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**A. O. OGUNNIYI
O. D. OLALEYE**

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Ultrasonographic assessment of fetal gender

AO Adeyinka, AM Agunloye and S Idris

Department of Radiology, University College Hospital Ibadan, Nigeria

Summary

The purpose of this study is to evaluate the value and accuracy of ultrasonography in the detection and determination of the gender of the fetus. This prospective study involves the Ultrasound examination of a total of 415 fetuses including 216 (52 %) females and 199 (48%) males. The mean gestational age at which the fetuses were scanned was 32 weeks 1day, with a range of 15 to 40 weeks. Fetal sex identification was only possible in 363 (87.5%) cases. Of these, the fetal sex corroborated birth sex in 314 (75.7%) and disagrees in 49(11.8%) cases. The overall estimated sensitivity of the scan in fetal sex determination is 86.5%, while the estimated specificity for identification of the female sex (90.6%) was higher than that of the male (83.2%). Despite the high efficacy of ultrasound in sex determination obtained in our study, the errors and failure rates should be made known to mothers who are willing to know the gender of their fetuses.

Keywords: *Ultrasonography, gender, gestational, efficacy*

Résumé

Le but de cette etude est d'évaluer la valeur et la precision de l'ultrasonographie dans la detection et la determination du gendre du fetus. Cette propective examinait l'ultrasound chez 415 fetus, 216(52%) females et 199(48%)males. L'age moyenne de gestation quand le fetus etaient scanned etait de 32 semaines et 1 jour variaient entre 15-40 semaines. L'identification du sex du fetus etait 32 seulement possible chez 323(87.5%) . 314(75.7) de prediction du sex a la naissance coïncidait reellement avec le sex du fetus contre 49(11.8%). La sensitivite du sanner dans la determination du sex du fetus etait de 86.5% alors que la specificite de l'identification du sex femelle a la naissance de 90.6% etait plus elevee qu'u males de 83.2%. Bienque la grande efficacite de l'ultrasound in determination du sex obtenue dans cette etude, les erreurs et taux d echec doivent etre communiqes aux parents qui veulent savoir le gendre du fetus.

Introduction

Ultrasonographic assessment of the fetal genitalia is possible from as early as 10 to 11 weeks gestation in males and by 15 weeks for females [1]. Various authors have recorded accuracies of up to 100% in all three trimesters [2,3,4].

Accuracy of fetal sex determination is said to increase with gestational age [4,5]. Routine or diagnostic obstetric sonograms were unheard of in our environment prior to 1986 [6], however it is now the norm in almost all maternity centres at all levels of health care.

The aim of this study is to investigate the ability of the sonologist to correctly diagnose the sex of the fetus when undertaken as part of a routine scan in our environment.

Materials and methods

This is a prospective study involving ultrasound examination of a total of 415 fetuses by experienced sonologists using a Siemens Sonoline 1300 ultrasound machine with a 3.5MHz linear transducer. The trans-abdominal route was used in all cases, with the mother in the supine or oblique positions as required, to maximally demonstrate the fetal parts. Both transverse and longitudinal scans of the fetal perineum were performed at each examination.

All the mothers were referred from a busy maternity centre in the Ibadan metropolis, Oyo state which is manned by experienced midwives. A record of the sex of the babies at delivery was kept. At ultrasound, an attempt was usually made to identify the fetal genitalia as part of the routine prenatal scan for fetal wellbeing. The fetal presenting parts and Ultrasound gestational age were also recorded.

Ultrasonographic appearance of the fetal sex:

1. Female- recognized by visualization of the two labia, which show as two oblong echogenic structures separated by an echo-free area. (Fig 1)

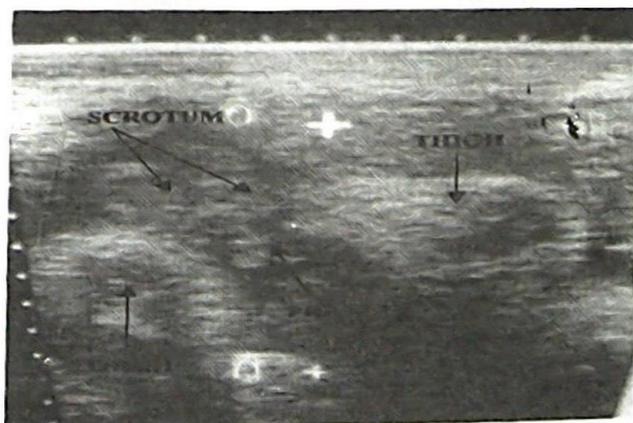


Fig. 1: Female genitalia showing the two labia as oblong echogenic structures separated by an echo free space.

