Clinical abdominal palpation for predicting oligohydramnios in suspected prolonged pregnancy

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Objective. In view of the scarcity of ultrasound in low-resource settings, to evaluate abdominal palpation for prediction of oligohydramnios in suspected prolonged pregnancy, using the ultrasound-obtained amniotic fluid index (AFI) as a gold standard, taking into account maternal and fetal factors that may affect amniotic fluid volume.
Methods. A cross-sectional analytical study at Chris Hani Baragwanath Academic Hospital, Johannesburg, South Africa, on women referred from midwife-run clinics with suspected gestational age ≥41 weeks. Eligible women had their AFI measured, then had abdominal palpation by the researcher, who was blinded to exact gestational age and AFI findings. Palpation focused on ballottability of fetal parts, ease of feeling fetal parts, and impression of fetal compaction. Gestational age was then recalculated using information from earlier ultrasound scans and menstrual dates. Univariable and multivariable logistic regression was performed with oligohydramnios (AFI <5 cm) as the dependent variable.
Results. Of 100 women, 45 had a recalculated gestational age ≥41 weeks. Twenty-three had oligohydramnios. Gestational age was a significant independent predictor for oligohydramnios (odds ratio (OR) 1.78; 95% confidence interval (CI) 1.08 - 2.94). The only component of palpation significantly associated with oligohydramnios, after adjustment for gestational age, was non-ballottability of the presenting part (adjusted OR 4.02; 95% CI 1.05 - 15.4). Non-ballottability had a sensitivity and specificity for oligohydramnios of 87% and 40%, respectively, with a negative predictive value of 91%.
Conclusion. When ultrasound is not available, ballottability of the presenting part may have value for excluding oligohydramnios and assisting clinical decisions in suspected prolonged pregnancy.

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When considering expectant management for post-term pregnancy, it is usual to assess amniotic fluid volume (AFV) by ultrasound scan as part of screening for fetal well-being.[1,2] In low-resource settings, ultrasound scanning may not be available, affecting both early pregnancy dating and assessment of AFV in pregnancies suspected to be post term. Clinicians in these settings frequently manage such pregnancies on the basis of uncertain evidence from menstrual dating. In such situations, it has been recommended that AFV be assessed by abdominal palpation, with normal AFV being reassuring for expectant management, and reduced AFV a trigger for labour induction.[3] According to textbooks, clinical evidence of reduced AFV (oligohydramnios) includes reduced uterine fundal height,[4] failure to ballot fetal parts in the uterus,[3-5] a fetus cramped for movement,[4,6] and easily felt fetal parts.[4,7] Only two studies, done in 1972 and 1984,[8,9] have evaluated abdominal palpation for prediction of oligohydramnios, using an overall subjective feel of AFV as their palpation method. The two studies did not consider the roles of separate components of abdominal palpation as listed above, and they did not account for the influence of maternal and fetal factors. Both reported that palpation for AFV was inaccurate and had no clinical value. This study was done to evaluate components of abdominal palpation for prediction of oligohydramnios in suspected prolonged pregnancy, using the ultrasound-obtained amniotic fluid index (AFI) as a gold standard, taking into account maternal and fetal factors that may affect AFV.

Methods

The University of the Witwatersrand's Human Research Ethics Committee approved the study, and written informed consent was given by all participants. The study was conducted from July to October 2011 in the antenatal clinic at Chris Hani Baragwanath Academic Hospital (CHBAH), Johannesburg, South Africa. In this setting, clinic midwives refer women to CHBAH for assessment by doctors if their pregnancies reach 41 weeks' gestation. On referral, doctors' assessment includes recalculation of gestational age, ultrasound assessment for AFV, and cardiotocography. Elective delivery is offered to women with gestation confirmed to be ≥41 weeks, and to those with uncertain gestational age who have reduced AFV or non-reassuring cardiotocograph tracings.

