ULTRASOUND IN THE FIRST TRIMESTER

4

INTRODUCTION

First trimester ultrasound is often done to assess pregnancy location and thus it overlaps between an obstetric and gynecologic ultrasound examination. Accurate performance of an ultrasound examination in the first trimester is important given its ability to confirm an intrauterine gestation, assess viability and number of embryo(s) and accurately date a pregnancy, all of which are critical for the course of pregnancy.

Main objectives of the first trimester ultrasound examination are listed in **Table 4.1**. These objectives may differ somewhat based upon the gestational age within the first trimester window, be it 6 weeks, 9 weeks, or 12 weeks, but the main goals are identical. In this chapter, the approach to the first trimester ultrasound examination will be first discussed followed by the indications to the ultrasound examination in early gestation. Chronologic sequence of the landmarks of the first trimester ultrasound in the normal pregnancy will be described and ultrasound findings of pregnancy failure will be presented. The chapter will also display some of the major fetal anomalies that can be recognized by ultrasound in the first trimester. Furthermore, given the importance of first trimester assignment of chorionicity in multiple pregnancies, this topic will also be addressed in this chapter.

TABLE 4.1 Main Objectives of Ultrasound Examination in the First Trimester

- Confirmation of pregnancy
- Intrauterine localization of gestational sac
- Confirmation of viability (cardiac activity in embryo/fetus)
- Detection of signs of early pregnancy failure
- Single vs. Multiple pregnancy (define chorionicity in multiples)
- Assessment of gestational age (pregnancy dating)
- Assessment of normal embryo and gestational sac before 10 weeks
- Assessment of basic anatomy after 11 week

TRANSVAGINAL ULTRASOUND EXAMINATION IN THE FIRST TRIMESTER

There is general consensus that, with rare exceptions, ultrasound examination in the first trimester of pregnancy should be performed transvaginally. The transvaginal transducers have higher resolution and are positioned closer to the uterus, the gestational sac and pelvic organs,

when compared to the abdominal transducers. The closer proximity and higher resolution of the transvaginal transducers allow for excellent anatomic details and recognition of first trimester anatomy (**Figure 4.1**). When inserted gently, the transvaginal ultrasound transducer is well tolerated by most women. **Table 4.2** lists recommended steps for the performance of the transvaginal ultrasound examination.

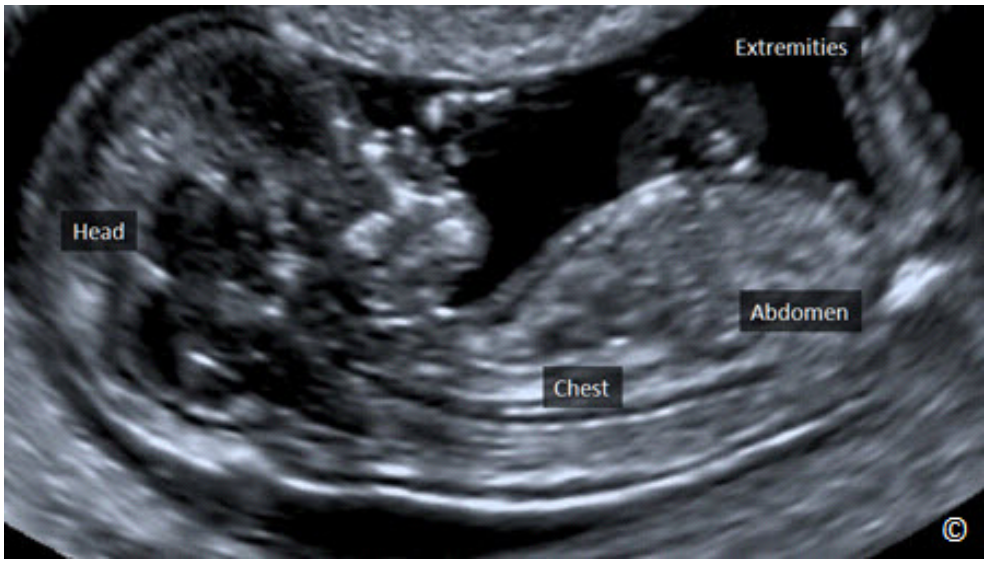

Figure 4.1: Transvaginal ultrasound of a fetus at 12 weeks' gestation in a midsagittal orientation. Note the high level of resolution, which allows for clear depiction of fetal anatomic structures (labeled).

TABLE 4.2 **Steps for the Performance of the Transvaginal Ultrasound Examination**

- The patient is informed and consented (orally) to the performance of the transvaginal ultrasound examination
- The patient emptied her bladder and is placed in a dorsal lithotomy position or in a supine position with the buttocks elevated by a cushion
- Cover sheet is applied to provide privacy and when possible it is recommended to have a third person (chaperon) present in the room in addition to the patient and examiner
- Check that the transvaginal transducer has been cleaned based upon recommended guidelines, is connected to the machine and is switched on before you start the examination
- Apply gel on the transducer tip, cover with a single-use condom (or latex glove) and apply gel on the outside of the condom, paying attention not to create air bubbles below the cover
- Insert the transducer gently and angle it inferiorly (towards rectum) during insertion into the vaginal canal as this reduces patient's discomfort
- Speak with the patient, explain what you are doing and ask about possible discomfort

The beginning of the examination should be performed in an overview without magnification, trying to visualize the uterus with its position, size, shape, content, as well as the neighboring organs, such as the left and right adnexa, the urinary bladder and the cul-de-sac. Following this overview, the region of interest, e.g. the pregnancy, should be magnified to get the best view and detailed assessment.

INDICATIONS FOR THE ULTRASOUND EXAMINATION IN THE FIRST TRIMESTER

In many parts of the world, first trimester ultrasound examination is often indication-driven (1) unlike the "routine" second trimester ultrasound examination that is commonly performed for fetal anatomic assessment. Indications for the first trimester ultrasound examination vary but typically are related to maternal symptoms. **Table 4.3** lists common indications for an ultrasound examination in the first trimester of pregnancy.

TABLE 4.3 Common Indications for Ultrasound in the First Trimester of Pregnancy

- Amenorrhea (patient does not know she is pregnant)
- Pelvic pain
- Vaginal bleeding
- Unknown menstrual dates
- Subjective feeling of pregnancy
- Uterus greater or smaller than dates on clinical evaluation
- Pregnancy test positive or increased Human Chorionic Gonadotropin (hCG) values
- Nuchal translucency measurement

SONOGRAPHIC LANDMARKS IN THE FIRST TRIMESTER

The normal intrauterine pregnancy undergoes significant and rapid change in early gestation, from a collection of undifferentiated cells to a fetus within an amniotic sac connected to a placenta and a yolk sac. All this change occurs within a span of 3-4 weeks. This significant progression can be seen on ultrasound from a chorionic sac: the first sonographic evidence of pregnancy, to the embryo with cardiac activity. Identifying the ultrasound landmarks of a normal pregnancy in the first trimester, and understanding their normal progression, helps to confirm pregnancy and assist in the diagnosis of pregnancy failure.

Gestational Sac

The gestational sac, also referred to as the chorionic cavity, is the first sonographic evidence of pregnancy. It is first located slightly paracentrically in the decidua and referred to as the "intradecidual sac sign", as the gestational sac is buried in the endometrium (**Figure 4.2**). The gestational sac should not be confused with a fluid accumulation (blood) between the decidual layers (**Figure 4.3 A and B**). This fluid collection in the decidua has been referred to as "pseudosac", especially in the presence of an ectopic pregnancy. The gestational sac on transvaginal ultrasound appears a few days after the menstrual period is missed and is first seen at 4 to 4.5 weeks from the first day of the last menstrual period (LMP). The first appearance of a gestational sac on ultrasound may be difficult to visualize but it has a rapid growth at about 1mm per day. When the gestational sac has a mean diameter of 2 - 4mm, its borders appear echogenic, which makes its demonstration easy (**Figure 4.4**). The echogenic ring of the gestational sac is an important ultrasound sign, which helps to differentiate it from an intrauterine fluid or blood collection. The shape of the gestational sac is first circular but with the appearance of the yolk sac and the embryo it becomes more ellipsoid (**Figure 4.5**). Size, growth and shape of the gestational sac can vary and the mean sac diameter (MSD) is calculated as the arithmetic mean of its greatest sagittal, transverse and coronal planes. A MSD cutoff of ≥25 mm with no embryo is diagnostic of failed pregnancy (**Figure 4.6**). This would yield a specificity and positive predictive value at (or as close as can be determined) to 100% (2). When the MSD is between 16 and 24 mm, the absence of an embryo is suspicious, though not diagnostic, for failed pregnancy (2).