- Male- recognized by visualization of the two scrotal sacs, which show as two rounded echogenic structures separated by the echogenic median raphe. In addition, the penis may be seen as an echogenic cylindrical structure in front of the scrotal sacs. (Fig 2)

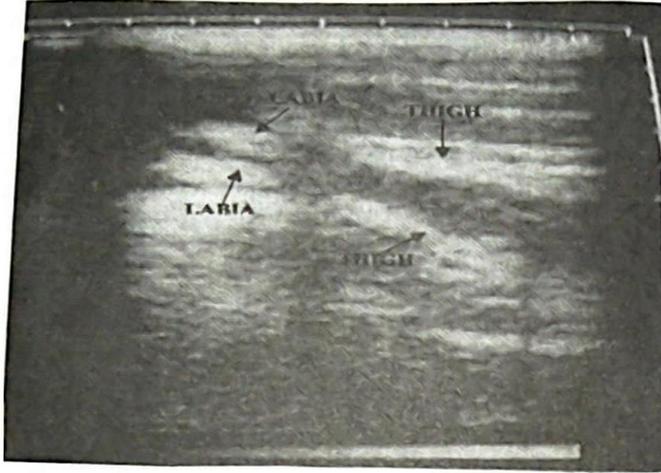


Fig.2: Male genitalia showing the cylindrical echogenic Phallus in front of the oval shaped echogenic scrotal Sac.

Ultrasound Efficacy:

The data obtained from the study would be subjected to the formula below to determine the efficacy of Ultrasonography in the determination of fetal sex.

- The sensitivity of sex determination by Ultrasound is defined as the ability of the ultrasound to recognize gender = $\frac{\text{True positives (TP)}}{\text{TP} + \text{False negatives (FN)}} \times 100$
- The specificity of sex determination by Ultrasound is the ability of the scan to differentiate the male and the female gender = $\frac{\text{True negative (TN)}}{\text{TN} + \text{False positive (FP)}} \times 100$

Results

A total of 415 fetuses including 216 (52%) females and 199 (48%) males were scanned. In 52 (12.5%) cases, it was not possible to determine the fetal sex. Fetal sex identification was possible in 363 (87.5%) cases. Of these, the fetal sex corroborated birth sex in 314 (75.7%) and disagreed in 49 (11.8%) cases (Table 1). The estimated sensitivity of the scan in fetal sex determination is 86.5%.

Of the 314 fetuses in whom the pre-natal sex was correctly identified by Ultrasound, 169 (53.8%) were females and 145 (46.2%) were males. Of the 49 fetuses that were incorrectly identified, 34 (69.4%) were males and 15 (30.6%) were females. The estimated Specificity for identification of the female sex (90.6%) was higher than that of the male (83.2%).

Table 1: Comparison of ultrasound fetal gender, with gender at time of Birth

USS Parameters	USS Fetal Sex	Sex at Birth	
		male	Female
Not Identified	52 (12.5%)	20/52 (38.5%)	32/52 (61.5%)
Correctly Identified	314 (75.7%)	145/314 (46.2%)	169/314 (53.8%)
Incorrectly Identified	49 (11.8%)	34/49 (69.4%)	15/49 (30.6%)
Total	415 (100%)	199/415 (48%)	216/415 (52%)
Sensitivity	86.5%		
Specificity		83.2%	90.6%

Table 2: Relationship of fetal sex and ultrasound gestational age.