This was a prospective cross-sectional analytical study. The study population was women with singleton live normal pregnancies referred to CHBAH with suspected gestational age ≥41 weeks. Suspected, rather than true, gestation ≥41 weeks was used as

the inclusion criterion, as it is women with suspected prolonged pregnancy who require clinical assessment at the time of referral, including AFV estimation. Exclusion criteria were age <18 years (because of legal restrictions on informed consent in minors in South Africa) and previous caesarean section. Participants were recruited on days on which the researcher (EJB) was in the antenatal clinic at CHBAH. No research data were available to inform a sample size calculation. The researcher estimated that the frequency of oligohydramnios in suspected prolonged pregnancies would be about 10%. Therefore, a sample of 101 women was required to show statistical significance for clinical palpation to detect oligohydramnios with a sensitivity of 75% and a specificity of 75%, with 80% power at a significance level of p=0.05.

Eligible women who agreed to participate were first sent for an ultrasound scan using a Siemens Sonoline G50 ultrasound scanner (Siemens Medical Solutions, Erlangen, Germany) with a 3.5 MHz curvilinear abdominal transducer. The ultrasonographer (NM) was an experienced certified professional with a graduate qualification in diagnostic ultrasound. While she knew that the women had suspected prolonged pregnancy, she did not recalculate or estimate the gestational ages. In each case she reported approximate fetal weight using a Hadlock formula,[10] and deepest amniotic fluid pool depth in each of the four uterine quadrants, summed to an AFI.[11] Oligohydramnios, the primary outcome measure for this study, was defined as an AFI <5 cm.[11,12] AFI was used as the reference standard because it remains the best non-invasive measure for AFV, with reasonable correlation.[13-16] AFI has been used as a gold standard in at least one published study.[17] If the AFI was <10 cm, the ultrasonographer repeated the measurement and calculated an average. She did not discuss the AFI findings with the woman, and inserted her report into the woman's file. Within 1 hour after the ultrasound scan, the researcher, an experienced clinical specialist in the Department of Obstetrics and Gynaecology at CHBAH, conducted a clinical assessment, blinded to the ultrasound report. The difference from the normal routine was that physical examination was done first, followed by history-taking and reading of the antenatal record. This reversal of the usual order was done to prevent biased clinical palpation related to history and gestational age.

The primary explanatory variables were clinical methods for assessing AFV. These included ballottement (present or absent) of fetal parts in the uterine fundus, and of the presenting part in the lower pole of the uterus. In addition, presence or absence of fetal compaction was determined, as well as ease of palpating fetal parts (yes or no). Symphysis-fundal height was measured from the upper edge of the pubic symphysis in the midline to the highest palpated point on the uterus, and repeated to obtain two measurements which were averaged. Also assessed were maternal height, abdominal circumference (measured once from the small of the back to include the widest part of the abdomen), and level of the fetal head above the pelvic brim in fifths (from five fifths being the highest to zero fifths being fully descended, using the fingerbreadths method described by Notelowitz).[18] Finally, the researcher made an overall subjective assessment of AFV, whether normal or reduced. A specialist colleague, blinded to gestational age and to the ultrasound and the researcher's findings, was then called to make a similar overall subjective assessment.

Other explanatory variables collected included maternal age, parity, HIV status, smoking, and weight at the first antenatal care visit. After the palpation findings were recorded, gestational age was calculated using an early ultrasound scan (<24 weeks) if available. Alternatively, the last menstrual period was used, or if there was still uncertainty, a later ultrasound scan or midwives' best estimate from the antenatal record. After entering all explanatory variable data, the researcher read the ultrasound report and entered the AFI onto the data sheet. The ultrasound result was then used for further clinical care of the woman.

Statistics

Data management and analysis was done using STATA version 11 (STATA Corp., College Station, Tex., USA). Frequencies and percentages for counts, and means (±standard deviations (SDs)) for continuous variables, were used to describe the data. Cohen's kappa was used to measure inter-observer variation for overall subjective palpation of AFV. Univariable and multivariable logistic regression was performed to identify maternal and fetal predictors for oligohydramnios after adjustment for the influence of covariates, showing odds ratios with 95% confidence intervals (CIs). Explanatory variables with two-sided p-values <0.2 in univariable analysis were included in the multivariable model. Then, the association between oligohydramnios and potentially predictive components of clinical palpation was investigated using univariable logistic regression analysis. Elements of clinical palpation found to be significantly associated with oligohydramnios were then placed in a multivariable model, alongside statistically significant maternal and fetal predictors for oligohydramnios, to determine their independent predictive value. For clinical observations found to be predictive for oligohydramnios, sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios were computed. In all statistical comparisons, p-values <0.05 indicated statistical significance.