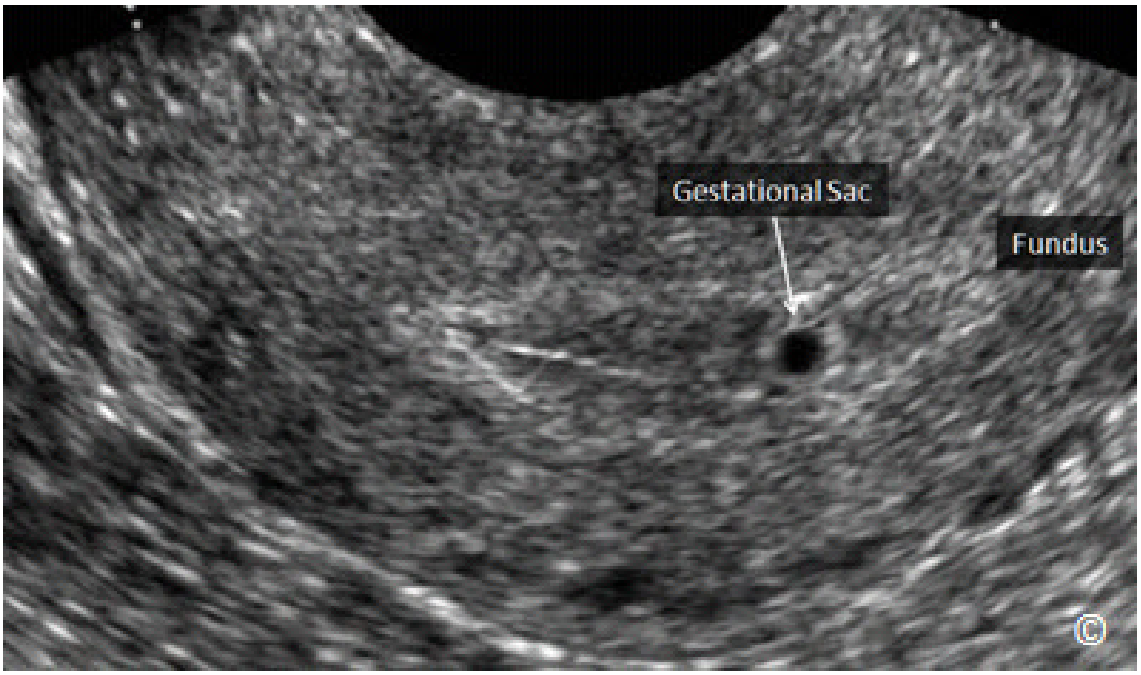

Figure 4.2: Mid-sagittal plane of the uterus showing a gestational sac at 5 weeks' gestation (labeled). Note the paracentric location of this gestational sac within the decidua. The uterine fundus is labeled for orientation.

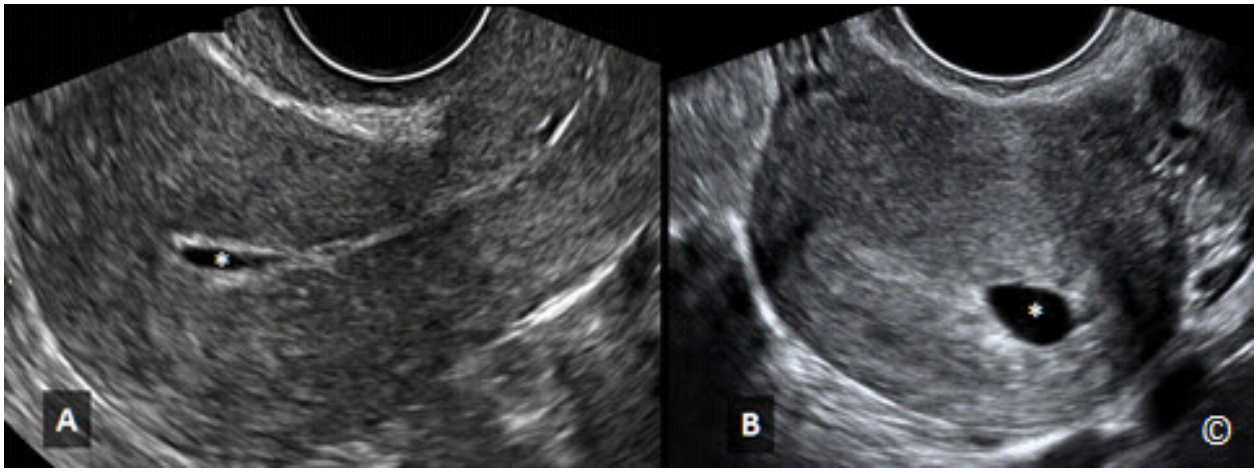

Figure 4.3 A & B: Mid-sagittal (A) and transverse (B) planes of two uteri showing fluid accumulation (asterisk) between the decidual layers (pseudosacs). This finding should not be confused with an intrauterine gestational sac. See text for details.

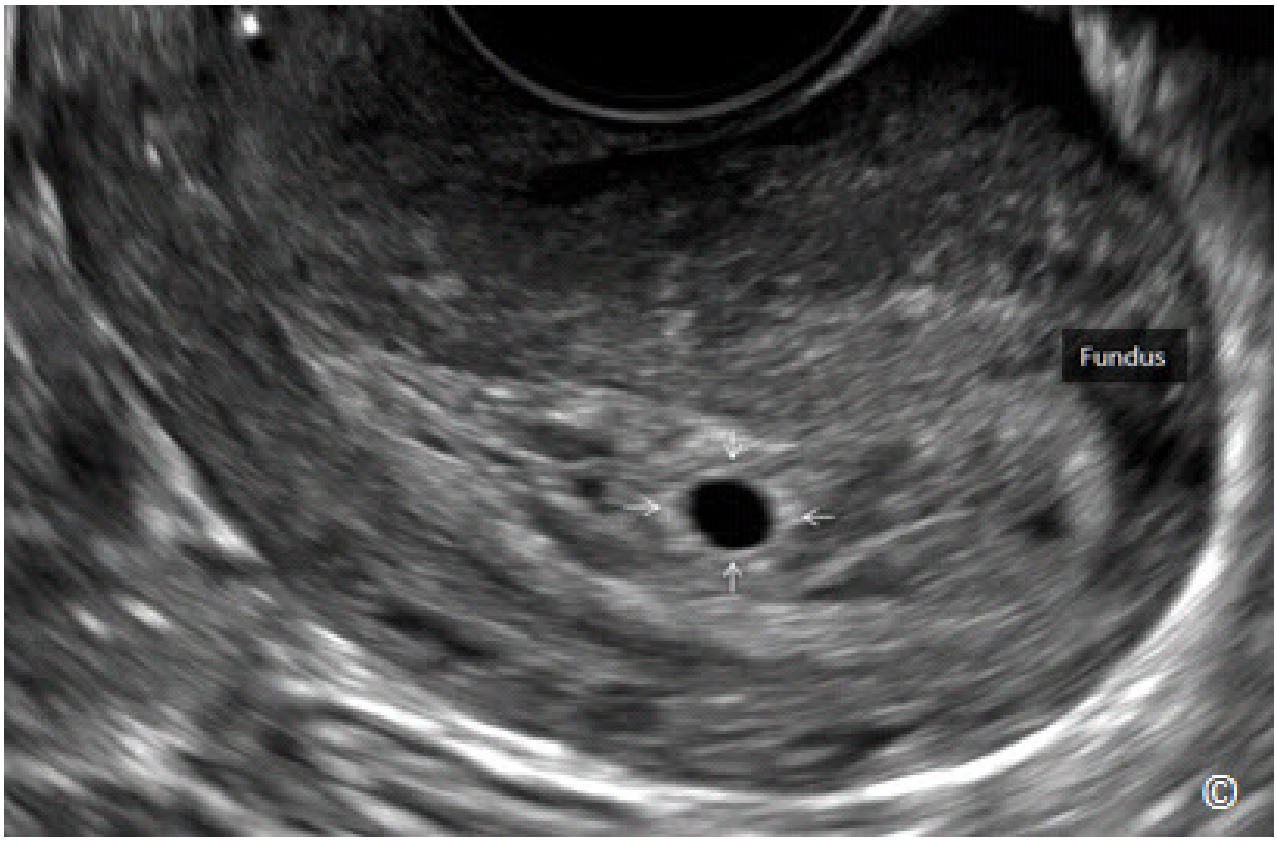

Figure 4.4: Sagittal plane of a uterus with a gestational sac at 4.5 weeks' gestation. Note the echogenic borders (arrows) of the gestational sac. The echogenic borders (ring) of the gestational sac help to differentiate it from an intrauterine fluid or blood collection.

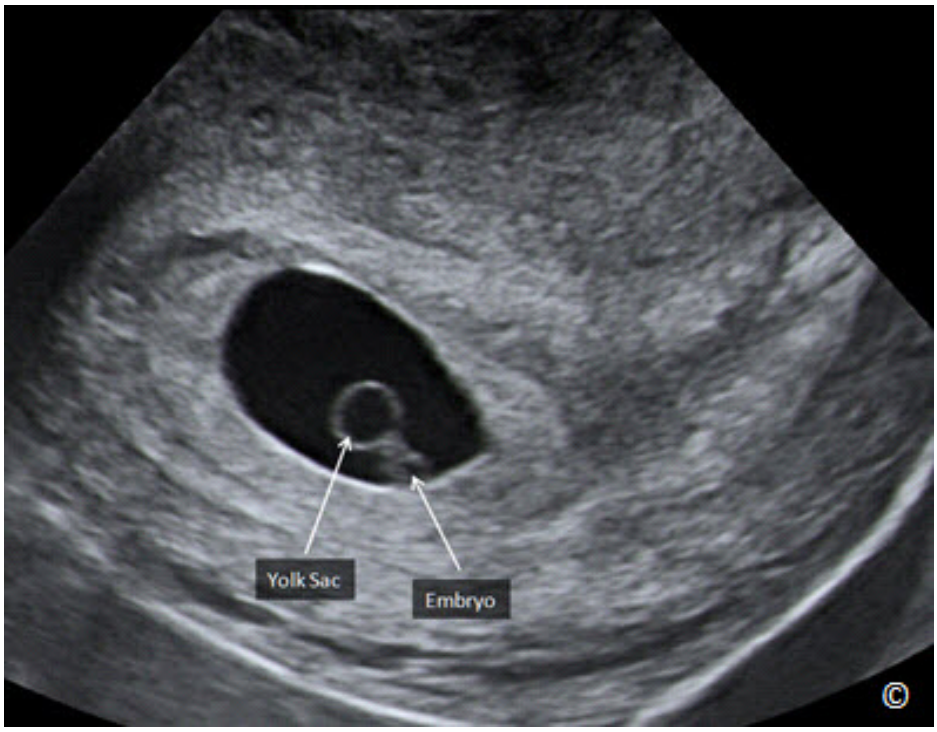

Figure 4.5: Mid-sagittal plane of a uterus with a gestational sac at 6 weeks' gestation. Note the presence of a yolk sac (labeled) and a small embryo (labeled). The shape of the gestational sac is more ellipsoid than circular.

