

The role of ultrasound in determining fetal sex

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Abstract

Background: The gender of a fetus is necessary to know for many different reasons. There are different ways of determining it during pregnancy. The recently developed method, which is relatively easy and noninvasive, is done by ultrasound of the fetal perineum. This can be done starting from 16 weeks of pregnancy in an average clinic.

Objective: To assess the accuracy of ultrasound in determining fetal sex in a routinely used ultrasound machine and setup.

Methods: Obstetric ultrasound and ultrasound of the perineal region of the fetus was done on 435 pregnant women to detect the sex of the fetus, with gestational age from 16 weeks to term, but only 269 mothers, who were available on the phone after delivery were included in the analysis. Ultrasound results were registered on pre-prepared form at the time of examination. The sex of the babies was confirmed at the expected time of delivery through a phone call to the mothers. Actual sex and ultrasound findings were compared to determine the accuracy.

Results: Out of 275 fetuses ultrasound was able to determine the sex for 260 (94.5%); 110 of whom were confirmed female and 150 were male. Overall accuracy was 93.8%. Accuracy for males was 91.3% and for females was 97.3%. When probable male and female cases are excluded in the analysis taking only definite signs of female and male gender the accuracy was found to be 100%.

Conclusion: Ultrasound is a safe and a relatively accurate method of determining fetal gender that can be used at the ordinary clinic level in Ethiopian situation. [*Ethiop. J. Health Dev.* 2011;25(3):216-221]

Introduction

Many parents are anxious to know the gender of fetuses accurately. The most commonly asked question next to fetal wellbeing is the gender of the fetus while doing obstetric ultrasound (1). Fetal sex determination is needed in many clinical conditions: The diagnosis of sex differentiation disorders to see sexual ambiguity; to rule out X-linked diseases in couples with a risk of transmitting the disease; when there is a risk for 21-Hydroxylase Deficiency which can lead to masculinization of female fetuses. The effect of which can be reduced by corticosteroid therapy (2-4); and sonographic assessment of fetal male genitalia can be done to see the time of testicular descent and scrotal abnormalities like hydrocele (5, 6).

Fetal sex can be determined by different ways: Chorionic villus sampling (CVS) at 10-11 weeks and genetic amniocentesis at 15-16 weeks of gestation were commonly used methods previously. However, both methods are invasive and are associated with a risk of miscarriage. Analysis of fetal deoxyribonucleic acid (DNA) in maternal blood for sex determination can be done at 6 weeks (3, 4). It is hoped that maternal blood or urine tests may give an indication of whether a fetus is a girl or boy using a hormone called MSHCG, which is much higher if the fetus is a girl than in a boy and the difference can be detected at very early gestational age (GA): 16 days after conception (2, 3).

Nowadays, gender is usually determined with ultrasound (US), which is non invasive and easier and it can be done even at an average clinic at 16 weeks or later, although it can also be done as early as 11-12 weeks with modern

equipment. Most of the time, one should be able to tell the sex of a fetus by 20 weeks (1-3).

Diagnosis is made by visualization of the external genitalia: A boy is diagnosed if one actually sees the penis and scrotum and a girl if one sees a labia. The three white lines denoting the labia in early gestational age are becoming a very valid and accurate indicator of female gender. Absence of scrotum or penis was previously taken as a girl (7), but recent studies mention that absence of scrotum must not be taken as sufficient evidence of the fetus being a girl. If good view of the perineum is not possible, seen gender may not be determined accurately (1).

The accuracy of US depends on the technician's skill, the position of the baby at the time of examination, the amount of liquor, and thickness of abdomen. The ability to assign fetal gender correctly increases with increasing gestational age (1).

