

لَا إِلَهَ إِلَّا اللَّهُ
مُحَمَّدٌ رَسُوْلُهُ



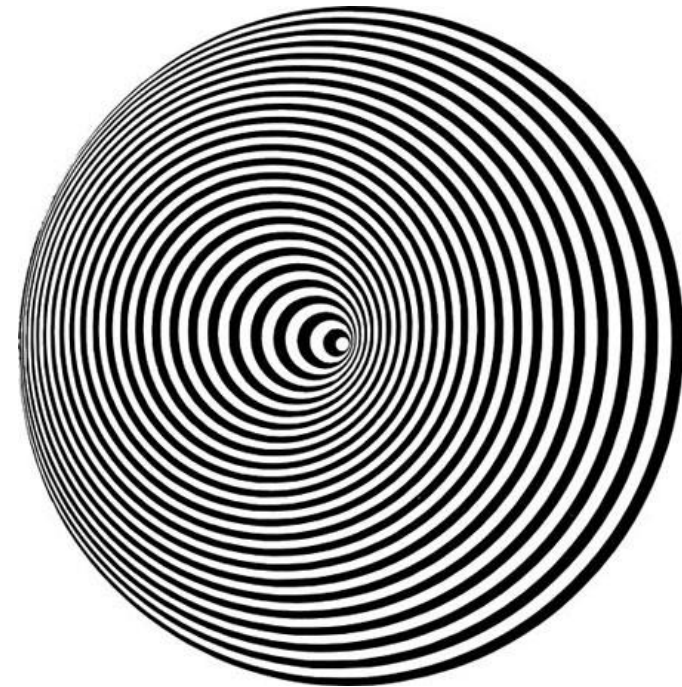
Artifacts, Pitfalls and Normal variants in Sonography imaging of an infertile female

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Isfahan Fertility and Infertility Center

چشمها را باید شست جور دیگر باید دید



What is the Problem?



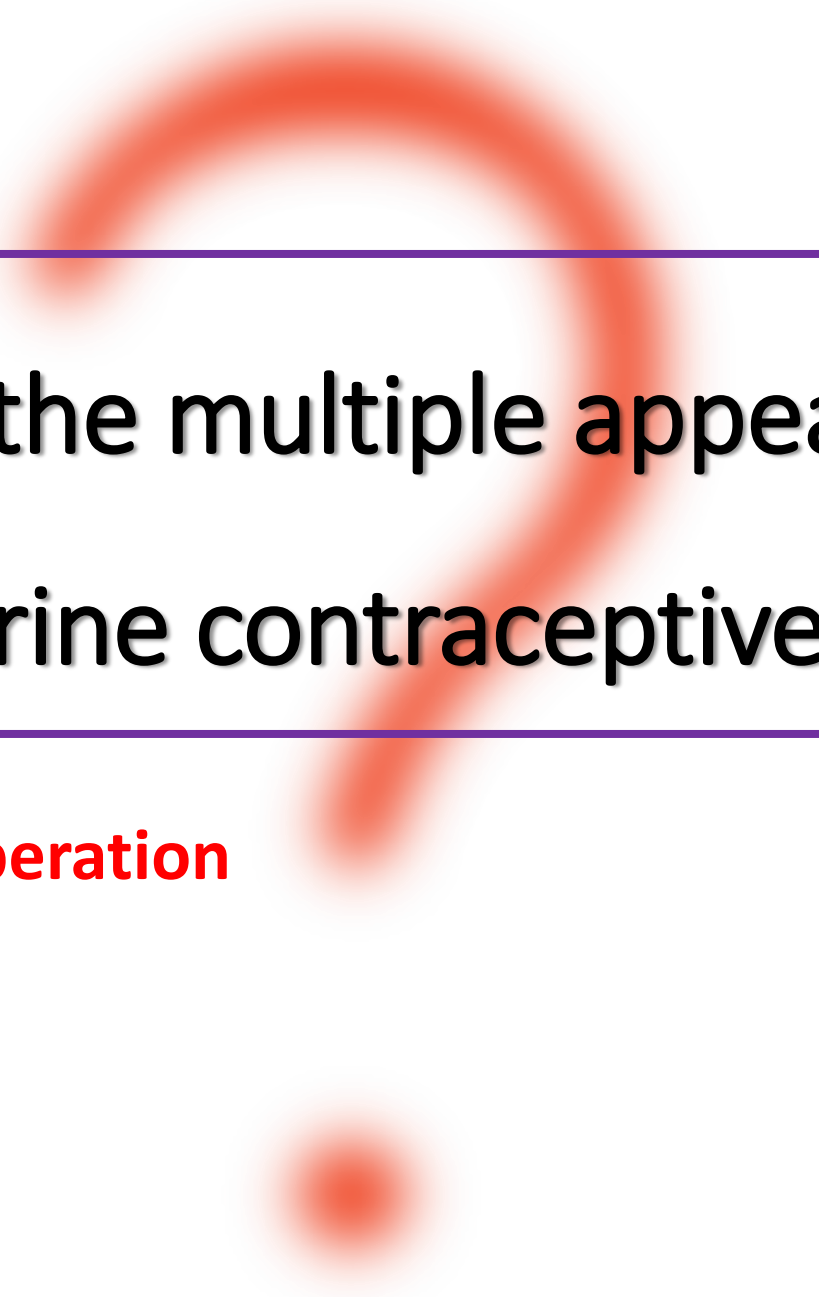
SONOGRAPHY??



SONOGRAPHER??

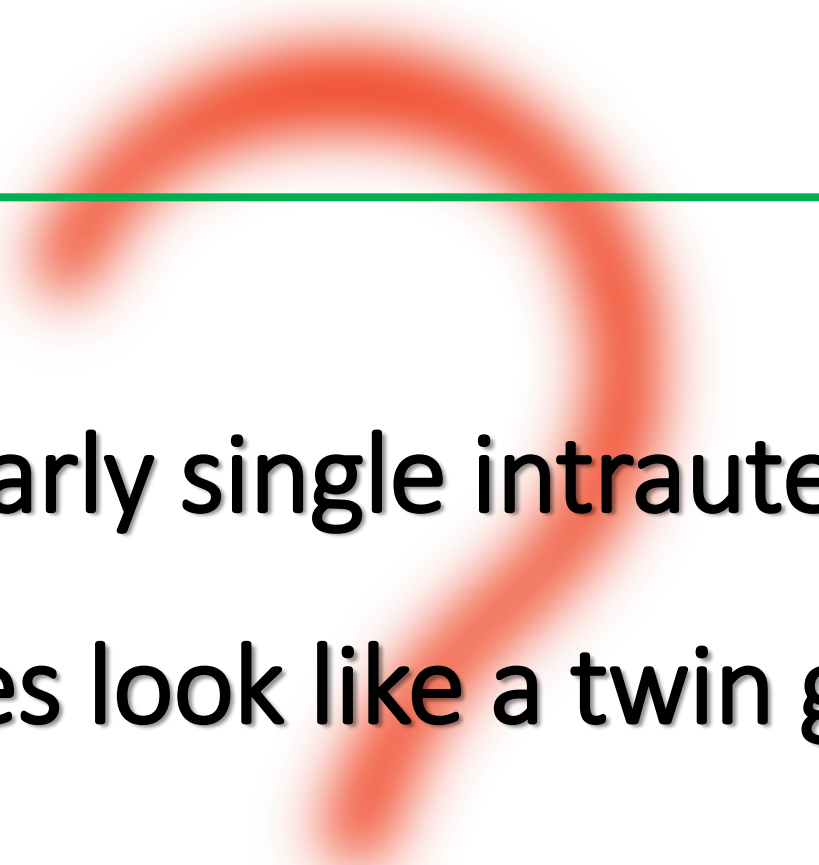


DECISION??



What gives the multiple appearance of an
intrauterine contraceptive device?

Answer: Reverberation



Why does an early single intrauterine pregnancy sometimes look like a twin gestation?

Answer: Duplication artifact



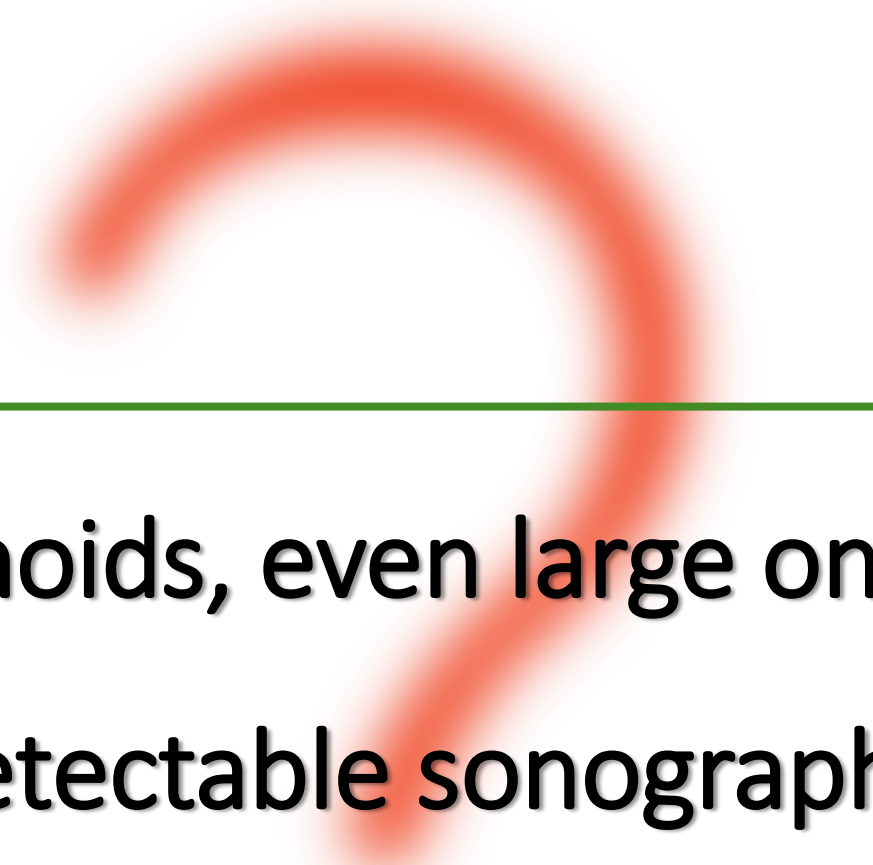
Why is a large cyst-like structure occasionally seen in the pelvis when it does not exist?

Answer: Mirror image artifact



Why does a simple cyst sometimes appear to contain a sludge-like layer?

Answer: Slice thickness artifact



Why are dermoids, even large ones, sometimes not detectable sonographically?

Answer: Shadowing (tip of the iceberg phenomenon)



How to recognize Artifacts??

How to minimize Artifacts??

Artifacts in ultrasound imaging occur as structures that are one of the following:

- **Not real**
- **Missing**
- **Of improper brightness**
- **Of improper shape**
- **Of improper size**
- **Improper equipment operation (e.g. improper transducer location and orientation information sent to the display)**
- **Improper settings (e.g. incorrect receiver compensation settings)**
- **Improper scanning technique (e.g. allowing patient or organ movement during scanning)**
- **Inherent in the ultrasound diagnostic method**

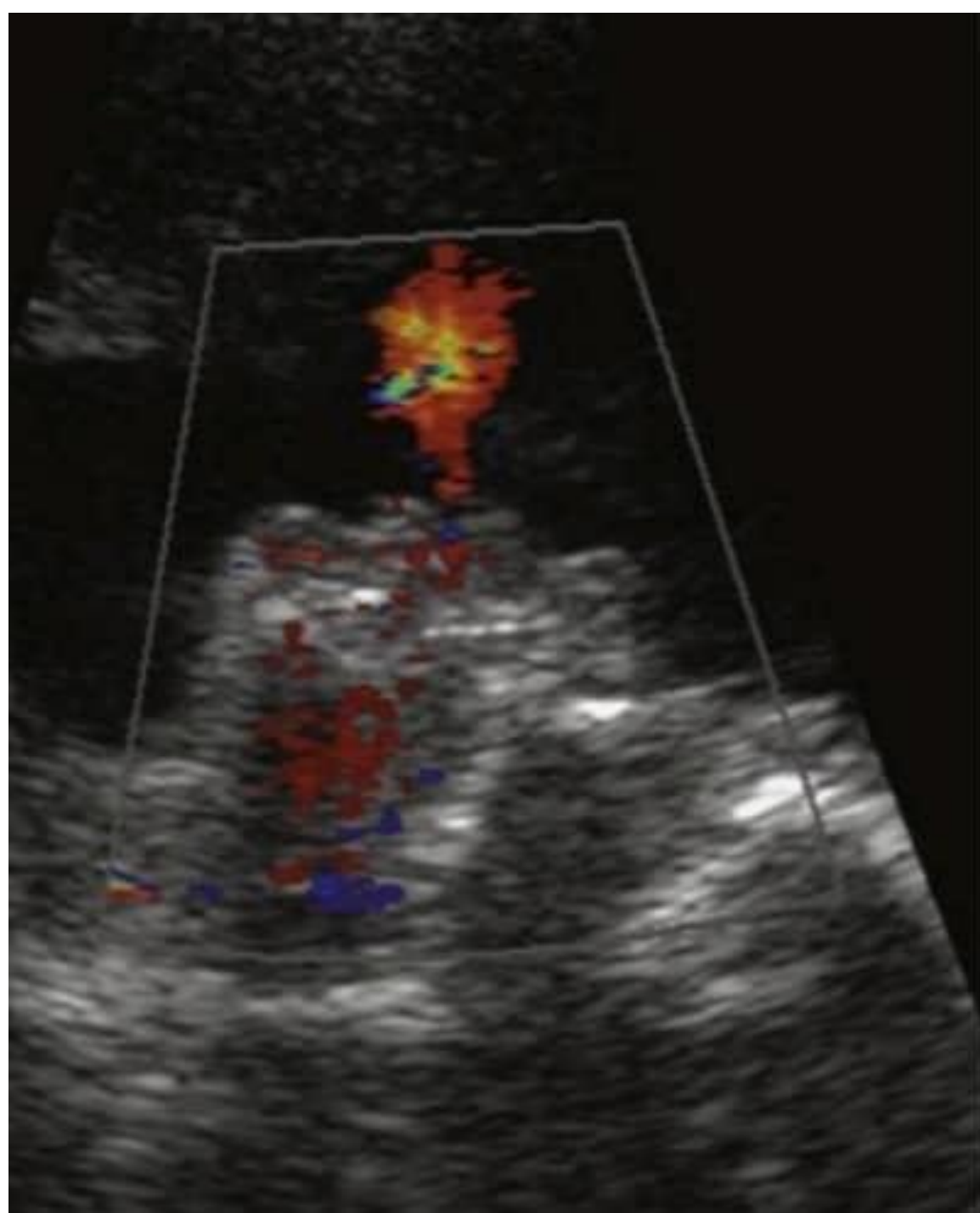
CLASSIFICATION of ARTIFACTS

1. Reverberation and ring-down
(comet tail)
2. Shadowing
3. Enhancement
4. Mirror (multipath) artifacts
5. Refraction and side lobes

6. Curved and oblique reflector
7. Propagation speed error
8. Resolution
9. Doppler artifacts
10. Three-dimensional artifacts

Important Artifacts in Obstetric & Gynecologic ultrasound examinations

1. REVERBERATION
2. SHADOWING
3. ENHANCEMENT
4. MIRROR ARTIFACTS
5. REFRACTION (DUPLICATION) AND SIDE LOBES



(یا)

بیایا که توئی جوهر و عصاره عشق

که جز تو کس نهد پای، در گزاره عشق

درون سینه چه داری که با هوای نفس

زبانه میکشد از سینه ات، شراره عشق؟

توئی که اول و آخر، به هم زنی پیوند

که این دو حلقه شود جفت، با اشاره عشق

به وقت آمدنت جای دم، بزن فریاد

بگوش پنخبران بر سر مناره عشق

سرود در غزلی، قصه می تورا "ساعی"

که ماندگار شود، تابش ستاره عشق

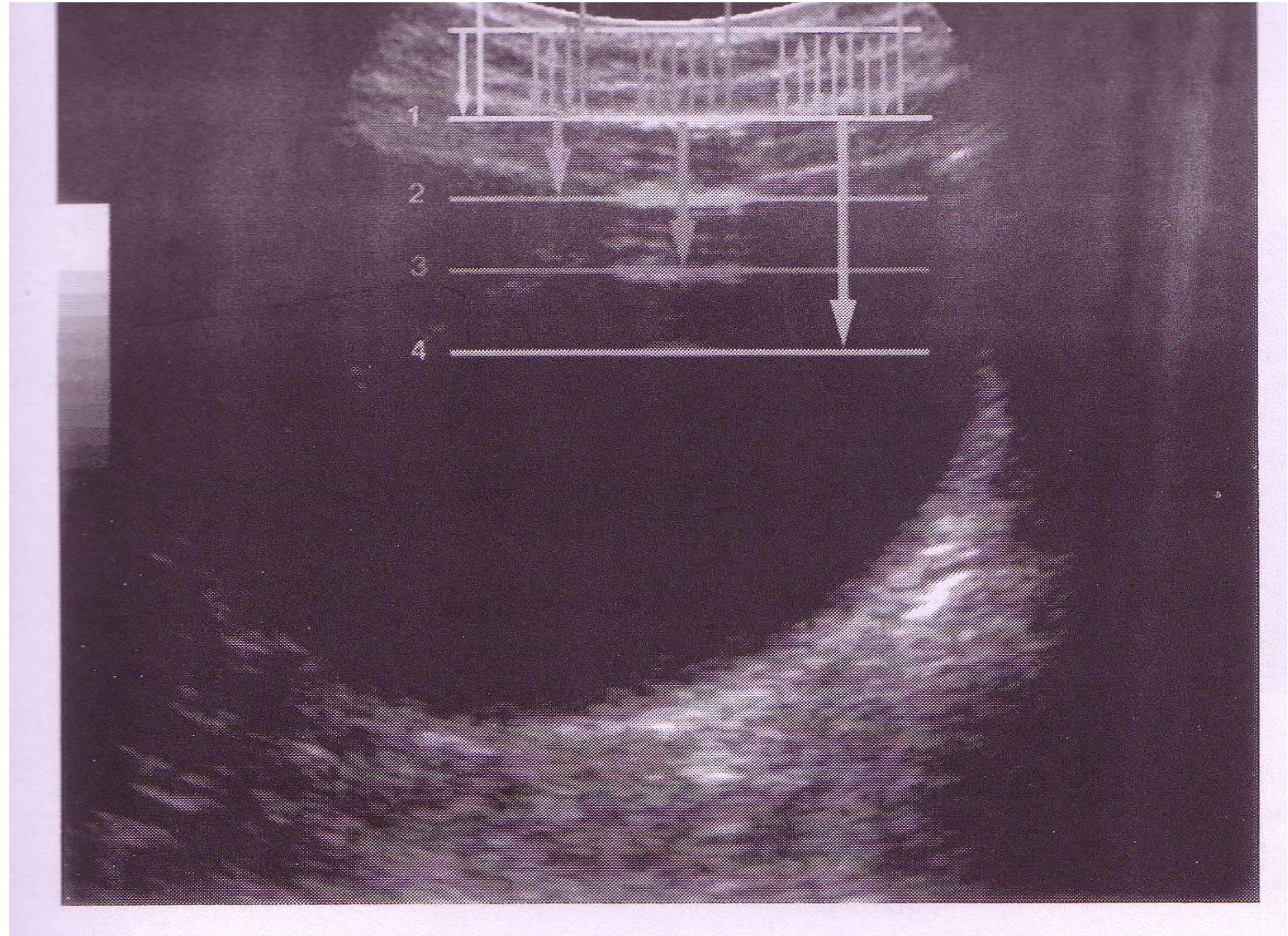
(دکتر اسد... کلاستری "ساعی")



1) REVERBERATION:

- Results in reflectors that are not real, being placed on the image.
- They will be placed behind the second real reflector at separation intervals equal to the separation between the first and second real reflectors.
- Each subsequent reflection will be weaker than prior ones.

- Ring Down
- Surgical Clip
- Gas Bubbles
- IUD
- Comet Tail
- Needle Aspiration



Reverberation can occur:

- 1. From the anterior wall of the urinary bladder, especially in an obese person.**
- 2. With intrauterine device (IUD) in the uterus.**
- 3. In simple cysts**

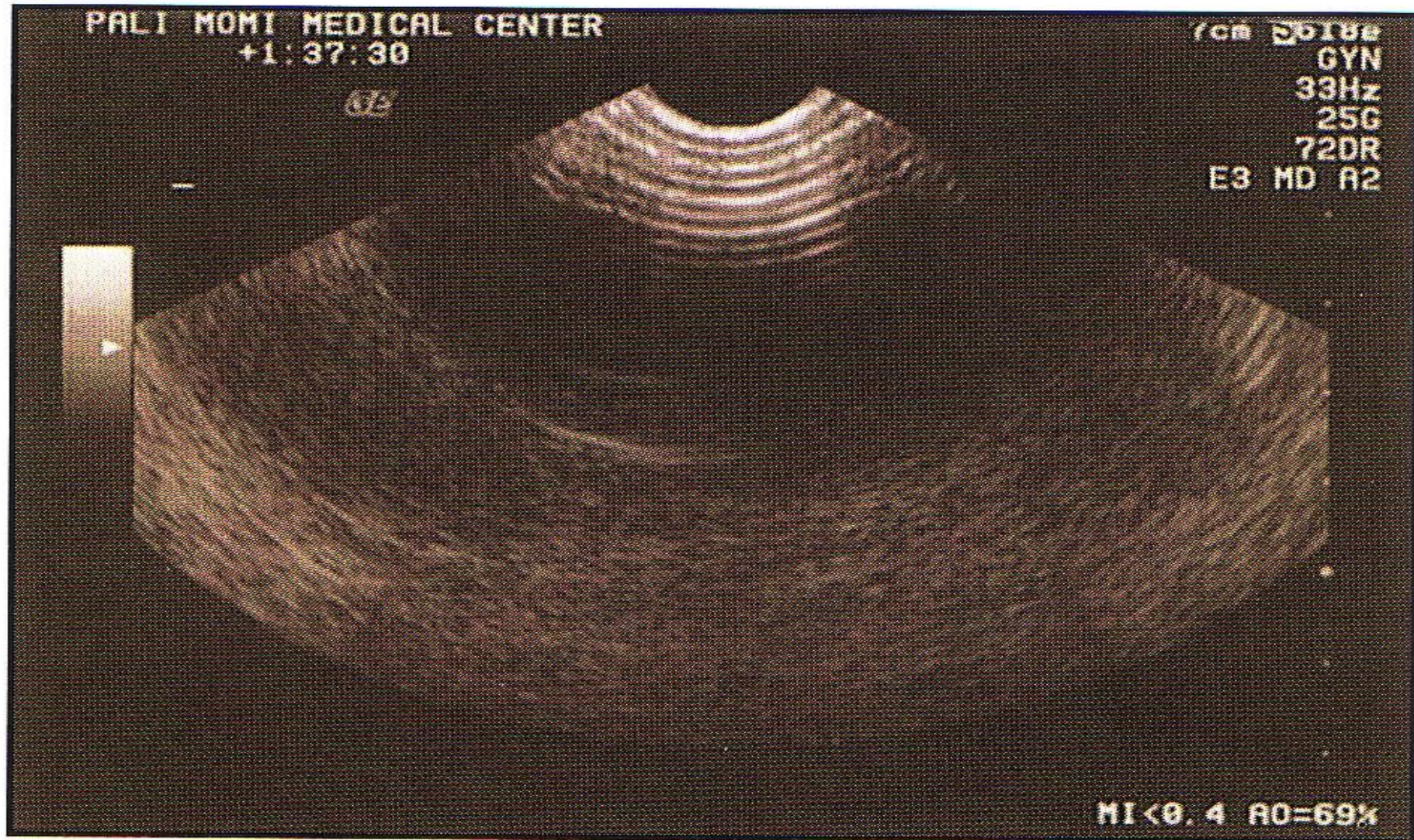


Figure 4.1: Reverberation. Anterior wall of the urinary bladder in an obese person

2) SHADOWING:

- **Shadowing is the reduction in reflection amplitude from reflectors that lie behind a strongly reflecting or attenuating structure.**
- **Shadows in ultrasound may be due to:**
 - **Reflection**
 - **Absorption**
 - **Refraction**

SHADOWING can occur:

- **Calcification**
- **Bone (clean shadow)**
- **Gas (Reverberation=dirty shadow)**
- **IUD**
- **Deremoid cyst**
- **Curved - Oblique - interface**

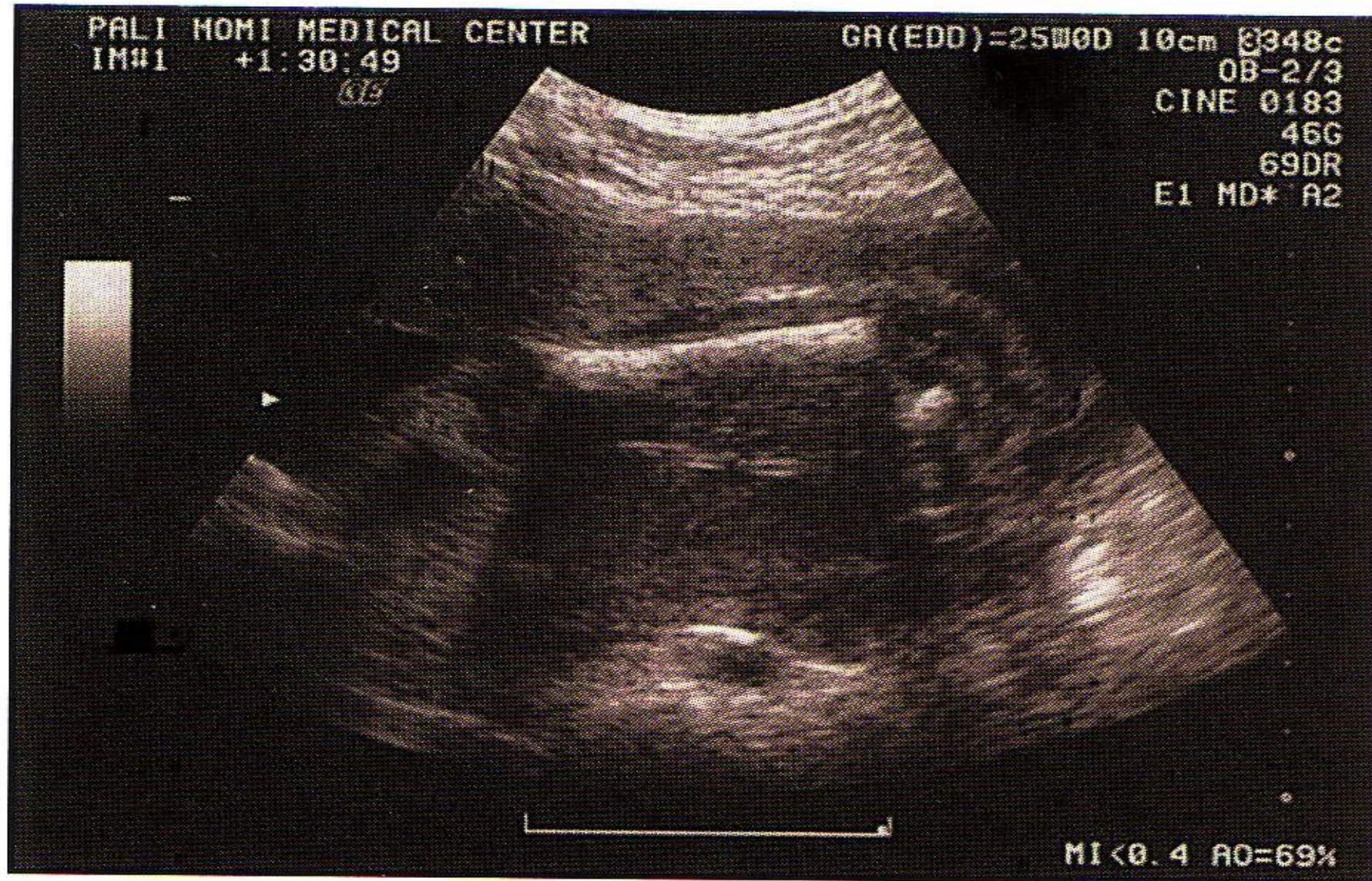


Figure 4.2:Shadowing. The ultrasound beam is blocked by a fetal femur to produce a shadow