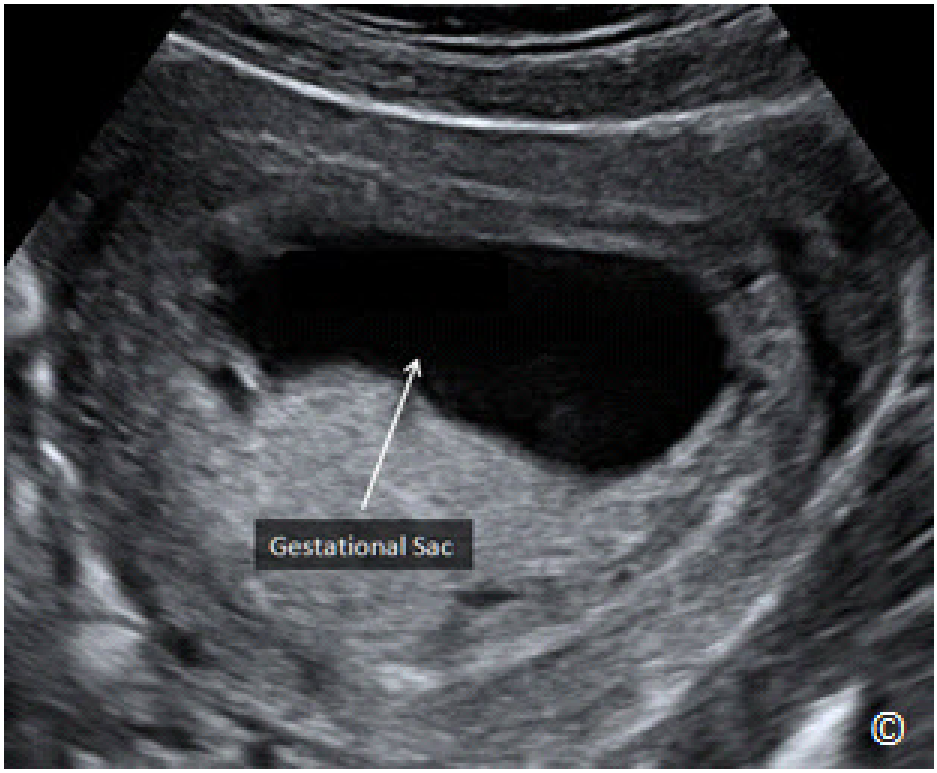

Figure 4.6: A large gestational sac (MSD > 25 mm) with no embryo seen. This is diagnostic of a failed pregnancy**.**

Yolk Sac

The yolk sac is seen at 5 weeks gestation (menstrual age) on transvaginal ultrasound, as a small ring within the gestational sac with highly echogenic borders (**Figure 4.7**). It is visible at 5 weeks + 5 days gestation. It has a diameter of around 2mm at 6 weeks and increases slowly to around 6mm at 12 weeks. The first detection of the embryo by ultrasound is noted in close proximity to the free wall of the yolk sac, since the yolk sac is connected to the embryo by the vitelline duct (**Figure 4.8**). A small yolk sac with a diameter less than 3mm between 6-10 weeks or a diameter of more than 7mm before 9 weeks are suspicious for an abnormal pregnancy and thus this observation requires a follow-up ultrasound examination to assess pregnancy viability (**Figure 4.9 A and B**).

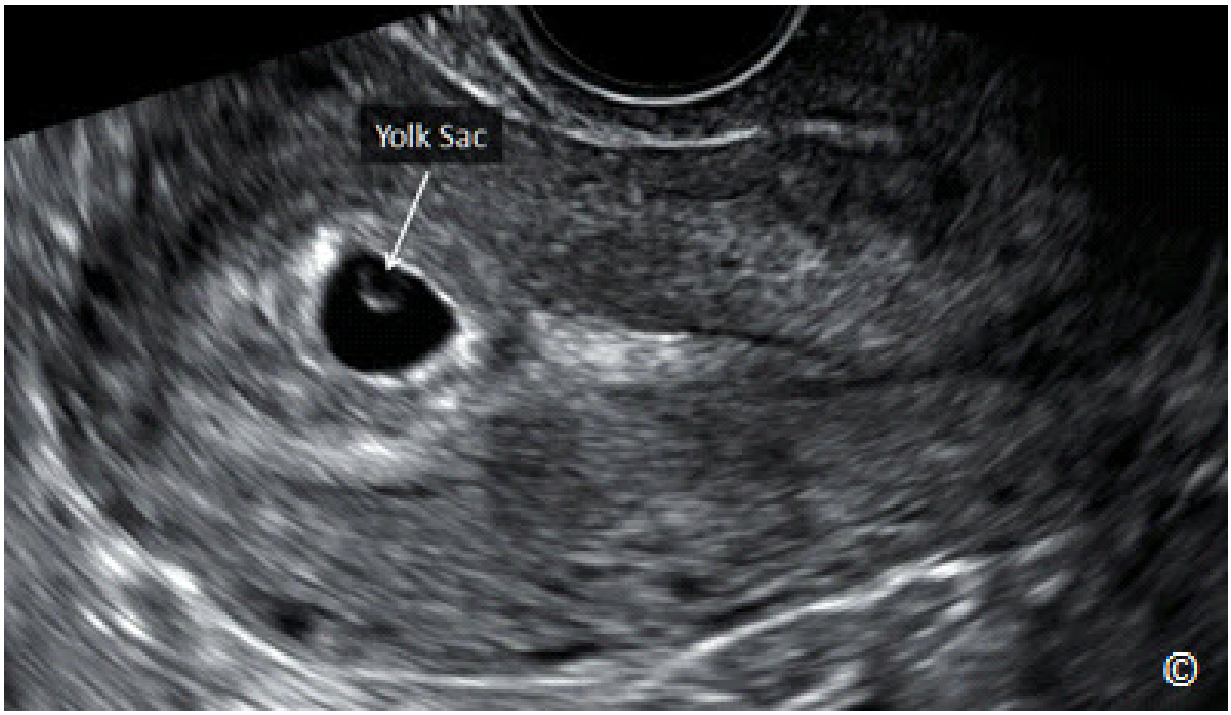

Figure 4.7: A mid-sagittal plane of a uterus with a gestational sac at 5.5 weeks' gestation. Note the yolk sac seen within the gestational sac (labeled) with highly echogenic borders.

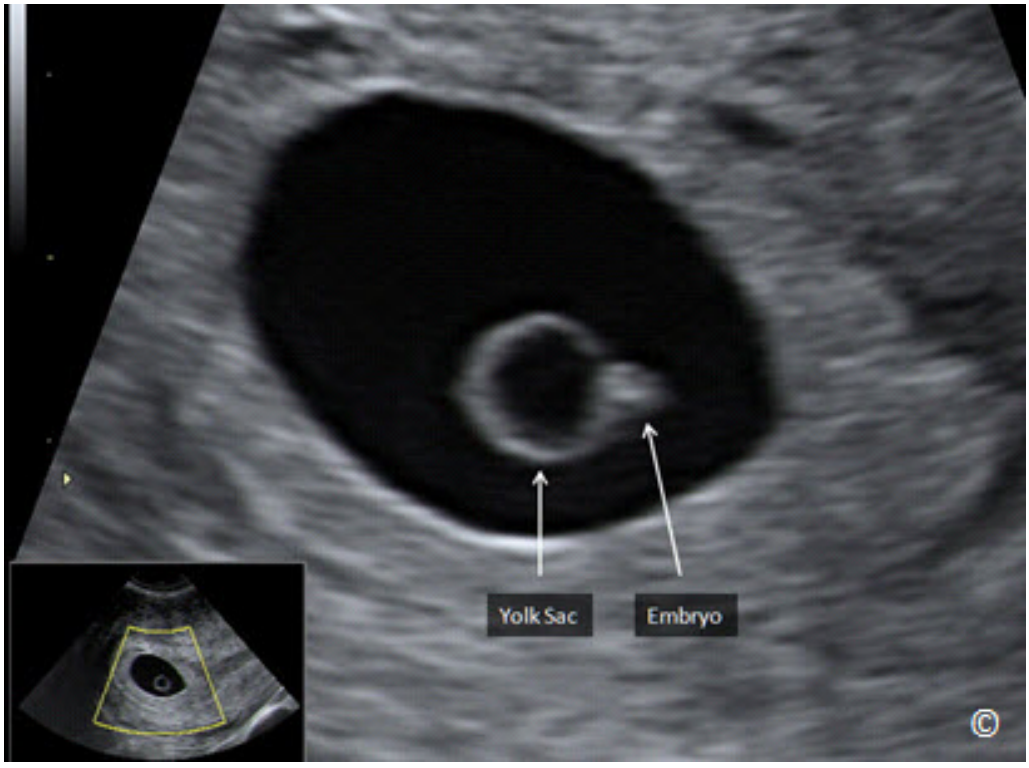

Figure 4.8: Gestational sac at 6 weeks. Note the location of the embryo (labeled) in close proximity to the free wall of the yolk sac (labeled). The embryo is attached to the yolk sac by the vitelline duct (not seen). The yolk sac and the embryo give the appearance of a diamond engagement ring at this gestation.

