What to Look for in the Ultrasound Examination of Multiple Pregnancy?

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ABSTRACT

Since multiple pregnancies are of higher perinatal risk to diminish the rate of complications and stillbirth, the proper ultrasound management has to be done. Twins differ in zygosity, chorionicity, and amnionicity. Authors summarize how to diagnose the type of pregnancy and its complications in ultrasound examination and what to look for to achieve as much as possible of vital information. Authors propose some general rules for sonographers:

- Prenatal US—the same schedule as in singletons for assessment of fetal morphology and markers of genetic abnormalities despite special schedule for twins.
- Keep patient aware about the possibility of “vanishing twin.”
- Set the chorionicity as early as possible.
- Set the amnionicity in the first-trimester scan.
- Look for the prognostic signs of twin-to-twin transfusion syndrome (TTTS) in the first- and second-trimester scan.
- Monitor the amniotic fluid volume from 16th week gestational age (GA) on.
- Monitor the fetal growth from the first-trimester scan on.
- Doppler US and growth every 2 weeks in monochorionic (MC) twins or every week if suspicious signs occur from the 16th week of GA on; every 4–6 weeks in DC twins.
- Exam the middle cerebral artery-peak systolic velocity (MCA-PSV) in MC from the mid-pregnancy on.
- Look for the cervix incompetence and the risk of preterm delivery.

Keywords: Amnionicity, Chorionicity, FGR, TAPS, TRAP, Twin pregnancy, TTTS, Ultrasound, Zygosity.

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The incidence of multiple pregnancies rises in recent years enormously. That is why we have become more interested in problems of such cases since human being is programmed to deliver one baby at a time.

Since it is not normal, the special attention has to be applied to such pregnancy in its proper management.

Sonography became the most important tool in the obstetric care and that is why we have to describe how the proper ultrasound survey should look like throughout the whole pregnancy. And, additionally the risk rises with the order of multiple pregnancy. So, the risk of triplets is higher than that of twins but quadruplet or quintuplet pregnancy is associated with extremely high risk of complications and stillbirths. Higher-order (than twins) pregnancies appear fortunately quite seldom, and for extremely high-order multiple pregnancy the procedure of fetoreduction should be considered.

Here we shall concentrate on twins.

Since one of twins can stop growing in the first trimester, each patient should be aware of the phenomenon of possible so-called “vanishing twin.”

Twins can differ in zygosity, chorionicity, and amnionicity. The perinatal risk depends on the type of twin pregnancy we deal with.¹

For perinatologist, the zygosity does not matter much, as the pregnancy complications usually do not arise from this difference or similarity. On the other hand, we cannot assess the zygosity of twins unless we perform the invasive diagnostics (DNA) of samples taken from both fetuses. It may be valuable if we look for special genetic purposes only. We cannot diagnose zygosity in ultrasound exam. Some suggestions may arise if you monitor the cycle by

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ultrasound and you see two separate ovums or two *corpora lutei* afterward, but still it is only a suggestion.

Dizygotic (DZ) pregnancy should always present two separate placentas but in selected cases placentas can fuse and present the image of one placenta, so you can never be sure. Monozygotic (MZ) twins, if split up to the 3rd day after conception, will also have two separate placentas and thus can mimic the DZ pregnancy. This does not bring huge problem, since separate placentas exclude major complications.

So, let's consider the chorionicity (number of chorions = placentas).

In dichorionic (DC) twins, the risk of all complications is about four times higher than in singletons, and the types of them are only the same as in singletons. But, MC twin pregnancy is associated with about 10 times higher risk of complications than in singletons and the special list of possible complications appears. This is due to

the presence of communicating vessels in common placenta and sometimes unequal placental sharing.

Thus, the first thing we have to get to know is if we deal with MC or DC pregnancy. To get to know this, it is enough to perform the ultrasound exam in the first trimester of pregnancy. Then you can clearly see one gestational sac in MC twin pregnancy and two gestational sacs in DC twins (Fig. 1).