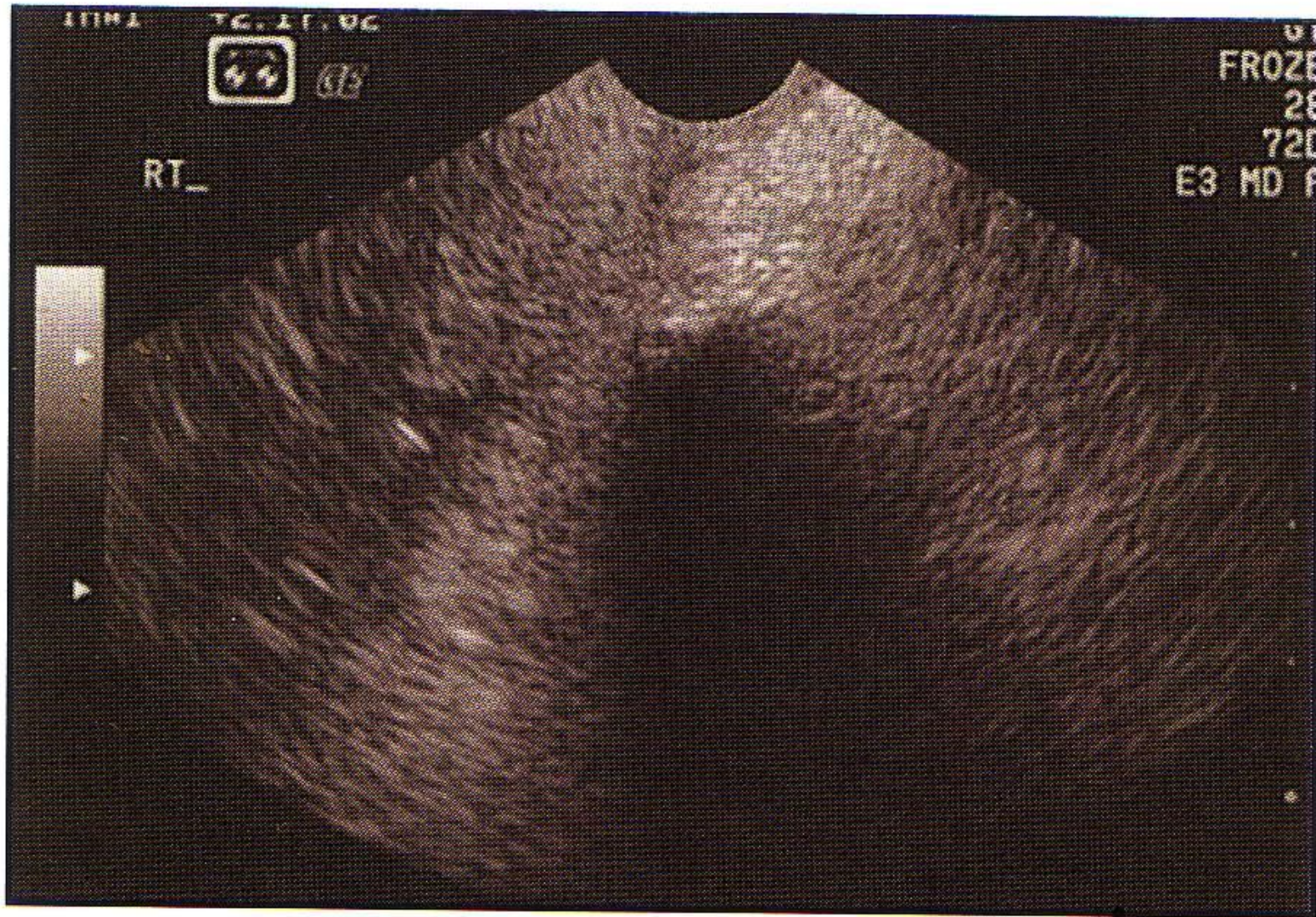


Figure 4.3:Shadowing. Air can also cause shadowing.
Bowels seen with an empty urinary bladder



Fig. 2: Shadowing artifacts on transvaginal ultrasound caused by air in the condom. Portion of the cervix and *cul-de-sac* are 'in the dark'



Fig. 3: Another example of shadowing caused by air in the bowels

3) ENHANCEMENT:

- **Enhancement is the opposite of shadowing.**
- **It is the increase in reflection amplitude from reflectors that lie behind a weakly attenuating structure.**
- **One example for this phenomenon is that the fluid replaces normal soft tissue in the intervening space, decreasing its attenuation.**

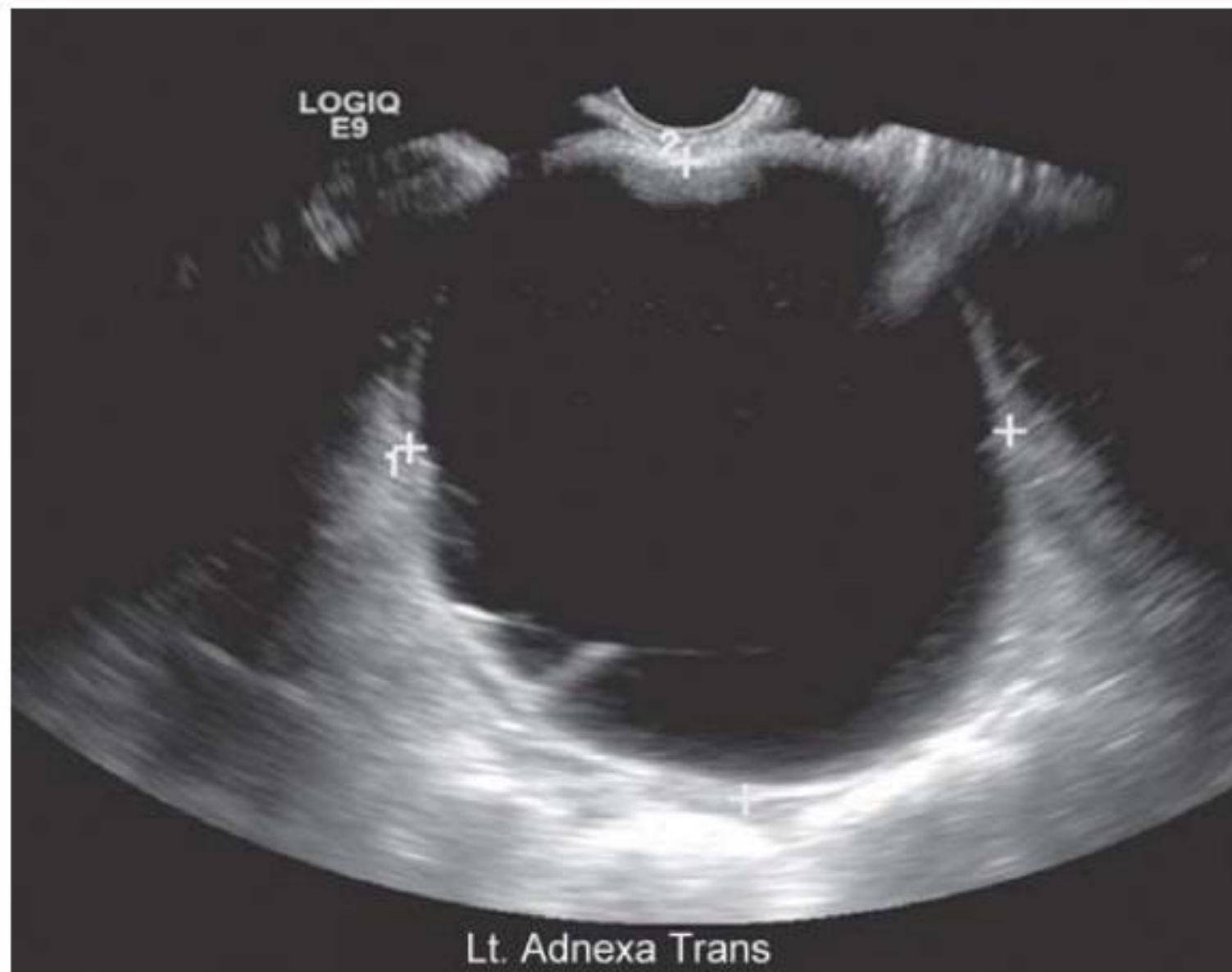


Fig. 4: Enhancement: The echoes returning from structures deep to the cyst appear more intense than if the ovarian cyst was not interposed



Fig. 5: Enhancement caused by amniotic fluid. Bright edges are clearly seen

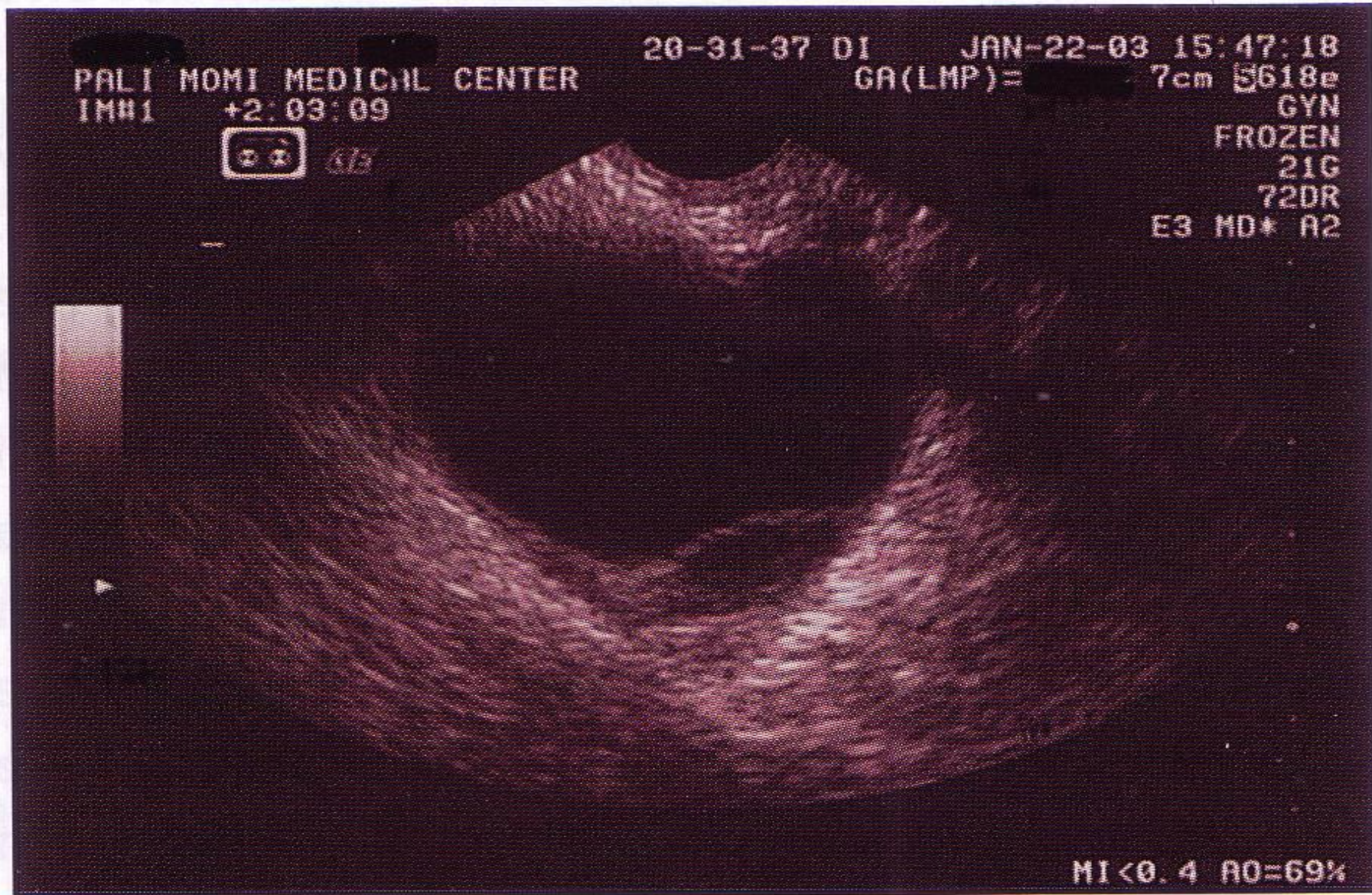
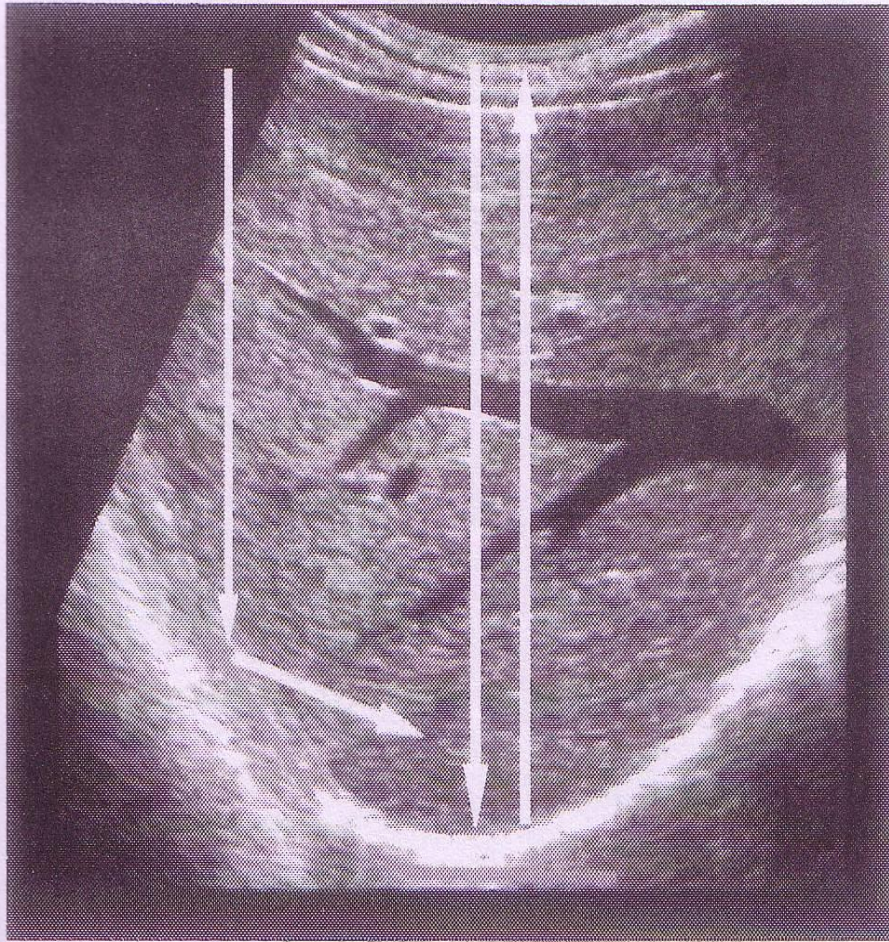


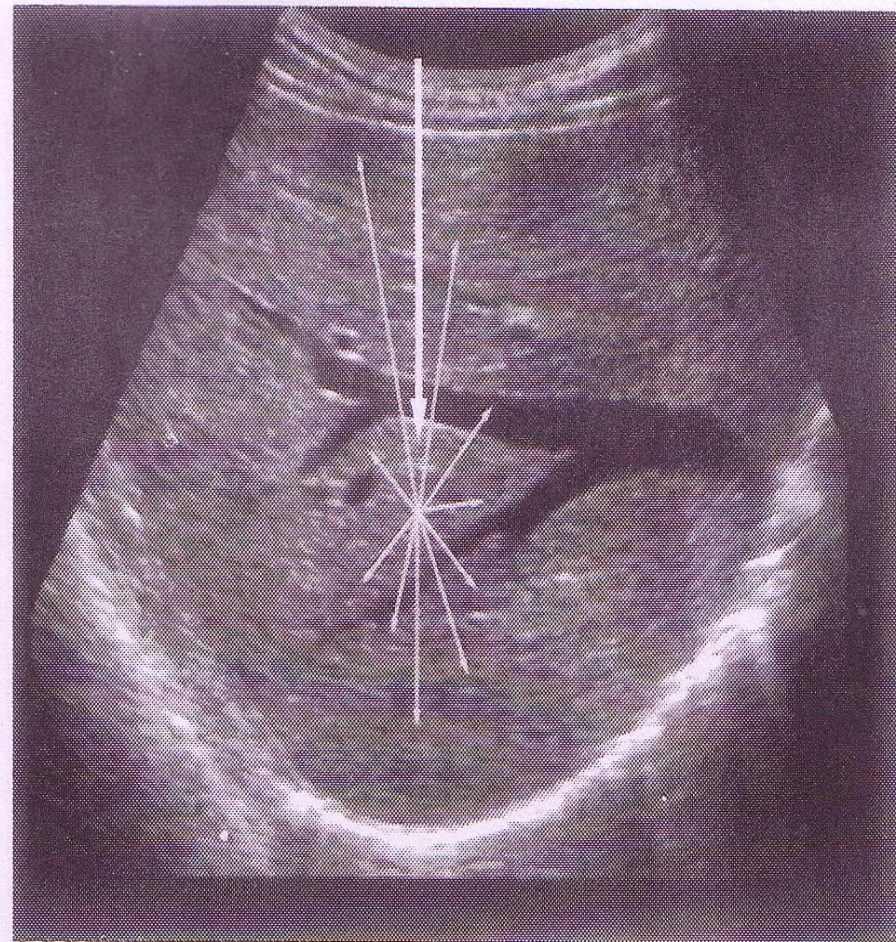
Figure 4.5: Another example of enhancement due to ovarian cysts.

4) MIRROR ARTIFACTS

- **The term mirror or multipath artifact describes the situation in which the paths to and from a reflector are different.**
- **This artifact results in improper reflector image positioning.**
- **Or multi path artifact describe the situation in which the paths to and from a reflector are different.**
- **It is important to realize that this artifact is seen on both transverse and longitudinal scans. One can have the patient partially empty the bladder.**

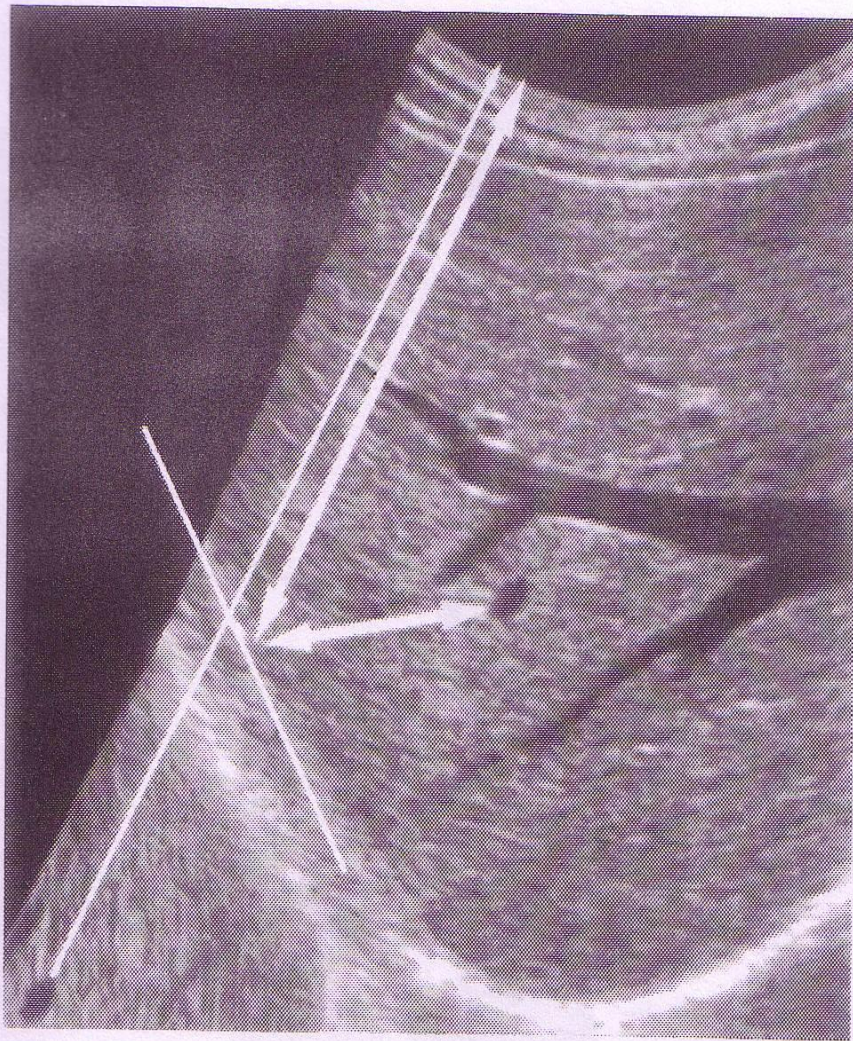


A

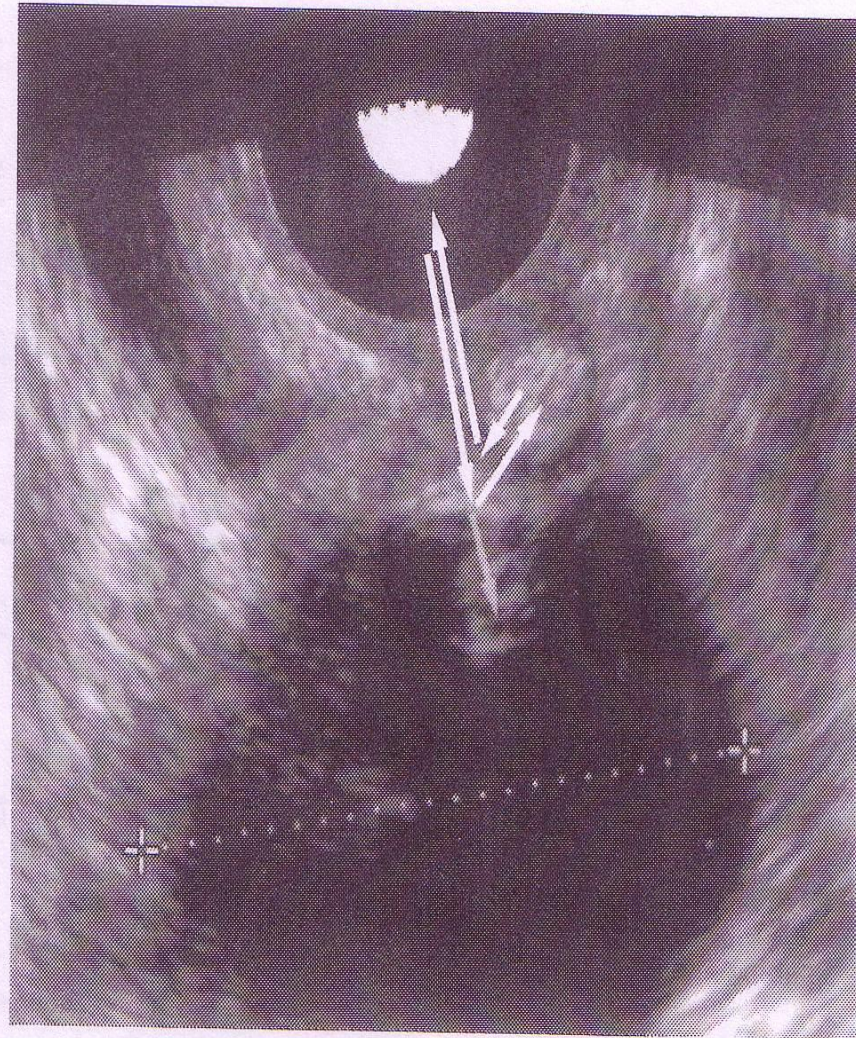


B

FIGURE 1-5. Specular and diffuse reflectors. Specular reflector. A. The diaphragm is a large and relatively smooth surface that reflects sound like a mirror reflects light. Thus, sound striking the diaphragm at nearly a 90-degree angle is reflected directly back to the transducer, resulting in a strong echo. Sound striking the diaphragm obliquely is reflected away from the transducer, and an echo is not displayed (*yellow arrow*). **Diffuse reflector. B.** In contrast to the diaphragm, the liver parenchyma consists of acoustic interfaces that are small in comparison to the wavelength of sound used for imaging. These interfaces scatter sound in all directions, and only a portion of the energy returns to the transducer to produce the image.



A



B

FIGURE 1-27. Multipath artifact. Echoes reflected from the **diaphragm** (A) and the wall of an **ovarian cyst** (B) create complex echo paths that delay return of echoes to the transducer. This results in the display of these echoes at a greater depth than they should normally appear. In A, this results in an artifactual image of the liver appearing above the diaphragm (simulated image). In B, the effect is more subtle and more likely to cause misdiagnosis because the artifact suggests a mural nodule in what is actually a simple ovarian cyst.