Results

One hundred women participated in the study. Their mean age was 25.7 years (SD ±6.0), and 44 were nulliparous. One was a smoker and 20 were HIV-infected. The mean maternal weight (available for 96 women) was 72.3 kg (SD ±12.4). The number of women with a body mass index ≥30 kg/m² was 24 (25.0%). Gestational age assessment was based on menstrual dates in 52 women, and on early ultrasound scanning in 26. The mean recalculated gestational age for all women was 39.9 weeks (SD ±1.5; range 34 - 43). Forty-five women had a gestational age ≥41 weeks. On ultrasound scan, the mean AFI was

Table 1. Findings on clinical abdominal measurement and palpation, all observations made without knowledge of the ultrasound scan results (N=100)

Finding	
Symphysis-fundal height (cm), mean (±SD)	37.9 (±2.6)
Abdominal circumference (cm), mean (±SD)	101.9 (±6.8)
Level of the fetal head in fifths (N=99*), n (%)	
5	55 (55.6)
4	31 (31.3)
3	13 (13.1)
Fetal parts not ballottable in the uterine fundus, n†	75
Presenting part not ballottable suprapubically, n	66
Impression of fetal compaction, n	13
Fetal parts easy to feel, n	41

SD = standard deviation.
*There was one breech presentation.
†Percentages not shown if N=100.

Table 2. Maternal and fetal factors compared between women with oligohydramnios (amniotic fluid index <5 cm) and normal amniotic fluid index (≥5 cm), by univariable (*N*=100) and multivariable (*N*=96) logistic regression analysis

Maternal or fetal factor	Oligohydramnios (*N*=23)	Normal AFV (*N*=77)	Univariable		Multivariable		Adjusted *p*-value
			OR	95% CI	AOR	95% CI	
Maternal age (years), mean (±SD)	26.5 (±6.3)	25.5 (±5.9)	1.03	0.95 - 1.11			
Parity ≥1 (reference para 0), *n* (%)	14 (60.9)	42 (54.5)	1.30	0.50 - 1.84			
Gestational age (weeks), mean (±SD)	40.7 (±1.0)	39.7 (±1.6)	1.84	1.13 - 3.00	1.78	1.08 - 1.94	0.02
HIV-infected (reference HIV-negative), *n* (%)	8 (34.8)	12 (15.6)	2.89	1.01 - 8.31	2.18	0.72 - 6.59	0.17
Maternal height (cm), mean (±SD)	161.0 (±4.4)	160.3 (±5.2)	1.03	0.93 - 1.13			
Maternal weight (kg), mean (±SD)	75.4 (±13.6)	71.3 (±12.0)	1.03	0.99 - 1.07	1.02	0.98 - 1.06	0.38
BMI, mean (±SD)	29.1 (±5.0)	27.8 (±4.9)	1.05	0.96 - 1.15			
Estimated fetal weight (g), mean (±SD)	3 682 (±477)	3 630 (±520)	1.00	1.00 - 1.00			
Male fetal sex (reference female), *n* (%)	15 (65.2)	38 (49.4)	1.88	0.71 - 4.94			

AFV = amniotic fluid volume; OR = odds ratio; AOR = adjusted odds ratio; CI = confidence interval; SD = standard deviation; BMI = body mass index.

