

ORIGINAL ARTICLE

Accuracy of Mid-Trimester Ultrasound Scan in Foetal Gender Determination at The University College Hospital, Ibadan, Nigeria

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ABSTRACT

Objectives: This study aimed to determine the accuracy of prenatal sonographic gender determination during foetal anomaly ultrasound and the overall sensitivity pattern in our institution.

Materials and Methods: A cross-sectional study of 520 consenting pregnant women who presented for foetal anomaly scans within a one-year period in our institution. The diagnostic accuracy of gender determination during the anomaly and delayed scans were determined by comparing the sonographic gender with the birth gender and calculating sensitivity, specificity, positive predictive value and negative predictive value. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Descriptive

statistics, frequencies, Mc-Nemar chi-square test were used at 5% level of significance.

Results: The mean maternal age was 31.51 ± 5.02 years. Of the 520 consenting pregnant women studied, 16 (6.0%) women were having twin gestation. Four hundred and ninety-seven (92.7%) genders were determined during foetal anomaly scan. The accuracy of the ultrasonography (US) examination performed by the resident doctors was 98.02% while the accuracy of the scan performed by the consultant radiologists was 100%. Overall, the accuracy of the gender determination on ultrasound was 98.69%. The general specificity and sensitivity of the US were 98.71% and 98.68% respectively while the positive and negative predictive value were 99.01% and 98.29% respectively.

Conclusion: The accuracy of ultrasound examination in detecting foetal gender during foetal anomaly ultrasound is high with equally high predictive values and therefore it is recommended as a mandatory variable during anomaly scans. There is

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need for continuous training of resident doctors or operators in lower cadre to improve their competency in foetal gender determination.

INTRODUCTION

In most developed countries of the world, mid trimester ultrasound screening for foetal anomalies has become a standard part of antenatal care. Anomalies of all the body systems can be diagnosed with high accuracy during the foetal anomaly scan using standardized views according to various guidelines. However, characterization of external genitalia to determine foetal gender is not considered mandatory in the context of a mid-trimester routine scan in most guidelines and the findings are usually documented upon parental request¹⁻³.

Prenatal sonographic sex determination is of importance and has both medical and non-medical significance. The medical indications for its use include x-linked disorders, testicular feminization syndrome, pseudo-hermaphroditism, genital anomalies, ambiguous genitalia, and determination of zygosity in multiple pregnancy⁴.

Foetal sex can be determined by various ways but the commonly used methods in developed countries are Chorionic villus sampling (CVS) at 10-11 weeks and Genetic amniocentesis at 15-16 weeks of gestation. However, both methods are invasive and are associated with increased risk of miscarriage⁵.

With advanced genetic technology, foetal sex determination can now be determined using maternal blood in some genetic diseases such as hemophilia, however, this method is very expensive and not readily available in low income countries⁶.

Ultrasound (US) technology has improved in recent years and it is readily available and affordable making it the preferred choice in low-income countries for the determination of foetal gender⁷. Early determination of foetal sex by ultrasonography is very significant for detecting gender-specific genetic diseases⁶. Studies

conducted on the accuracy of first trimester ultrasound in prenatal sex determination showed very low accuracy between 46% and 92.3% from 11 to 14 weeks GA⁶⁻⁸. However, Efrat et al reported the accuracy increased from 70.3% at 11 weeks of gestation to 100% at 13 weeks⁹. Improvement in the sensitivity value increases with high proficiency and experience as well as machine with good resolution^{9,10}. Also, the ability to assign foetal gender correctly on ultrasound increases with increasing gestational age^{5,9}.

The accuracy in the determination of foetal gender by ultrasound examination during foetal anomaly scan ranges between 92% and 100%, but it is usually performed upon parental request¹¹. According to the guideline for mid trimester ultrasound by ISUOG, reporting of foetal gender should be considered only with parental consent and in the context of local practices¹.

Many parents are anxious to know the gender of foetuses accurately most importantly when they present for anomaly scans. Incorrectly determined sex can have some psychological effects on the family especially in our environment where there is male gender preference. Many studies have been done on the accuracy of ultrasound in the determination of foetal sex in our setting^{4,12-14}. However, no study has determined its accuracy during mid trimester foetal anomaly scan, hence the reason for this study.

MATERIALS AND METHODS

This cross-sectional study was conducted at the ultrasound suite of the antenatal clinic, University College Hospital (UCH), Ibadan, Nigeria between January and December 2018. Five hundred and twenty (520) consenting pregnant women between 18- and 24-weeks gestational age, who presented for foetal anomaly ultrasound scan during the study period, were recruited for the study. The ISUOG guideline for prenatal screening for anomalies in mid trimester was followed and foetal gender was determined during the scan¹. A repeat scan was

performed for those whose gender was not determined during the anomaly scan. A Voluson P6 General Electric ultrasound machine with curvilinear transducer (2-5MHz) was used. The scans were done by consultant and resident doctors (senior registrar) in radiology department who were adjudge to be able to perform anomaly scan without supervision based on their years of experience. A foetus was termed a male if a hypoechoic phallus is seen in between the thighs (figure 1) and a female was determined by the presence of 3 echogenic lines converging in the perineum as seen in the image (figure 2) which were taken during this study.