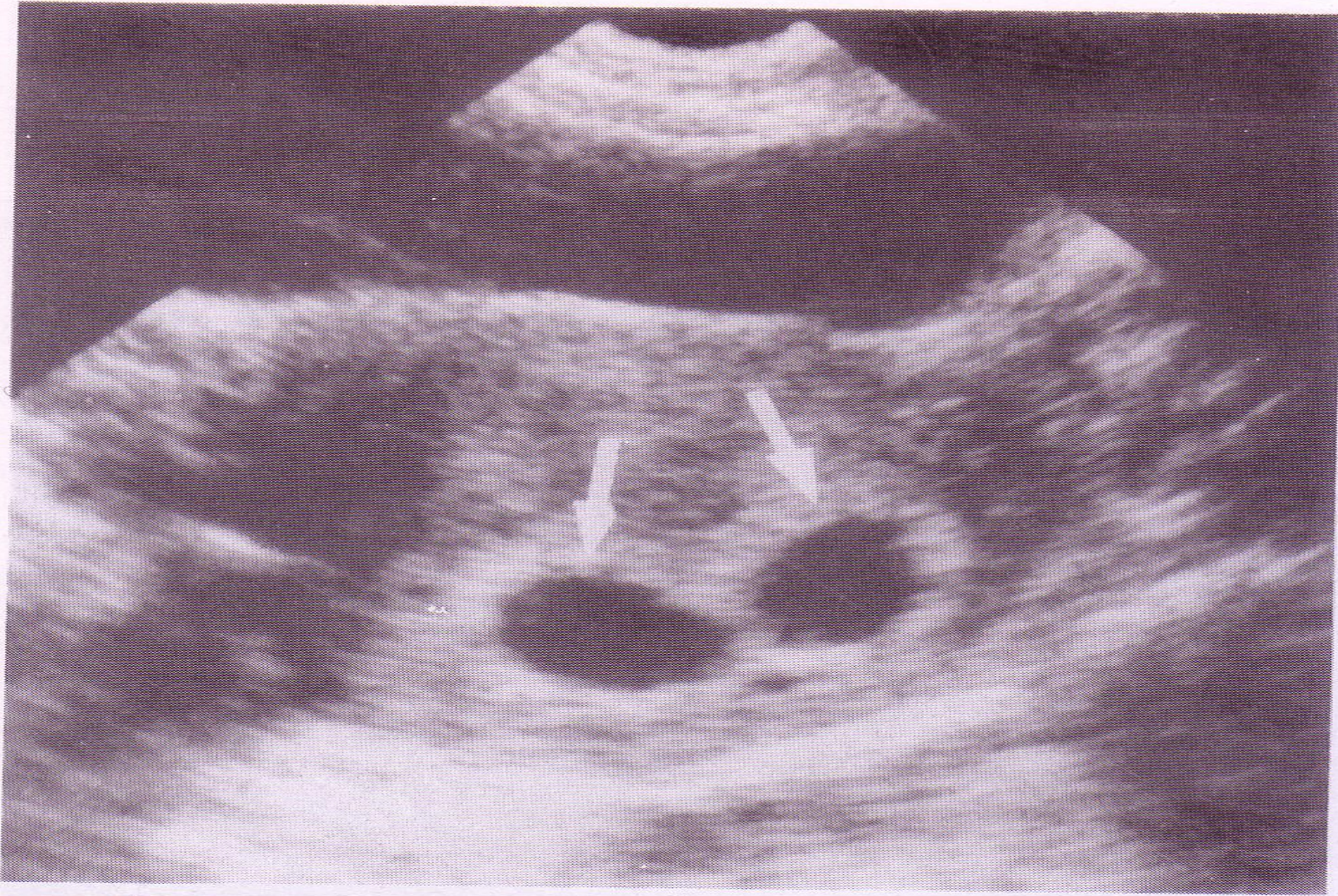


FIGURE 35-21. Transverse scan of an early gravid uterus. Although there appears to be two gestational sacs (*arrows*), in fact, there was only one. Moving the transducer slightly over to one side demonstrated the single gestational sac. This effect is believed to be due to the refraction of sound at the interface between the abdominal musculature and fat.

5) REFRACTION (DUPLICATION) AND SIDE LOBES

- This most interesting artifact occurs uniquely when the transducer is held in a transverse plane over the linea alba.
- The sound is refracted toward the midline when the transducer is pointing to the medial edge of the rectal muscle on either side. This makes small midline structures appear duplicated on the screen.
- This phenomenon can occur:
 - Rectus Muscle
 - G.S
 - IUD
 - Bowel

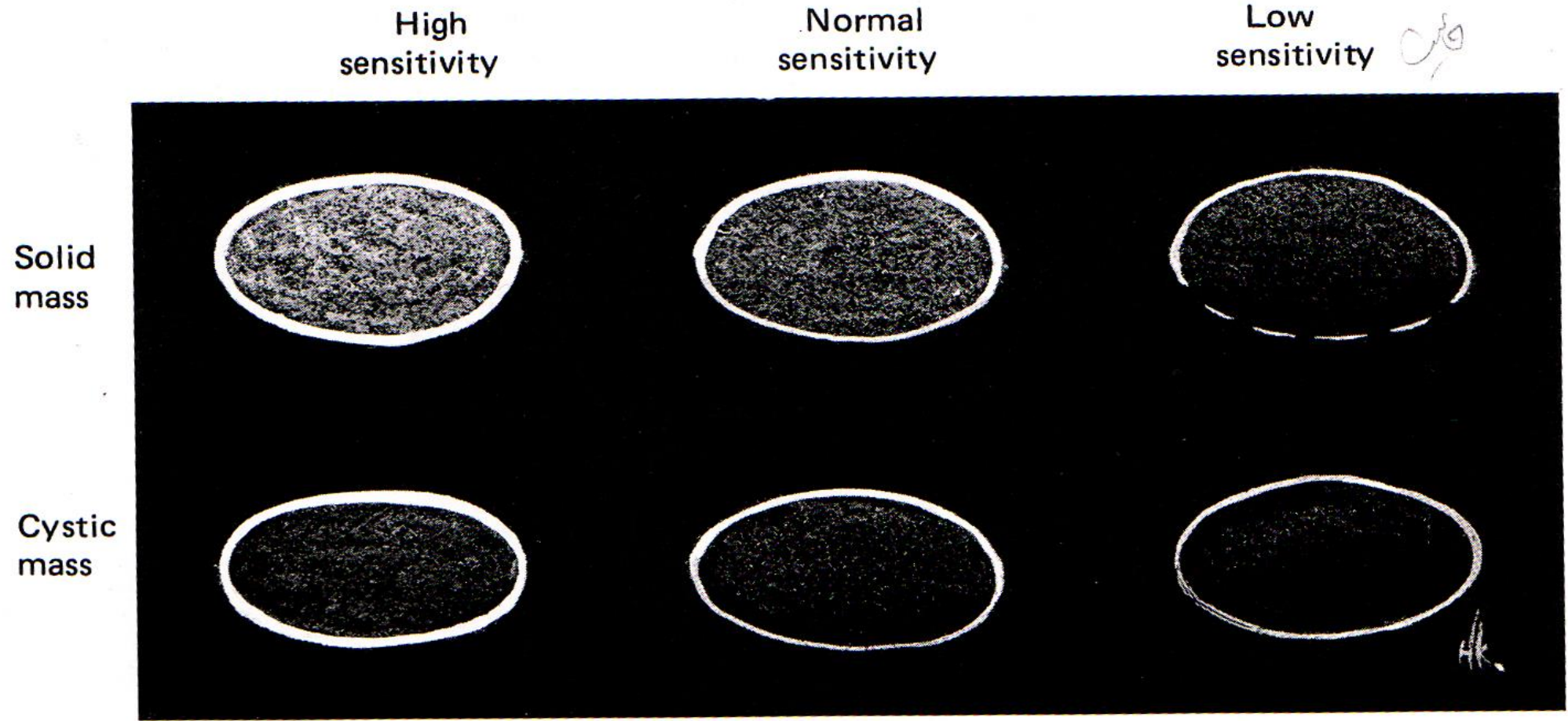


Fig. 1 Differential diagnosis between solid and cystic masses.

The appearance of numerous echoes within solid masses at high sensitivity is called the fill-in. The fill-in pattern is diagnostic of solid masses and produced by the enhanced echo reflection at minute interfaces within solid masses.



A



B

FIGURE 35-1. Longitudinal sonograms demonstrating the maternal urinary bladder and the gravid uterus. *A.* An apparent soft tissue mass is seen in the urinary bladder (*arrow*). *B.* In fact, this is the stream of urine entering the bladder through the ureteral orifice.

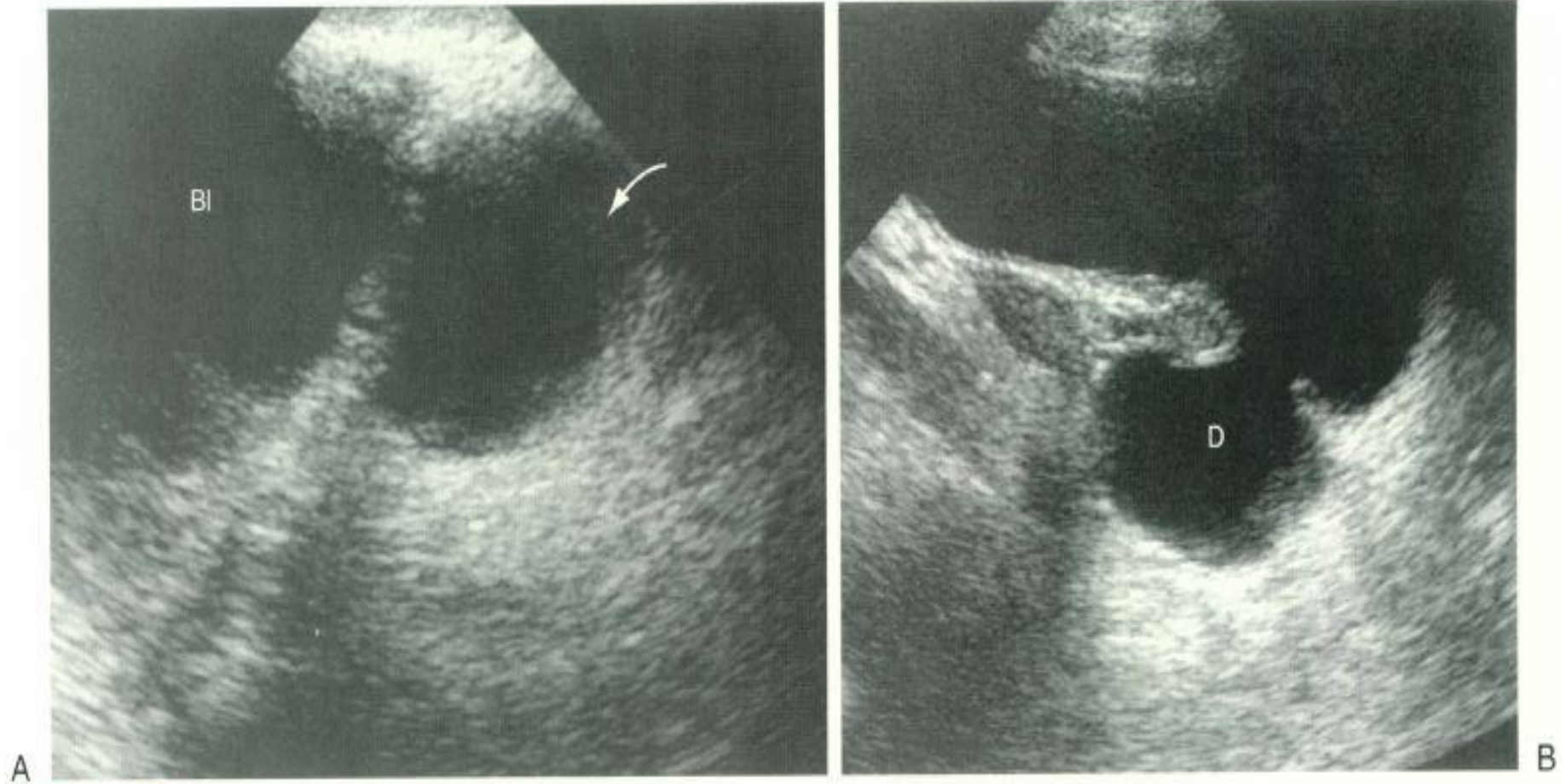


FIGURE 35-2. A. What appears to be a large pelvic cyst is seen in this patient (*arrow*). BI, bladder. B. Although the connection to the bladder was not seen in A, this bladder diverticulum (D) is clearly seen in another plane of section.



FIGURE 35-6. Bowel simulating an ovarian cystic teratoma (dermoid). **A.** A large shadowing mass (asterisk) is seen adjacent to or possibly emanating from the ovary (Ov). **B.** Minutes later the normal ovary and adnexal structures are well seen. The bowel, which was the cause of the shadowing, was not seen.



FIGURE 35-7. Two round and oval structures are seen in the right adnexa. Although they might be mistaken for abnormal ovaries or paraovarian masses they represent normal prominent bowel. Typical hypoechoic muscularis (arrows) is seen.



FIGURE 35-10. Longitudinal scan through the cervix of a gravid uterus. Multiple nabothian cysts are seen in the cervix. These retention cysts are common and should not be confused with low-implanted gestational sacs or other pathology.



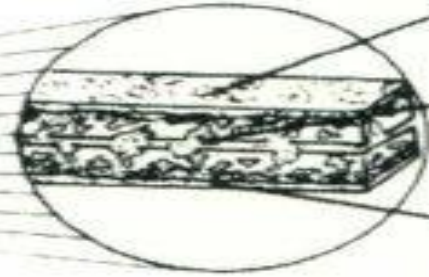
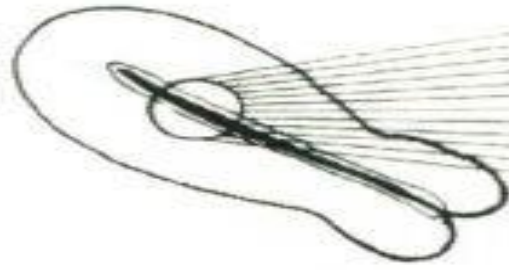
A

B

FIGURE 35-29. Prominent vessels (*arrows*) at the periphery of the uterus. These are common in the uterus and should not be mistaken as a precursor to an abruption or as trophoblastic disease. *A.* In this patient, the arcuate vessels (*arrows*) at the periphery of the uterus are quite prominent. *B.* With color Doppler flow imaging, the vascular nature of these structures is well seen.

*Examples of
Artifacts, Pitfalls and Normal variants
in GYN & infertility sonograms*

Menstrual

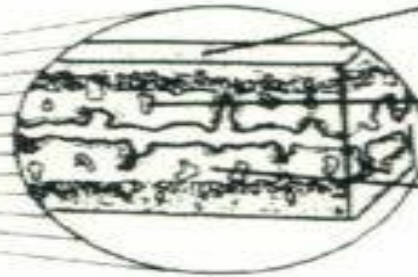
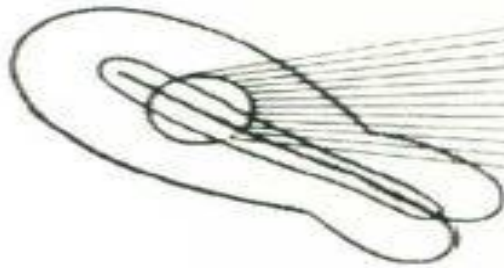


Basalis

Sloughed Tissue
and Blood

Basalis

Proliferative

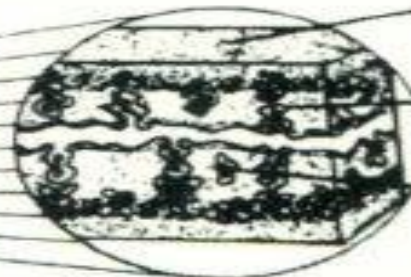
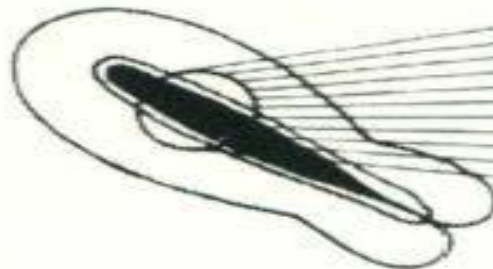


Basalis

Glands

Stroma

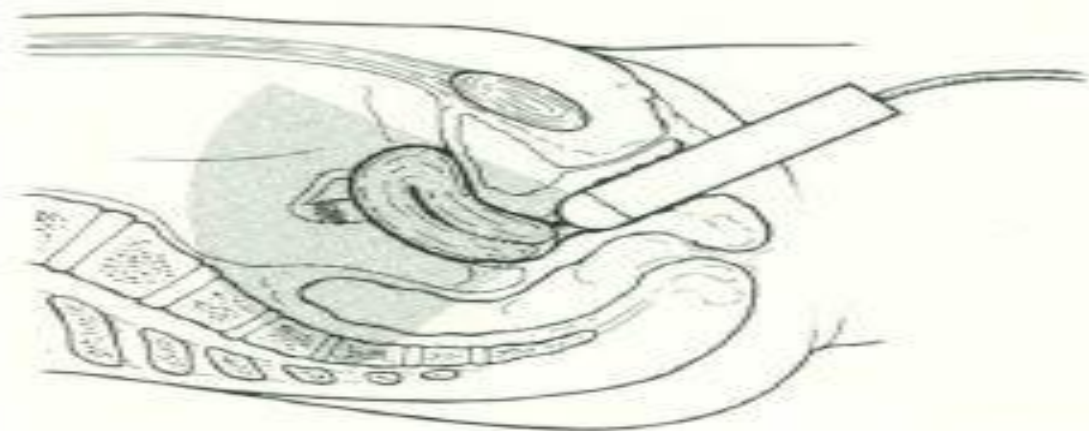
Secretory



Basalis

Glands

Secretions



A



B

FIGURE 26-1. A. Diagram of sagittal transvaginal scan plane. (From Lyons EA, Gratton D, Harrington C: *Transvaginal sonography of normal pelvic anatomy. Radiol Clin North Am* 30:663, 1992.) B. Transvaginal sonogram in the sagittal plane showing the corpus (U) and fundus (f) of the uterus. Endometrial canal (vertical arrow) basal layer of the endometrium (oblique arrow).

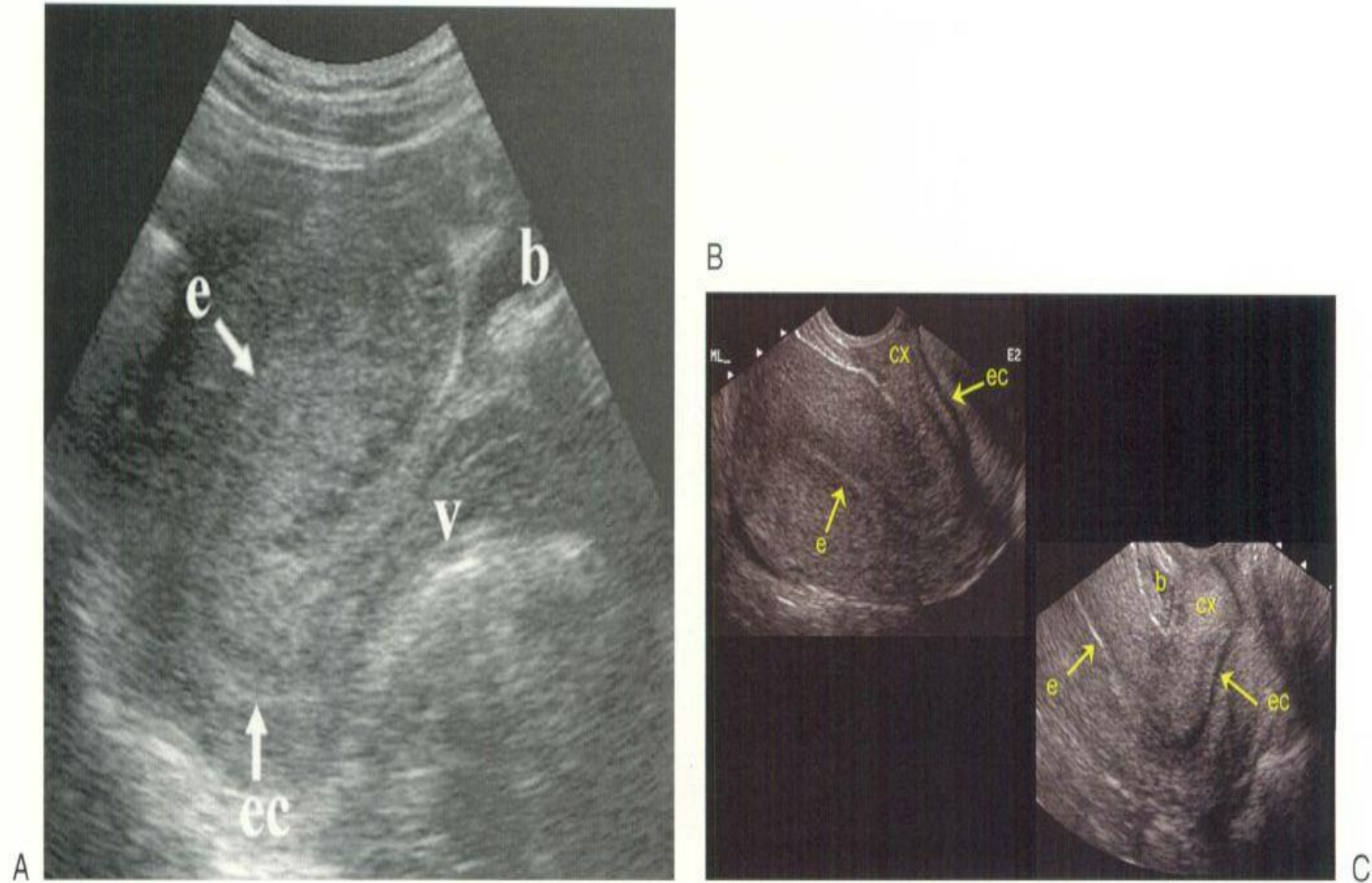


FIGURE 26-37. Anteflexed uterus. *A.* Transabdominal sonogram in the midline sagittal plane through the uterus. The bladder (*b*) is almost completely empty, *v*, vagina. *B.* Transvaginal midsagittal scan of an anteflexed uterus. *C.* Transvaginal scan of the cervix and lower uterine segment. The bladder (*b*) is almost empty. The endocervical canal (*ec*) and endometrial canals (*e*) form an angle of approximately 90 degrees in all three images.

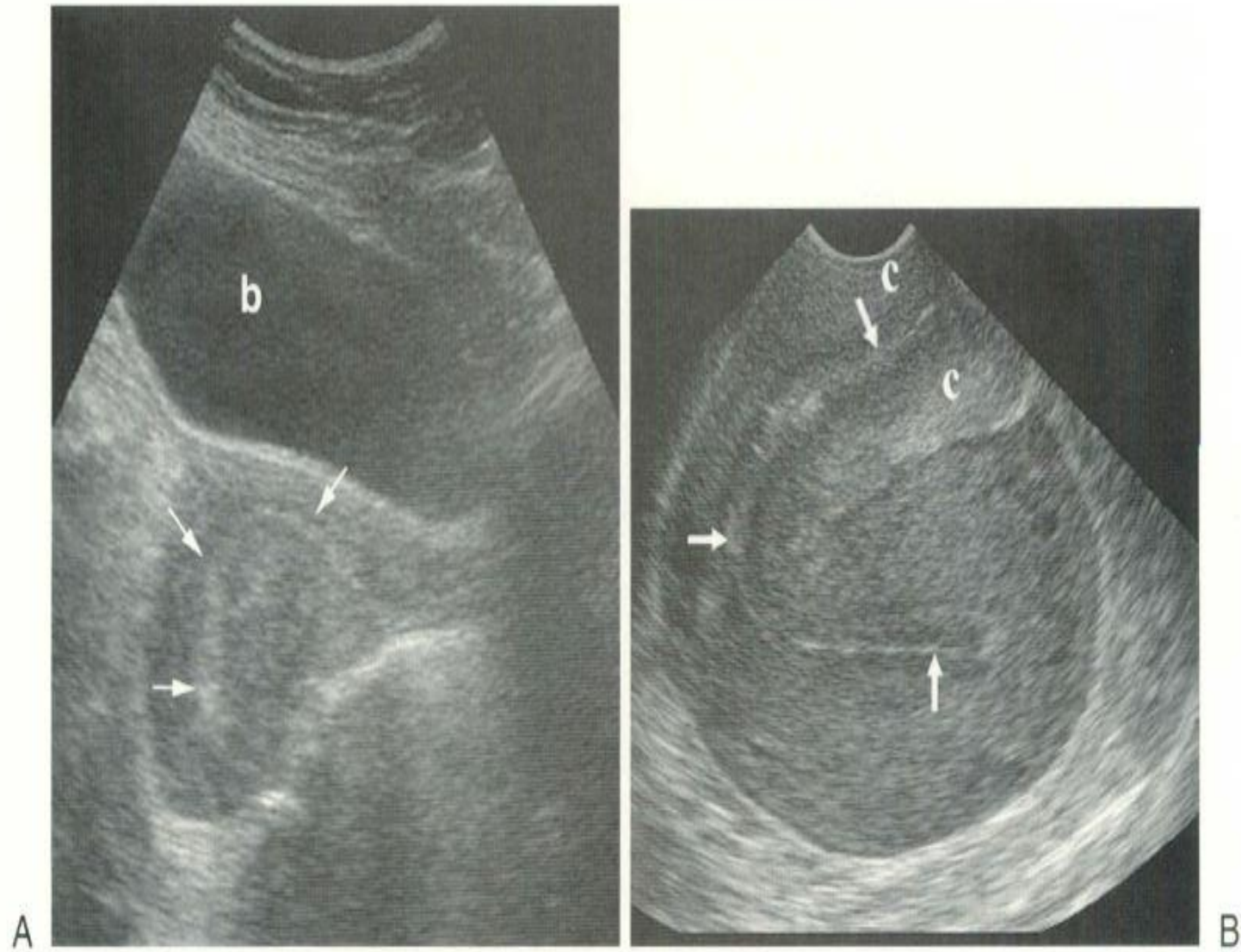


FIGURE 26-38. Retroflexed uterus. Transabdominal (A) and transvaginal (B) sonograms in the midline sagittal plane through the uterus demonstrating a retroflexed uterus. Endometrial and endocervical canals (arrows). b, bladder; c, cervix.