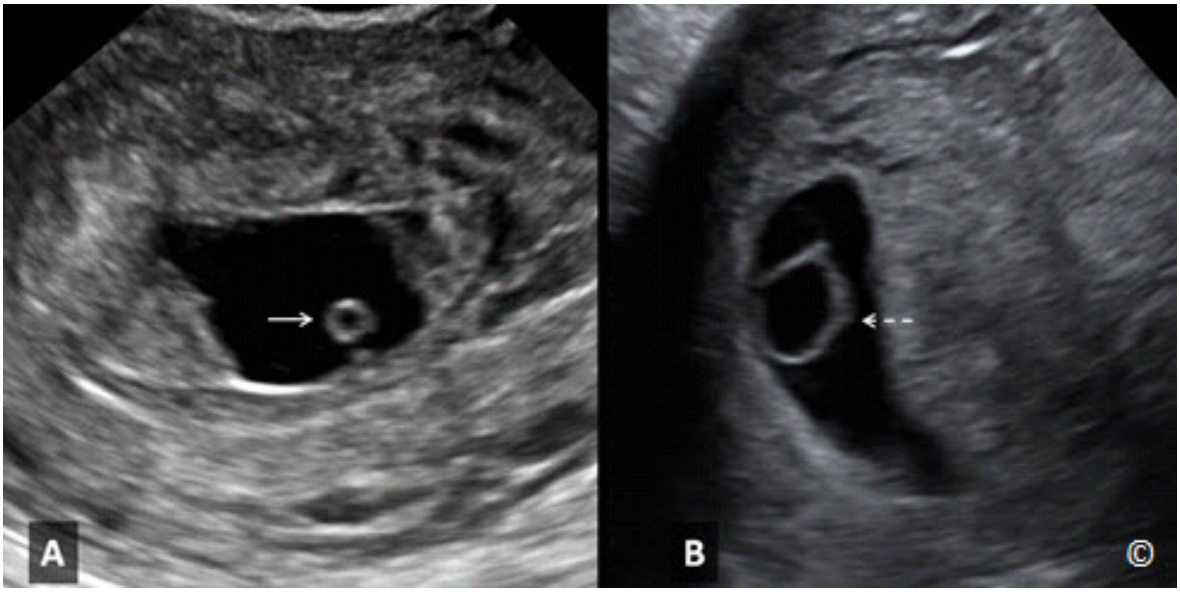

Figure 4.9 A & B: Figures 4.9 A and B show 2 gestational sacs with abnormal size yolk sacs: small in A - (solid arrow) and large in B (broken arrow). Abnormal size of yolk sacs is correlated with a suspicion for an abnormal pregnancy.

Amnion

The amniotic sac develops as a thin echogenic structure surrounding the embryo (**Figure 4.10**). The amniotic sac appears following the appearance of the yolk sac and just before the appearance of the embryo. Whereas the gestational sac shows variations in size and shape, the growth of the amniotic sac is closely related to that of the embryo between 6 and 10 weeks.

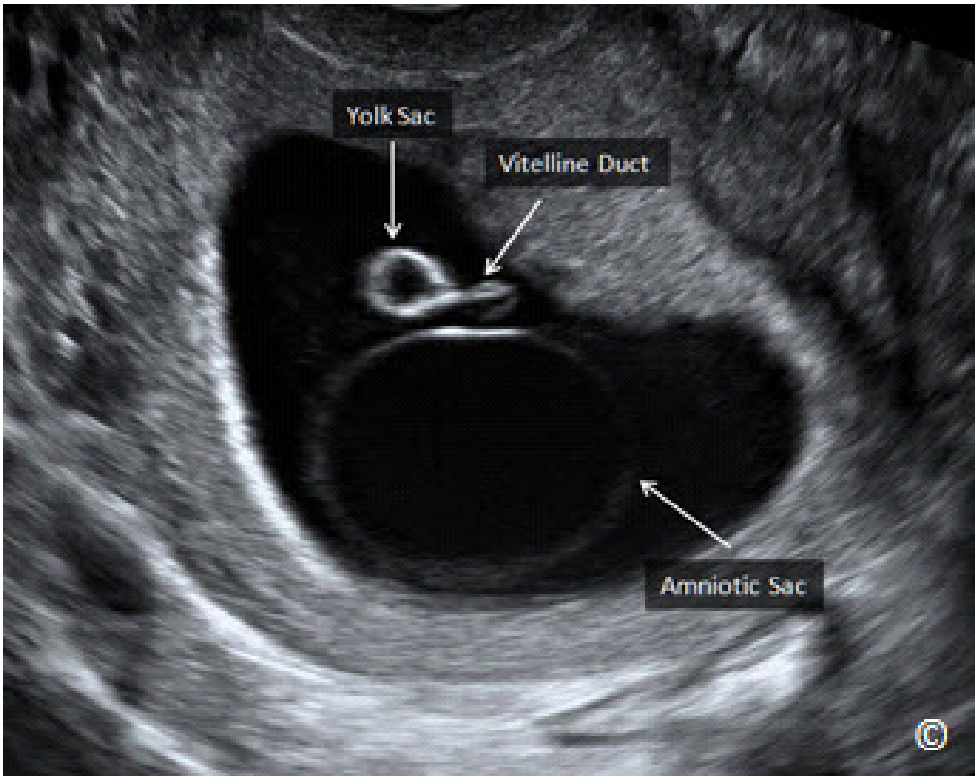

Figure 4.10: Gestational sac at 7 weeks gestation. The amniotic sac (labeled) is seen as a thin reflective circular membrane. The yolk sac and vitelline duct are seen as extra-amniotic structures (labeled).

Embryo

The embryo is first seen on transvaginal ultrasound as a focal thickening on top of the yolk sac, giving the appearance of a "diamond engagement ring" (**Figure 4.8**), at around the 5th menstrual week. First cardiac activity should be seen at 6 to 6.5 weeks. The embryo can be recognized by high resolution transvaginal ultrasound at the 2-3mm length size (**Figure 4.11**), but cardiac activity can be consistently seen when the embryo reaches a 5-7 mm in length or greater. Cardiac rhythm increases rapidly in early gestation being around 100-115 before 6 weeks, rising to 145-170 at 8 weeks and dropping down to a plateau of 137 to 144 after 9 weeks gestation. The size of the embryo increases rapidly by approximately 1mm per day in length. The measurement of the length of the embryo, referred to as the Crown-Rump-Length (CRL), is reported in millimeters.

It is the longest distance in a straight line from the cranial to the caudal end of the body and is the most accurate assessment for pregnancy dating. Recent studies suggest that it is prudent to use a cutoff of ≥7 mm (rather than ≥5 mm) for CRL with no cardiac activity for diagnosing failed pregnancy. This would yield a specificity and positive predictive value at (or as close as can be determined) to 100%. Since cardiac activity is usually visible as soon as an embryo is detectable, the finding of no heartbeat with a CRL <7 mm is suspicious, though not diagnostic, for failed pregnancy (2, 3).

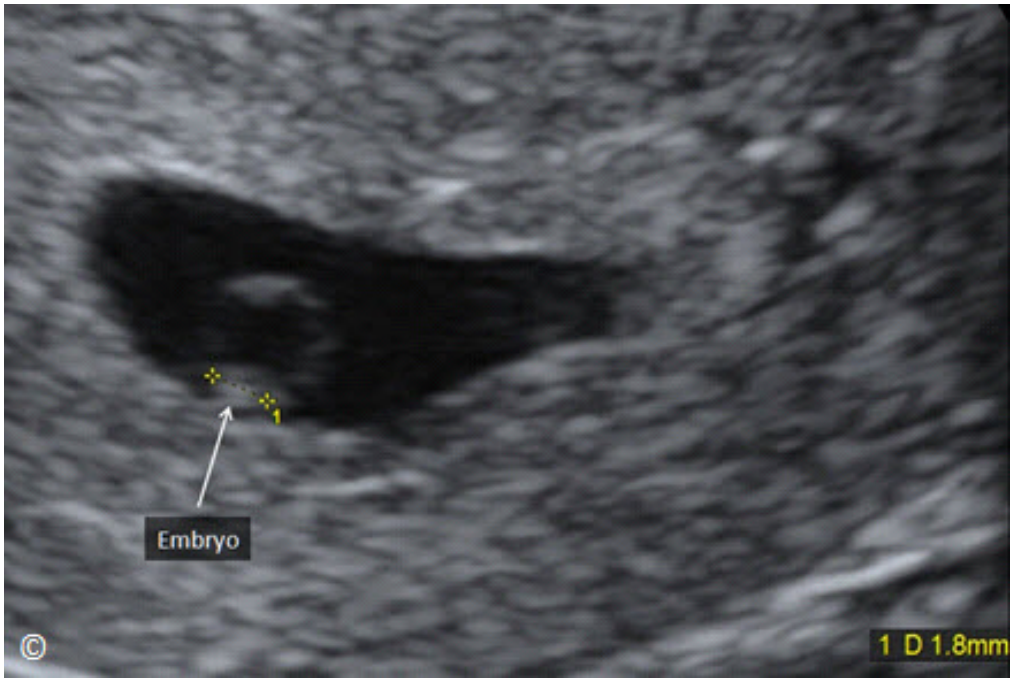

Figure 4.11: Transvaginal ultrasound of a gestational sac with an embryo (labeled) measuring 1.8 mm in size. Note the proximal location of the yolk sac (not labeled) to the embryo.

Note that the embryo develops within the amniotic cavity and is referred to as intraamniotic whereas the yolk sac is outside of the amniotic cavity and is referred to as extraamniotic (**Figure 4-10**). The fluid that the yolk sac in embedded into is the extraembryonic coelom.

The appearance of the embryo on ultrasound changes from 6 weeks to 12 weeks gestation. At 6 weeks gestation, the embryo appears as a thin cylinder with no discernible body parts "the grain of rice appearance" (**Figure 4.12**). As gestational age advances, the embryo develops body curvature and clear delineation on ultrasound of a head, chest, abdomen and extremities "the gummy-bear appearance" (**Figure 4.13, 4.14 and 4.1**). Close observation of anatomic details on transvaginal ultrasound at or beyond 12 weeks gestation may allow for the diagnosis of major fetal malformations. This requires extensive expertise and is beyond the scope of this book. We provide a table of major fetal malformations (**Table 4.4**) that can be diagnosed at 12 weeks or

beyond. **Figures 4.15 – 4.18** show examples of fetuses with major malformations at or before 12 weeks of gestation.

