TECHNOLOGY

ongenital uterine anomalies: why an accurate diagnosis needs 3D ultrasound

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Septate, bicornuate, unicornuate or double uterus: how these anomalies arise, what they mean for pre gnancy and why they can only be told apart on the coronal plane of a 3D ultrasound. Based on a talk by u ltrasound doctor Andrii Sukhotskyi.

A woman can go for years without knowing that her uterus has an unusual shape, until she faces a mi scarriage, a premature birth or repeated failed attempts to conceive. The cause may be a congenital uterine anomaly, also called a Müllerian anomaly. These are not rare: according to current data, 4–7% of all wom en have one, and among patients with recurrent pregnancy loss the figure is 13–25%.

his article is based on a talk by Andrii Sukhotskyi, ultrasound doctor at the Ekstramed clinic, entitled “Mül lerian anomalies: the evolution of diagnosis from 2D to 3D”. We explain what kinds of anomaly exist, w y they matter and why a standard ultrasound is often not enough for an accurate diagnosis.

Where uterine anomalies come from

The uterus forms before birth from two paired tubes, the Müllerian (paramesonephric) ducts. They give r ise to the uterus, the fallopian tubes, the cervix and the upper part of the vagina. The key events happen i n two stages:

- at around the 10th week of foetal development the ducts fuse into one. If they fail to fuse, or fuse only partly, the result is a unicornuate, bicornuate or double uterus;
- at around the 20th week the wall between the fused ducts is reabsorbed. If it is not reabsorbed c ompletely, a septum remains in the uterus, or the top of the uterus keeps a saddle-shaped (arcuat e) dip.

A separate group consists of errors in organ formation itself, when the uterus does not form at all or re mains rudimentary. Vaginal septa also belong here: a transverse septum can block the outflow of menst rual blood, while a longitudinal one often occurs together with a bicornuate or double uterus.

portant: about 30% of women with uterine anomalies also have anomalies of the urinary tract, such as a m issing or unusually positioned kidney. The genital and urinary tracts share a common embryonic origin, s o whenever a uterine anomaly is found, the kidneys are always examined too.

ow uterine anomalies show themselves

Outside pregnancy, a woman may see a doctor because of:

- no periods from the start of puberty (primary amenorrhoea);
- very painful periods or pelvic pain;
- infertility, as an unusually shaped cavity lowers the chance of embryo implantation;
- a mass in the vagina when menstrual blood cannot drain;
- associated anomalies of the kidneys or skeleton.

During pregnancy the list of possible complications is longer:

- miscarriage and recurrent miscarriage: a uterine septum raises this risk to as much as 44%;
- premature birth: up to 20% with a bicornuate uterus;
- the waters breaking too early, and restricted foetal growth;
- abnormal placental attachment, and bleeding before and after birth;
- cervical insufficiency, an abnormal position of the baby, and caesarean section;
- most dangerous of all, rupture of a rudimentary horn if the pregnancy develops inside it.

hat is why early and accurate diagnosis of a uterine anomaly is not an academic exercise but a practi cal necessity: it determines how a pregnancy is managed and whether surgery is needed.

Why a standard ultrasound is not enough

n a standard 2D ultrasound the doctor sees the uterus in longitudinal and transverse sections. But the mo st informative view for assessing the shape of the cavity is a different one, the coronal (frontal) plane . Only on this plane can the doctor see at the same time:

- the outer contour of the top of the uterus (the fundus);
- the inner contour of the cavity;
- the openings of both fallopian tubes.

his is where the depth of the external fundal indentation, the internal indentation and the angle between the horns are measured, and these figures decide the diagnosis. The problem is that with the uterus in its u sual position, obtaining this plane on a 2D machine is technically difficult or impossible. This is where thre e-dimensional (3D) ultrasound comes in.

What 3D ultrasound offers

During a 3D scan the machine records the whole volume of the uterus, from which any section can then b e “cut”. GE Voluson ultrasound systems have several tools for this:

- multiplanar mode: three mutually perpendicular planes from a single volume, and the main way to obtain the coronal plane “in one click”;
- VCI (Volume Contrast Imaging): adjusts the slice thickness and improves contrast, which is espe cially valuable for assessing the myometrium and septa;
- OmniView: a section along any line or curve, useful for a uterus of unusual shape or one tilted bac kwards (retroflexed);
- I: up to eight parallel slices at once, so the uterus can be “leafed through” layer by layer, as on CT or MRI;
- OCAL: measures volume, of a rudimentary horn for example, and assesses blood flow with 3D Dopple r;

- HDlive: a realistic volume image with virtual lighting, clear for documentation and for explaining fi ndings to the patient.

According to a meta-analysis (Graupera et al., 2015), the sensitivity and specificity of 3D ultrasound in di agnosing uterine anomalies are comparable to those of MRI and exceed 90%. Standard 2D ultrasou nd performs considerably worse, especially when a septate uterus has to be told apart from a bicornu ate one.

Multiplanar mode: two planes from one 3D volume (top) and the coronal plane of a normal uterus reconstructed from them (bottom).

The uterine cavity in HDlive mode: a volume image with virtual lighting.

When to have the scan

he best time is the secretory phase of the cycle, days 21–24, when the endometrium is at its thickest and s tands out well against the muscular wall. The doctor assesses the outer contour of the fundus, the sh pe of the cavity, whether there is a septum, the angle between the horns and the ratio of the external t o the internal indentation depth, which is the key to the diagnosis.