Previous studies have documented the accuracy of US: In a prospective study done by Watson WJ, US fetal sex determination was done at 13-19 weeks gestation and the findings were compared with phenotypic sex after birth. The overall accuracy of sex prediction was 92 %, with a bread own of male 89.5 % and for female 97.1 % (8). In another study done by G Plattner and etal, US of the fetal perineal area was done on fetuses from 16 weeks to term for 367 cases. The overall accuracy was 93% and for cases less than 24 weeks of gestation, accuracy was 86% (9).

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In a study done by B J Whitlow et al. with a sample of 524 women who underwent a detailed assessment of fetal anatomy by US at 11 to 14 weeks of gestation, fetal gender was identified and confirmed at birth. At 11 weeks predictions were correct in 46 %, at 12 weeks 75 %, at 13 weeks 79 % and at 14 weeks a 90 % success rate was reached, while overall accuracy between 11 to 14 weeks was 80% (1-10).

In the Ethiopian context, no study has yet been done so far on the accuracy of US gender identification. The objective of this study is thus to assess the accuracy of US in determining fetal sex in the local setups.

Methods

The study was conducted at Teklehaimanot Higher Private clinic in Addis Ababa.

It was a prospective study, done between September 2004 and April 2006.

Study participants were women visiting the clinic for obstetric US in that specified time. Inclusion criteria were GA of 16 weeks and above with accessible telephone number (residence, office, neighbor, relative).

Sample size was calculated assuming an average accuracy of US 90%, a desired precision of 4%, 95% confidence interval and 10% allowance for non-respondents. The minimum sample size required for the study was 240 pregnant women.

A quota sampling procedure was employed in the study (Mothers were recruited until the sample size was fulfilled).

A form was developed to record relevant information like maternal age, place of referral (if referred from another health facility), gravidity, gestational age, and the US findings: amniotic fluid pool, placental position, fetal lie, US determined fetal sex and confirmed actual sex after birth. Obstetric US and US of the fetal perineal region were done by two radiologists giving adequate time using the US available at the clinic: Fukuda 4000, 3 and 3.5 Mhz. Diagnosis was made based on the following criteria:

1. If scrotum and/or penis seen, as male (Figures 1A and 1B);
2. Three white lines or labia, as female (Figures 2A and 2B);
3. Empty perineum, as probably female
4. Soft tissue dome, as probably male and
5. If perineum is tight (not well visualized), entered as sex not determined.

The above standard criteria were discussed between the two radiologists. Then about 10 cases were seen by both of them independently before the start of the main study so as to minimize inter-observer bias. The agreement between the two radiologists on the pre-study cases was

100%. After standardizing the criteria, cases were seen once by one of the two Radiologists in the actual main study. A great majority of the cases were seen by the primary investigator and some of the remaining ones were examined by the second Radiologist, the co-investigator.

US results were recorded just after the examination and the phone numbers of mothers were taken following verbal consent from the mothers. Phone calls were made given to the mothers by the time of the expected date of delivery to confirm the actual gender of the babies and filled in the form. The genders of the babies reported by the mother were taken as a gold standard.

Data were entered after coding and analyzed using EPI Info version 3.3 for windows statistical software. Data cleaning was done before analysis. Descriptive statistics and accuracy along with the corresponding 95% confidence interval were calculated.

Results

US examinations were done for a total of 435 mothers, however, 166 of them were excluded from the study since they could not be reached through the given phone numbers. A total of 269 mothers with 275 fetuses (6 twins) were included in the analysis.

The mothers were sent to the clinic for the obstetric US examination from different facilities, of which 247 had known referrals: 59 (23.9%) were from Teklehaimanot Clinic, 45 (18.2%) from Zewuditu Hospital, 39 (15.8%) from Tikur Anbesa Hospital, 25 (10.1%) from Teklehaimanot Health Center, 15 (6.1%) from Gulele Health Center and 64 (25.9%) from other clinics in the city (Table 1).