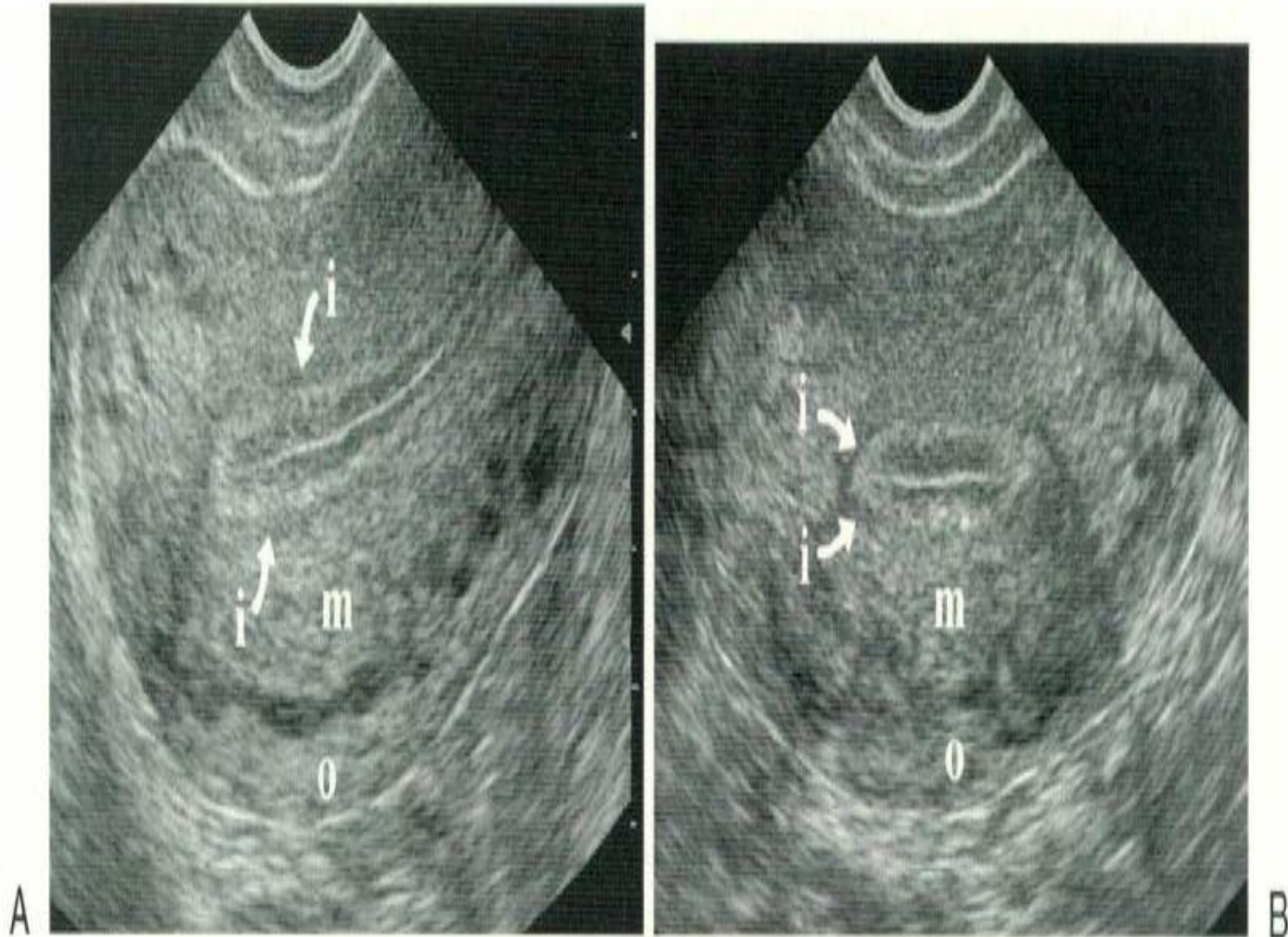


FIGURE 26-40 Myometrial layers. Transvaginal sonogram in the (A) sagittal and (B) coronal planes demonstrating the inner (i), middle (m), and outer (o) layers of myometrium.

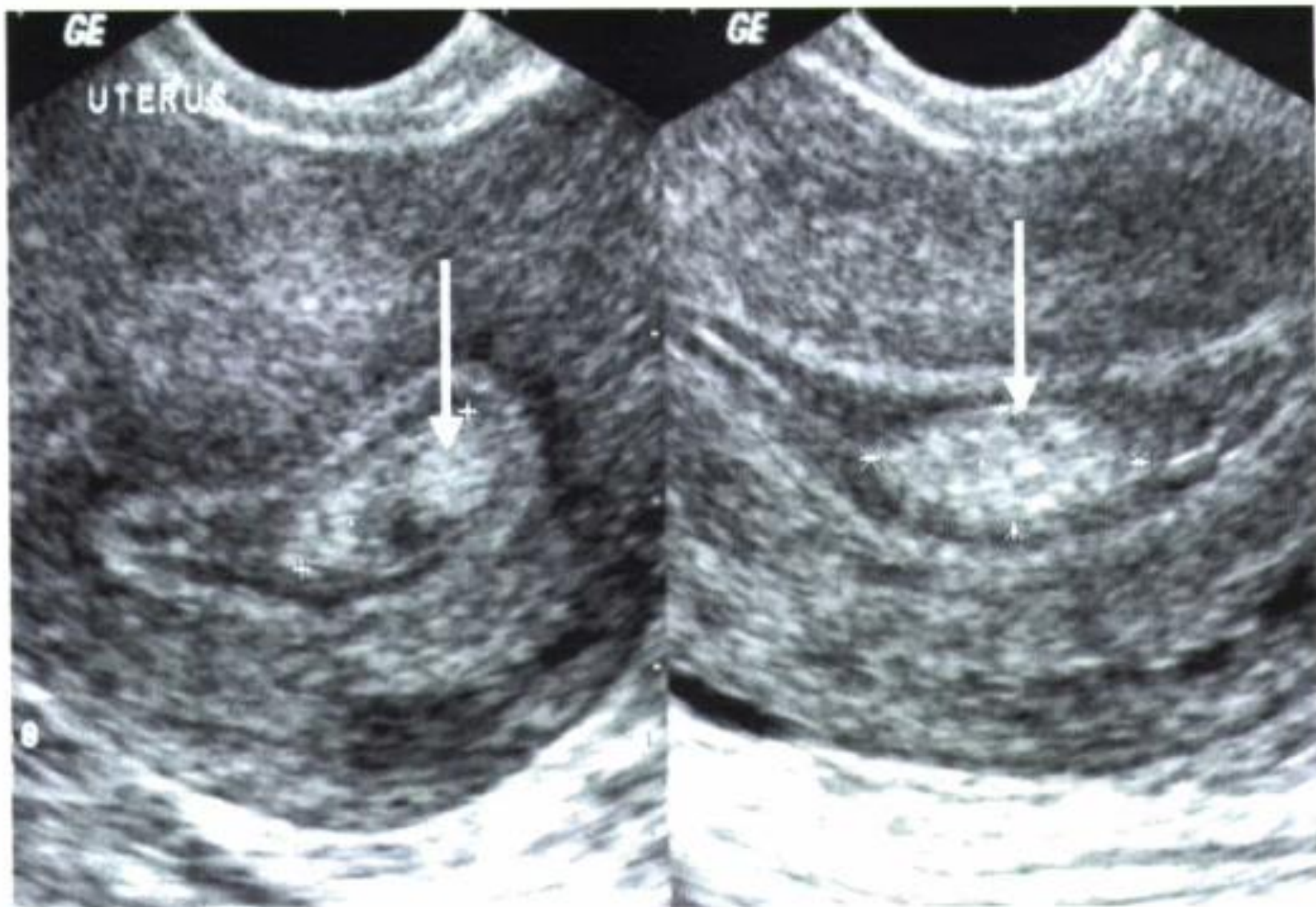


Figure 5.29: Endometrial polyp causing a focal endometrial thickening in a patient of intermenstrual spotting

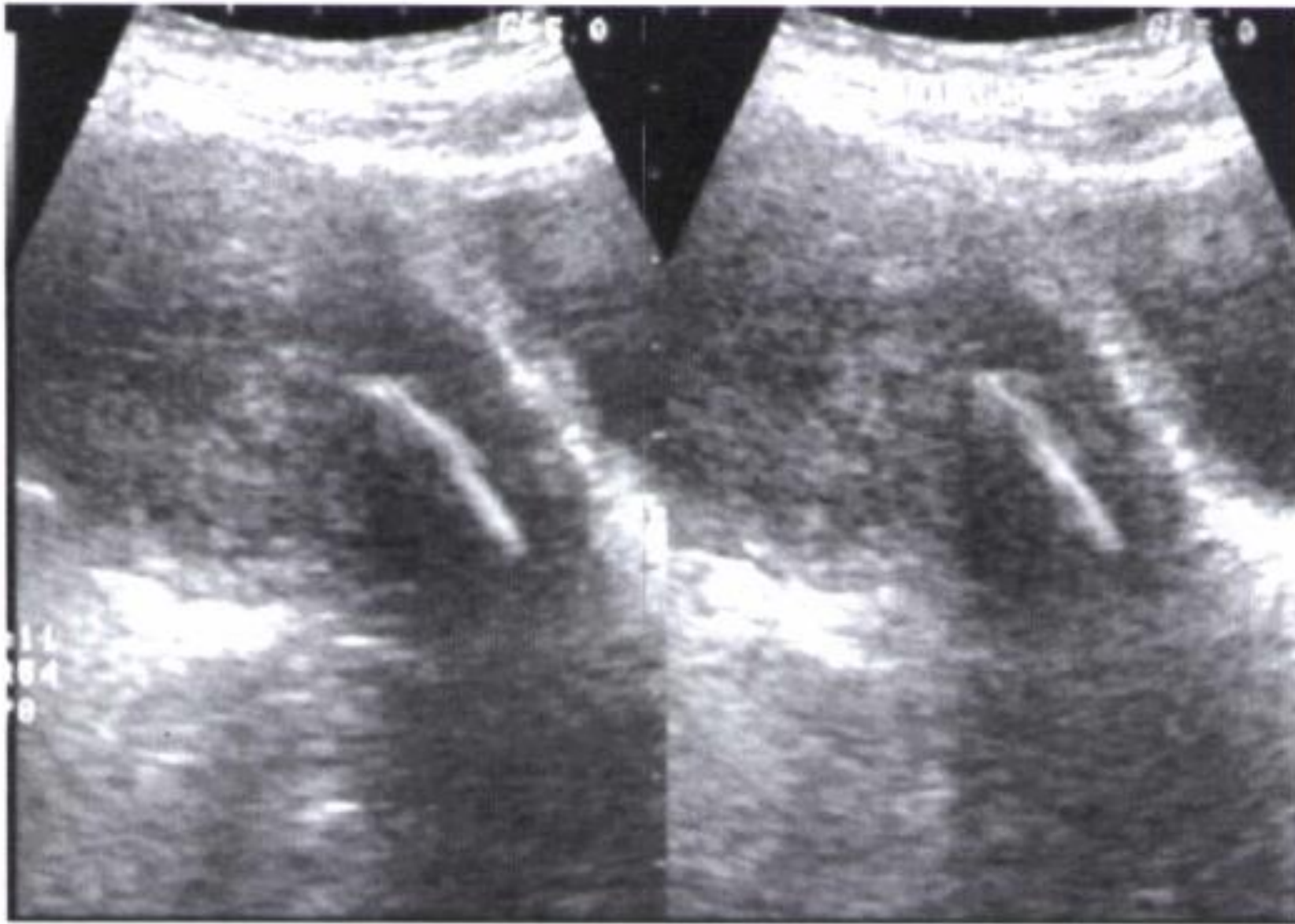
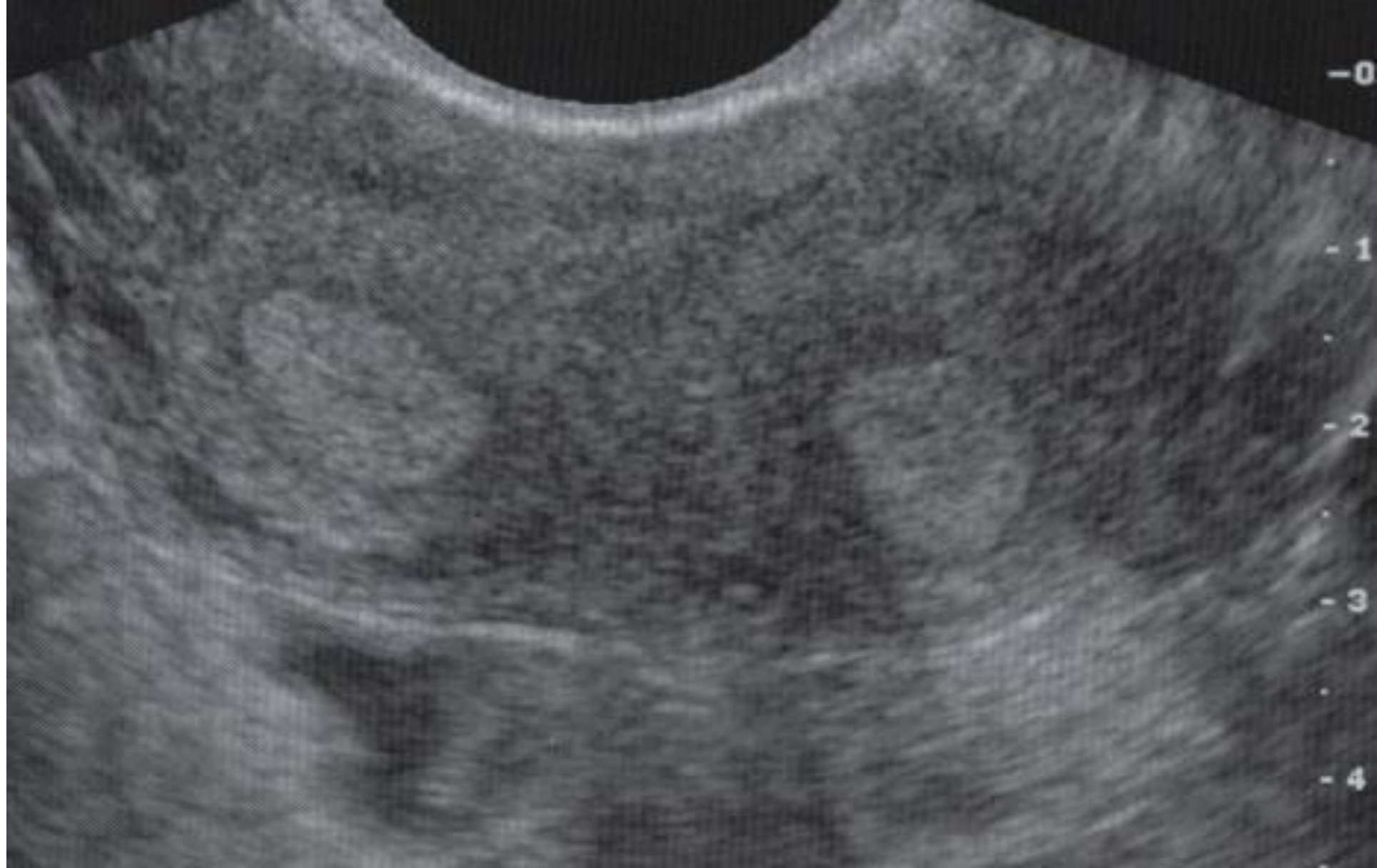


Figure 5.37: Intrauterine contraceptive device seen in the uterine corpus



TRANSVERS IMAGE OF A BICORNATE UTERUS



Endometrial hyperplasia



Typical endometrial hyperplasia



Typical endometrial hyperplasia

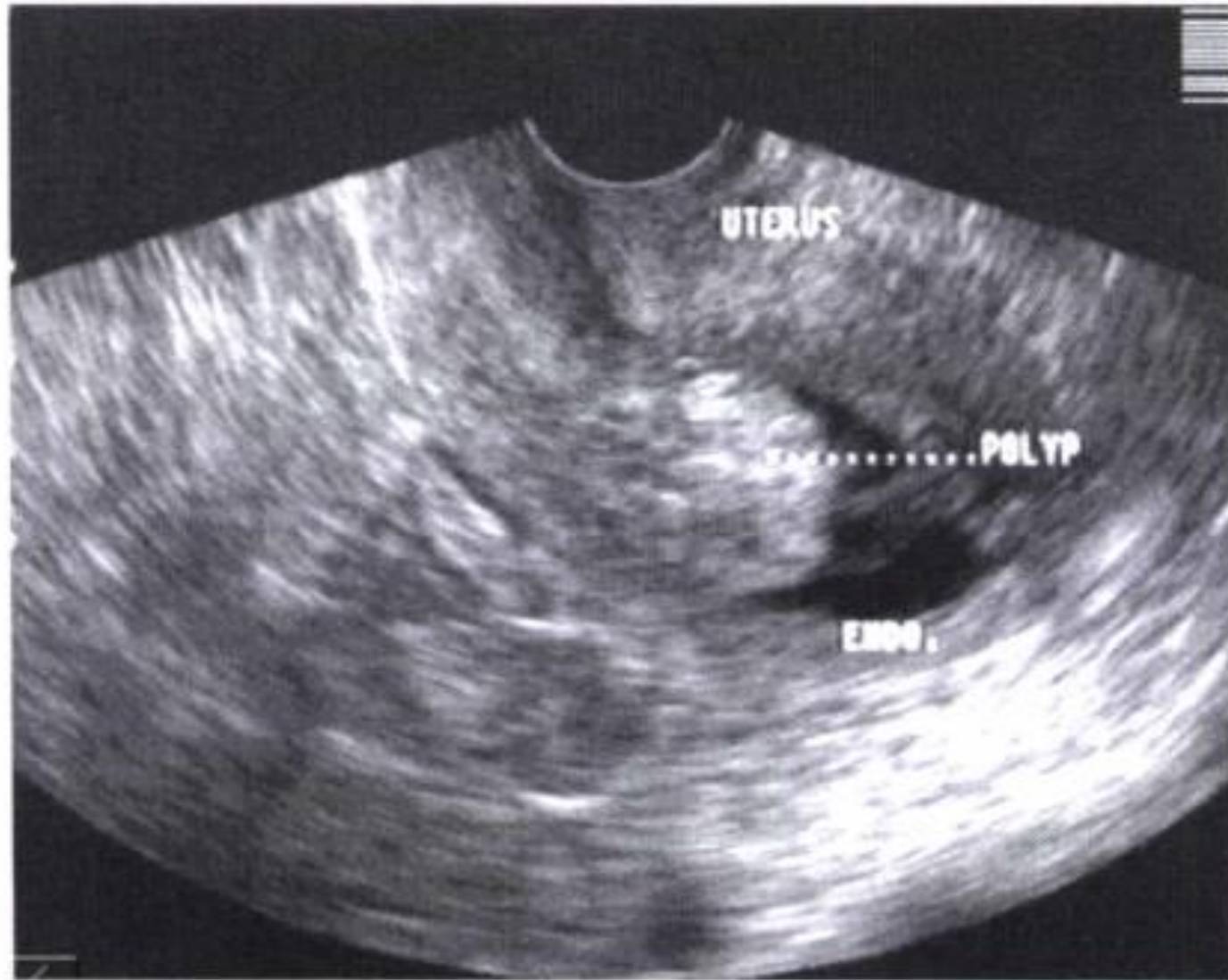
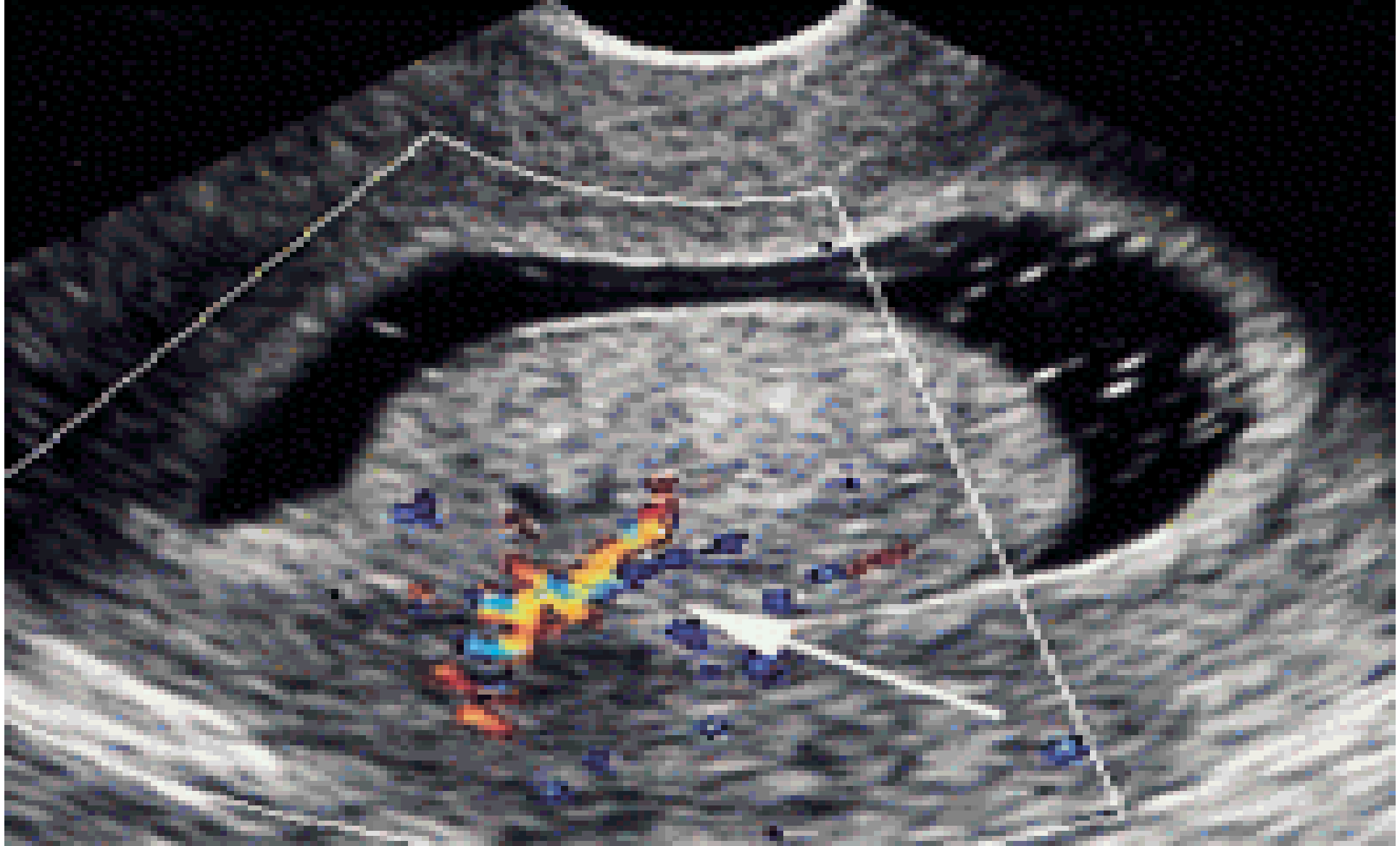


Figure 5.48: Another case of polyp showing so clearly after a sonohysterography



Typical endometrial polyp



Multiple endometrial polyps



Pedunculated submucosal fibroid



Figure 17.10 Transvaginal sonogram demonstrating a large submucous leiomyoma

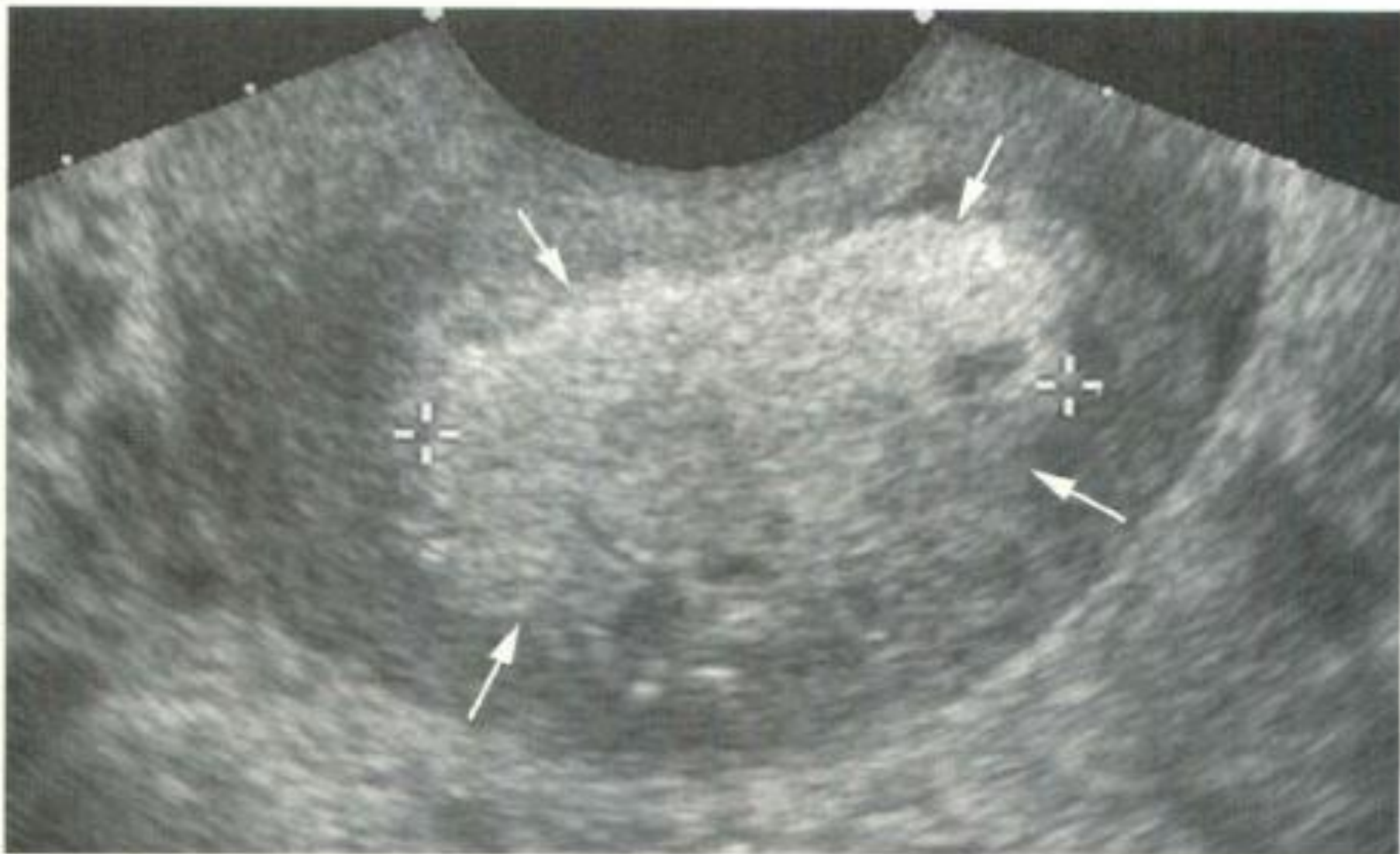


FIGURE 27-36. A patient presented with vaginal bleeding continuing 2 months after delivery. A hyperechogenic soft tissue mass (*arrows*) was seen within the uterus. This was retained placental tissue.

