Ultrasound screening in second and third trimester of pregnancy: an update

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Abstract. Ultrasound screening of structural fetal malformations is mainly based on the use of ultrasounds during the second trimester of pregnancy. The diagnostic sensibility of ultrasounds varies in the different multicentric studies reported in literature and is correlated to different factors: gestation period, type of malformation, number of ultrasounds performed, operator experience, etc. Third trimester ultrasounds may identify late-onset malformations and offer adequate information for postnatal assistance. (www.actabiomedica.it)

Key words: Ultrasound, screening, fetal malformations

In the last twenty years prenatal ultrasound imaging has shown great technological advancement and has spread widely in the entire population of pregnant women, including those at low risk.

The possibility of "seeing the fetus" is presently emphasized and is made possible by ultrasounds, especially with second trimester (19-22 weeks) ultrasounds, which have the role of analyzing in detail the fetal anatomy with the aim of evidencing the presence of eventual structural abnormalities. The ever more relevant expectations of mothers and the present laws regarding the theme of abortion have made this exam increasingly important. Moreover, it is of public opinion that fetal abnormalities are diagnosable in this period of gestation and that the successive evaluations are only aimed at monitoring fetal development. Reality is however different, and it appears necessary to clearly define the indications and limits of ultrasounds in the identification and diagnosis of fetal structural abnormalities during pregnancy.

In industrialized countries, structural abnormalities represent the first cause of prenatal death (20-25%) and are related to an elevated morbidity in the neonatal and post-natal period. The actual prevalence of these abnormalities is difficult to determine since various classifications exist which are based on the timing of diagnosis (natal or perinatal), the type of abnormality (major or minor), and on the kind of registration that is used by the various centers. In literature, the prevalence of structural abnormalities in the perinatal period varies from 2 to 5%. In Emiglia Romagna, a survey conducted by the IMER in 2002, showed a prevalence of 1.8%.

There is no doubt that ultrasounds are able to increase the identification of malformations. The detection rate of major malformations is of 40% in women who undergo routine ultrasounds during pregnancy compared to 28% in women who undergo selective ultrasounds based on physician's request.

Ultrasound performance is based on technical and organizational variables including the number of exams performed, operator experience, organization, type of equipment used in the different centers, and health policy, but also on variables that are related to the structural abnormalities such as the gestational period in which the exam should be performed, severity of malformations, and type of malformation.

Data regarding this topic in literature is extremely variable. Some of the most important trials are summarized in Table 1 which clearly evidences the variability in the sensibility of the exam in defining fetal abnormalities.

Table 1. Sensibility in the diagnosis of fetal malformations (data from literature)

Author/ year	Country	Examined population/ N. of cases	Center	Type of study	Prevalence of malformations (%)	Sensibility
Helsinky (2) 1990	Finland	Low risk 4691	I and II level	Monocentric	0.99	77% 36%
Radius (20) 1993	US	Low risk 7812	I and II level	Multicentric	2.4	35% II level 13% I level
Boyd (21) 1999	UK	Low risk 33376	I level	Multicentric	2.1	42% 91-93 68% 94-96
Eurofetus (13) 1999	Europe	Low risk 170800	II level	Multicentric	2.7	61%
Euroscan (18) 2000	Europe	Low risk 709030	I level	Multicentric Retrospective	1.1	44%
Wong (14) 2004	Australia	Low risk 12169	I level	Multicentric	1.4	72% for major malformations
Eurocat (16) 2005	Europe	Low risk 1198519	I level	Multicentric retrospective	0.3	64% for 11 major malformations
Nakling (15) 2005	Norway	Low risk 18181	I level I level	Multicentric	1.5	39%

This table evidences the different types of patients considered (at low and at high risk of malformations), the different centers in which I or II level exams were performed, the different methodologies used (multicentric, monocentric, retrospective, or prospective), and the different classification and prevalence of malformations.

The diagnostic accuracy of fetal ultrasounds results higher when the exam is performed on women at high risk, when it is performed in specialized centers, and when major malformations are considered.

Two important and closely related parameters that need to be considered, which significantly influence sensibility are gestational period in which the exam is performed and type of malformation considered.

A meta-analysis performed by Bricker (2000) on the sensibility of routine ultrasounds for all fetal abnormalities demonstrated a variability in the different trials that ranged from 13.5 to 85.3% with an overall sensibility before the 24th week of gestation of 41.3% in populations at low risk.