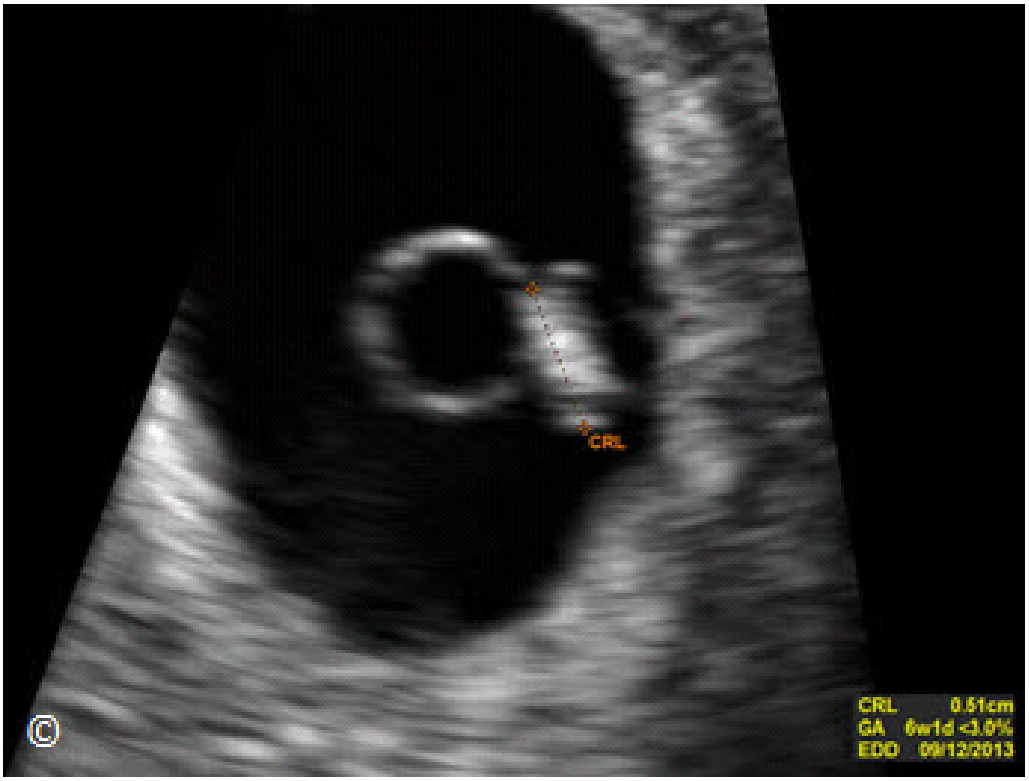

Figure 4.12: Gestational sac at 6 weeks with an embryo measuring 5.1 mm in Crown-Rump Length (CRL). Note the straight shape of the embryo, resembling a grain of rice.

Figure 4.13: Gestational sac with an embryo at 8 weeks. Note the appearance of body curvature of the embryo (labeled), resembling a gummy bear in shape. The yolk sac is also labeled.

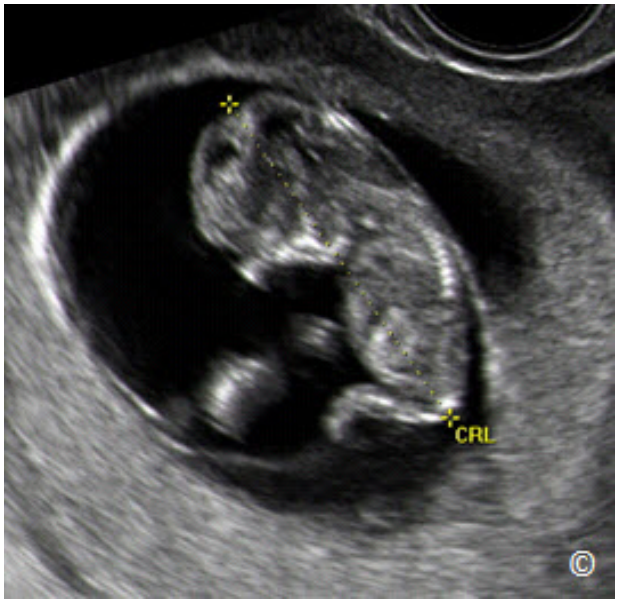

Figure 4.14: Gestational sac with an embryo at 10 weeks gestation. Note the clear delineation of a head, chest, abdomen and extremities. CRL=Crown-Rump Length.

TABLE 4.4	Major Fetal Malformation that can be Diagnosed in Early Gestation

- Anencephaly-exencephaly sequence
- Alobar and semilobar holoprosencephaly
- Large encephalocele
- Pentallogy of Cantrell (severe thoraco-abdominal wall defect with ectopia cordis and exomphalos)
- Gastroschisis
- Large omphalocele (watch-out for possible physiologic herniation of the bowel)
- Limb-body-wall complex (also known as body-stalk anomaly)
- Cystic hygroma
- Gross limb defects
- Frank hydrops

Figure 4.15: Mid-sagittal view of a fetus at 11 weeks gestation with anencephaly. Note the abnormally shaped head with absence of cranium (arrow).

Figure 4.16: Coronal view of a fetus at 10 weeks gestation with cystic hygroma. Note the generalized subcutaneous swelling (arrows). CRL = Crown-Rump Length.

Figure 4.17: A fetus with Pentalogy of Cantrell at 12 weeks gestation. Note the presence of a large abdominal and chest defect (arrow), with a protruding omphalocele.

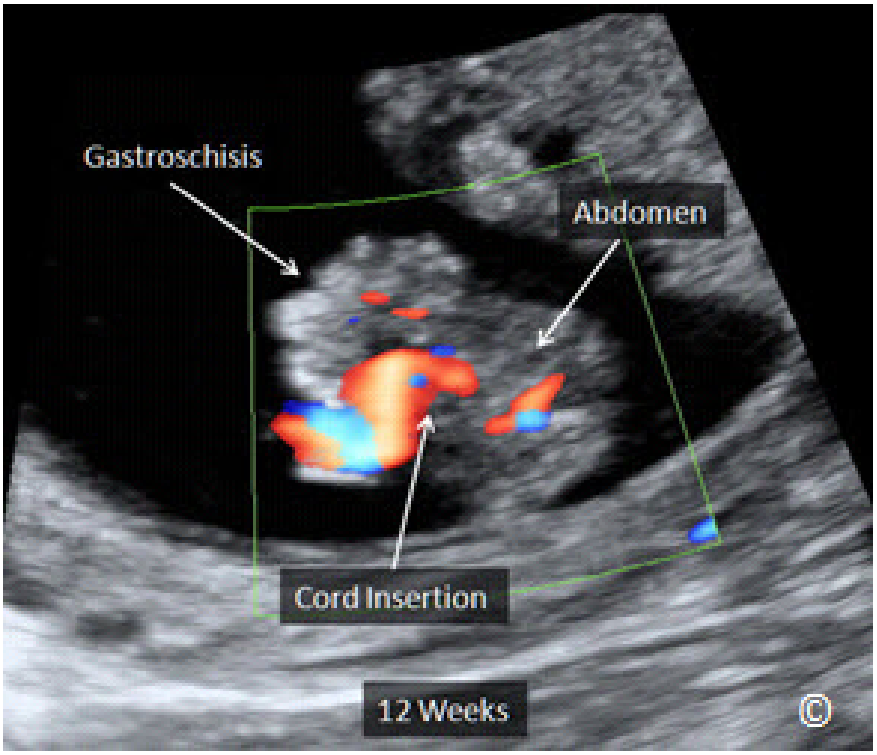

Figure 4.18: Gastroschisis (labeled) in a fetus at 12 weeks gestation demonstrated in a transverse view of the abdomen. Note the cord insertion (labeled) to the left of the defect.

MULTIPLE GESTATION AND CHORIONICITY

Chapter 7 describes in details ultrasound in multiple gestations. We will present here the role of the first trimester ultrasound in assigning chorionicity and amnionicity. Twins and higher order multiple gestations are easily diagnosed in early gestation. The first trimester is the most optimum time for the diagnosis of multiple gestations and for the assessment of chorionicity. In multiple gestations, first trimester ultrasound has also the essential role of assessing the type of chorionicity and recording it in the written ultrasound report. As pregnancy advances, it becomes more difficult to be certain of the chorionicity of multiple gestations.

We will focus on twins in this section as higher order multiple pregnancies is beyond the scope of this book and applies the same diagnostic principles as twins. The presence of a higher older multiple pregnancy should necessitate referral to an advanced imaging center. Twins can share one placenta and are thus referred to as monochorionic (MC). Twins can have two separate placentas and are then called dichorionic (DC). Dichorionic twins are two independent pregnancies within one uterus and with very rare exceptions have no shared placental vascular network between the twins. All dichorionic placentas, by definition, have 2 amniotic sacs and thus are diamniotic also. Dizygotic twins always have dichorionic placentation. Their placentas

may be separated or intimately fused. Dizygotic twins are more common than monozygotic twins, with a ratio of 3 to 1.

Most monozygotic twins have a placenta that is monochorionic – diamniotic (~75 %), some monozygotic twins have a dichorionic – diamniotic placenta (~25 %), and rarely, the placenta can be monochorionic- monoamniotic (~1%). Conjoined twins are monoamniotic and are less common still. These three entities of twinning are best diagnosed in early gestation after 8 weeks when yolk sac(s) are present and further management and follow up of gestation depends highly on the twin subgroup detected:

1) In dichorionic-diamniotic twins there are two gestational sacs with thick dividing membrane that includes chorionic tissue, separating both gestational sacs. The chorionic tissue separating the gestational sacs is referred to as "delta, lambda or twin-peak" sign and is diagnostic of a dichorionic gestation (**Figure 4.19**). In each sac we can find a yolk sac and an embryo.
2) In monochorionic- diamniotic twins, there is one gestational sac but each embryo has its own amniotic sac and yolk sac (**Figure 4.20**). The dividing membrane that separates the amniotic cavities is thin and inserts in a characteristic "T" configuration into the shared placenta (**Figure 4.21**).
3) In monochorionic-monoamniotic twins, there is one gestational sac, one amniotic sac, one yolk sac but two embryos. No separating/dividing membrane is noted (**Figure 4.22**).
4) Conjoined twins will have the same placental characteristics as a monochorionic-monoamniotic placenta with conjoined embryos (**Figure 4.23**). Note that the term "conjoined" is a misnomer as the twin has actually failed to separate completely instead of being conjoined. The terminology however is well accepted.

