

Ultrasound and Fetal Gender (A Review)

Maryam Nakhaee Moghadam¹

¹Department of Radiology, Faculty of medicine University of Medical Sciences, Egypt

ARTICLE INFO

Corresponding Author:

Maryam Nakhaee
Moghadam

Keywords:- Ultrasound,
Fetal Gender, Review

ABSTRACT

Ultrasound (Sonography) uses high-frequency sound waves; these waves are produced and transmitted to the body by a device placed on the abdomen. A softener gel is applied to the body for a more complete wave transfer to the body. The waves pass through the tissues after entering the body and travel from one organ to another and then are bounced off to the body surface. Ultrasound device receives these waves which are used to take images of internal organs. Movement observation is also possible in ultrasound, so fetal movements or its internal organs can be detected and examined. In weeks 5 to 6 of pregnancy, fetal heart rate is visible as well. Pregnancy ultrasound is used to diagnose the health of the fetus in the mother's uterus and is normally performed four times as recommended by a gynecologist. All these measurements are carried out to determine the exact age of the fetus and the risk of disease which must be reported by an accurate ultrasound. According to specialists, women are better to have an ultrasound of the uterus and ovaries prior to planning to conceive to get informed about their fertility status. Ultrasound helps the physician to know about the health of the uterus (in terms of size or presence of abnormalities), the presence of apolipo fibroids or ovarian cyst, and many other uterine problems; however, in case of the need for treatment and follow up measures, the patient receives necessary instructions from her doctor.

©2022, JMPR, All Right Reserved

Introduction:

Ultrasound (Sonography) uses high-frequency sound waves; these waves are produced and transmitted to the body by a device placed on the abdomen. A softener gel is applied to the body for a more complete wave transfer to the body. The waves pass through the tissues after entering the body and travel from one organ to another and then are bounced off to the body surface. Ultrasound device receives these waves which are used to take images of internal organs. Movement observation is also possible in ultrasound, so fetal

Movements or its internal organs can be detected and examined. In weeks 5 to 6 of pregnancy, fetal heart rate is visible as well (1).

Many people use ultrasound to determine fetal gender. Gender determination is easier if the legs of the fetus are open. Color, three-dimensional, and four-dimensional ultrasounds can nowadays identify gender quicker than conventional ultrasounds. The baby's gender can be recognized by skilled physicians in thin women at their 12th to 16th week

and in overweight women at their 16th to 20th week of pregnancy (2).

Ultrasound is performed for following cases:

1. Pregnancy diagnosis
2. Checking the health, growth, and heart rate of the fetus
3. Examining location of the placenta
4. Examination of trophoblastic or molar disorders
5. Congenital abnormalities
6. Checking the amount of amniotic fluid
7. Examination of abortion and extra-uterus pregnancy
8. Multiple births examination
9. Measuring the size of the fetus's skull, femur, and spine to estimate gestational age
10. Gender determination

Pregnancy ultrasound is used to diagnose the health of the fetus in the mother's uterus and is normally performed four times as recommended by a gynecologist. All these measurements are carried out to determine the exact age of the fetus and the risk of disease which must be reported by an accurate ultrasound. According to specialists, women are better to have an ultrasound of the uterus and ovaries prior to planning to conceive to get informed about their fertility status. Ultrasound helps the physician to know about the health of the uterus (in terms of size or presence of abnormalities), the presence of apolipo fibroids or ovarian cyst, and many other uterine problems; however, in case of the need for treatment and follow up measures, the patient receives necessary instructions from her doctor (3). In addition, with pre-pregnancy ultrasound, the ovulation time could be detected, especially in women with irregular periods or infertility. The number of follicles, their size, and the exact time of ovulation are examined on the 12th to 16th day of the menstrual cycle (4).