The main types of anomaly

Diagrams of the anomalies: 1, septate uterus; 2, arcuate uterus; 3, bicornuate uterus; 4, unicornuate uterus with a rudimen tary horn; 5, uterus didelphys.

ormal and arcuate uterus

An arcuate (saddle-shaped) uterus is a borderline variant of normal: the outer contour is smooth or has a n indentation of up to 10 mm, and the cavity has a slight curved dip at the top (up to 10–15 mm). Under the European ESHRE/ESGE classification it is a variant of normal (class U0), whereas the American ASR M classification places it in a separate class VI. As a result, the same report may be interpreted differ ently by doctors working with different systems.

ptate uterus (U2)

The most common anomaly, accounting for up to 35% of all cases. The outer contour of the uterus is norm al, but inside a septum divides the cavity, either partly (U2a) or completely, down to the level of the intern al os (U2b). The septum is the anomaly most often linked to miscarriage, and it is also the one that can be removed by hysteroscopy, a minimally invasive operation performed through the cervix.

Partial uterine septum: on the coronal plane (bottom) the width of the cavity (1) and the length of the septum (2) are me asured.

A complete septum divides the uterine cavity down to the internal os.

Bicornuate uterus (U3)

Here the body of the uterus is split in two: the outer contour of the fundus has an indentation of more th an 1 cm (or more than 50% of the wall thickness), and two muscular horns, each with its own cavity, joi n above the cervix. There is usually a single cervix and vagina. Partial (U3a), complete (U3b) and combi ned forms with an additional septum (U3c) are distinguished. Surgical correction of a bicornuate uterus is much more complex, the indications for it are limited, and in most cases the pregnancy is managed con servatively.

Unicornuate uterus, or hemi-uterus (U4)

nly one Müllerian duct develops; this accounts for about 20% of uterine anomalies. The other half may b e absent or remain as a rudimentary horn:

- with a functional cavity (U4a): the most dangerous variant. Menstrual blood from the horn cannot d rain, which leads to endometriosis and pelvic pain. If a pregnancy develops in the rudimentary horn, it may rupture at 10–20 weeks with massive haemorrhage. For this reason such a horn is removed lap aroscopically;
- without a functional cavity (U4b): the horn can mimic a fibroid, which the doctor bears in mind when m aking a differential diagnosis.

Unicornuate uterus: in the 3D reconstruction (bottom right) the cavity has only one horn.

Uterus didelphys

The ducts do not fuse at all: two separate uteri form, each with its own cervix, often with a longitudinal sept um in the vagina. The anomaly often causes no symptoms; the septum may cause pain during sex or diffi culty using tampons. The two uterine bodies are set wide apart, so here, unlike with other anomalies, diagnosis is often actually better on 2D. Variants in which half of the vagina is closed off need urgent t reatment: division of the septum.

Uterus didelphys in a 3D reconstruction: two separate cavities.

T-shaped uterus (U1) and MRKH syndrome (U5)

A T-shaped (dysmorphic) uterus has a normal outer contour but a narrow cavity because of thickened side walls. In Mayer–Rokitansky–Küster–Hauser (MRKH) syndrome the uterus and upper vagina are absent or only rudimentary, although the ovaries work normally, the karyotype is female (46,XX) and puberty h pens on time. The main complaint is the absence of periods. Because the eggs do mature, IVF with sur rogacy is an option for these women.

T-shaped uterus: a narrow cavity with a normal outer contour (3D reconstruction, bottom right).

ptate or bicornuate: the key question

The most important diagnostic task is to tell a septate uterus apart from a bicornuate one. This decid es whether the patient is referred for hysteroscopic division of the septum or monitoring is chosen. A wrong diagnosis means the wrong treatment.

he cavity can look similar in both cases, and the difference shows only on the outer contour, that is, on the coronal 3D plane. Different classifications draw the line in different places:

- ASRM (American, updated in 2021): a septate uterus has a smooth outer contour (an indentation of less than 1 cm), an internal indentation of more than 1.5 cm and an angle of less than 90°; a bi cornuate uterus has an external indentation of more than 1 cm;

- ESHRE/ESGE (European, 2013): measures the indentation not in millimetres but as a percentage of the uterine wall thickness; a uterus is septate when the internal indentation exceeds 50% of the wall thic kness and the external one is less than 50%;
- CUME 2018: a consensus that brought together the views of 769 specialists from 56 countries. It defines a septum that needs surgery as follows: an internal indentation of more than 10 mm, an an gle of less than 140°, and a ratio of indentation depth to wall thickness of more than 110%.

n the speaker's view, ESHRE tends towards overdiagnosis and unnecessary operations, ASRM can lead t o a problem being overlooked, and the CUME 2018 criteria give the most accurate and safest guide. Th at is why it matters for the report to state not only the name of the anomaly but also the measured depth s and angles.

y points

- Congenital uterine anomalies affect 4–7% of women; they influence both the ability to conceive an d the course of pregnancy.
- An accurate diagnosis needs a coronal plane of the uterus, and 3D ultrasound is the method of c hoice for obtaining it.
- The best time for the scan is days 21–24 of the cycle.
- When a uterine anomaly is found, the kidneys are examined as well.
- Most importantly, a septum that can be removed hysteroscopically has to be told apart from a bicor nuate uterus.

f you have had miscarriages, a premature birth or infertility, book a 3D ultrasound of the uterus or an app ointment with a gynaecologist at Ekstramed in Ivano-Frankivsk.

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his article is for information only and does not replace a consultation with a doctor. The diagnosis and trea tment are decided by a doctor after an examination.

Sources: talk by A. Sukhotskyi, “Müllerian anomalies: the evolution of diagnosis from 2D to 3D”; AFS/ASRM (1988), ESHRE/ESGE (2013) and ASRM Müllerian Anomalies Classification 2021; Ludwin A. et al., Congenital Uterine Malformation by Experts (CUME), 2018; Graupera B. et al., 2015.