That shows how it is essential to count sacs in the beginning of pregnancy, since this possibility will resolve later on. Usually after the midpregnancy (about the 20th week of gestational age), the description of chorionicity is not possible unless you see completely separate placentas located far apart.

In DC twin pregnancy the separating membrane has 4 layers and is quite rigid. If babies are moving, you can see that kicks of one fetus do not pass to the other side and can hardly touch the other twin. In MC pregnancy you can see the 2-layer separating membrane that can "float" and extremities of babies can easily touch the other twin. That can be easily seen in 2-D but also in 4-D movies.

Next, in DC pregnancy this 4-layer separating membrane attachment to placenta forms a so called "lambda-sign" in comparison to "t-sign" in monochorionics (Fig. 2).

Then, we should look for the number of amnions. Dichorionic pregnancy is always diamniotic (DA) but monochorionic pregnancy can be diamniotic or monoamniotic (MA). The early sign of amnionicity is the number of yolk sacs (Fig. 3). If there are two then the pregnancy is diamniotic. Then, later on we have to look for the separating membrane in ultrasound exam and the kind of its attachment to placenta.

The two-layer amniotic separating membrane in MC twins can be not clearly seen and could mimic the MA twins in technical unclear image. Thus, we should also seek yolk sacs in the early pregnancy. If we see two yolk sacs, then we should expect DA twins and if there is only one seen, then unfortunately, we should expect MA twins of the highest possible risk for complications and for adverse outcome.

This is also essential to set amnionicity as early as possible because in severe cases of TTTS the lack of amniotic fluid and presence of "stuck twin" may erroneously suggest MA pregnancy.

To approach to the answer which type of twin pregnancy we deal with you may consult the table (Table 1).

General ultrasound surveillance of twin pregnancy is the same as in singleton pregnancy for morphology of fetuses and for genetic markers, and is performed according to the same schedule

Figs 1A and B: Two gestational sacs on the left and one gestational sac on the right picture

Figs 2A and B: Lambda sign on the left picture and t-sign on the right picture

Fig. 3: Two yolk sacs indicating DA twins

Fig. 4: Unequal placental sharing in MC twins—postpartum image

Table 1: Guidance on how to diagnose the type of twins

Variant of twins	MC, MA	MC, DA	DC, DA
Corpus luteum	1	1	1 or 2
Gestational sac	1	1	2
Yolk sac	1	2	2
Separating membranes	No	Thin (<2 mm), two layers	thick (>2 mm), four layers
Membrane attachment	No	T-sign	Lambda sign
Fetal sex	Same	Same	Same or different

and rules. Nevertheless, ultrasound should be performed more frequently for other causes—the risk of complications typical for twin pregnancy:

- In DC twins every 4–6 weeks as fetal growth restriction (FGR) can appear more frequently
- In MC twins every 2 weeks in cases without prognostic features for TTTS, FGR, and/or twin anemia-polycythemia sequence (TAPS) development
- In MC twins every week in suspected cases for any of the abovementioned causes.

If the MC pregnancy is diagnosed, then all ultrasound exams have to be extended (as mentioned above) to look for possible complications typical for pregnancy with common placenta. The possible complications in MC pregnancy are:

- Twin-to-twin transfusion syndrome
- Selective fetal growth restriction (sFGR)
- Twin anemia-polycythemia sequence
- Twin-reversed arterial perfusion (TRAP).