Pregnant women who spend pregnancy stages without any problems usually carry out four ultrasounds until the end of their pregnancy, including:

- **First pregnancy ultrasound:** In the first pregnancy ultrasound which is usually performed between the 5th and 7th week, not only the fetus's heart is visible but also the heartbeat is audible as well. What doctors examine in this ultrasound scan is the measurement of the fetal crown-rump length through which they can determine the exact age

of pregnancy, the diagnosis of ectopic pregnancy, and the determination of a single or twin fetus is possible as well (5).

Of course the fetus's heart could also be detected in the fourth and half week after the first day of the last cycle of the menstrual period through transvaginal ultrasound; close examination of the heart and fetus development are also possible (6).

- **Screening ultrasound in the first trimester of pregnancy:** Nuchal translucency

The NT ultrasound with blood test detects the probability of developing genetic abnormalities in the fetus. The time of this ultrasound would be at the beginning of the 11th week to the end of the 13th week of pregnancy. The accuracy of ultrasound in the diagnosis of fetal abnormalities is about 75%, and if accompanied with blood test, the accuracy would be 85%. These tests are performed to examine some anomalies, such as the risk of Down syndrome, trisomy 21, 18, and 13; trisomy means a disruption in the number of chromosomes. In NT ultrasound, the amount of fluid from the back of the fetus's neck is measured; this fluid tends to be more in a fetus with Down syndrome. Lack of nasal bone in the ultrasound examination can also be a sign of Down syndrome (7).

Last ultrasound of pregnancy:

After the second trimester and during the third trimester, the internal organs of the fetus are formed and now it is time to weigh the fetus. The 28th week ultrasound is the basis for determining the weight of the fetus, which is measured according to the standard curves of the ideal weight (based on the pregnancy weeks). Head and abdominal circumferences and the length of the thigh bone are measured and are placed on the curve, and the fetal weight is estimated. If fetal size and age do not match after the 30th week of pregnancy, and the difference is more than two weeks, it is likely that the fetal growth has not been sufficient through these weeks, in which case fetal blood supply should be checked by another type of ultrasound, which here color Doppler ultrasound is recommended.

Color Doppler ultrasound:

This kind of ultrasound is performed to examine the blood flow in cases such as blood flow resistance, blood flow rate of the placenta, and brain blood flow

resistance. This type of ultrasound is usually performed after the 28th week of pregnancy (8).

3D and 4D ultrasound in pregnancy:

These types of ultrasounds are often used for detection in pregnancy, the most common of which is two-dimensional ultrasound. In the three-dimensional ultrasound, waves are emitted from various angles unlike the two-dimensional type where waves are emitted directly; therefore three-dimensional and more detailed images of the fetus are obtained, which in addition to length and width have depth as well. The organ scan can be performed by the sonographer manually and three-dimensional images can be obtained through more modern devices by probing of the device (9). The 4D ultrasound is similar to the 3D ultrasound, with the difference that in the 4D ultrasound, images do not have delays and live time fetal movements can be displayed, meaning that the dimension of time is added as well. In the 4D ultrasound, the 3D speed rises and the parts of the image are taken together quickly; in such a situation the fetal movements, such as opening and closing of the mouth, and the movement of the hands and legs are clearly observed.

Criteria for the determination of fetal health and age by pregnancy ultrasounds:

Biparietal diameter (BPD): Indicates the size of the diameter between the two temporal bones of the fetus's skull.

Head circumference (HD): Indicates the head circumference of the fetus.

Abdominal circumference (AD): Indicates the abdominal circumference of the fetus.

Femur length (FL): Indicates the femur length of the fetus.

Crown-rump length (CRL): The acceptable CRL for measuring NT is 39-81 mm in Iran.

Nuchal translucency (NT): This scan is measuring the fetus's nuchal fold thickness which is important for testing the health of the fetus and has to be accurate. The normal amount of NT with CRL is about 39 mm, 1.2 mm, and with CRL is about 81 mm, 2.1 mm.

Excessive ultrasound is harmful to the fetus.

