultrasound scan. Studies undertaken as part of a research protocol in which clinical examination was followed by an ultrasound scan

reported that palpation correctly identified non-cephalic presentation in 57–70% of cases; however, the design of such studies is likely to have introduced positive bias in favor of clinical examination[25,26]. A more realistic estimate of the accuracy of routine clinical examination in the detection of non-cephalic presentation is 44%, as reported in a study from Cambridge, UK[27]. Additionally, a study from Oxford, UK, reported that ultrasound examination confirmed non-cephalic presentation in only 41% of 7775 pregnancies suspected of breech presentation during routine antenatal care[32].

In our study, only 49% of eligible women with non-cephalic presentation agreed to ECV and, when this was carried out, it was successful in only 39% of cases. Our patients were counseled and managed by their own obstetricians and midwives rather than in a dedicated clinic. In the Cambridge study, the uptake of ECV among eligible women was 65% and this was successful in only 14% of cases[27]. In contrast, in the Oxford study, in which all women with breech presentation were managed in a specialist clinic, the uptake of ECV among eligible women was 90% and this was successful in 49% of cases[32]. In relation to the timing of ECV, a Cochrane review of three trials reported that the success rate is higher if ECV is carried out at 34–35 weeks' gestation, rather than at 37–38 weeks, but at the expense of a higher rate of preterm birth[33].

We found a high rate of spontaneous rotation from non-cephalic presentation between the time of the 35 + 0 to 36 + 6-week scan and delivery. This is consistent with the results of a study in a registry of 127 171 births, which reported that the frequency of breech presentation in births at 35–36 weeks' gestation was 4.9% and this declined to 3.6% for births at 37–38 weeks, 2.6% at 39–40 weeks and 1.7% at > 40 weeks[34].

Our findings of maternal and pregnancy characteristics that predict non-cephalic presentation and successful ECV are consistent with those of previous studies[32,35]. In addition, we report on the predictors of spontaneous rotation from non-cephalic to cephalic presentation that persisted until delivery.

Implications for clinical practice

Routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation detects non-cephalic presentation in about 5% of pregnancies. Such diagnosis could potentially improve pregnancy outcome by preventing unexpected abnormal presentation in labor and, through ECV, reducing the incidence of non-cephalic presentation. However, the study has highlighted that, in a small number of cases of, first, cephalic presentation at the time of the scan, second, those with spontaneous rotation from non-cephalic to cephalic presentation, and, third, those with successful ECV, there was subsequent spontaneous rotation to non-cephalic presentation, at rates of 0.3%, 1.2% and 2.1%, respectively. Consequently, the only strategy that would truly avoid unexpected non-cephalic presentation in labor is to perform a routine ultrasound examination in all women on admission to the labor ward.

In cases of breech presentation, ECV, compared with no attempted ECV, reduces the incidence of non-cephalic presentation at birth and the rate of Cesarean delivery[36]. However, our study has highlighted that the main contributor to cephalic presentation at birth in cases of non-cephalic presentation at the 35 + 0 to 36 + 6-week scan is spontaneous rotation rather than ECV. It is possible that the contribution of ECV could be increased by women being seen in specialist clinics in which the uptake and success of the procedure may be higher.

Strengths and limitations

The strengths of our study are examination of a large number of pregnancies undergoing a routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation to determine presentation, and description of the subsequent management of pregnancies with abnormal presentation.

This was not a randomized trial on the contribution of the 35 + 0 to 36 + 6-week scan in predicting presentation at birth. Other limitations include lack of reporting of presentation at routine clinical examination prior to the scan and absence of a standardized protocol for the management of pregnancies with non-cephalic presentation, which was left to the decision of the attending obstetricians and midwives. Consequently, the uptake of ECV and success of the procedure are not generalizable.

Conclusions

The performance of abdominal palpation during routine antenatal care in the diagnosis of non-cephalic presentation at term is poor, resulting in a high proportion of such pregnancies being undiagnosed when they present in labor. This problem can, to a great extent, be overcome by a routine ultrasound examination at 35 + 0 to 36 + 6 weeks' gestation. The incidence of non-cephalic presentation at the 35 + 0 to 36 + 6-week scan was about 5%, but, in about 40% of these cases, the presentation at birth was cephalic, mainly due to subsequent spontaneous rotation and to a lesser extent as a consequence of successful ECV.