Depending on trials, the incidence of these complications varies, but on average the risk of all adverse outcomes is, in high range, about 20%.^{2–4}

For TTTS, it is enough to measure the depth of two maximal vertical pockets (Pools) and if they outstand from the normal range (MVP in donor twin below 2 cm and at the same time above 8 cm in the recipient twin) the diagnosis of at least first stage of TTTS according to Quintero is set. Then, this patient should be transferred to the referential center to assess other possible features of TTTS:

invisible urinary bladder in donor (second stage), improper blood flow on tricuspid valve (tricuspid regurgitation), ductus venosus (reverse “a”-wave), and/or umbilical artery absent or reverse end-diastolic flow (AREDF) (third stage), fetal edema (fourth stage), and eventually one or two fetal demise (fifth stage).^{4,5}

The diagnosis of TTTS can be hardly set in the first trimester as there is little information about TTTS at early gestational stage. On the other hand, the early diagnosis leads to little clinical usefulness because we cannot perform placental vessel laser obliteration before the 16th week of gestational age (the only causative therapeutic procedure). Nevertheless, there are some ultrasound image prognostic factors in the first-trimester US for further TTTS development:⁶

- Discordant fetal growth (difference in CRL > 6 mm; PPV—19%)
- Fetal NT discrepancy (>20%, even if each NT in normal range; PPV = 24%)
- Discordant amniotic fluid in amniotic sacs (MVP >5 cm and <1 cm; adverse outcome in 80% of pregnancies and survival rate 50%)
- Reverse “a”-wave in DV blood flow in one or both twins (PPV = 38%)
- Fetal heart contractility changes (measured by shortening fraction and/or Tei index).

Entering the second trimester, we should look in ultrasound exam for other prognostic signs of TTTS like:

- Presence of single umbilical artery (SUA)
- Improper umbilical cord course and insertion (membranous, marginal, etc.)
- Absence of superficial anastomoses
- Separating membrane folding

Despite unbalanced circulation in common placenta, twins can suffer from unequal placental sharing. Then, a fetus sharing smaller part of common placenta can present restricted intrauterine growth called sFGR. Depending on how small part of the placenta the smaller fetus share, the prognosis to survive differs more (Fig. 4).

This is not unexpected that twins differ in body mass. But the question how small is too small remains open since common ultrasound systems are not equipped with growth charts for twins? And also should we put the limit on 3rd, 5th, or may be 10th centile in diagnosis of fetal growth restriction?

The presence of superficial anastomoses plays the protective role for smaller baby.⁹

If we diagnose the sFGR, then we have to monitor the blood flow in umbilical artery and this result in qualifying the problem to one of three types.⁷⁻¹⁰

- Normal blood flow pattern—better prognosis
- Persistent AREDF—poor prognosis
- Unstable blood flow—unclear prognosis

The strict monitoring of concordance in fetal growth and setting the blood flow type is important while considering the possible laser fetoscopic approach for treatment.

Fetal growth restriction can appear also in the DC pregnancy but for a bit other cause than in MC twins—due to small placenta of one or two twins.

If the unbalanced blood flow in placenta appears through very small vessels (<1 mm in diameter), then the twin anemia-polycythemia sequence can occur. In such cases, we do not observe significant difference in amniotic volume between both sacs and other TTTS symptoms. But the major symptom of TAPS is the significant difference in red-cell blood counts and hemoglobin concentration between twins.

We distinguish five stages of TAPS based on antenatal ultrasound examination of middle cerebral artery peak systolic velocity values set in multiple of medians (MoMs). These values correlate with the hemoglobin concentration in fetal blood (Table 2).

To summarize at this point, in twin pregnancy it is essential to advise all sonographers to look for three features of eventual MC twin pathology diagnosis:

- Amniotic fluid MVPs—for TTTS diagnosis
- Fetal growth accuracy and concordance as well as umbilical artery blood flow patterns for sFGR
- Middle cerebral artery-peak systolic velocity (MCA-PSV) for TAPS

Table 2: Stages of TAPS

Stage	In utero result
1	MCA-PSV donor >1.5 MoM MCA-PSV recipient <1.0 MoM
2	MCA-PSV donor >1.7 MoM MCA-PSV recipient <0.8 MoM
3	As in stage 1 or 2 + critical circulatory failure
4	Donor edema
5	One or two fetuses dead when TAPS previously confirmed

Other possible pathology of twin pregnancy quite easily diagnosed is TRAP—previously known as “acardiac” twin. This is due to the lack of heart or presence of rudimentary heart in one twin leading to reverse blood flow in this malformed twin.