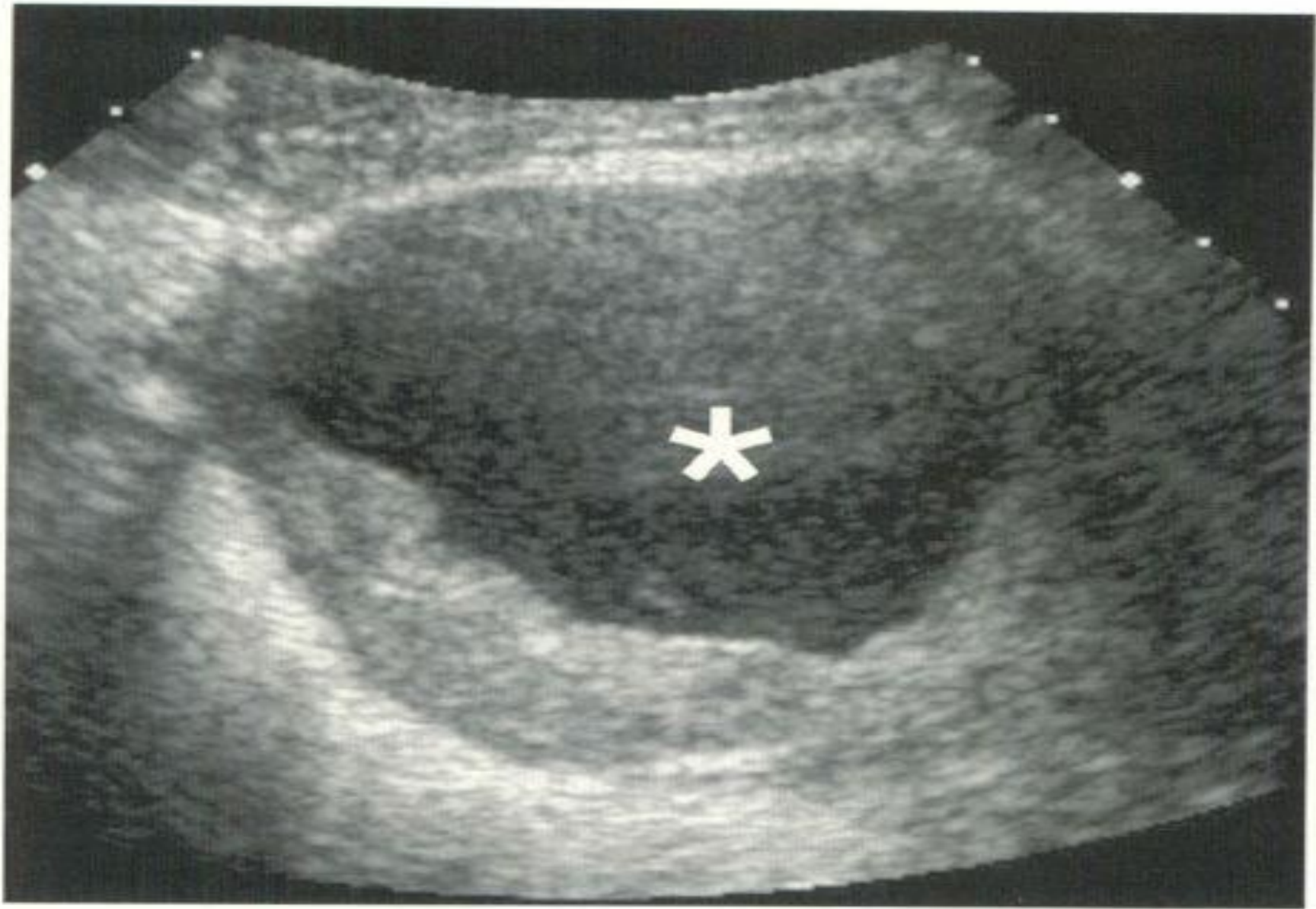
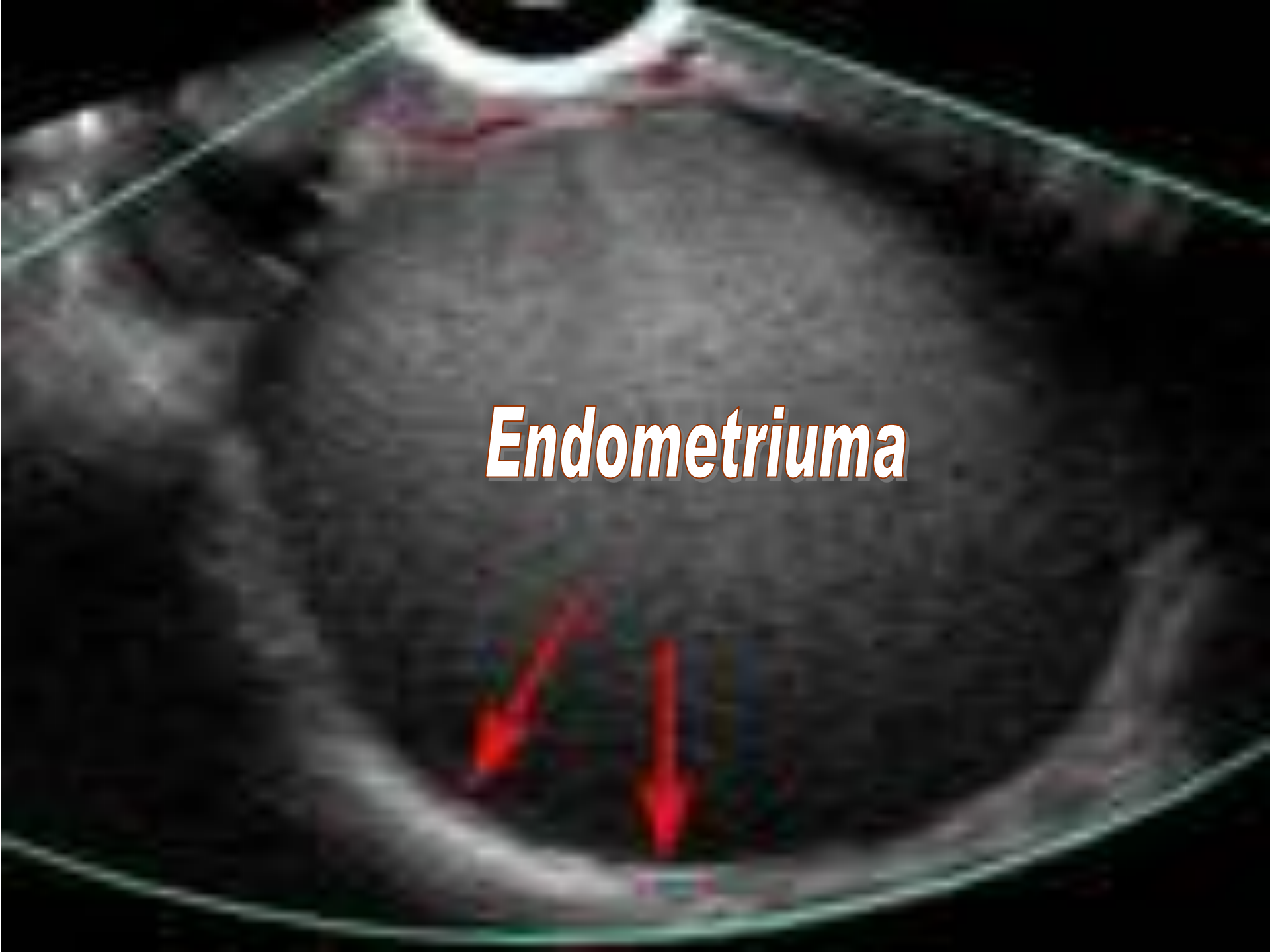


FIGURE 27-23. Marked cystic degeneration (*asterisk*) of a large intramural fibroid.