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REFERENCES

1. Ficara A, Syngelaki A, Hammami A, Akolekar R, Nicolaides KH. Value of routine ultrasound examination at 35–37 weeks' gestation in diagnosis of fetal abnormalities. *Ultrasound Obstet Gynecol* 2020; **55**: 75–80.
2. Panaitescu A, Ciobanu A, Syngelaki A, Wright A, Wright D, Nicolaides KH. Screening for pre-eclampsia at 35–37 weeks' gestation. *Ultrasound Obstet Gynecol* 2018; **52**: 501–506.
3. Panaitescu AM, Wright D, Militello A, Akolekar R, Nicolaides KH. Proposed clinical management of pregnancies after combined screening for pre-eclampsia at 35–37 weeks' gestation. *Ultrasound Obstet Gynecol* 2017; **50**: 383–387.

4. Ciobanu A, Wright A, Panaitescu A, Syngelaki A, Wright D, Nicolaides KH. Prediction of imminent preeclampsia at 35–37 weeks gestation. *Am J Obstet Gynecol* 2019; **220**: 584.e1–e11.
5. Sovio U, White IR, Dacey A, Pasupathy D, Smith GCS. Screening for fetal growth restriction with universal third trimester ultrasonography in nulliparous women in the Pregnancy Outcome Prediction (POP) study: a prospective cohort study. *Lancet* 2015; **386**: 2089–2097.
6. Roma E, Arnau A, Berdala R, Bergos C, Montesinos J, Figueras F. Ultrasound screening for fetal growth restriction at 36 *vs* 32 weeks' gestation: a randomized trial (ROUTE). *Ultrasound Obstet Gynecol* 2015; **46**: 391–397.
7. Ciobanu A, Anthoulakis C, Syngelaki A, Akolekar R, Nicolaides KH. Prediction of small-for-gestational-age neonates at 35–37 weeks' gestation: contribution of maternal factors and growth velocity between 32 and 36 weeks. *Ultrasound Obstet Gynecol* 2019; **53**: 630–637.
8. Ciobanu A, Khan N, Syngelaki A, Akolekar R, Nicolaides KH. Routine ultrasound at 32 *vs* 36 weeks' gestation: prediction of small-for-gestational-age neonates. *Ultrasound Obstet Gynecol* 2019; **53**: 761–768.
9. Ciobanu A, Formuso C, Syngelaki A, Akolekar R, Nicolaides KH. Prediction of small-for-gestational-age neonates at 35–37 weeks' gestation: contribution of maternal factors and growth velocity between 20 and 36 weeks. *Ultrasound Obstet Gynecol* 2019; **53**: 488–495.
10. Ciobanu A, Rouvali A, Syngelaki A, Akolekar R, Nicolaides KH. Prediction of small for gestational age neonates: screening by maternal factors, fetal biometry, and biomarkers at 35–37 weeks' gestation. *Am J Obstet Gynecol* 2019; **220**: 486.e1–e11.
11. Akolekar R, Panaitescu AM, Ciobanu A, Syngelaki A, Nicolaides KH. Two-stage approach for prediction of small for gestational age neonate and adverse perinatal outcome by routine ultrasound examination at 35–37 weeks' gestation. *Ultrasound Obstet Gynecol* 2019; **54**: 484–491.
12. Khan N, Ciobanu A, Karampitsakos T, Akolekar R, Nicolaides KH. Prediction of large-for-gestational-age neonate by routine third-trimester ultrasound. *Ultrasound Obstet Gynecol* 2019; **54**: 326–333.
13. Akolekar R, Ciobanu A, Zingler E, Syngelaki A, Nicolaides KH. Routine assessment of cerebroplacental ratio at 35–37 weeks' gestation in the prediction of adverse perinatal outcome. *Am J Obstet Gynecol* 2019; **221**: 65.e1–e18.
14. Waterstone M, Bewley S, Wolfe C. Incidence and predictors of severe obstetric morbidity: case-control study. *BMJ* 2001; **322**: 1089–1093.
15. Hannah ME, Hannah WJ, Hewson SA, Hodnett ED, Saigal S, Willan AR. Planned caesarean section versus planned vaginal birth for breech presentation at term: a randomised multicentre trial. Term Breech Trial Collaborative Group. *Lancet* 2000; **356**: 1375–1383.