Table 3. Clinical signs of amniotic fluid volume on abdominal examination, compared between women with oligohydramnios (amniotic fluid index <5 cm) and normal amniotic fluid volume (amniotic fluid index ≥5 cm), by univariable logistic regression analysis (*N*=100)

Explanatory variable	Oligohydramnios (*N*=23)	Normal AFV (*N*=77)	OR	95% CI	*p*-value
Mean symphysis-fundal height (cm), mean (±SD)	37.4 (±3.0)	38.0 (±2.5)	0.91	0.76 - 1.10	0.34
Mean abdominal circumference (cm), mean (±SD)	103.4 (±7.9)	101.5 (±6.4)	1.04	0.97 - 1.12	0.22
Head five fifths palpable* (*N*=99), *n* (%)	11 (50.0)	44 (57.1)	0.69	0.27 - 1.75	0.43
Parts not ballottable in uterine fundus, *n* (%)	19 (82.6)	56 (72.7)	1.78	0.54 - 5.85	0.34
Presenting part not ballottable,† *n* (%)	20 (87.0)	46 (59.7)	4.49	1.23 - 16.42	0.02
Fetal compaction,† *n* (%)	3 (13.0)	10 (13.0)	1.00	0.25 - 4.01	0.99
Fetal parts easy to feel,† *n* (%)	12 (52.2)	47 (61.0)	0.70	0.27 - 1.78	0.45

AFV = amniotic fluid volume; OR = odds ratio: CI = confidence interval; SD = standard deviation.
Binary explanatory variables: *reference is head four fifths or less; †reference is opposite or absent finding of that given in table.

8.1 cm (SD ±4.4), and 23 women had oligohydramnios (AFI <5 cm). One extreme AFI value, at 22.5 cm, was included in the data. On follow-up, the baby was morphologically normal at birth. A summary of the researcher's clinical findings is shown in Table 1.

When on overall subjective assessment the researcher considered the AFV to be reduced (*n*=28), the mean AFI was 7.0 cm (SD ±3.5), and when he considered the AFV to be normal (*n*=72), the mean AFI was 8.5 cm (SD ±4.5) (*p*=0.11). The corresponding values for the colleagues (consultants in 95 cases and registrars in 5) were AFIs of 8.3 cm (SD ±4.5) for reduced AFV (*n*=37) and 8.0 cm (SD ±4.2) for an AFV that felt normal (*n*=63) (*p*=0.75). The researcher correctly predicted reduced AFV in 7/23 women (sensitivity 30%) who were found to have an AFI of <5 cm, and the colleagues correctly predicted reduced AFV in 8 women (sensitivity 35%). Corresponding specificities were 73% (56/77) for the researcher and 62% (48/77) for the colleagues. The kappa statistic for inter-observer agreement between the researcher and the colleagues was 0.03 (standard error 0.10; *p*=0.38), indicating no agreement in assessment of AFV by overall subjective assessment.

Maternal and fetal factors were compared with respect to oligohydramnios and normal AFV using univariable logistic regression analysis (Table 2). Only gestational age, HIV status and maternal weight showed trends to an association with oligohydramnios. On multivariable logistic regression analysis, only gestational age showed a statistically significant association, suggesting that the odds of finding oligohydramnios increased by 1.78 for each week of gestation, after adjusting for HIV status and maternal weight.

The association of each of the measurements and clinical signs with oligohydramnios was investigated using univariable logistic regression analysis (Table 3). Only presenting part ballottability was significantly associated with oligohydramnios, suggesting that the odds of finding oligohydramnios were increased by a factor of 4.49 (95% CI 1.23 - 16.4) if the presenting part was not ballottable in the uterus. Sixty-six women had a non-ballottable presenting part, and of the women with a gestational age ≥41 weeks (*n*=45), 13 (28.9%) had a non-ballottable presenting part.

Presenting part non-ballottability was then placed in a multivariable logistic regression model alongside the significant predictor (gestational age) obtained from the multivariable analysis for maternal and fetal predictors of oligohydramnios (Table 4). Presenting part non-ballottability remained a statistically significant predictor after adjustment for gestational age, indicating that the odds of oligohydramnios increased by a factor of 4.02 (95% CI 1.05 - 15.4) if the presenting part was not ballottable, after adjusting for gestational age.

For predictive value of abdominal palpation, presenting part non-ballottability had a sensitivity of 87% for oligohydramnios, with a specificity of 40%, a negative predictive value of 91%, and a positive likelihood ratio of 1.46 (Table 5).