Endometrium

Image 11
Ultrasound in
Pregnancy Week
20-24
Transverse
Plane

TRANSVERSE

Endometrium



Hydrocephalus
Normal
20-25mm
15-20mm

HYDROCEPHALUS

Hydrocephalus



Hydrosalpinx



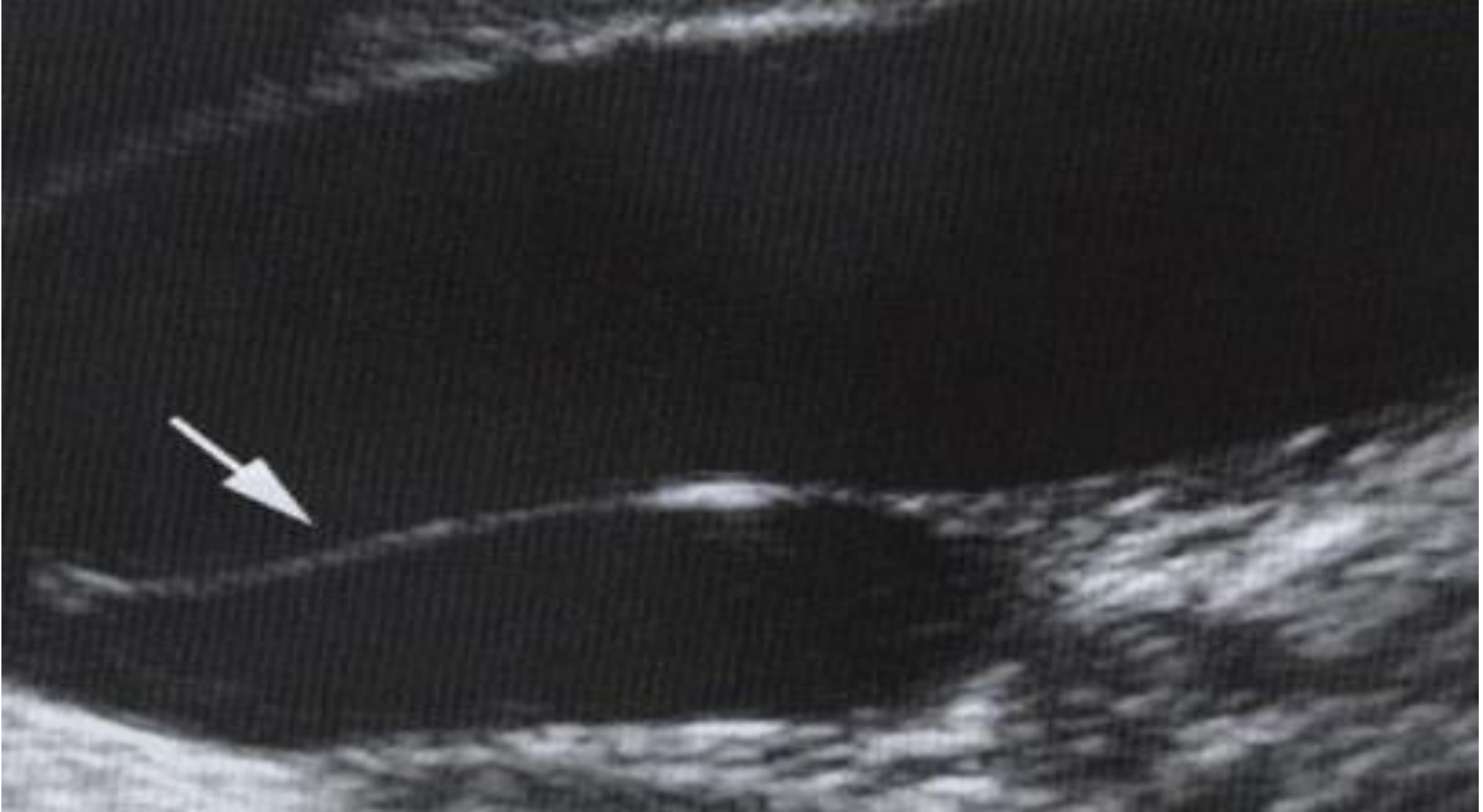
ULTRASOUND



Hydrosalpinx



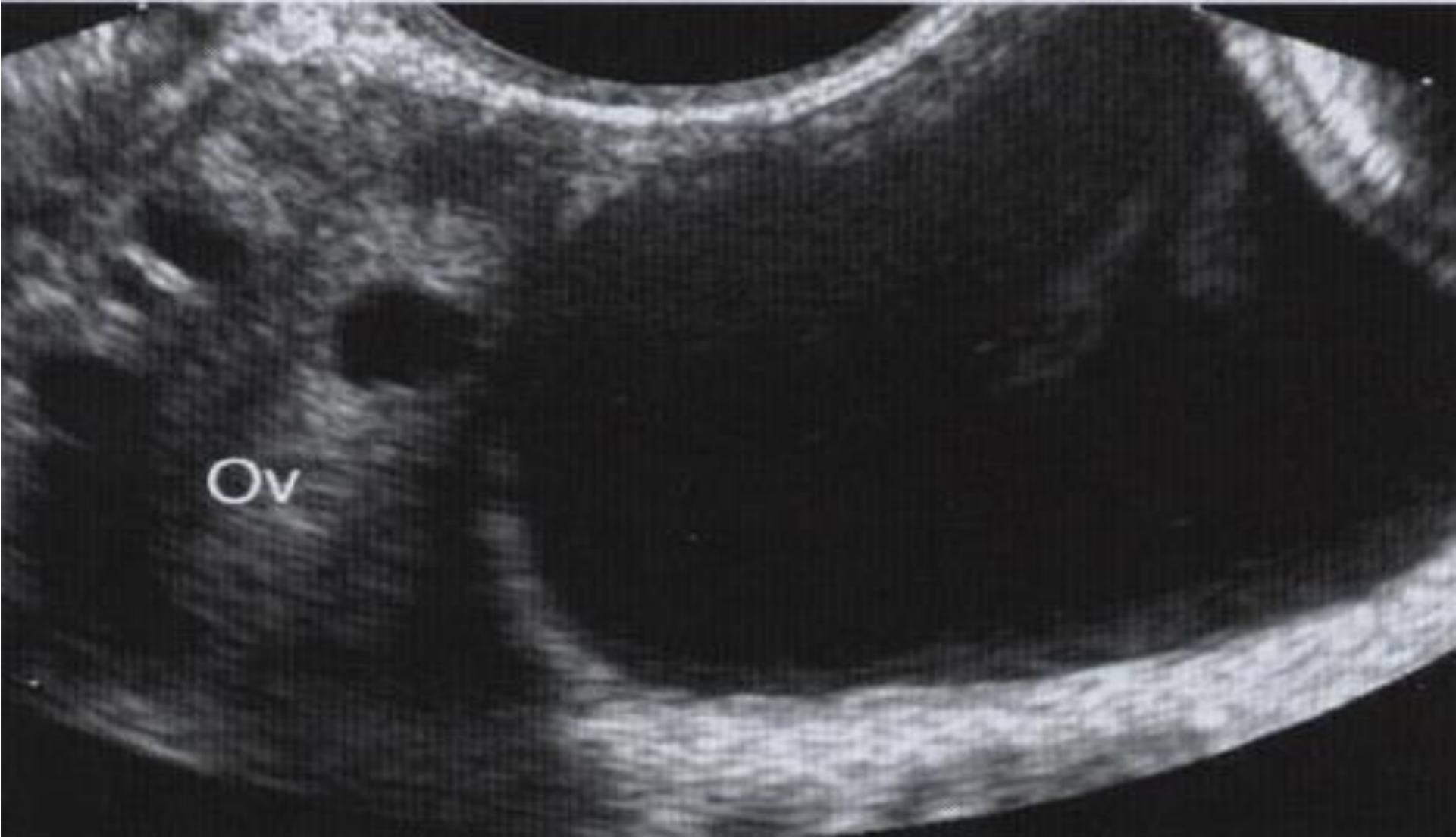
HYDROSALPINX WITH MARKEDLY DILATED FLUID-FILLED TUBE



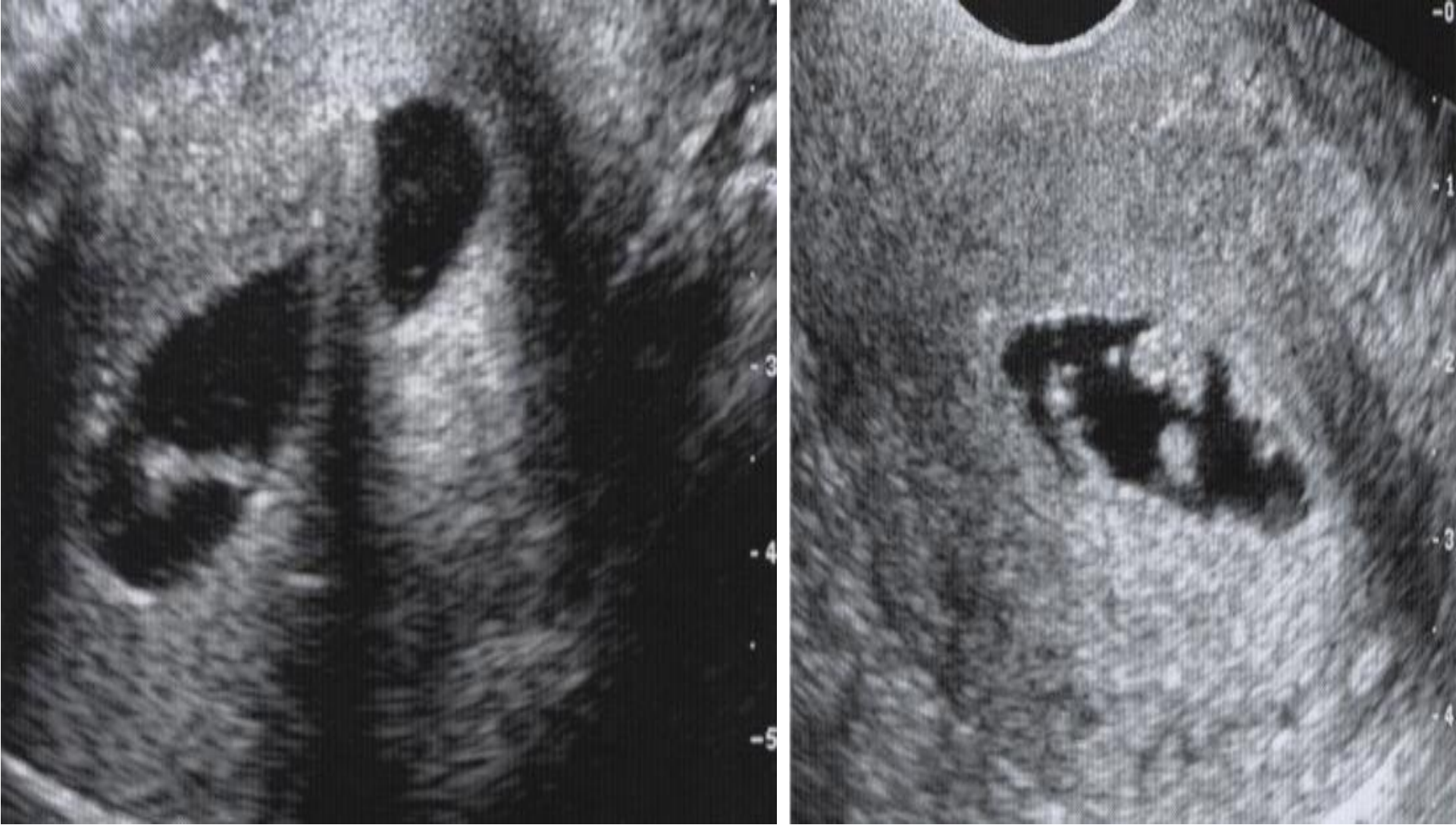
HYDROSALPINX WITH DILATED CONVOLUTED FLUID – FILLED TUBE



PARAOVARIAN CYST



PARAOVARIAN CYST



ENDOMETRIAL POLYPS & ADHESIONS



Fig. 10.3: Right ovarian dermoid



Fig. 10.4: Large ovarian endometrioma



Thick endometrial adhesions

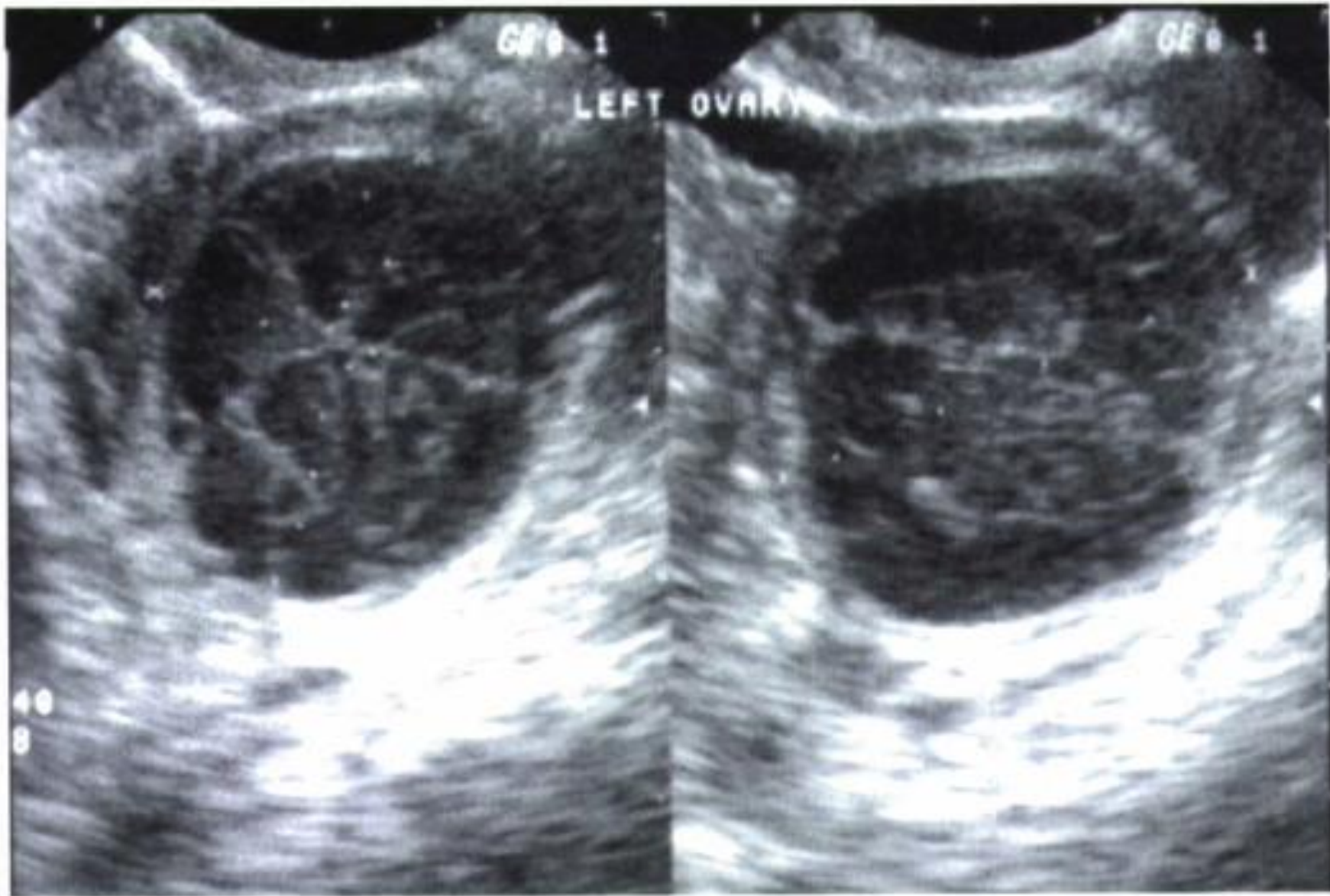


Figure 6.8: Hemorrhagic cyst with dense coarse internal echoes

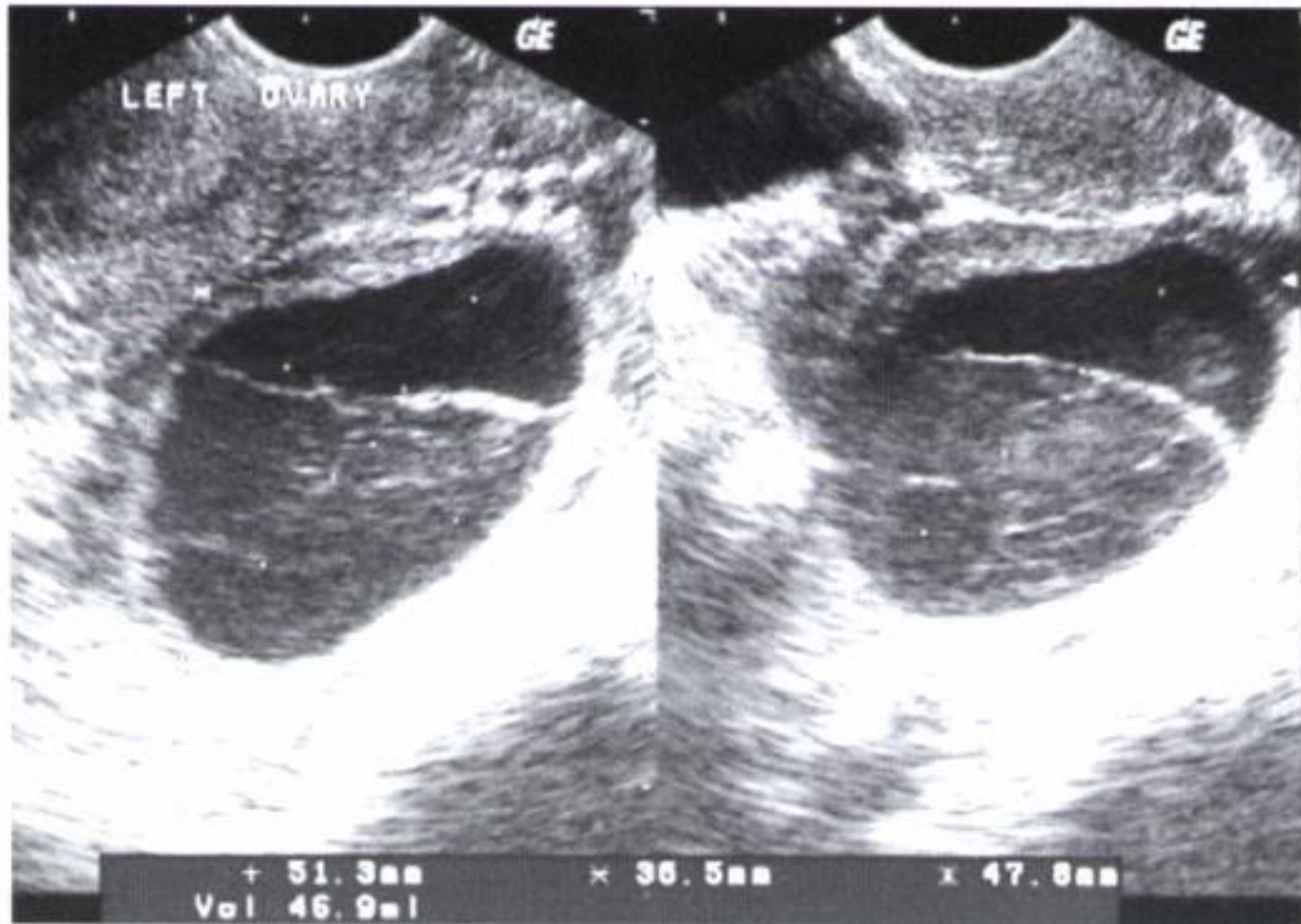


Figure 6.10: Hemorrhagic cyst showing a fluid-fluid level

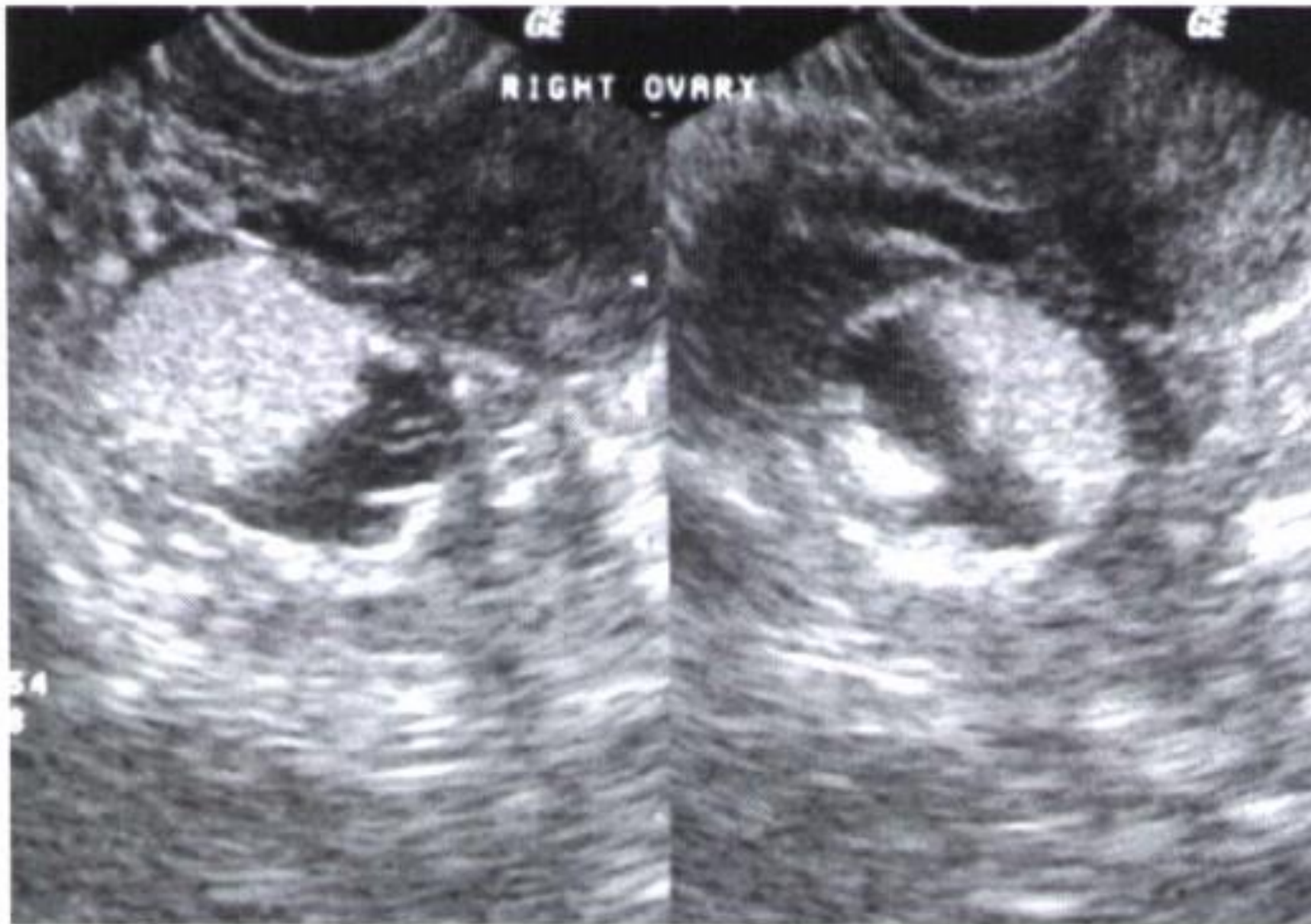


Figure 6.14: Right ovarian dermoid



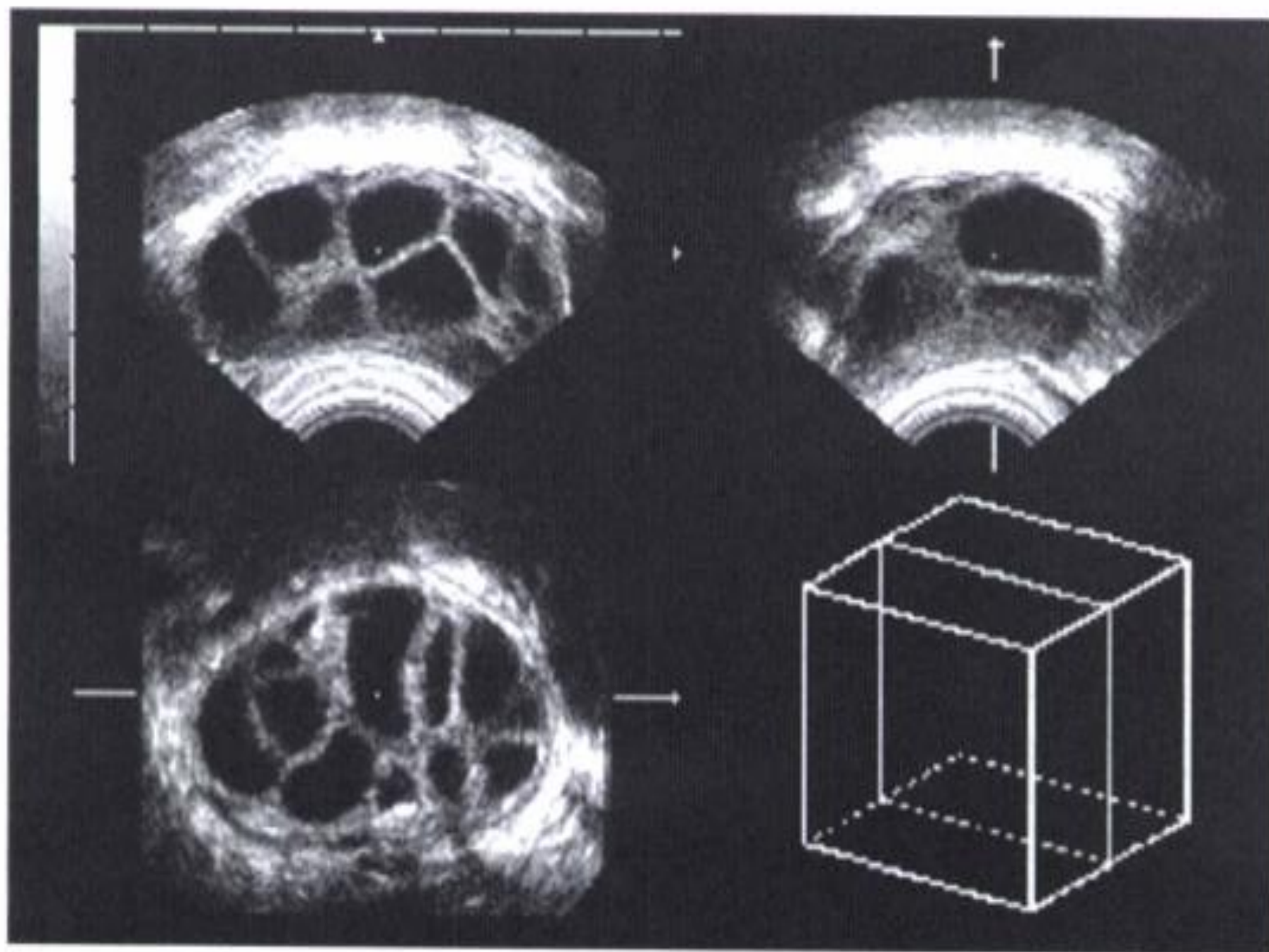
Figure 6.27: Polycystic ovaries with a dense stroma and multiple thin-walled clear cysts along the periphery



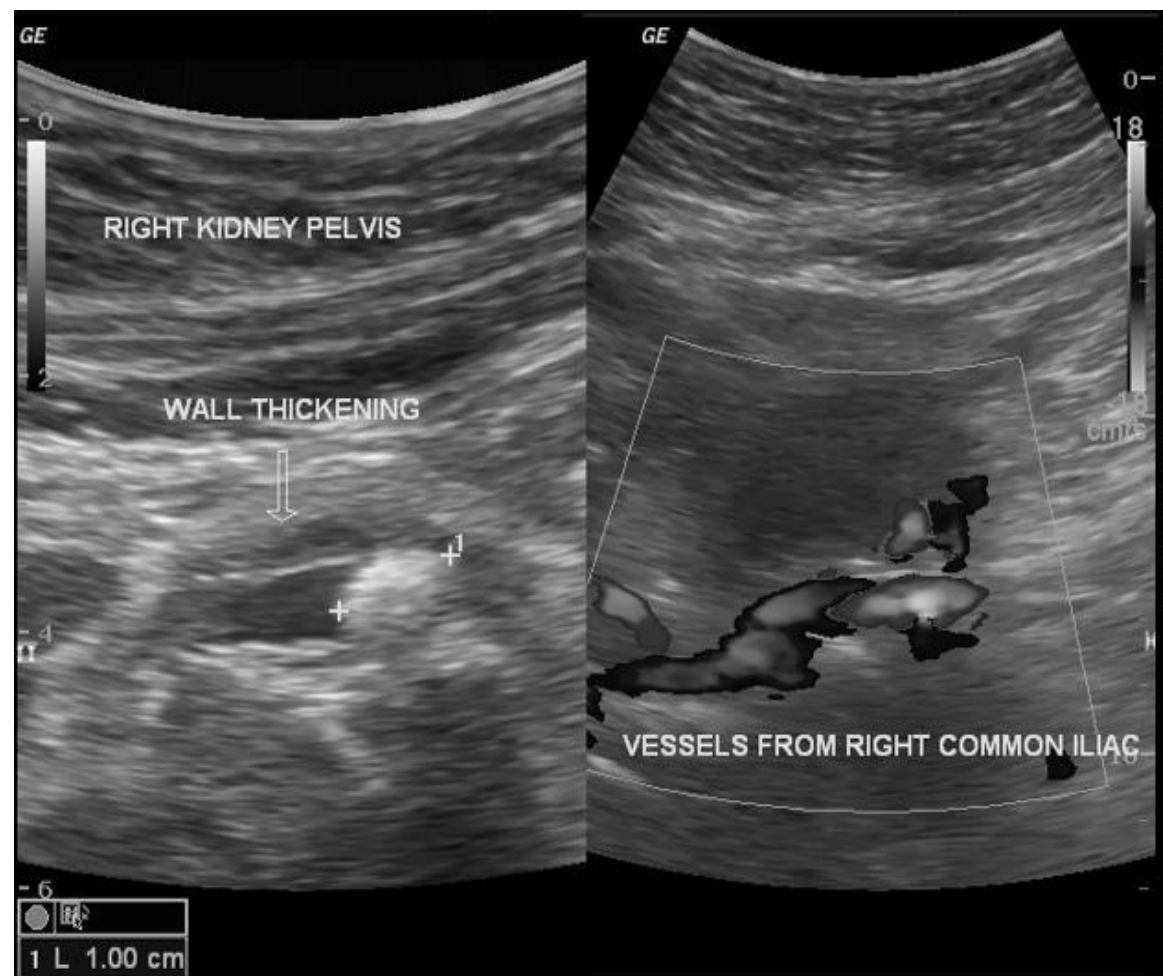
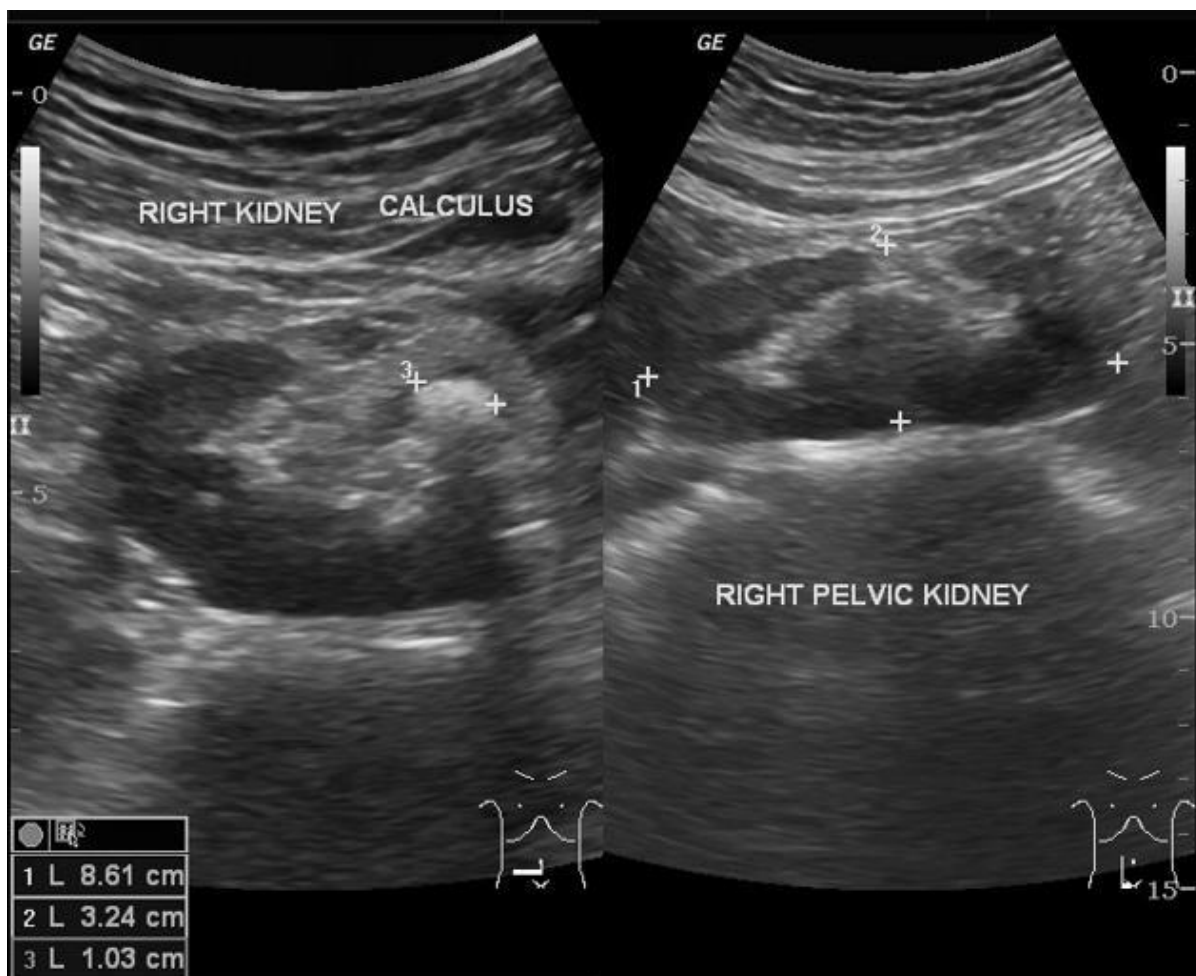
FIGURE 27-14. A three-dimensional image that demonstrates a heart-shaped **bicornuate uterus**. Fundal indentation is well seen (*arrow*), as well as the widely divergent horns (*asterisks*) with a single cervix (*arrowhead*). (Courtesy of Beryl R. Benacerraf, Boston, MA.)



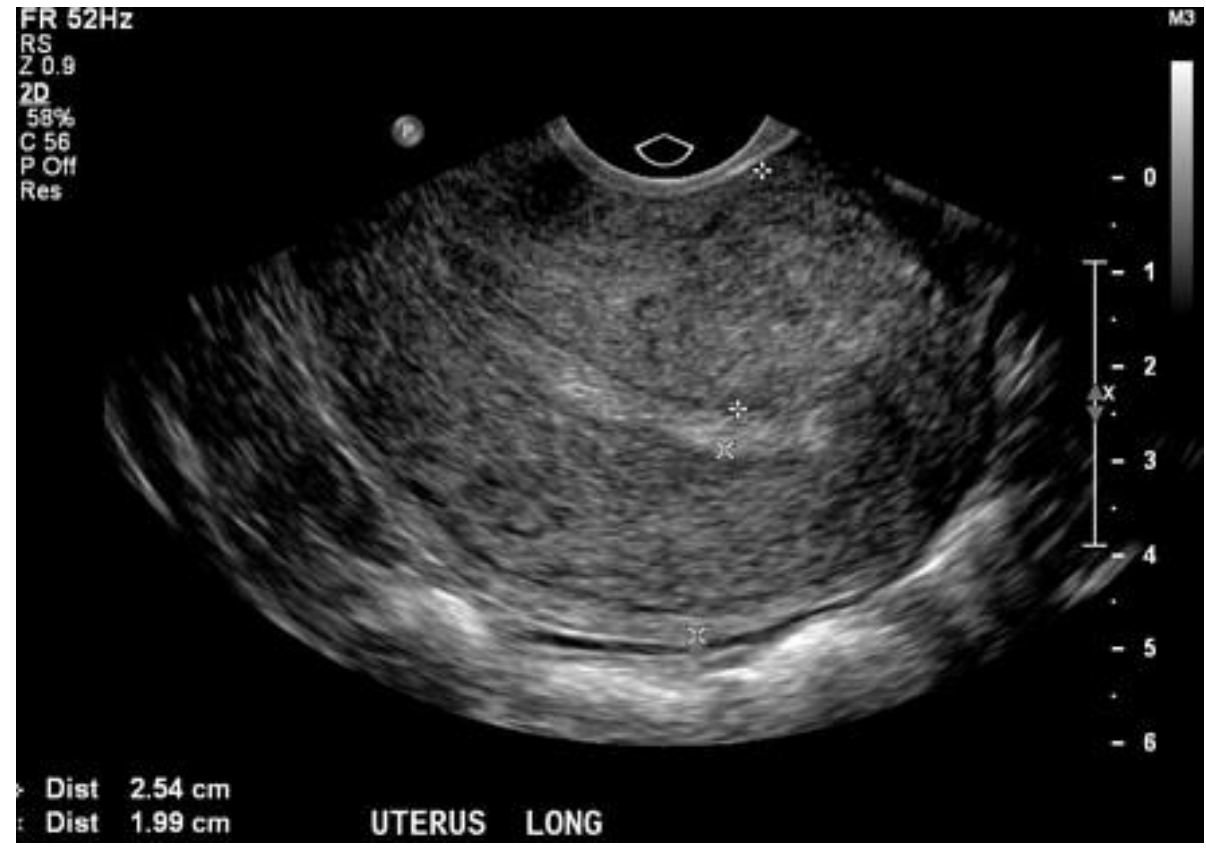
FIGURE 27-15. Coronal three-dimensional image of **septate uterus**. Two separate but close cavities, fibrous septum, and smooth-appearing fundal contour. (Courtesy of Beryl R. Benacerraf, Boston, MA.)



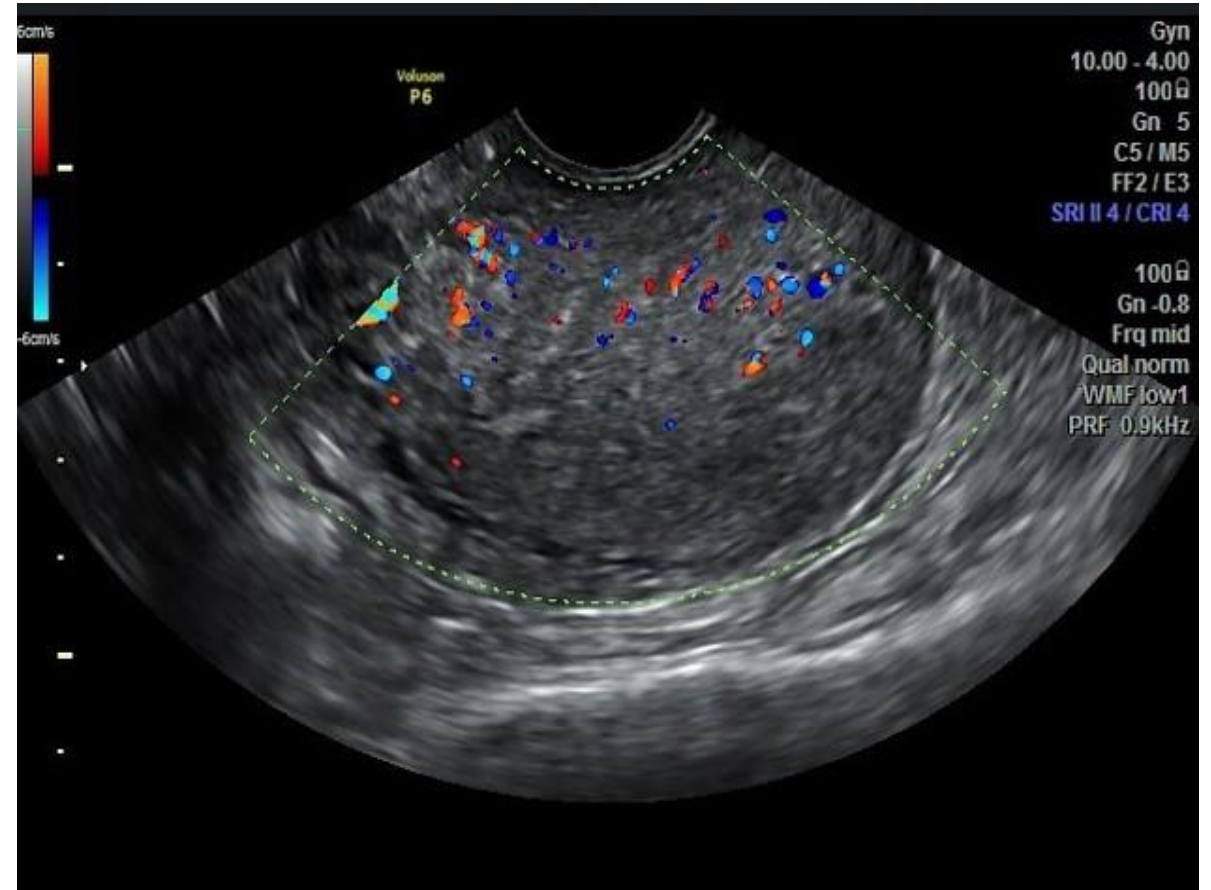
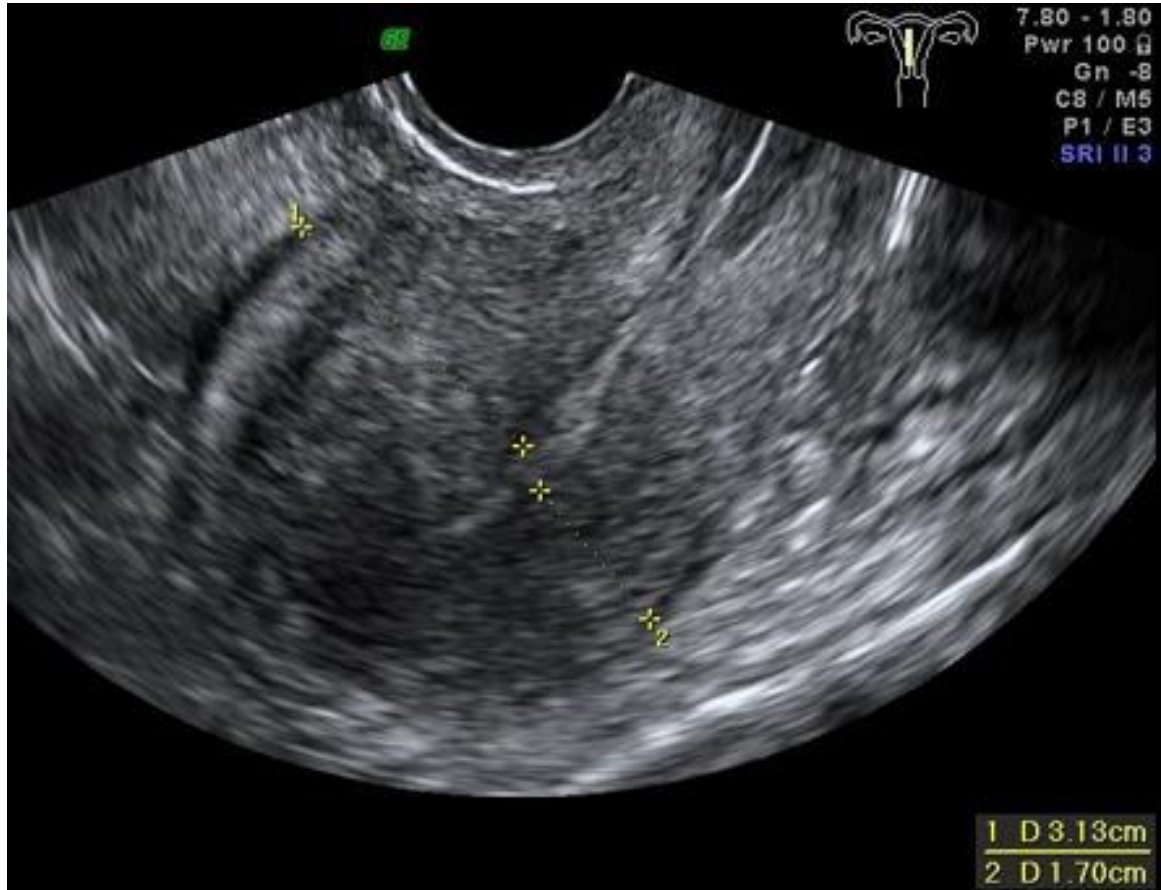
Pelvic Kidney



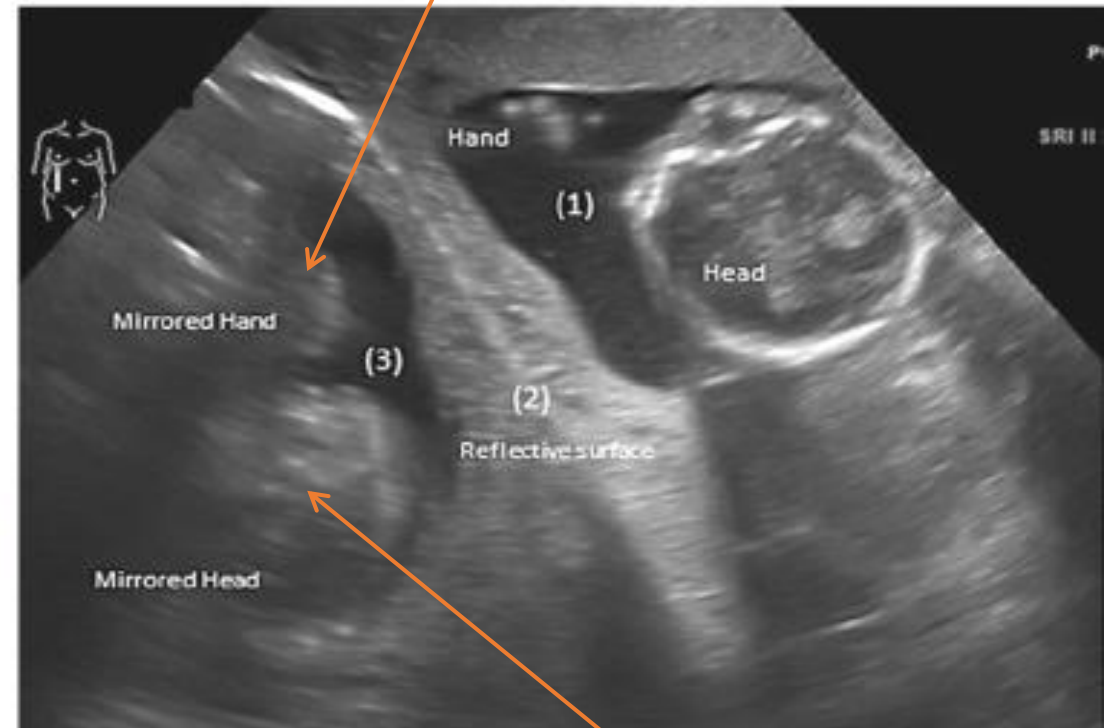
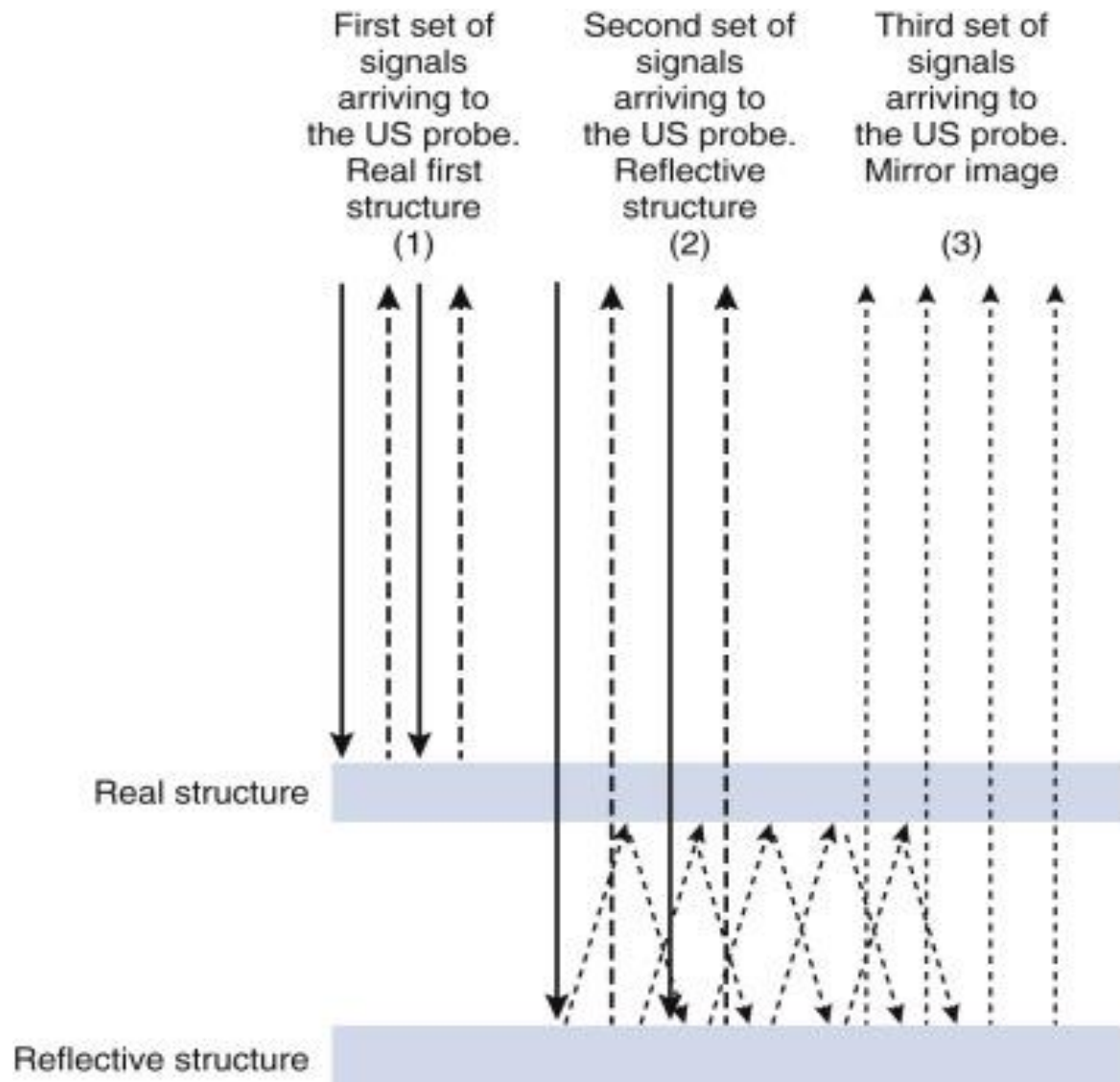
Adenomyosis