The Eurofetus Study showed a sensibility of 44% when the screening was performed before the 24th week of gestation and a global sensibility of 61% (73.3% for major malformations, 45.7% for minor malformations): this prospective study, which included 170800 fetuses from 14 European countries, conducted II level ultrasounds during the 2nd and 3rd trimester and showed a prevalence of structural abnormalities of 2.7% (Tab. 1). If we analyze in detail the abnormalities that were detected before the 24th week of gestation, we notice a high sensibility in the detection rate of central nervous system (CNS), urinary, and skeletal abnormalities, and a low detection rate of gastrointestinal and cardiovascular abnormalities. The 2nd trimester ultrasound also shows a different sensibility for the different types of malformations of the different organs: the diagnosis of anencephalus and encephalocele has a sensibility of 82 and 66% respectively, while the diagnosis of hydrocephalus has a sensibility of 35%. The most common abnormalities of the urinary tract that are diagnosed before the 24th week of gestation are mono and bilateral multicistic kidneys, bilateral agenesis of the kidneys, and bladder estrophy.

The study conducted by Wong on a population of

Table 2. Detection rate of fetal anomalies by ultrasound screening in the second trimester

	Central nervous system	Gastro-enterological tract	Urinary tract	Cardio-vascular system	Skeletal system
Eurofetus (13)	56.8%	12.5%	Major malformations: 56.8% Minor malformations: 27.7%	Major malformations: 40.7% Minor malformations: 5.1%	Major malformations: 62.9% Minor malformations: 59.6%
Wong (major malformations) (14)	92.9%	54.5%	87.5%	46.7%	
Nakling (15)	59.4%	41.7%	74.4%	14.5%	8.3%

12169 pregnant Australian women evaluated only major malformations. For this reason it showed a total sensibility and a sensibility for the different types malformations that was higher when compared to the Eurofetus study. The study showed a sensibility of 92% for CNS malformations, 54% for gastrointestinal malformations, 87% for urinary tract malformations, and 46% for heart malformations.

A Norwegian multicentric study that was published in 2004 demonstrated a global sensibility of 38.7% in a population of pregnant women at low risk, with a 1.5% prevalence of congenital abnormalities. The sensibility varied according to the type of malformation considered: from 8.3% for skeletal malformations to 74.4% for urinary tract malformations.

Some kinds of malformations are not easily detectible with second trimester ultrasounds due to the kind of development of the abnormality, its natural history, the presence of pathogenic noxae in a later period of gestation that may alter normal fetal development, and to the difficulty in evaluating certain fetal structures during the second trimester.

Few studies that evaluate the sensibility of third trimester ultrasounds in detecting fetal malformations have been conducted.

A recently published multicentric retrospective European study (EUROCAT) represents a regional indicator since it evaluated the diagnostic sensibility of ultrasounds in 17 European centers and considered 11 major malformations (anencephalus, encephalocele, etc.). The total sensibility was 64% while the gestational age at diagnosis was before the 24th week in 68% of the cases.

The Eurofetus study identifies an average gestational age at diagnosis of 25.8 ± 7.5 weeks, and is even lower when considering multiple or major malformations. The different kinds of malformations and the different organs involved show a different gestational age at diagnosis, which seems lower for muscular-skeletal (23 weeks), CNS (24 weeks), and major urinary malformations. Heart, gastrointestinal, and minor urinary malformations present a greater gestational age at diagnosis (28, 30, and 29 weeks respectively). In this study 38.5% of fetal abnormalities were identified after the 29th week of gestation.

The registered malformations in the region of Emilia-Romagna were prenataly diagnosed with ultrasounds in 45% of the cases, considering both born fetuses and abortions. In the born fetuses, the diagnosis was made before the 24th week of gestation in 44% of the cases, ranging from 50% with associated malformations to 42% with isolated malformations. The detection rate varied in relation with the organs involved and with the age of gestation.

Based on these data, it is evident that different structural fetal abnormalities with a late onset can be diagnosed during the third trimester of pregnancy. The prenatal diagnosis of these malformations can supply useful information for the eventual birth in specialized centers, for the timing and type of delivery, and for an adequate natal and postnatal assistance.

The advantages of prenatal diagnosis are evident even under a legal point of view, even if for some authors the diagnosis of fetal abnormalities in the third trimester does not reduce fetal morbidity and mortality in an evident way.

However, it is important from a legal point of view to increase, when possible, the detection rate of certain pathologies that are otherwise hard to diagnosis in the uterus.

In Italy, the law (D.M. September 10, 1998) which decides the timing and type of assessment that should be performed during physiological pregnancies, recommends 3 ultrasounds for all pregnant women: in I, II, and III trimester. The criteria for these ultrasounds are defined by he SIEOG guidelines.

This type of screening protocol permits for a more accurate control of fetal morphology and for a 15-20% increase in diagnostic sensibility of second trimester ultrasounds. A routine ultrasound during the third trimester is therefore justified not only for the evaluation of fetal growth, amniotic fluid, and placental growth but also for a second evaluation of fetal morphology, particularly of certain organs (GI, urinary tract, CNS).

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