Table 1: Place of Referral for the Study Subjects, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06

Place of referral	Number	Percent
Teklehaimanot Clinic	59	23.9
Zewuditu Hospital	45	18.2
Tikur Anbesa Hospital	39	15.8
Teklehaimanot Health Center	25	10.1
Gulele Health Center	15	6.1
other clinics	64	25.9
Total	247	100 [*]

* Since there are some missing values, the total may not give the overall sample size.

The mean (\pm SD) age of the mothers was 26 (\pm 5) years with a range of 16 yrs - 40 years. Mean gravidity was 2 with a range of 1- 8. Mean gestational age was 35 weeks and 5 days with a range of 16 - 40 weeks, of the total births 263 pregnancies were singleton and 6 were twin pregnancies, which give a total of 275 babies. Risks for the pregnancy, based on history and US examination

were seen in 42 (15.4%) fetuses. The commonest risk was abnormal fetal lie 15 (35.7%) followed by twin pregnancy 12 (28.6%). Other risks seen were polyhydraminious, big size, bleeding, mayoma and premature rupture of membrane.

Fetal lie was evaluated for 268 fetuses and cephalic was 217 (81%), breech in 40 (14.9%), transverse in 10 (3.7%), and oblique in 1 (0.4%). The mean amniotic fluid pool at deepest pocket was 5.7cm (range 1.9 cm - 9.5 cm) (Table 2).

Placental position was also assessed and fundal and anterior were seen in 127 (47.0%), fundal and posterior (37.0%), fundal and lateral (14.5%) and low lying (1.5%) (Table 3).

Table 2: Fetal Lie by Ultrasound, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06

Fetal lie	Number	Percent
Cephalic	217	81
Breech	40	14.9
Transverse	10	3.7
Oblique	1	0.4
Total	268	100

Table 3: Placenta Position by Ultrasound, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06

Placenta position	Number	Percent
Fundal	25	9.3
Fundal and anterior	127	47.2
Fundal and Lateral	14	5.2
Fundal and posterior	99	36.8
Low lying	4	1.5
Total	269	100

From the total 275 fetuses included in the analysis, US finding showed that 132 (48.0%) were definitely male and all were confirmed to be so at birth, 90 (32.7%) were definitely female and all were confirmed to be female at birth, 30 (10.9%) were probably female, 17 (56.7%) of whom were confirmed to be female in the end, 8 (2.9%)

were probably male and 5 (62.5 %) of them were confirmed male. US determined probably female were higher than probably male cases, 30 (11.2%) versus 8 (2.9%). For 15 (5.5%) of the cases, perineum was not visualized and as a result fetal sex could not be determined. The total confirmed actual fetal genders obtained from the mothers were 118 (42.9%) female and the rest 157 (57.1%) males.

Including cases with probably male and females US was able to determine sex for 260 fetuses (94.5%) with 95% CI of (91.2%, 96.7%). Of whom 110 (42.3%) were female and 150 (57.7%) males. Overall accuracy was 93.8% with 95% CI of (90.2%, 96.2%). Accuracy for males was 91.3% with 95% CI of (85.7%, 94.9%) and for females 97.3% with 95% CI of (92.3%, 99.1%). When probably male and female cases were excluded in the analysis, the accuracy was found to be 100% (Table 4).

Table 4: Confirmed Fetal Sex vs Ultrasound Determined, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06

US sex	Confirmed Sex		
	Female N (%)	Male N (%)	Total N (%)
Prob. female	17 (56.7)	13 (43.3)	30 (100)
Prob. male	3 (37.5)	5 (62.5)	8 (100)
Female	90 (100)	0 (0)	90 (100)
Male	0 (0)	132 (100)	132 (100)
Not determined	8 (53.3)	7 (46.7)	15 (100)
Total	118 (42.9)	157 (57.1)	275 (100)

Further classification was made at the time of trimester with a cut-off point of 28 weeks. Accordingly, for gestational age above 28 weeks (third trimester) the accuracy was 95.5% and for 16- 28 weeks (second trimester) it was 89.8% (Table 5).