Ultrasound and gender determination of the fetus:

Efforts to determine fetal gender during pregnancy have long been practiced in different ways in societies with different cultures. Regardless of the curiosity of human beings for various purposes, and sometimes false and incorrect, the determination of fetal gender encompasses important information in various clinical areas, important points of which are as follows:

1. Diagnosis of normal genitalia from ambiguous genitalia by analyzing perineal and external genitalia.
2. Decision making concerning invasive tests before birth and cases when there is a positive family history on sex-related abnormalities such as hemophilia and Duchenne-muscular-dystrophy. Male gender diagnosis suggests a genetic transfer with 50% probability, while female gender diagnosis declines traces of the disease; in such cases, if invasive tests before birth is considered (for example, amniocentesis or chorionic villus sampling), doing such tests could be ignored by female gender diagnosis, and abortion or fetus injury will be reduced.
3. Facilitating the diagnosis of specific fetal anomalies by identifying the fetus gender and vice versa; e.g. posterior urethral valve in males and Turner syndrome in females.
4. Confirming dichorionic in heterogeneous twin pregnancies.
5. The probability of hermaphroditism in cases of inconsistency between ultrasound findings and amniocentesis.
6. Pre-eclampsia prevalence in pregnancies with male fetus.
7. Along with the progression in ultrasound technology and the increasing use of transvaginal ultrasound, gender determination is recommended at the early stages of pregnancy. Considering the embryology, there is no morphological difference between male and female genitalia until the 7th week of pregnancy. Detection of external genital in the male sex is possible at the beginning of the 15th week of amenorrhea and in the female sex close to the 17th week of amenorrhea with a percentage error. The evaluation is performed by observing the sagittal, perineal transverse, and external genital sections. Penis

and scrotum are features of male gender; scrotum is observed in transverse position like a dome-shaped structure at the base of the penis. In the second trimester of pregnancy, it is easier to observe the penis (Fig. 1) (24 & 26).

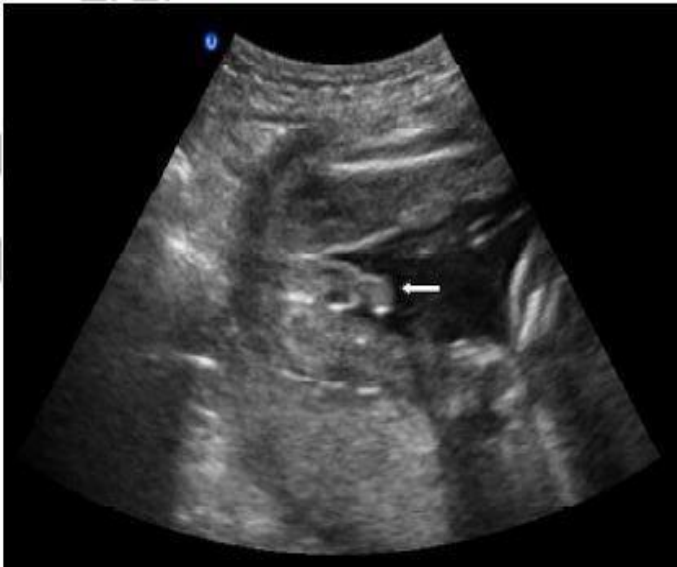


Figure 1: Penis (arrow) is observed as echogenic structure. The testicles have not entered the scrotal sac; 24th week of pregnancy.

During the 34th week of gestational age, scrotum carries testicles (Fig. 2). At this time viewing the penis is more difficult due to the growing size of the scrotum.



Figure 2: Penis (horizontal arrow) is viewed as echogenic, and testicles (vertical arrow) are viewed in the scrotal sac; 34th week of pregnancy.