Because the heart of normally formed baby pumps blood not only for itself but also for the body of malformed baby, this pathology can lead to the heart failure and fetal death. The prognosis depends on the proportion of the malformed baby mass to the mass of healthy one. In severe cases, early diagnosis is crucial because early umbilical cord occlusion (umbilical cord laser or bipolar occlusion or umbilical cord ligation) of malformed twin improves the pregnancy outcome.

In such pregnancy, a sonographer has to look for the proportions of twin bodies and for possible signs of healthy fetus heart failure.

Finally, there is the ultrasound diagnosis of amnionity in MC twins.

If the splitting into twins occurs between 8th and 13th day after conception, then the monoamniotic pregnancy appears. This is the extremely risky pregnancy in the final outcome due to normally observed umbilical cord entanglement leading to stillbirth. Usually cord entanglement can be seen in 2-D and 3-D ultrasound but there are no clear signs in sonography of approaching fetal demise due to cord entanglement and it is advised to deliver such babies electively between the 32nd and 34th week of gestational age. You may obtain the ideal Doppler profile of both twins and few minutes later fetuses may be dead *in utero* (Fig. 5).

If the splitting appears from the 14th day on after conception, then we usually observe the presence of conjoined twins (known as “Siamese twins”). In the early pregnancy ultrasound scans, we can see babies situated close one to the other, moving together, and sometimes common organs can be diagnosed. The other approach to the prognosis was proposed by the Leachman scale based on the common parts of hearts. Nevertheless, despite some selected cases, the prognosis is generally poor (also prognosis for eventual afterbirth separation) and the termination of pregnancy is usually counseled since this not only affects babies but also the delivery by the cesarean section is difficult and harmful for the mother.

In all multiple pregnancies, the risk of preterm labor and delivery is augmented and thus in each such pregnancy the strict monitoring of the uterine cervix is advised. We usually measure the length of the cervical canal and assess the internal os. If the

Figs 5A to C: Umbilical cord entanglement in 3-D and postpartum images

Figs 6A and B: Elastographic image of the rigid (nonripened) cervix presents the left picture and the elastic (ripened) cervix presents the right image

cervix shortens in consecutive exams or the internal os dilates, the special attention should be given to prolong pregnancy as much as possible.¹

There is a new ultrasound tool—the elastography—used to monitor cervix ripening (Fig. 6). The accuracy of this method is now under trials. The first approach for the application of this method in pregnancy was published by us in 2009 and 2011.^{11,12}

The ultrasound diagnosis of twin (and also higher-order) pregnancy develops constantly and is time-consuming. However, on the other hand, it ameliorates the final outcome of such pregnancies. We can avoid or diminish the incidence of fetal demises and postpartum complications like cerebral palsy. Thus, if any signs (described above) of pathology arise, such patient should be under strict care of a referential center specialized for appropriate multiple pregnancy management.

In summary, we can propose some general rules for sonographers:

- Prenatal US—the same schedule as in singletons for assessment of fetal morphology and markers of genetic abnormalities despite special schedule for twins.
- Keep the patient aware about the possibility of “vanishing twin.”
- Set the chorionicity as early as possible.
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- Look for the prognostic signs of TTTS in the first- and second-trimester scan.
- Monitor the amniotic fluid volume from 16th week gestational age (GA) on.
- Monitor the fetal growth from the first-trimester scan on.
- Doppler US and growth every 2 weeks in MC twins or every week if suspicious signs occur from the 16th week of GA on—every 4–6 weeks in DC twins.
- Exam the MCA-PSV in MC from the midpregnancy on.
- Look for the cervix incompetence and the risk of preterm delivery.

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