For amniotic fluid above 5cm accuracy was 94.8% and for < 5cm deepest pocket was 89.8%. For abnormal fetal lie the accuracy was found to be 95.6% while for cephalic it was observed to be 94.2%. For placenta anterior and fundal position, the accuracy was 95.0% and for other placental positions it was found to be 93.3%.

Table 5: Confirmed Fetal Sex vs Ultrasound Determined Stratified by Gestational Age, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06

US sex	Confirmed Sex			
	GA 16-28 weeks (2 nd trimester)		GA > 28 weeks (3 rd trimester)	
	F	M	F	M
Female + probably female	24	4	83	9
Male + probably male	2	29	0	107
Accuracy	89.8%		95.5%	



Picture 1 A: US of the Perineum when Scrotum and/or Penis Seen Being Male- Early pregnancy, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06



Picture 1 B: US of the Perineum When Scrotum and/or Penis Seen Being Male- Late Pregnancy, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06



Picture 2 A: Us of Perineum When Three White Lines Demonstrated for Female- Early Pregnancy, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06



Picture 2B: US of Perineum When Labia Demonstrated for Female-Late Pregnancy, Teklehaimanot Higher Clinic, Addis Ababa, 2004-06

Discussion

US was able to determine fetal sex in 260 out of a total of 275 fetuses. The overall accuracy of US in determining fetal sex was (93.8%), which is comparable to other studies done by G. Plattner 93%, W.J. Watson 92.3%, by J. Stocker and L. Evens 95% (7-9).

Taking only the definite criteria of female and male, accuracy was 100%. That tells if one sees the scrotum/penis in males or three white line or formed labia in the case of females one can certainly tell the sex of a fetus. And this also tells us that the three white lines visible in early female fetal, US is a very sensitive criteria which is equivalent with visualizing the labia and this finding is consistent with other studies (1).

The accuracy for female was higher than the accuracy for male, 97.3% versus 91.3%. The reason for this might be probably female cases were higher than probably male, 30 versus 8, and only 56.7% of the probably female were confirmed to be female at the end, significant proportion of male cases were miss labeled as probably female. The criteria used for probably female was empty perineum. This shows empty perineum doesn't mean simply female. This goes against a study done by J. Stocker while being consistent with that of Joseph Woo (1, 7, 10). The scrotum may hide above or below the premium and may not be seen. Only 8 cases were probably male ones and 62.5 % of them were confirmed to be male. In this study, 15 (5.5%) of the cases, fetal sex was not determined by ultrasound. This happens when good view of the perineum is not seen and this is also consistent with other similar studies (1).

Accuracy was higher for the gestational age above 28 weeks (third trimester): 95.5% versus 89.8% for 16-28 weeks (second trimester).

This shows that the ability to assign gender increased with increasing gestational age. That is consistent with other studies done by G. Plattner and Whitlow (9-11).

Higher accuracy of fetal sex determination was seen for amniotic fluid deepest pocket above 5 cm which was 94.8%, and for deepest pocket below 5 cm it was 89.8%.

For placenta anterior and fundal position, the accuracy was 95.0% and for other placental positions it was found to be 93.3%. Almost similar accuracy was found for fetal presentation of cephalic and other: 94.2% and 95.6%, respectively. This shows that this study didn't demonstrate the significance of fetal presentation. The reason may be the sample was not adequate to further stratify it.

The mean age of mothers was 26 years. Mean gravity was 2 which appeared low for our country, the reason might be the cases came from Addis Ababa only and

hence may not, represent the whole country. The mean GA was 35W+5D. Most frequent fetal lie was cephalic 217(81%). Commonest placental position was fundal and anterior 127(47.0%).

Conclusion

Accuracy of US in determining fetal sex is high and it is a recommendable for use as a method in our set up. To assess the different contributing factors for accurately in determining the fetal sex, a large-scale study with adequate sample size is recommended.

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