The female genital in the transversal section is characterized by the observation of two or four parallel lines representing majora and minora labia

(Fig. 3) and extends along sagittal clitoris. In the second trimester, minora labia are between two prominent majora labia. At the end of pregnancy, only the majora labia are viewed in the form of echogenic bilabial (empty echogenic scrotum) and parentheses-like. There are factors which can prevent the proper observation of external genitals by ultrasound, such as fetal hyperactivity, shrinkage of the genital, fetus's crossed legs, position of the umbilical cord between the thighs, inappropriate position of the fetus, maternal obesity, and the shadows of the mother's intestine gas. Of course mother's using of transvaginal ultrasound is not problematic (10-14).



Figure 3: Female external genitalia on the fetus in four echogenic lines; 24th week of pregnancy.

References:

1. Kieler H, Haglund B, Cnattingius S, Palmgren J, Axelsson O. Does prenatal sonography affect intellectual performance? *Epidemiology*. 2005;16(3):304-10.
2. Kongnyuy EJ, Van Den Broek N. The use of ultrasonography in obstetrics in developing countries. *Tropical doctor*. 2007;37(2):70-2.
3. Obeidi N, Russell N, Higgins JR, O'donoghue K. The natural history of anencephaly. *Prenatal diagnosis*. 2010;30(4):357-60.
4. Omo-Aghoja L, Aisien O, Akuse J, Bergstrom S, Okonofua F. Maternal mortality and emergency obstetric care in Benin City, South-South Nigeria. *Journal of clinical medicine and research*. 2010;2(4):055-60.
5. Harris RD, Marks WM. *Compact Ultrasound for Improving Maternal and Perinatal Care in*

- Low-Resource Settings. *Journal of Ultrasound in Medicine*. 2009;28(8):1067-76.
6. Tautz S, Jahn A, Molokomme I, Görden R. Between fear and relief: how rural pregnant women experience foetal ultrasound in a Botswana district hospital. *Social Science & Medicine*. 2000;50(5):689-701.
 7. Kalish RB, Thaler HT, Chasen ST, Gupta M, Berman SJ, Rosenwaks Z, et al. First-and second-trimester ultrasound assessment of gestational age. *American journal of obstetrics and gynecology*. 2004;191(3):975-8.
 8. Ewigman BG, Crane JP, Frigoletto FD, LeFevre ML, Bain RP, McNellis D. Effect of prenatal ultrasound screening on perinatal outcome. *New England Journal of Medicine*. 1993;329(12):821-7.
 9. Dorland WAN. *Dorland's medical dictionary*: Saunders; 1968.
 10. Bashour H, Hafez R, Abdulsalam A. Syrian women's perceptions and experiences of ultrasound screening in pregnancy: implications for antenatal policy. *Reproductive health matters*. 2005;13(25):147-54.
 11. Nemati M, Hajalioghli P, Jahed S, Behzadmehr R, Rafeey M, Fouladi DF. Normal values of spleen length and volume: an ultrasonographic study in children. *Ultrasound in Medicine and Biology*. 2016 Aug 1;42(8):1771-8.
 12. Poureisa M, Behzadmehr R, Daghighi MH, Akhoondzadeh L, Fouladi DF. Orientation of the facet joints in degenerative rotatory lumbar scoliosis: an MR study on 52 patients. *Acta neurochirurgica*. 2016 Mar 1;158(3):473-9.
 13. Behzadmehr R, Keikhaie KR, Pour NS. The Study of Pregnant Women's Attitude toward Using Ultrasound in Pregnancy and its Diagnostic Value based on the Demographic Features in Amir-al-Momenin Hospital of Zabol. *Int J Adv Res Biol Sci*. 2017;4(6):58-63.
 14. Daghighi MH, Poureisa M, Safarpour M, Behzadmehr R, Fouladi DF, Meshkini A, Varshochi M, Kiani Nazarlou A. Diffusion-weighted magnetic resonance imaging in differentiating acute infectious spondylitis from degenerative Modic type 1 change; the role of b-value, apparent diffusion coefficient, claw sign and amorphous increased signal. *The British journal of radiology*. 2016 Aug 11;89(1066):20150152.