Further detailed discussion of multiple gestations is presented in Chapter 7.

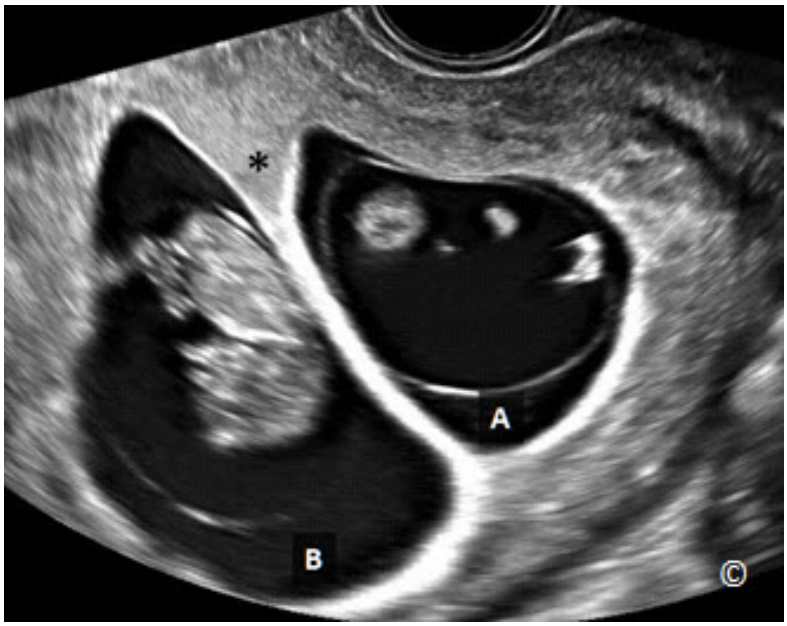

Figure 4.19: Dichorionic-diamniotic twin pregnancy. Note the thick dividing membrane separating both gestational sacs (A and B). Chorionic tissue (asterisk) is present at the attachment of the dividing membrane known as "delta or lamda" sign.

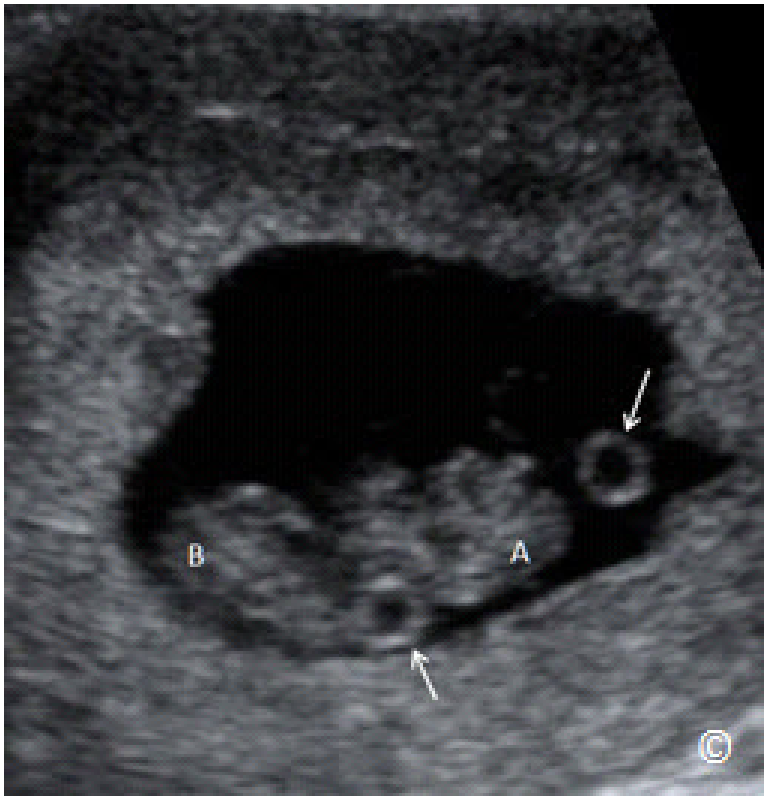

Figure 4.20: Monochorionic- diamniotic twins (A and B) at 8 weeks gestation. Note the presence of 2 yolk sacs (arrows). A thin separating membrane is not visible in this image.

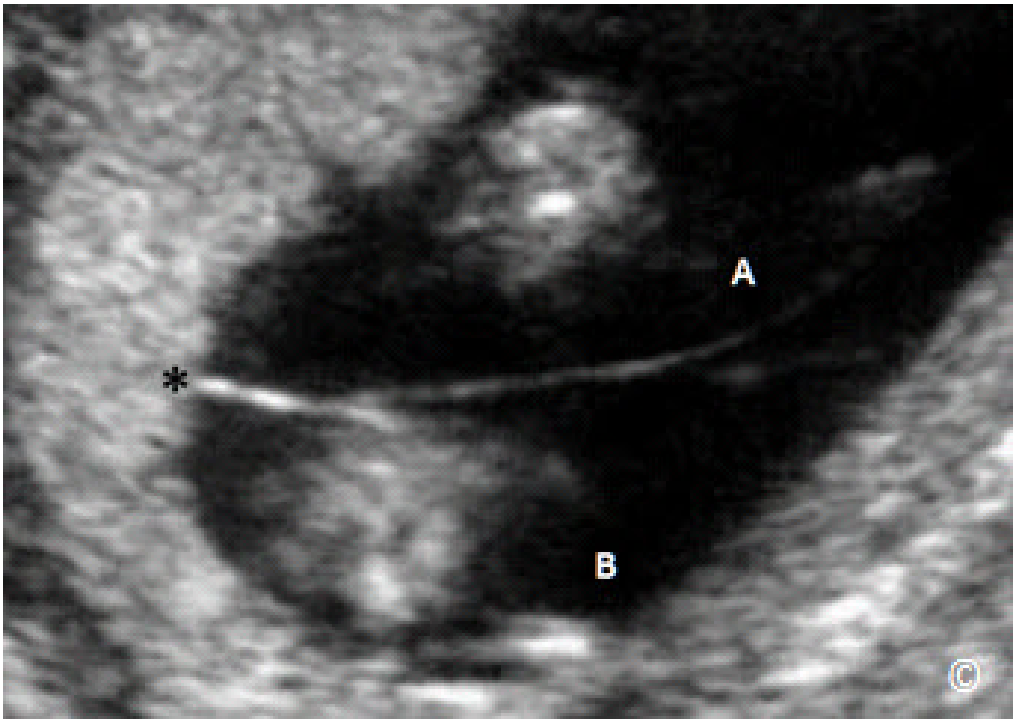

Figure 4.21: Monochorionic-Diamniotic twins. Note a thin dividing membrane that separates the amniotic cavities (A and B) and inserts in a characteristic "T" configuration (asterisk) into the shared placenta.

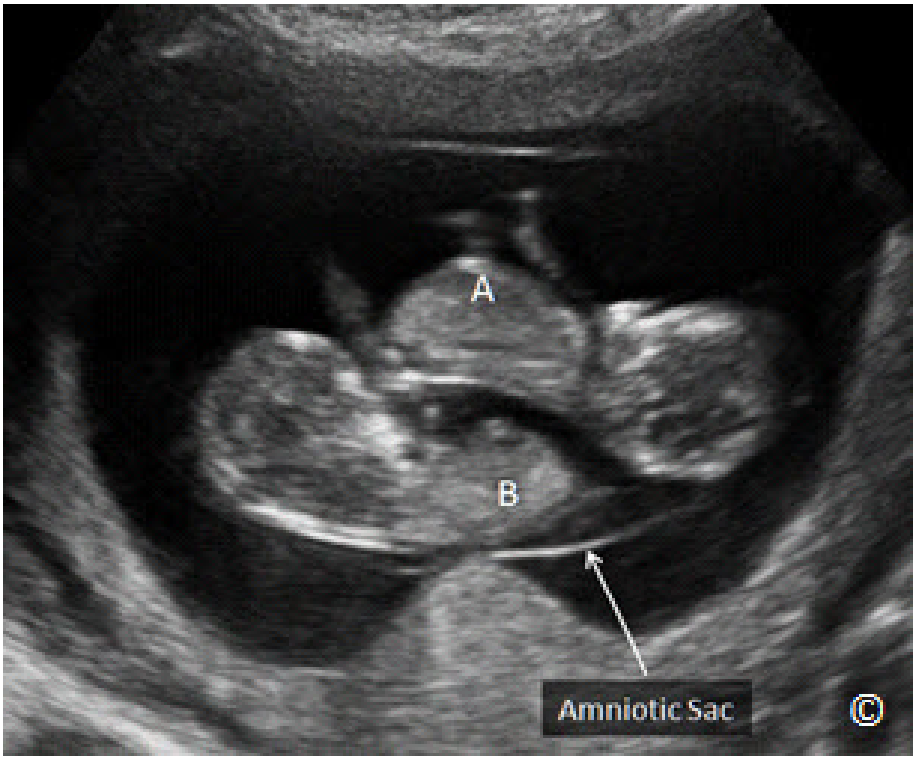

Figure 4.22: Monochorionic- monoamniotic twins (A and B). Note the presence of a single amniotic sac (labeled).