These women were followed up till delivery and the sex of their babies at birth were obtained from the hospital records and phone call were made across to those who did not deliver in the hospital. The foetuses whose sex were not determined during the study period and those whose gender were not confirmed after delivery were excluded from the study.

Data on the respondents' demographic and obstetrics characteristics, gestational age at detection, sonographic and birth gender and status of attending sonologist were accurately documented.

The study was approved by the Joint University of Ibadan and University College Hospital Ethics Review Committee.



Figure 1: Ultrasound images showing the male gender with the phallus (arrow) in between the thighs.

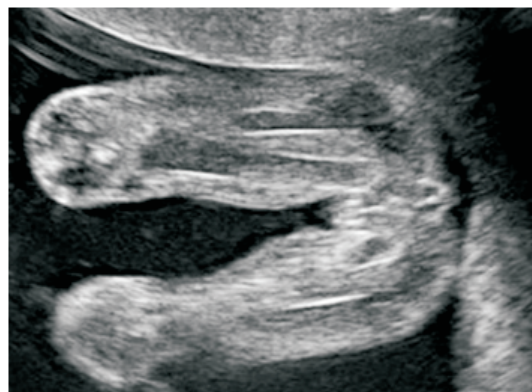


Figure 2: Ultrasound image showing the female gender with three echogenic lines converging at the perineum (arrow).

RESULTS

A total of 520 pregnant women who met the inclusion criteria were recruited for the study, 504 (96.9%) had single foetuses and 16 (3.1%) had twin cyesis making a total number of 536 foetuses. The mean maternal age was 31.51 ± 5.02 years which ranged between 20 and 56 years. Four hundred and ninety-seven (92.7%) foetuses had their sex determined during the anomaly scans while 39 (7.3%) were detected during follow up scans (Table 1). Three hundred and two (56.3%) foetuses were identified as males while 234 (43.7%) were identified as females during the ultrasound examinations. Placenta location in 225 (42.5%) foetuses was anterior, followed by posterior placenta which was found in 212 (39.6%) of them. (Table 1).

At birth, the number of males identified was 303 (56.5%) while number of females was 233 (43.5%). (Table 1).

All the twin foetuses had their sexes correctly determined while the gender of 7 (1.4%) were missed among the single foetuses (Table 1).

During the anomaly scan, 7 (1.4%) sexes were missed giving an accuracy of 98.6%, however, those determined after the anomaly scan period (>24 weeks) had an accuracy of 100%. During the

ultrasound examination, three female fetuses (1.7%) were mistakenly identified as male fetuses while four (1.0%) male fetuses were mistakenly identified as female fetuses. (Tables 1 and 2).

Resident doctors in radiology determined the sex on ultrasound in 353(65.9%) fetuses while consultant radiologists did for 183 (34.1%) fetuses. In addition, the accuracy of the ultrasound performed by the resident doctors was 98.0% while the accuracy of the scan performed by the consultant Radiologists was 100% (Table 3). One hundred and twenty-six males and 99 females had anterior placenta with 125 males and 87 females having posterior placenta. Equal number of the male and females (9 each) had fundal placenta (figure 3).

The positive predictive value for ultrasound in the determination of gender was 99.01%. while the negative predictive value was 98.29%. The sensitivity and specificity were 98.68% and 98.71% respectively (table 4).

DISCUSSION

According to various guidelines for mid trimester prenatal screening for foetal anomaly, every woman should undergo a comprehensive evaluation of the fetus between 18 and 22weeks gestation to rule out structural abnormalities and to assess for soft markers as a sign of chromosomal abnormalities¹⁻³. Presently in Nigeria there is no national guideline for foetal anomaly scans and the ISUOG guideline for mid trimester obstetric ultrasound scan is the adopted guideline¹. However, due to late antenatal booking in our environment, the period for the scan is usually extended to 24-week GA. The accuracy of gender determination during anomaly scan in this study was 98.6%. This was slightly lower than the accuracy reported by Gitte Størup et al in Denmark, who recorded an accuracy of 99.2% during the 20-week anomaly scans¹⁵. Findings from this study is however higher than the findings by Harrington et al who got an accuracy of 96.7% at 20weeks GA¹⁶. The rather low accuracy was attributed to maternal habitus and foetal position in Harrington et al study.¹⁶

Many studies have shown that the ability to assign gender on ultrasound scan increases with increasing gestational age. This was corroborated in our study in which we found accuracy of 100% in the determined gender done after the anomaly scan. This was similar to finding by Maaji et al, who determined foetal gender between 36- and 42-weeks GA and they got an accuracy of 100% after delivery¹⁷. There was also increase in the gender accuracy in a study by Gelaw et al in Addis Ababa from 89.8% at 16-28 weeks GA to 95.5% after 28weeks⁵.