Adenomyosis



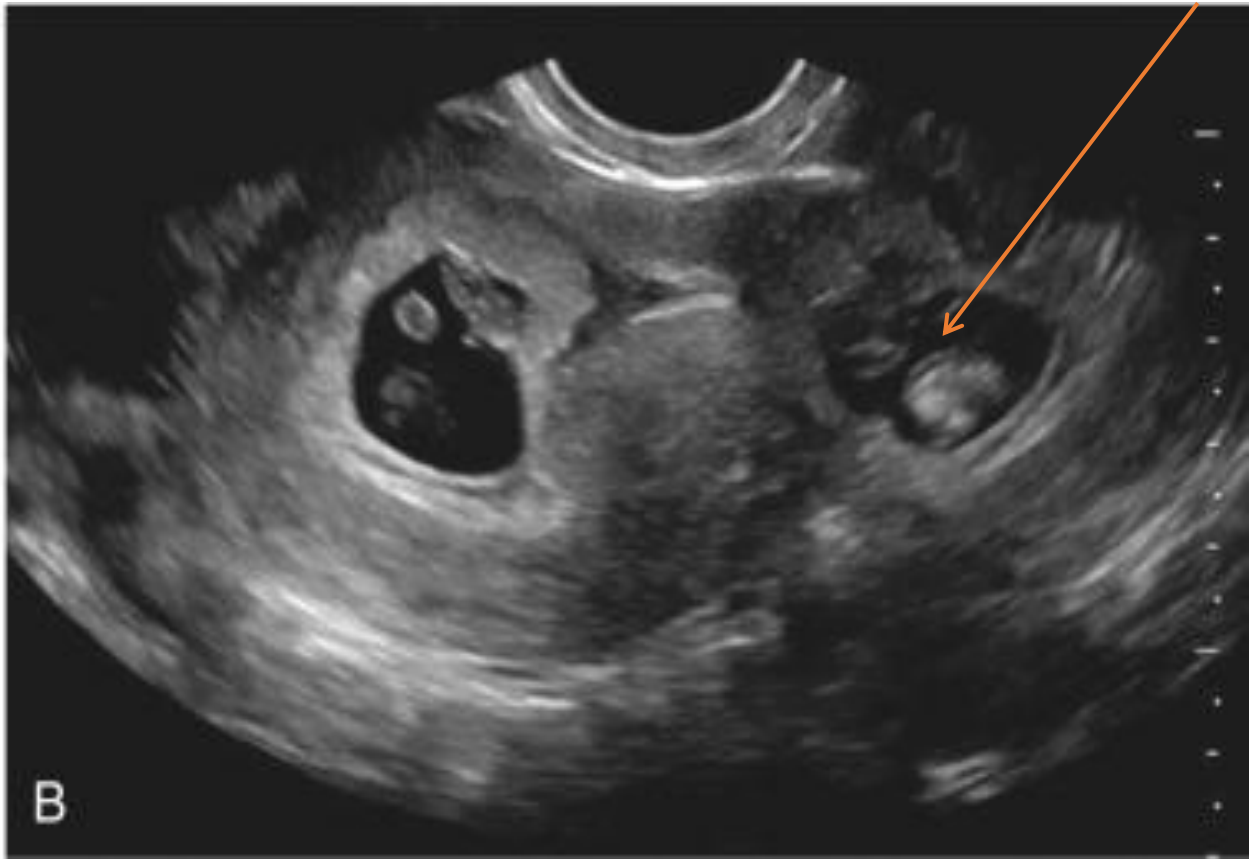
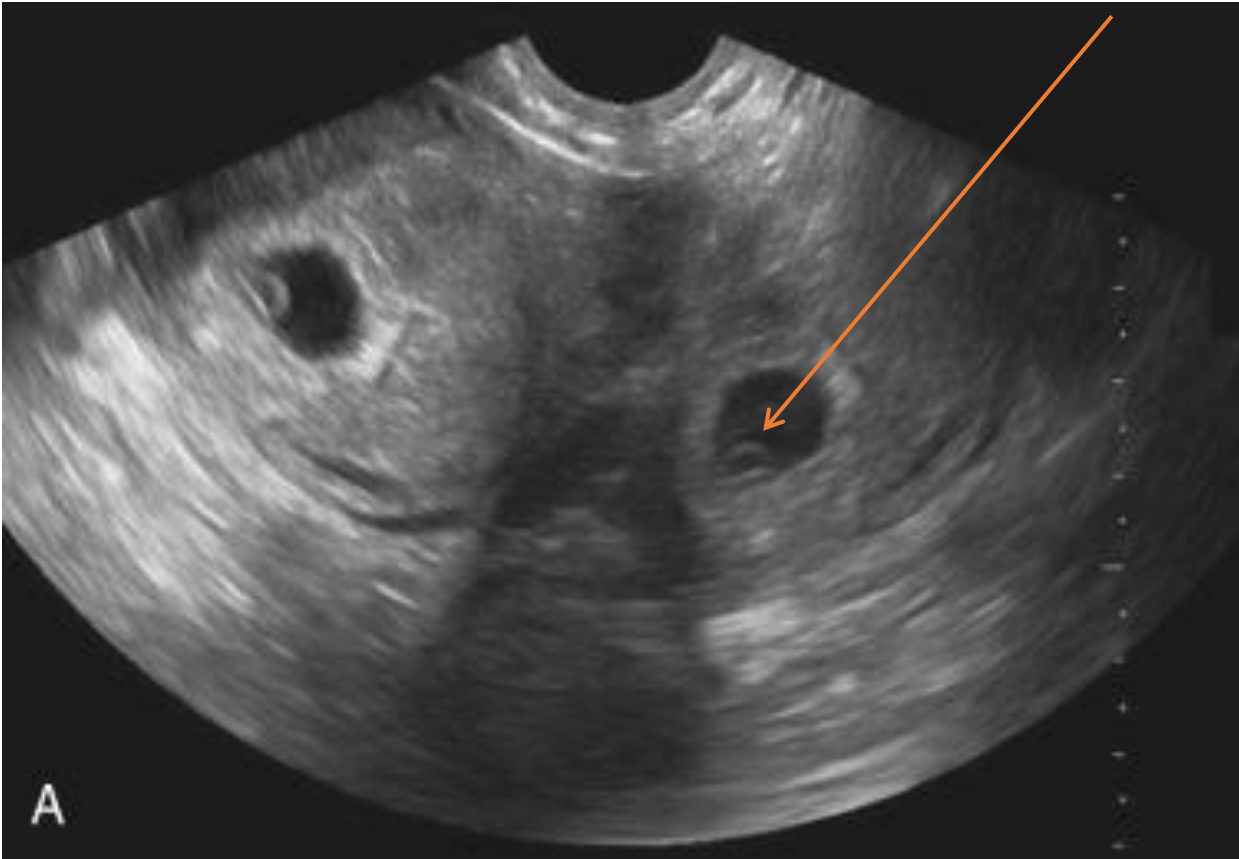
*Examples of
Artifacts, Pitfalls and Normal variants
in Obstetrics sonograms*



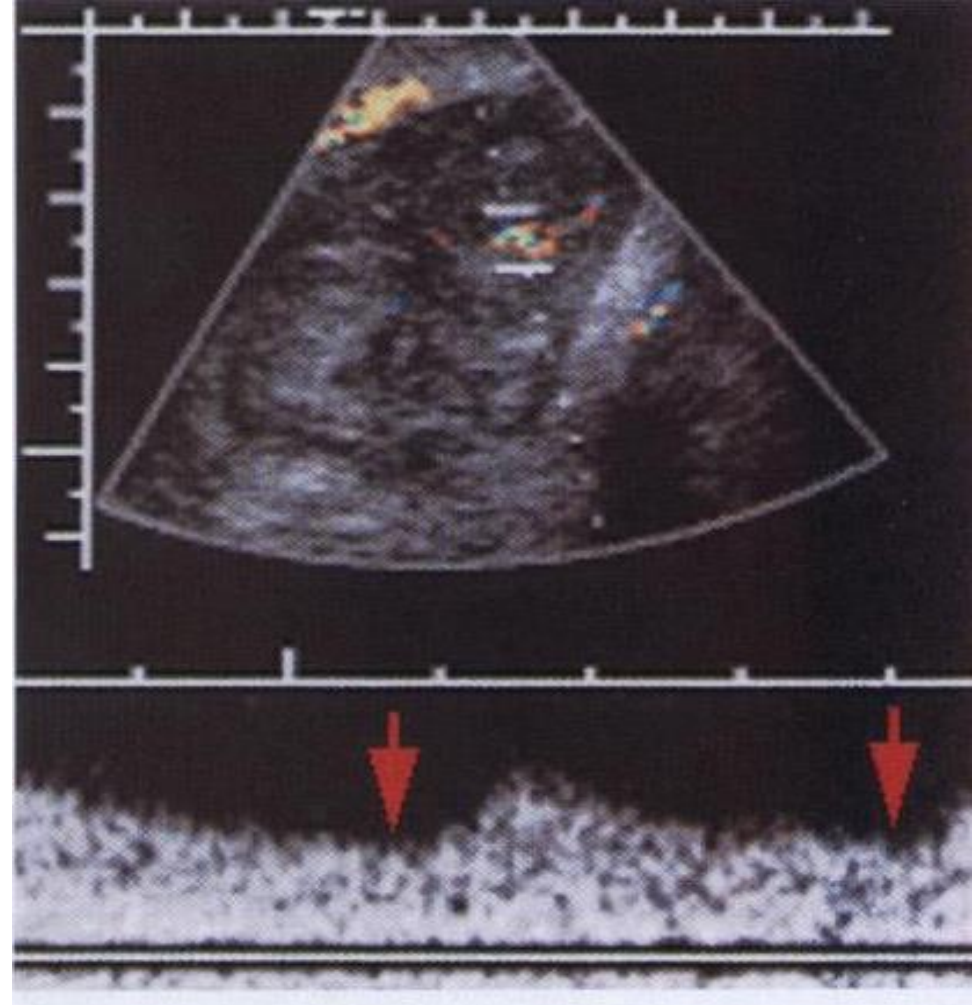
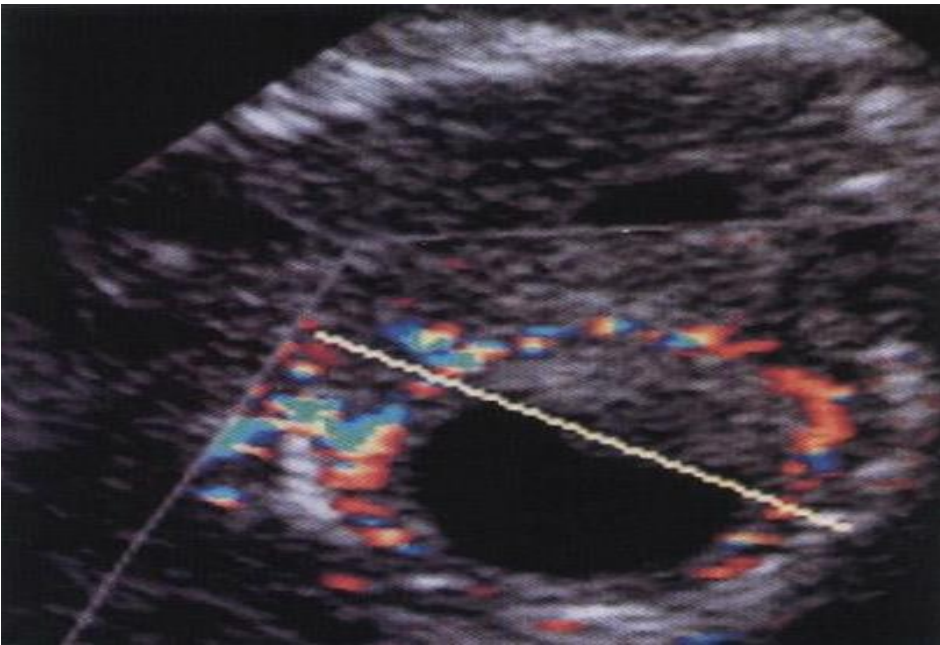
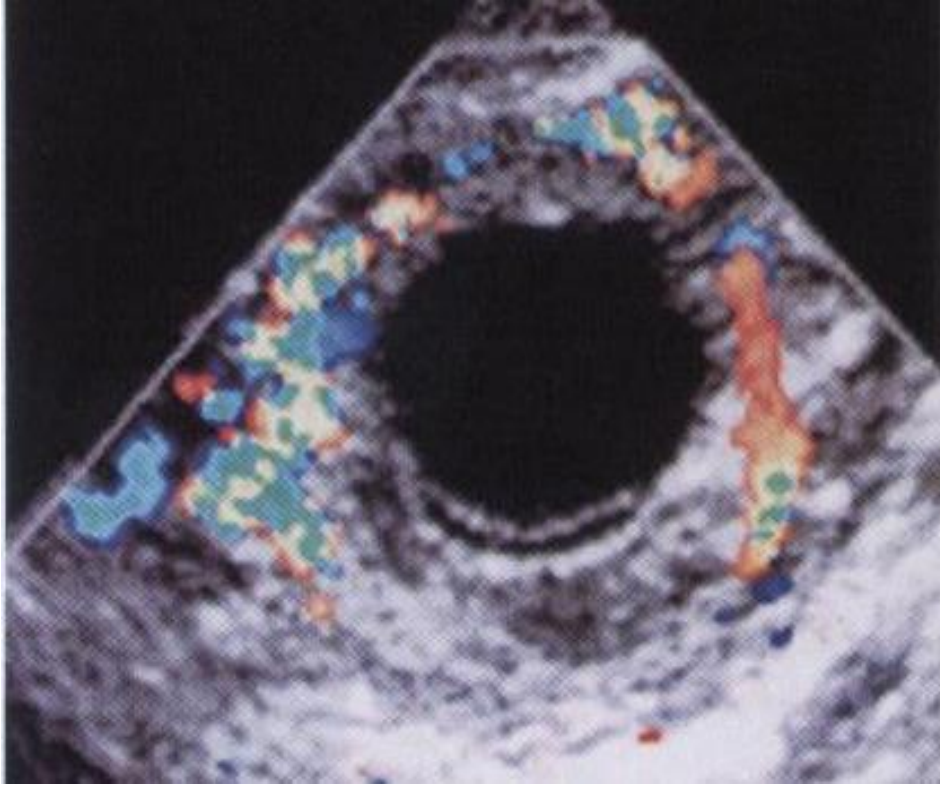
Ultrasound (US) signals are normally reflected by the structure (fetal head) and by the reflective surface (posterior uterine wall and bowel) arriving on time to the transducer. Some ultrasound signals bounce back and forth between the head and the reflective surface, finally returning to the transducer. Because they arrive later than the original signals, they are represented as another structure behind/deep to the reflective surface.

mirror

mirror

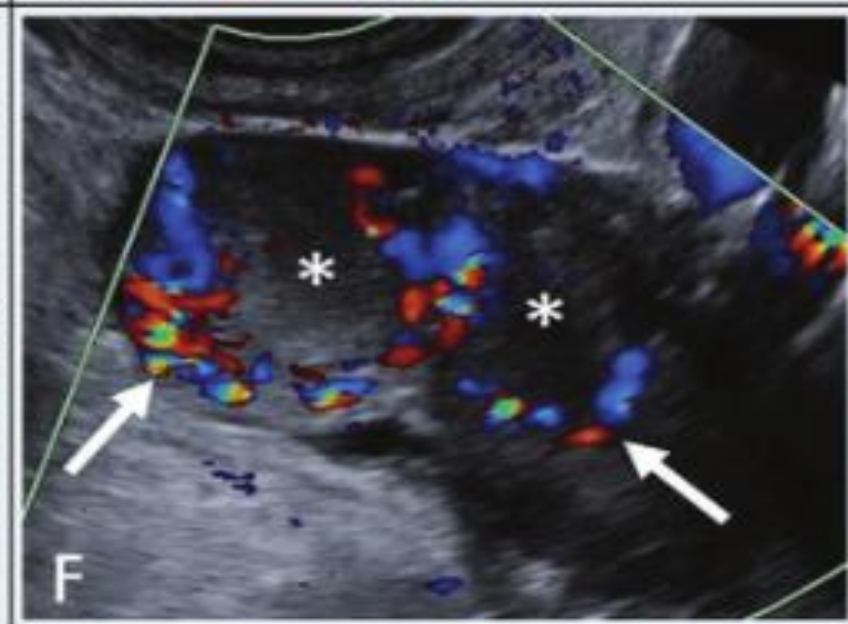
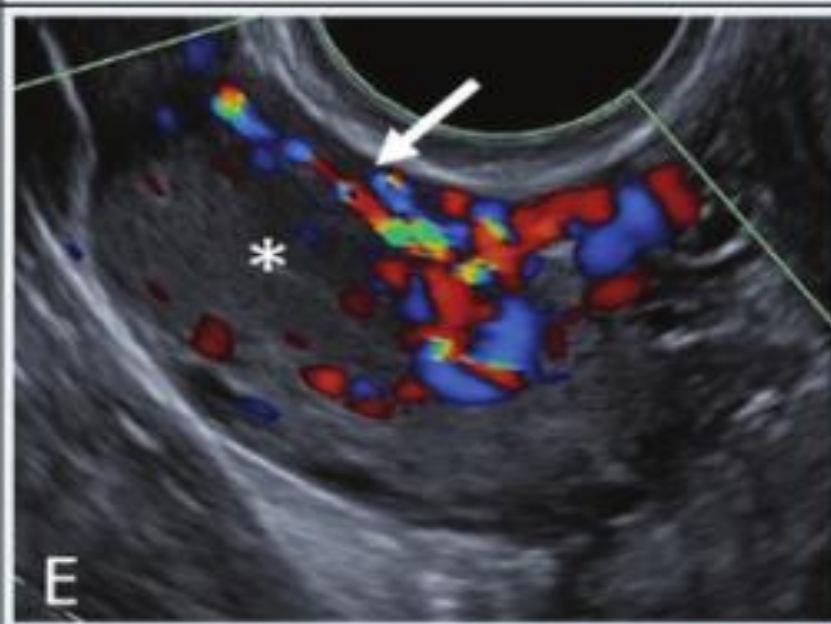
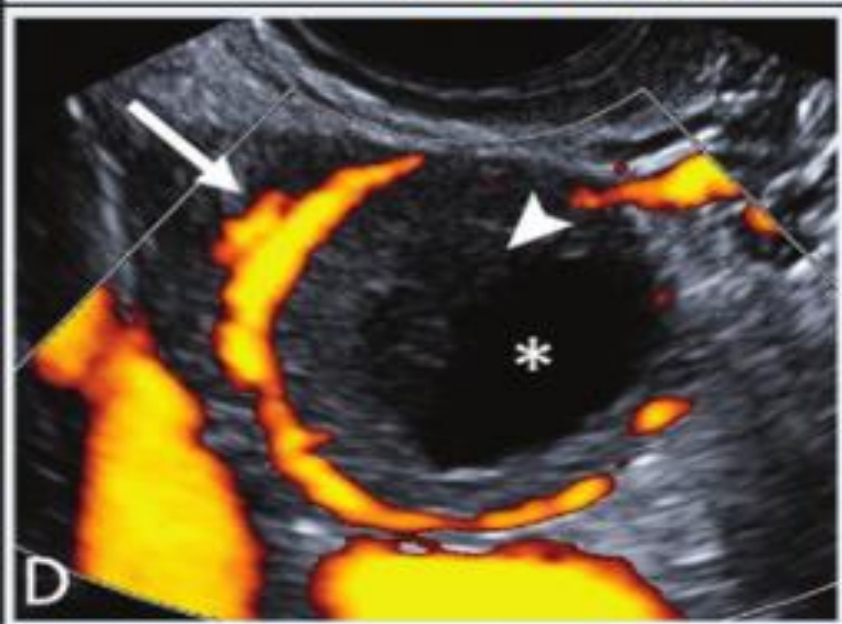
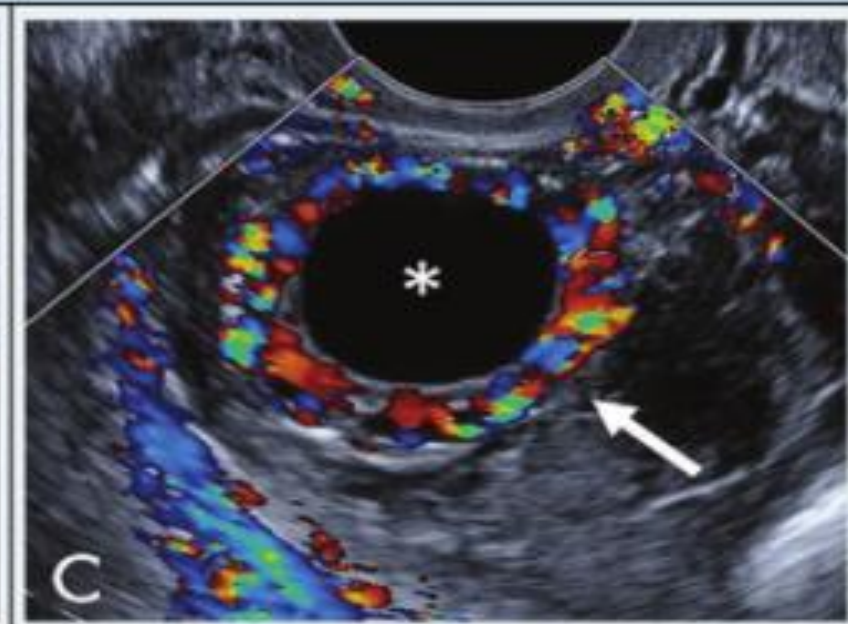
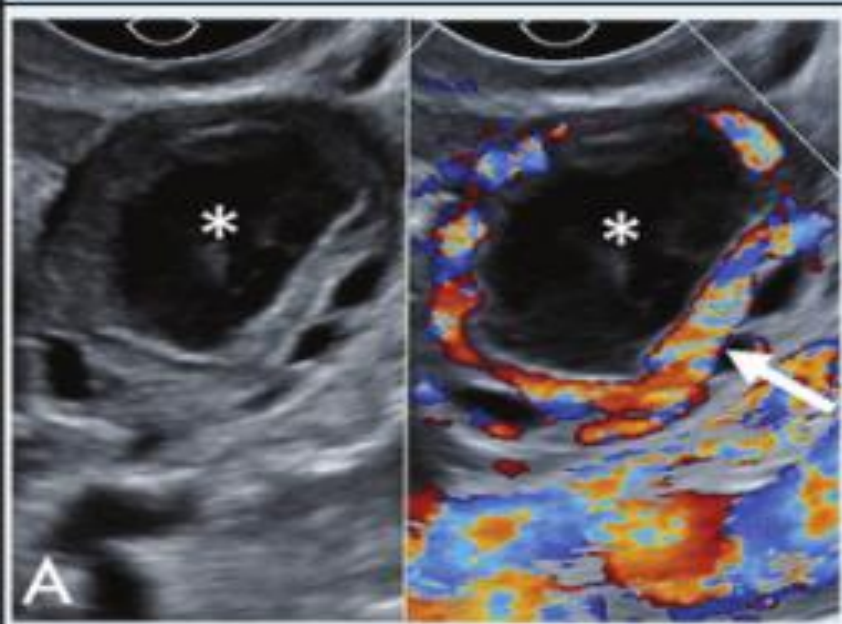