Table 4. Multivariable logistic regression model for predictors of amniotic fluid index <5 cm (*N*=100)

Explanatory variable	AOR	95% CI	*p*-value
Gestational age (weeks)	1.82	1.08 - 3.07	0.02
Presenting part not ballottable (reference ballottable)	4.02	1.05 - 15.35	0.04

AOR = adjusted odds ratio; CI = confidence interval.

Table 5. Predictive value of presenting part ballottability for oligohydramnios (amniotic fluid index <5 cm) (*N*=100)

	Oligo-hydramnios	Normal AFV	Total
Presenting part not ballottable	20	46	66
Presenting part ballottable	3	31	34
Totals	23	77	100

Sensitivity 87.0%, 95% confidence interval 66.4 - 97.2%; specificity 40.3%, 95% CI 29.2 - 52.1%; positive predictive value 30.3%, 95% CI 19.6 - 42.9%; negative predictive value 91.2%, 95% CI 76.3 - 98.1%; positive likelihood ratio 1.46; negative likelihood ratio 0.32.

AFV = amniotic fluid volume.

Discussion

By separate analysis of different components of abdominal palpation, failure to ballot the presenting part was significantly predictive of oligohydramnios, taking into account maternal and fetal factors associated with AFV. These findings were made in a clinically relevant population, suspected by referring midwives to have prolonged pregnancies. Ease of palpation of fetal parts, the impression of a fetus cramped for space, symphysis-fundal height, and a composite overall assessment of AFV were not associated with oligohydramnios. The lack of any statistical agreement about overall composite estimation of AFV between the researcher and the colleagues illustrated the weakness of an unfocused 'general feel' of the uterus for AFV, as suggested in previous studies.[8,9]

Presenting part non-ballottability, however, had only a weak predictive value, with a positive likelihood ratio of only 1.46 and modest sensitivity and specificity. The most important finding was in the negative predictive value of 91%. The practical significance is that if a woman in this setting presents with a suspected prolonged pregnancy and the presenting part can be ballotted in the uterus, there is a 91% probability that there is no oligohydramnios (AFI <5 cm). While this may seem impressive, the results also show that without palpating the uterus at all, there is a 77% probability that a randomly selected woman from this study would not have had oligohydramnios (the prevalence of oligohydramnios was 23%). The precision of these estimates is limited by the small sample size, which leaves wide confidence intervals around these estimates.

This study has important strengths and limitations. All clinical observations were done by a single observer, lending consistency and individual commitment to the results. It was not possible to involve colleagues in the assessment of each component of palpation. Inter-observer variation could only be tested for the overall subjective assessment. The blinding of the researcher to the ultrasound results and to details of the gestational age gave assurance of minimal bias in the clinical palpation. A valid criticism would be the use of the AFI as a gold standard for AFV, since the AFI is only an indirect measure. As stated earlier, the AFI is the best non-invasive method, performing marginally better than deepest vertical pool for quantitative AFV prediction, and has been used as a reference standard in at least one published study.[13-17] Dye dilution by amniocentesis, or direct measurement of AFV at caesarean section or hysterotomy, are the best reference standards,[19] but are difficult to do and would have been invasive or inappropriate here, as these women were not scheduled for immediate delivery. It was reassuring that oligohydramnios was significantly inversely associated with increasing gestational age, as expected at advanced gestation.[20-22] This provided some validation for the AFI measurements obtained in this study.

This study has added to knowledge by identifying a statistically significant predictive component among recommended clinical palpation methods for AFV, to back up textbook descriptions that suggest ballottability as a method of assessing AFV. The study provides the necessary research evidence to clinicians who practise and teach ballottement to estimate AFV. The design did not allow for comparison between abdominal palpation and ultrasound, and there is no suggestion that palpation can replace ultrasound. The results show that ballottement of the presenting part offers a method for excluding oligohydramnios where ultrasound is not easily available. This clinical sign could be used in conjunction with the pregnant woman's wishes and a full clinical assessment to assist decision-making when prolonged pregnancy is suspected in low-resource settings.

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