16. Hartnack Tharin JE, Rasmussen S, Krebs L. Consequences of the Term Breech Trial in Denmark. *Acta Obstet Gynecol Scand* 2011; **90**: 767–771.
17. Sullivan EA, Moran K, Chapman M. Term breech singletons and caesarean section: a population study, Australia 1991–2005. *Aust N Z J Obstet Gynaecol* 2009; **49**: 456–460.
18. Miller ES, Hahn K, Grobman WA, Committee SfM-FMHP. Consequences of a primary elective cesarean delivery across the reproductive life. *Obstet Gynecol* 2013; **121**: 789–797.
19. Biasucci G, Rubini M, Riboni S, Morelli L, Bessi E, Retetangos C. Mode of delivery affects the bacterial community in the newborn gut. *Early Hum Dev* 2010; **86**: 13–15.
20. Hansen AK, Wisborg K, Uldbjerg N, Henriksen TB. Risk of respiratory morbidity in term infants delivered by elective caesarean section: cohort study. *BMJ* 2008; **336**: 85–87.
21. Penders J, Thijs C, Vink C, Stelma FF, Snijders B, Kummeling I, van den Brandt PA, Stobberingh EE. Factors influencing the composition of the intestinal microbiota in early infancy. *Pediatrics* 2006; **118**: 511–521.
22. Management of Breech Presentation: Green-top Guideline No. 20b. *BJOG* 2017; **124**: e151–e177.
23. External Cephalic Version and Reducing the Incidence of Term Breech Presentation: Green-top Guideline No. 20a. *BJOG* 2017; **124**: e178–e192.
24. American College of Obstetricians and Gynecologists' Committee on Practice Bulletins--Obstetrics. Practice Bulletin No. 161: External Cephalic Version. *Obstet Gynecol* 2016; **127**: e54–e61.
25. Nassar N, Roberts CL, Cameron CA, Olive EC. Diagnostic accuracy of clinical examination for detection of non-cephalic presentation in late pregnancy: cross sectional analytic study. *BMJ* 2006; **333**: 578–580.
26. Watson WJ, Welter S, Day D. Antepartum identification of breech presentation. *J Reprod Med* 2004; **49**: 294–296.
27. Wastlund D, Moraitis AA, Dacey A, Sovio U, Wilson ECF, Smith GCS. Screening for breech presentation using universal late-pregnancy ultrasonography: A prospective cohort study and cost effectiveness analysis. *PLoS Med* 2019; **16**: e1002778.
28. Hadlock FP, Harrist RB, Sharman RS, Deter RL, Park SK. Estimation of fetal weight with the use of head, body, and femur measurements–a prospective study. *Am J Obstet Gynecol* 1985; **151**: 333–337.
29. Robinson HP, Fleming JE. A critical evaluation of sonar crown rump length measurements. *Br J Obstet Gynaecol* 1975; **82**: 702–710.
30. Snijders RJ, Nicolaides KH. Fetal biometry at 14–40 weeks' gestation. *Ultrasound Obstet Gynecol* 1994; **4**: 34–48.
31. Nicolaides KH, Wright D, Syngelaki A, Wright A, Akolekar R. Fetal Medicine Foundation fetal and neonatal population weight charts. *Ultrasound Obstet Gynecol* 2018; **52**: 44–51.
32. Melo P, Georgiou EX, Hedditch A, Ellaway P, Impey L. External cephalic version at term: a cohort study of 18 years' experience. *BJOG* 2019; **126**: 493–499.
33. Hutton EK, Hofmeyr GJ, Dowswell T. External cephalic version for breech presentation before term. *Cochrane Database Syst Rev* 2015; **7**: CD000084.
34. Hickok DE, Gordon DC, Milberg JA, Williams MA, Daling JR. The frequency of breech presentation by gestational age at birth: a large population-based study. *Am J Obstet Gynecol* 1992; **166**: 851–852.
35. Cammu H, Dony N, Martens G, Colman R. Common determinants of breech presentation at birth in singletons: a population-based study. *Eur J Obstet Gynecol Reprod Biol* 2014; **177**: 106–109.
36. Hofmeyr GJ, Kulier R, West HM. External cephalic version for breech presentation at term. *Cochrane Database Syst Rev* 2015; **4**: CD000083.