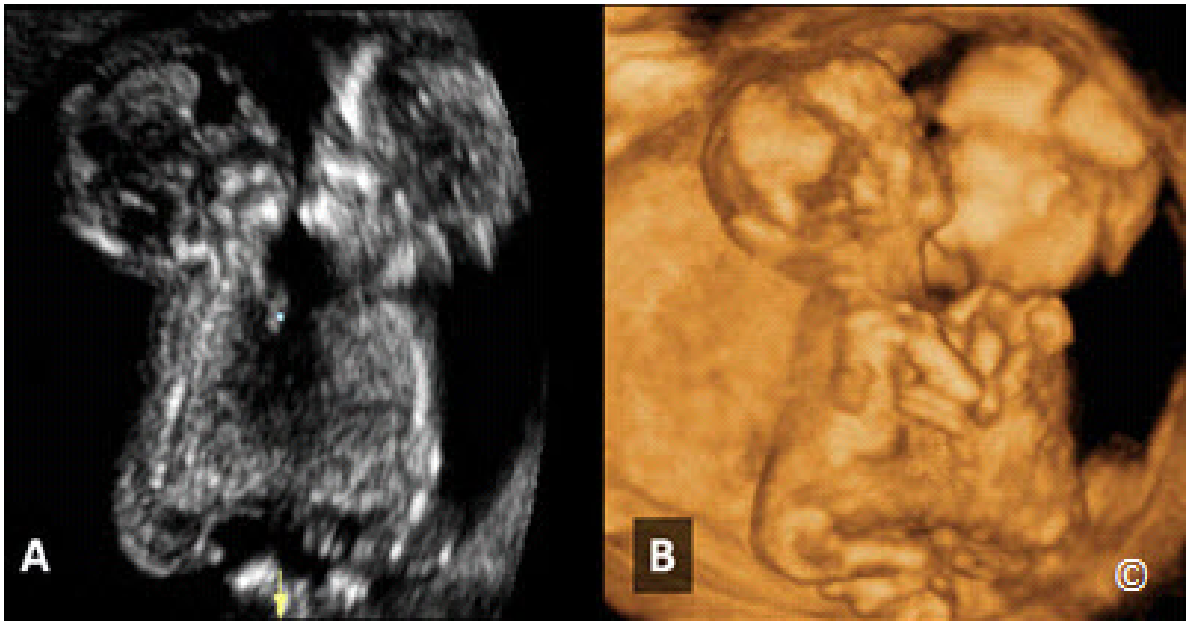

Figure 4.23 A & B: Conjoined twins at 12 weeks gestation on 2D (A) and 3D (B) ultrasound. Note that the twins are joined at the chest and abdomen. More detail on conjoined twins is presented in chapter 7.

PREGNANCY DATING IN THE FIRST TRIMETESTER

One of the most important aspects of obstetric ultrasound in the 1st trimester is dating of pregnancy; this is accomplished by performing few simple biometric measurements: 1) the gestational sac diameter, when no embryo is seen; 2) the length of the embryo, or Crown-Rump Length (CRL); 3) in the late 1st trimester (12-13 weeks), the Biparietal Diameter (BPD). The obtained values are to be compared with established reference ranges to provide an accurate dating. With an accurate ultrasound-derived gestational age in the first and second trimester of pregnancy, ultrasound can reliably date a pregnancy with unknown dates and establish an estimated date of delivery with accuracy.

In clinical medicine the age of an embryo or a fetus is expressed in "*weeks of gestation*" and not in months and these weeks are calculated from the first day of the last menstrual period (LMP), which corresponds to 2 additional weeks from the date of conception. Gestational age is therefore calculated from the first day of the last menstrual period (LMP) and roughly corresponds to the dates of conception plus about 14 days. An easy estimation of the date of delivery is the Naegle's rule, which is the first day of the LMP + 7 days and minus 3 months (use the next calendar year). In general most ultrasound equipment has an integrated calculator, which calculates the estimated date of delivery as the LMP is entered. **Table 4.5** lists some facts about gestational dating in the first trimester.

TABLE 4.5 Facts about Gestational Dating in the First Trimester

- Gestational age is calculated from date of onset of the last menstrual period (LMP) and not from time of conception
- Date of delivery = first day of LMP + 280 days
- Ultrasound equipment provide a calculator of gestational age
- Measuring the embryo or the fetus or other structures before 14 weeks is the most reliable way to estimate gestational age by ultrasound

In estimating gestational age by ultrasound, it is important to remember these critical points:

- Once an established date of delivery is assigned to a pregnancy following an ultrasound examination, irrespective whether the assigned established dates were those by ultrasound or by menstrual dates, these dates should not be changed during pregnancy.

- If a patient reports no menstrual dates, ultrasound in the first or second trimester should establish the estimated date of delivery.
- If the ultrasound biometric measurements vary from the menstrual dates by more than 5-7 days in the first trimester, than ultrasound should be used to establish the date of delivery (1).
- Ultrasound dating of pregnancy is most accurate in the first trimester.

BIOMETRIC MEASUREMENTS IN THE FIRST TRIMESTER

Biometric measurements for dating in the first trimester of pregnancy include the length of the embryo; referred to as the crown-rump length (CRL), mean gestational sac diameter (MSD), embryo/fetus biparietal diameter (greater than 11 weeks), and more rarely, the yolk sac and/or amnion sac diameters. The most accurate and reproducible biometric measurement is the CRL and should be the preferred measurement when feasible.

Crown-Rump Length

The CRL corresponds to the length of the embryo in millimeters. Although, the name implies a measurement from the crown to the rump of the embryo, the actual measurement corresponds to the longest "straight line" distance from the top of the head to the rump of the embryo/fetus (**Figure 4.24**), despite the noted body curvature. The CRL measurements are more accurate in the earlier parts of the first trimester. When measuring the CRL, the operator should use the mean of three discrete measurements, obtained in a mid-sagittal plane. It is recommended to follow the following parameters when dating a first trimester pregnancy (< 14 weeks) by CRL:

- For pregnancies at less than 9 weeks' gestation, a discrepancy of more than 5 days from LMP is an appropriate reason for changing the Expected Date of Delivery (EDD).
- For pregnancies between 9 and 13 6/7 weeks' gestation, a discrepancy of more than 7 days should result in a change in the EDD.

The CRL increases rapidly at a rate of approximately 1.1 mm per day. An approximate formula to calculate gestational age from the CRL is Gestational Age in days = CRL (mm) + 42, however this may not be needed since most ultrasound equipment have integrated software which allows gestational age determination upon measurement of CRL or other biometric data. **Table 4.6** shows gestational age and corresponding CRL in mm.

Figure 4.24: Crown-Rump Length (CRL) measurement of a fetus at 12 weeks gestation. Note that the CRL measurement corresponds to the longest straight line from the top of the head to the rump region.

TABLE 4.6 **Gestational age and corresponding Crown Rump Length (mm)**

Gestational Age (GA	Crown Rump Length (mm)
6 + 0 weeks	5
7 + 0 weeks	10
8 + 0 weeks	15
9 + 0 weeks	23
10 + 0 weeks	32
11 + 0 weeks	42

Mean Sac Diameter

Since the gestational sac is the first evidence of pregnancy on ultrasound and is first visualized within the endometrial cavity at 4 to 4.5 weeks after the LMP, its detection and measurement can be used to confirm and date a pregnancy. Its size at first appearance is around 2 to 4 mm in diameter, and is localized in the decidua, paracentrically with echogenic borders. The early demonstration of a gestational sac is best performed by transvaginal ultrasound. The biometric measurement for pregnancy dating uses the mean sac diameter (MSD) calculated as the arithmetic mean diameters derived from its greatest sagittal, transverse and coronal planes (**Figure 4.25 A and B**). Gestational sac confirms the presence of an intrauterine pregnancy but not the viability of the embryo. Therefore an empty gestational sac or with a yolk sac are signs

that the pregnancy is 5-6 weeks gestation, a follow in 7-14 days will demonstrate the presence of an embryo and confirms viability. It is not recommended to use the MSD for estimating the due date, as the CRL is a more precise dating method and should be the preferred choice.

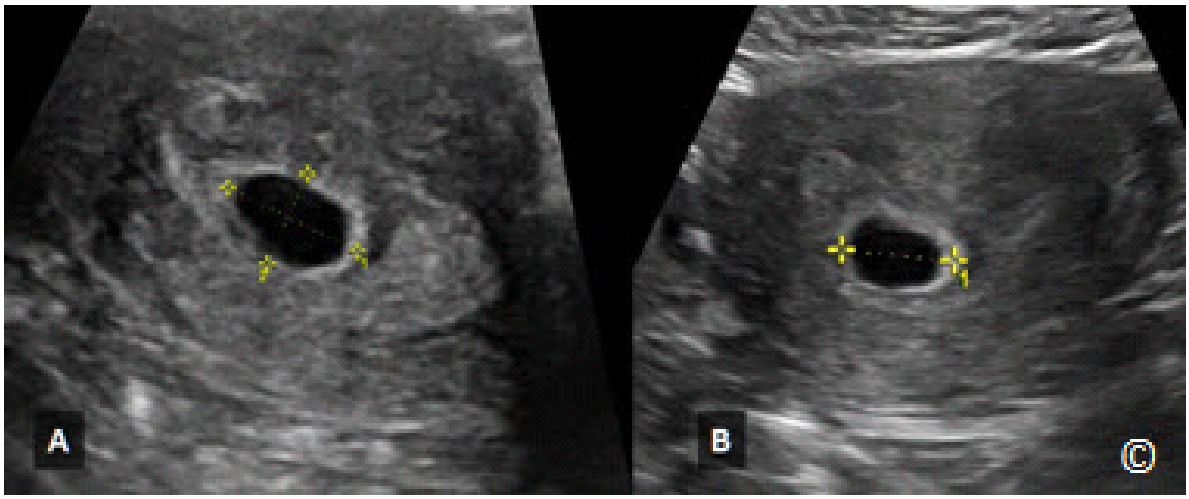

Figure 4.25 A & B: Mean sac diameter (MSD) of a gestational sac at 5 weeks calculated as the arithmetic mean diameters derived from its greatest sagittal (A1), transverse (A2) and coronal planes (B1).