Gestational age (wks)	Ultrasound fetal sex			Total	Sensitivity (%)
	Not identified	Correctly Identified	Incorrectly Identified		
2 nd trimester (14-26wks)	8 (40%)	7(35%)	5(25%)	20(100%)	60%
3 rd trimester (27-40wks)	44(11%)	307(78%)	44(11%)	395(100%)	89%
Total	52	314	49	415	

Table 2 shows the accuracy of ultrasound fetal sex determination in relation to gestational age (G.A). The mean gestational age at which the fetuses were scanned was 32 weeks 1day, with a range of 15 to 40 weeks. No fetuses were scanned in the first trimester, while 20 (4.8%) and 395 (95.2%) were scanned in the second and third trimesters respectively. Ultrasound fetal sex identification (Sensitivity) increased from 60% in the 2nd Trimester to 89% in the 3rd Trimester period.

Discussion

The clinical importance of identifying the fetal gender includes determination of the chorionicity in twins, interpretation of sex chromosome mosaicism and aneuploidy as well as in sex-linked conditions [7]. When clinically indicated as above, fetal gender assignment by ultrasound is usually done in the first trimester. This is possible by trans-abdominal, transvaginal and 3D-ultrasonography [1-4,8,9]. In most instances in this environment, parents wish to know the gender of their unborn babies for social reasons. This may explain why most (95.2%) of the scans were in the third trimester when the chances of determining the fetal sex is generally perceived to be higher. The average gestational age at scan in this study was 32 weeks and 1day as there were no specific medical indications for fetal gender assignment. Most mothers are also unable to have more than one scan in a pregnancy for financial reasons.

In India and China, there are legislations against the use of ultrasonography and amniocentesis for the fetal sex determination because of cultural aversion to female infants and selective induced abortions of unwanted genders usually females [10,11].

Attempts should always be made to carefully demonstrate the penis in addition to the scrotum whenever male sex determination is of clinical importance [12] as lack of visualization of male genitalia does not allow one to conclude that fetus is female, since the fetal labia major may appear large enough to simulate the scrotum. It is also possible to assess testicular descent which occurs in males between 23 to 26 weeks gestational age [1,13]. Errors in assignment of fetal sex may be minimized by combining both tangential/transverse with sagittal views of the fetal perineum during imaging as was done in this case study.

The fetal sex was correctly identified in 86.5% of those fetuses in whom the sonologist was able to visualize the fetal genitalia. Previous authors have recorded rates ranging from 70% to 100% [2-4,7,8,14,15]. Interestingly, 100% transabdominal ultrasonographic gender identification has also been documented in horses [16].

Meagher and Davison [7] reported that errors in diagnosis of gender were more likely to occur in the female fetus, but Mielke *et al* [15] recorded equal identification rates for both sexes. Both these studies were done in the 1st and 2nd Trimesters. This study, most of which were in the 3rd Trimester, recorded more errors in the male fetuses. This observation is at variance with the two cited studies above and is presumed to be due to the well-developed labia major simulating the scrotum in advanced pregnancy.

It is not unusual for fetal sex to be indeterminate during a routine scan as values of 10-20% have been previously documented [14,15], which is in agreement with our finding of 12.5%. Failure to demonstrate the fetal sex may be due to a number of reasons. These include inadequate amniotic fluid as seen in the only patient with oligohydramnios in this study, an unfavorable fetal position to provide an interface that will allow adequate characterization [12] including breech presentations [17]. In 6 of the 18 breech fetuses, in this study the gender could not be determined. Inexperience of the sonologist is also a cause. In the authors' experience a previously unidentified gender may be clearly seen at a scan on a later date usually due to a more favorable fetal position.

Other ways of predicting fetal gender include molecular analysis of Deoxyribonucleic acid (DNA) extracted from whole maternal blood but this may have a false negative result of up to 50% for male fetuses [9]. This type of analysis is not readily available in this environment.

Conclusion

In addition to its various clinical uses, ultrasound is also a valuable tool in prenatal sex determination. However the

social outcome has far-reaching ethical implications because of the potential risk of sex-selected abortions. Since about 12.5% genders may be incorrectly assigned, parents who wish to know the gender of their fetuses should always be made aware of the error and failure rates of fetal sex identification using ultrasound in order to avoid litigation and maintain the confidence of patients in sonologists.

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