Ultrasonography is wholly dependent on the operator and high degree of accuracy is attributed to the level of experience and expertise of the operators. In the current study, the accuracy of gender determined by consultant radiologists was 100%, while resident doctors were accurate in 98% of cases. This finding is similar to the results reported by Okeke et al, where the authors reported 100% accuracy in gender determined by consultant Obstetricians and consultant Radiologists, while an accuracy of 88% was found among the resident doctors¹⁸.

Also, in experienced hands, foetal gender can be determined accurately in the first trimester. Efrat et al who determined foetal gender between 11- and 13-weeks GA got an accuracy of 70.3% at 11weeks GA and 100% at 13weeks GA⁹. In a similar study by Ergin et al, the accuracy at 11week GA and 13week GA were 81.1% and 89.2% respectively.⁶

Other factors known to affect gender determination include resolution of the ultrasound machine, foetal presentation, maternal habitus, placenta location and amniotic fluid volume^{4,10,18}. Even though foetal presentation was not assessed in this study, Okeke et al recorded an accuracy of 99.4% in fetuses in cephalic presentation while those with breech presentation had an accuracy of 72.7%¹⁸. This was attributed to the smaller dimension of the lower segment of the uterus compared to the upper segment in which the breech of the foetus is usually fixed tightly, preventing the baby from exposing the

perineum for visualization. Also, in the same study, accuracy was reduced with increasing body mass index (BMI) which was more likely due to higher abdominal fat, which affects the resolution of the ultrasound machine.

The most common ultrasound location of the placenta was anterior and this was followed closely by posterior location. Placenta location did not affect the accuracy of the determined gender, the accuracy with anterior and posterior placenta locations were 98.7% and 99.1% respectively while the accuracy with fundal position was 100%. In a study by Gelaw et al, anterior and fundal placenta location were found in 47.2% of the foetuses while posterior and fundal position accounted for 36.8%⁵. Jafari et al on the other hand reported 51.5% and 48.5% for anterior and posterior placenta locations respectively and there was a strong association between placenta location and gender¹⁰. Anterior placenta was found in 72.8% of the female gender with only 27.2% of the males having it. There was also a statistically significant relationship between placental location and determined sex in a study by Mirbolouk et al²⁰. On the contrary, The S & Chan found no correlation between placenta location and gender determination. In our study, there was no such relationship, 56% and 59% of the male gender had anterior and posterior placenta respectively while 44% and 41% of the females had anterior and posterior placenta respectively²¹.

In the present study, we recorded a slightly higher accuracy in the determination of male gender (99%) when compared with the female gender (98.3%). A much higher accuracy was observed in a similar study by Eze et al who recorded an accuracy of 100% in males and 78.3% in female gender determination¹². This observation is however different from the findings by Adeyinka *et al*, in a similar study done earlier in the same centre, where the accuracy was 90.6% for females and 83.2% for males¹⁴. Gelaw et al⁵ recorded an accuracy of 97.3% for female and 91.3% for males while Igbinedion et al in their study had 100% accuracy for female gender with 98.2% accuracy for the male gender⁴.

Some studies on the other hand recorded similar accuracy in the determination of both sexes^{15,17}. The reasons for these contradicting gender accuracies include the varying gestational ages at determination, the resolution of the ultrasound machines, the experience and expertise of the operator as well as the position of the foetus.

The overall sensitivity for sonographic gender determination in the current study was 98.7%. This is similar to the sensitivity recorded by Igbinedion et al, Størup G et al and Eze et al who recorded sensitivity of 98.2%, 99.2% and 98.1% respectively^{4,12,15}. Maaji et al recorded a much higher sensitivity of 100%¹⁷. However, the sensitivity of 86.5% and 93.8% reported by Gelaw et al and Adeyinka et al were much lower^{5,14}. The higher sensitivity recorded in this study is attributed to the experience and expertise of the sonologists as well as the better resolution of the ultrasound machine used.

Despite the high sensitivity recorded in various studies, gender determination is an optional parameter in most guidelines for second trimester foetal anomaly ultrasound examination. As a result, there are no protocols on how to assess it which may make it difficult to accurately diagnose anomalies of the genitalia, if present. Following a similar research by Gitte Størup et al in Denmark¹⁵, a need for a protocol for gender determination was realized and a national guideline on foetal sex determination was developed by the Danish Foetal Medicine Society²². A protocol for foetal sex determination was included which included sagittal, transverse and tangential projections of the foetal genitals. This is now recommended as an integral part of the Danish second-trimester anomaly scan^{15,22}. There is a need for a similar protocol to be added to other guidelines to ensure more accurate determination of gender especially when there are malformed or ambiguous genitals or when medically indicated e.g. in sex linked diseases.

CONCLUSION

The accuracy of ultrasound examination in detecting foetal gender during foetal anomaly ultrasound is high with equally high predictive values and therefore it is recommended as a mandatory variable during anomaly scans. There is need for continuous training of resident doctors or operators in lower cadre to improve their competency in foetal gender determination.

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