Amniotic Sac / Yolk Sac

The amniotic sac develops around the embryo as a thin membrane that surrounds the embryo and is less echogenic than the yolk sac (**Figure 4.10**). Whereas the gestational sac shows variations in size and shape, the growth of the amniotic sac is closely related to the growing embryo.

Once an embryo with cardiac activity is seen on ultrasound, the MSD, the size of the amniotic cavity or yolk sac are not used for dating, but for documentation of normal development. Observation of abnormal measurements of these structures in association with a normal developing embryo are often not enough to diagnose a failed pregnancy, but close follow up is prudent.

NUCHAL TRANSLUCENCY

Nuchal translucency (NT) is a measurement of a collection of fluid under the skin behind the fetal neck in the first-trimester of pregnancy. NT is measured between 11weeks and 13 weeks and 6 days or a CRL of 45 – 84 mm. NT provides a risk assessment for chromosomal abnormalities and can be a marker of other fetal abnormalities. For efficiency in screening, NT is best combined with maternal age and maternal blood biochemical markers such as hCG and pregnancy-associated plasma protein (PAPP-A). In order to incorporate NT in clinical practice,

physicians and sonographers should get certified in NT measurement and an ongoing quality assurance program on NT measurement should be established. National and international NT quality assurance programs exist such as the Fetal Medicine Foundation (www.fetalmedicine.com) and the Nuchal Translucency Quality Review (www.ntqr.org). **Table 4.7** shows the technical aspects of NT measurement. **Figures 4.26 and 4.27** show 2 fetuses with a normal and large NT measurement respectively.

TABLE 4.7	Technical Aspects of Nuchal Translucency Measurement (NT) – From NTQR.org with Permission

1. Margins of NT edges clear
2. Fetus in the mid-sagittal plane
3. Fetus occupies the majority of the ultrasound image
4. Fetal head in the neutral position
5. Fetus observed away from the amnion
6. (+) Calipers used
7. The calipers horizontal crossbars are placed on the NT line
8. The calipers are placed perpendicular to the long axis of the fetus
9. The measurement is at the widest NT space

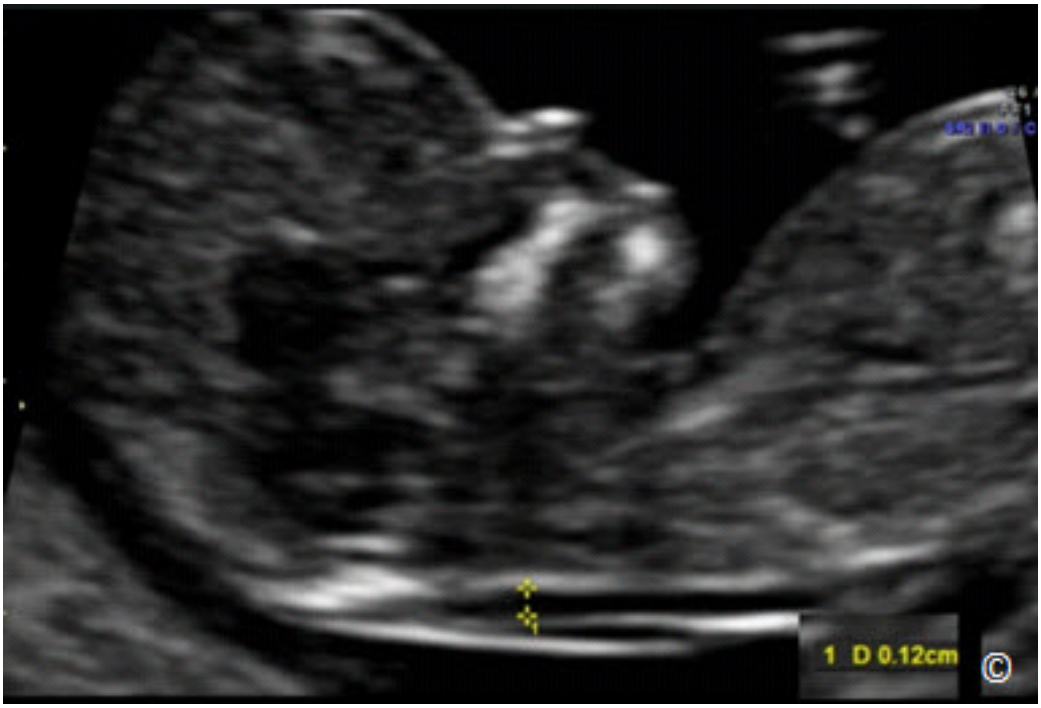

Figure 4.26: Mid-sagittal plane of a fetus in the first trimester of pregnancy with a normal nuchal translucency measurement (NT).

Figure 4.27: Mid-sagittal plane of a fetus in the first trimester of pregnancy with an enlarged nuchal translucency measurement (NT).

ELEMENTS OF PREGNANCY FAILURE

The examiner dealing with first trimester ultrasound is often confronted with the situation of a suspected or a confirmed early pregnancy failure. It should be known that during this stage, at least 10-15% of all pregnancies end as pregnancy failure and the diagnosis can often be made by ultrasound, typically before symptoms develop by patients. Depending on the gestational age of pregnancy, several scenarios can be expected:

- Pregnancy confirmed by a positive pregnancy test but no gestational sac is noted in the uterine cavity by ultrasound, suggesting the differential diagnosis of an incomplete abortion, an ectopic pregnancy or an early intrauterine pregnancy that is not yet recognizable by transvaginal ultrasound.
- Gestational sac noted by transvaginal ultrasound, but no signs of embryo or yolk sac within it.
- An embryo visualized on transvaginal ultrasound, but no cardiac activity detected.
- An embryo with cardiac activity detected, but various measurements are out of range (heart rate, size of yolk sac, embryo, amniotic sac etc.).
- Presence of subchorionic bleeding, with or without clinical signs of bleeding.
- Abnormal anatomic appearance of the embryo.

In many conditions if the health of the patient is not in danger (bleeding, pain etc.) and an ectopic pregnancy is not in the differential diagnosis, a follow-up ultrasound examination is helpful to assess for change in the ultrasound findings and in confirming the suspected diagnosis. Given that the developing gestational sac undergoes notable significant change on a weekly basis in the first trimester, follow-up ultrasound that fails to show a noticeable change after 1 week or more, casts a poor prognostic sign and can confirm the diagnosis of a suspected failed pregnancy. The presence of subchorionic bleeding is generally associated with a good outcome in the absence of other markers of pregnancy failure **(Figure 4.28 A & B)**. It is the opinion of the authors that in the absence of specific findings of failed pregnancy, conservative management with follow-up ultrasound examination is helpful in the evaluation of a suspected failed pregnancy in the first trimester. **Table 4.8** lists specific findings of failed pregnancy in the first trimester which when noted can establish the diagnosis without a need for a follow-up examination.

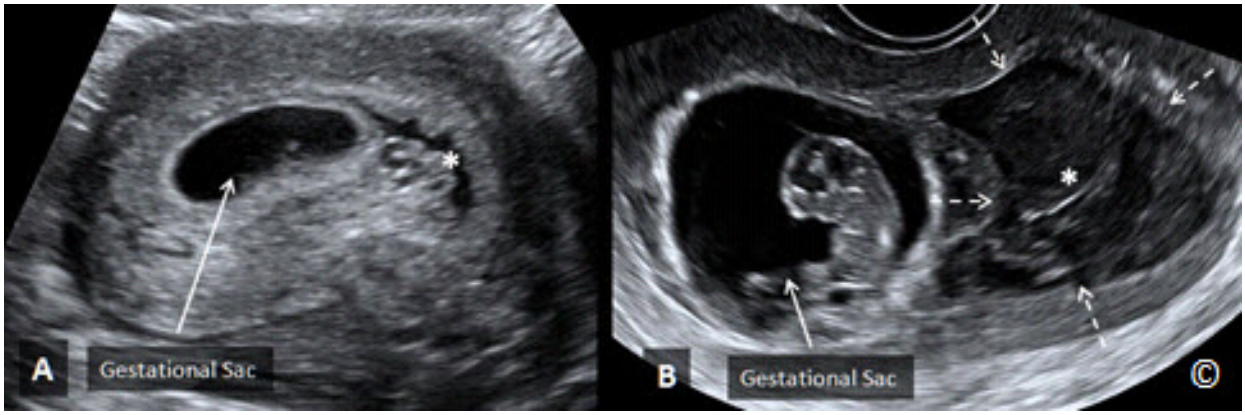

Figure 4.28 A & B: Small (A - asterisk) and large (B – asterisk and broken arrows) subchorionic bleeding in 2 pregnancies. Despite its size, the subchorionic bleeding in B was associated with a good pregnancy outcome.

TABLE 4.8	Diagnostic Signs of Early Pregnancy Failure in the First Trimester

- Crown-Rump length of equal to or greater than 7 mm without cardiac activity
- MSD of equal to or greater than 25 mm without an embryo
- Absence of embryo with heartbeat at 2 or more weeks after an ultrasound that showed a gestational sac without a yolk sac
- Absence of embryo with heartbeat at 11 days or more after an ultrasound that showed a gestational sac with a yolk sac

CONCLUSIONS

The ultrasound examination in the first trimester is an important step in the evaluation of the pregnancy as it allows for confirmation of an intrauterine gestation and for accurate pregnancy dating. It is of note that significant change occurs in the first trimester in the normal pregnancy and this change can be detected by transvaginal ultrasound examination. Sequential steps of the normal development of the pregnancy should be known in order to better compare the actual ultrasound findings with the corresponding gestational age. This is the basic knowledge that is needed in order to differentiate a normal from an abnormal gestation.

References:

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3) Abdallah Y, Daemen A, Kirk E, Pexsters A, Naji O, Stalder C, Gould D, Ahmed S, Guha S, Syed S, Bottomley C, Timmerman, Bourne T. Limitations of current definitions of miscarriage using mean gestational sac diameter and crown–rump length measurements: a multicenter observational study. Ultrasound Obstet Gynecol 2011; 38: 497-502.