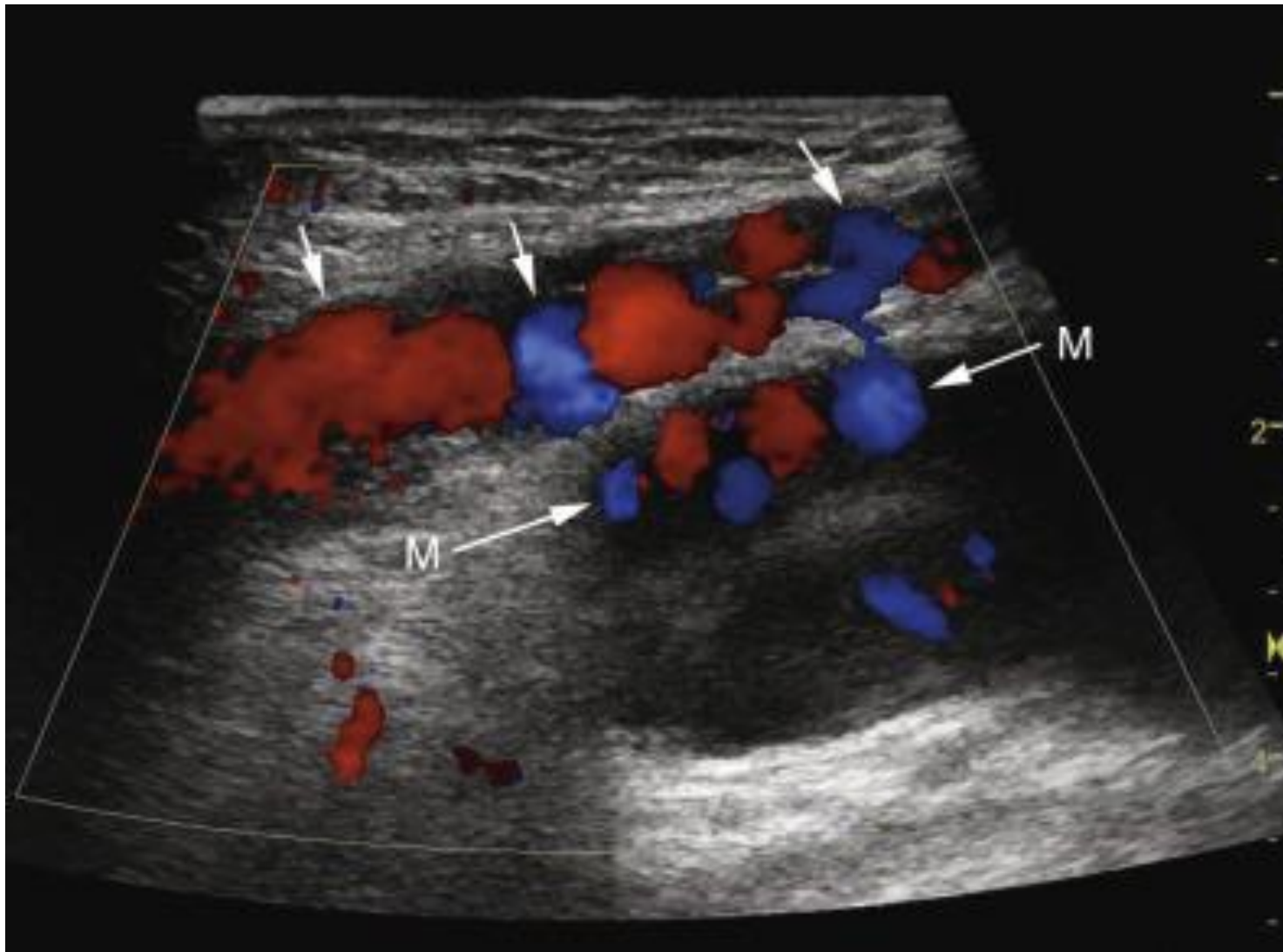
An intrauterine pregnancy on the left and the mirror image artifact of the image on the right



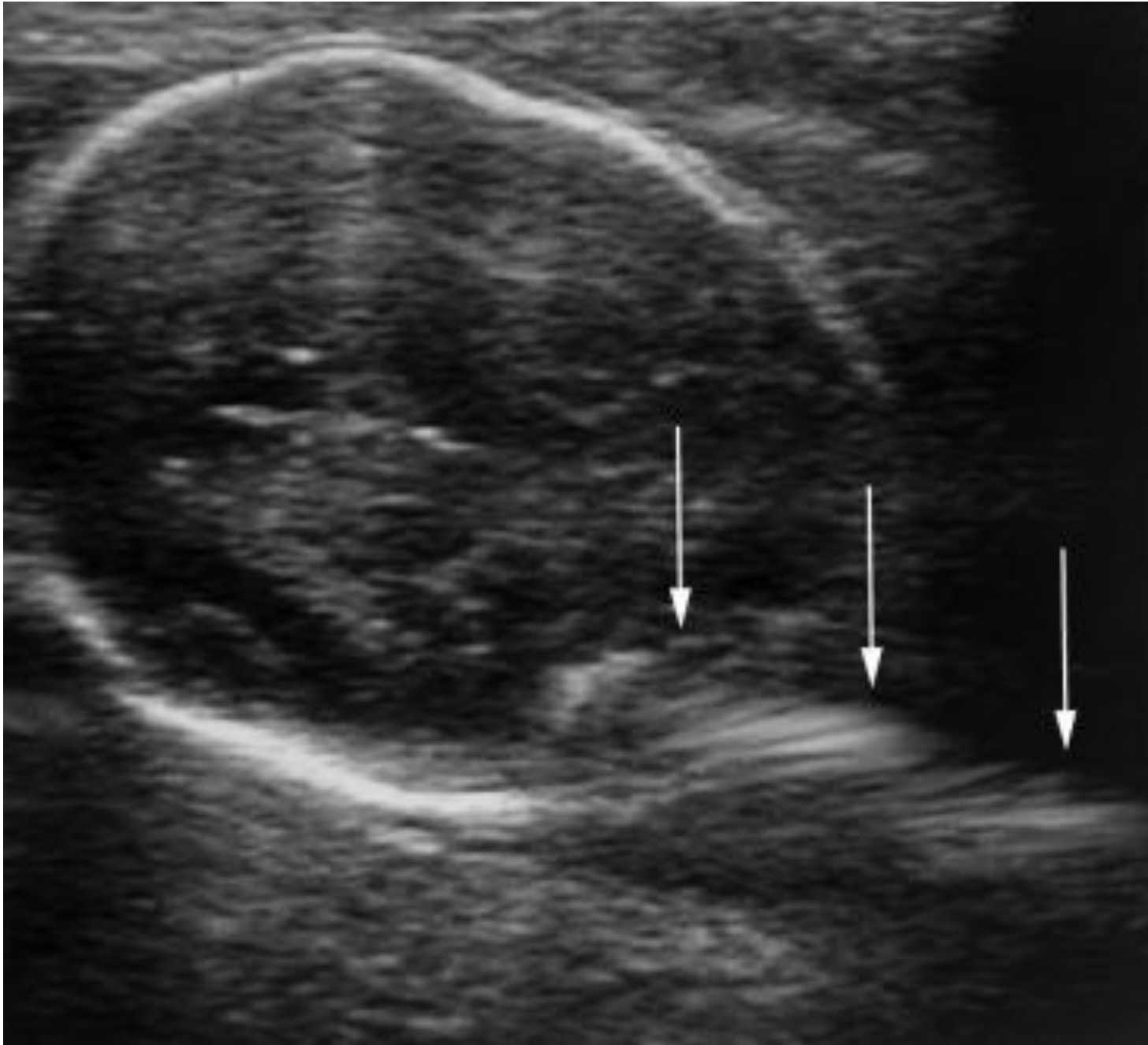
**COLOR DOPPLER OF
ECTOPIC PREGNANCY**

Typical Corpora Lutea





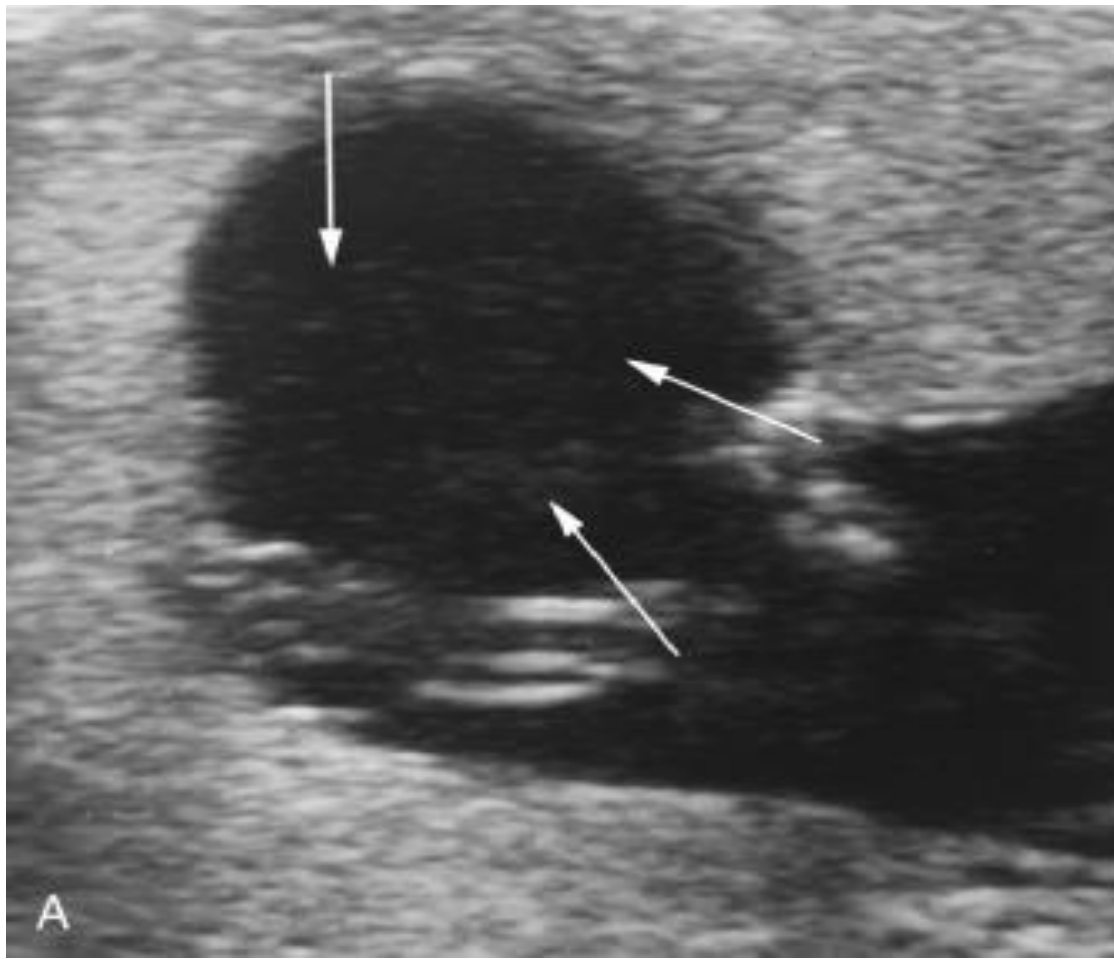
Sonogram over the inguinal area in a gravid patient at 34 weeks with round ligament varices. Color Doppler imaging demonstrates prominent vessels with venous flow (*arrows*). A mirror image (M) of the varices is seen deep to the vessels.



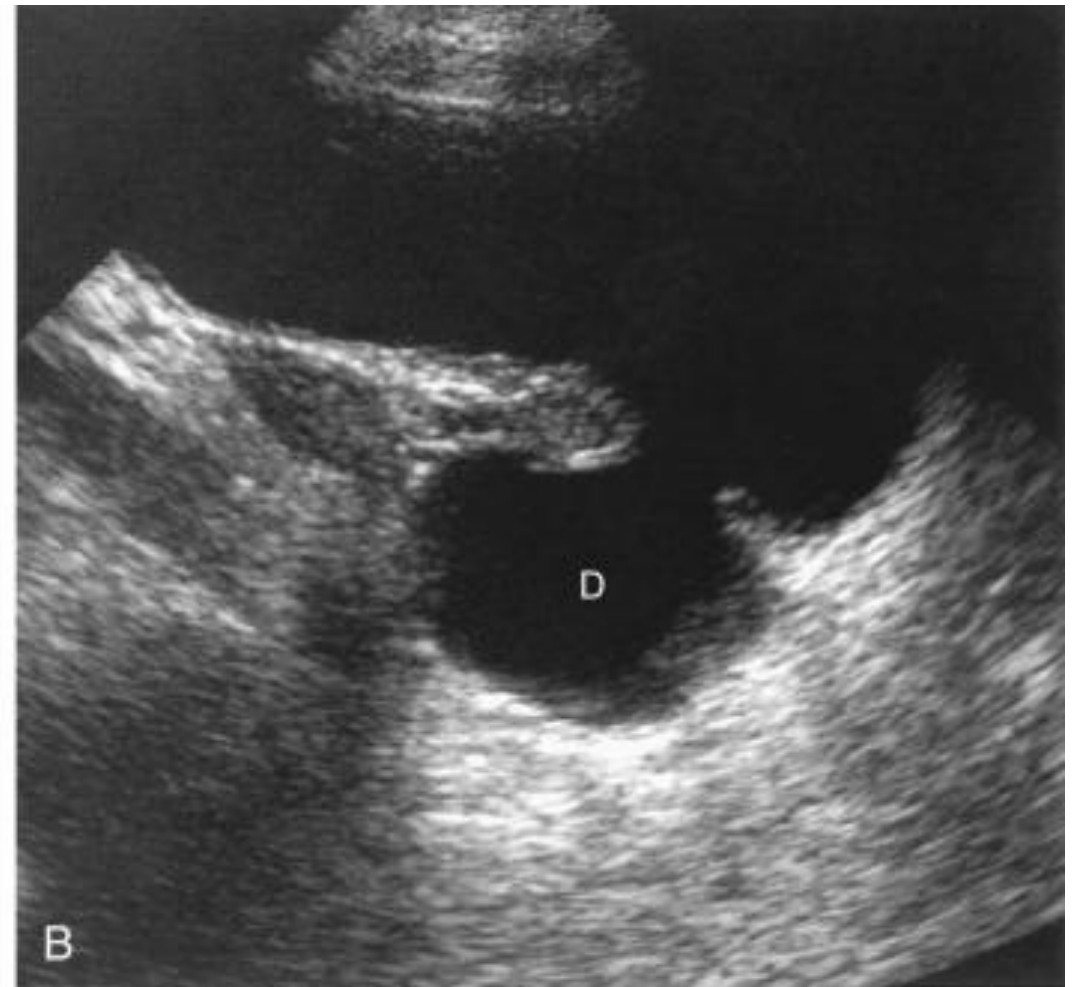
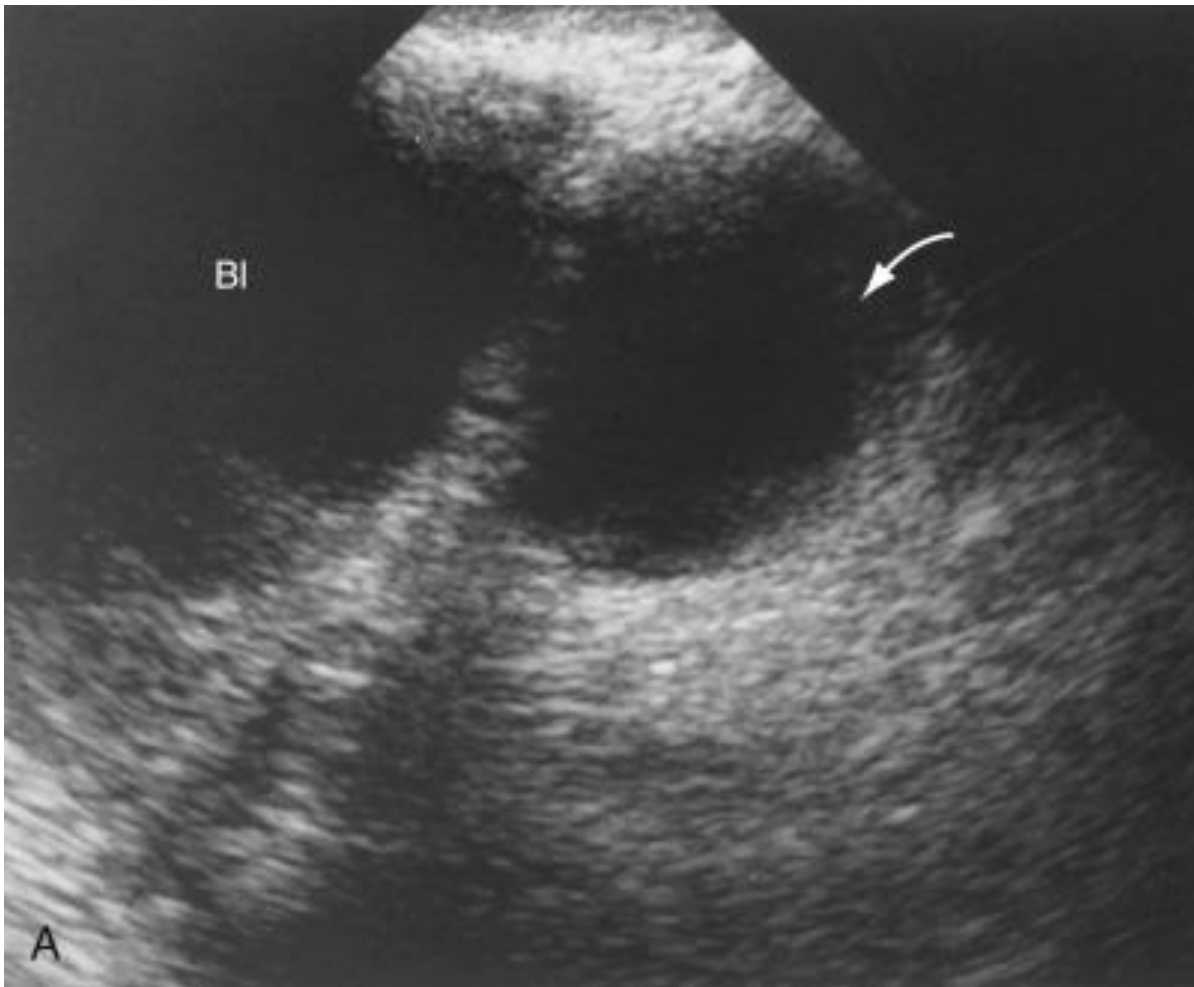
Side lobe (gradient) artifact can occur with even the most sophisticated ultrasound scanning equipment.

In this case, a side lobe artifact is seen overlying the fetal head (*arrows*).

The artifactual nature of these echoes can be confirmed by noting that these echoes are not confined to the head but extend beyond its confines. In addition, changing the scan plane orientation will show the region to be normal.



A, In this patient, numerous low-level echoes (*arrows*) were seen swirling in the amniotic fluid during real-time scanning. Although the origin of the echoes is not known, they may represent shed fetal epithelial cells. B, When the system gain was decreased, these real echoes virtually disappeared. Although the hard copy images do not resolve this dilemma, the echoes were clearly seen to be moving and real when the sonologist was performing the scan.



A, What appears to be a large pelvic cyst (*arrow*) is seen in this patient. Bl, bladder.

B, Although the connection to the bladder was not seen in A, this bladder diverticulum (D) is clearly seen in another plane of section.

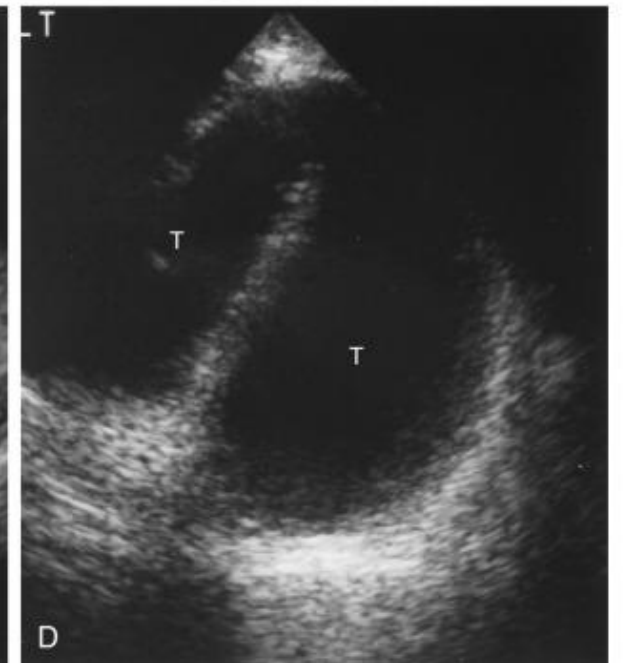
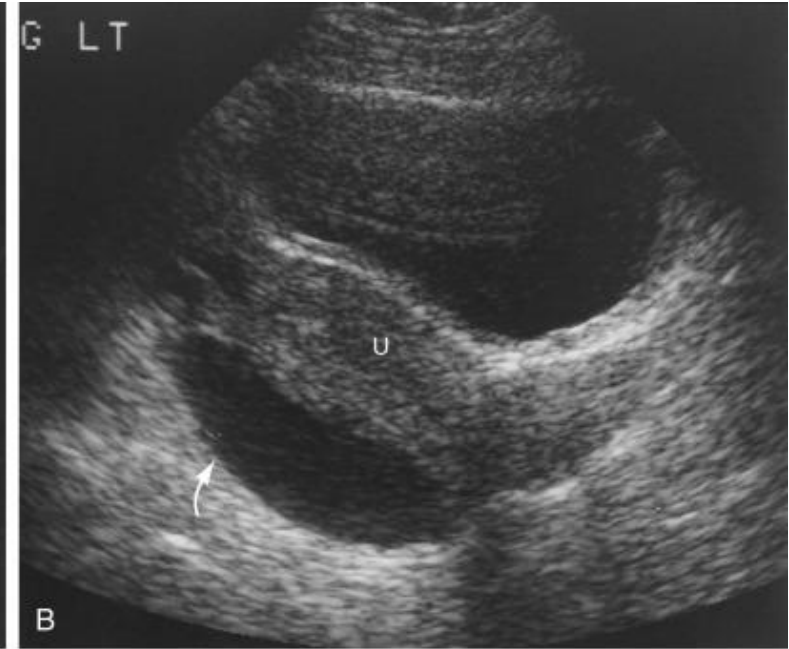
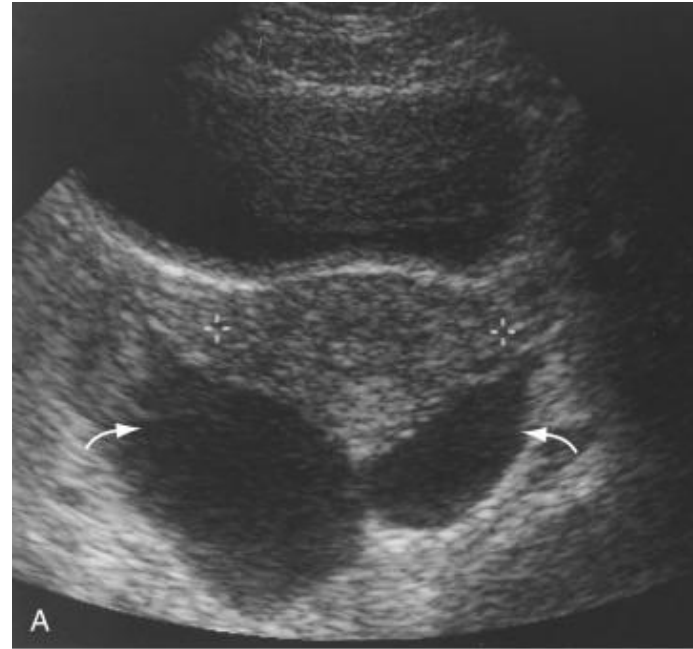
Dilated fallopian tubes simulating ovarian cysts.

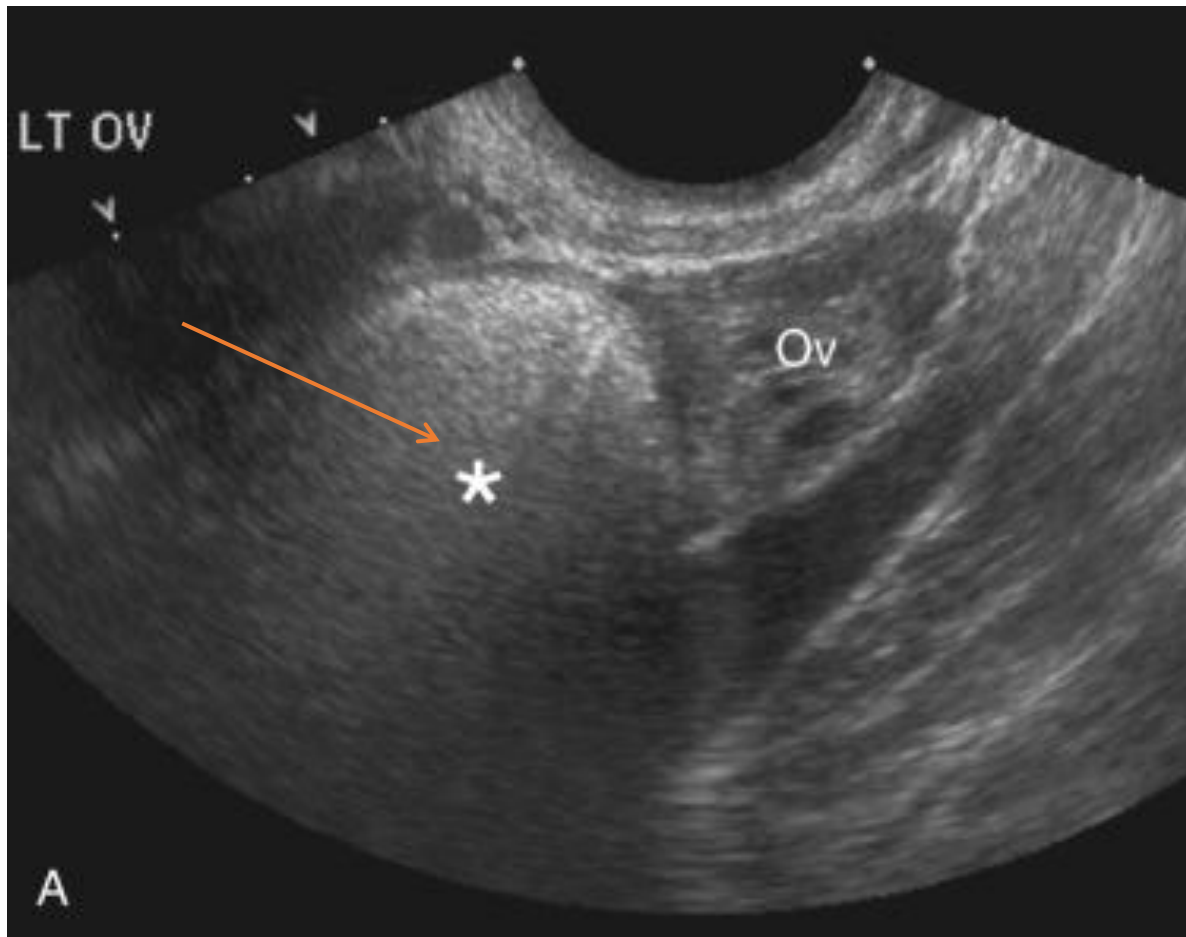
A, A transverse sonogram in this patient demonstrates what appear to be two ovarian cysts (*arrows*) posterior to the uterus (*cursors*).

B, A longitudinal sonogram displays the elongated tubular nature of this fluid collection (*arrow*), which is more compatible with a dilated fallopian tube. U, uterus.

C, In another patient, two large, rounded fluid collections are seen (*arrows*) simulating ovarian cysts.

D, A longitudinal plane of section through one of these collections demonstrates the tubular (T) retort nature of these dilated fallopian tubes.





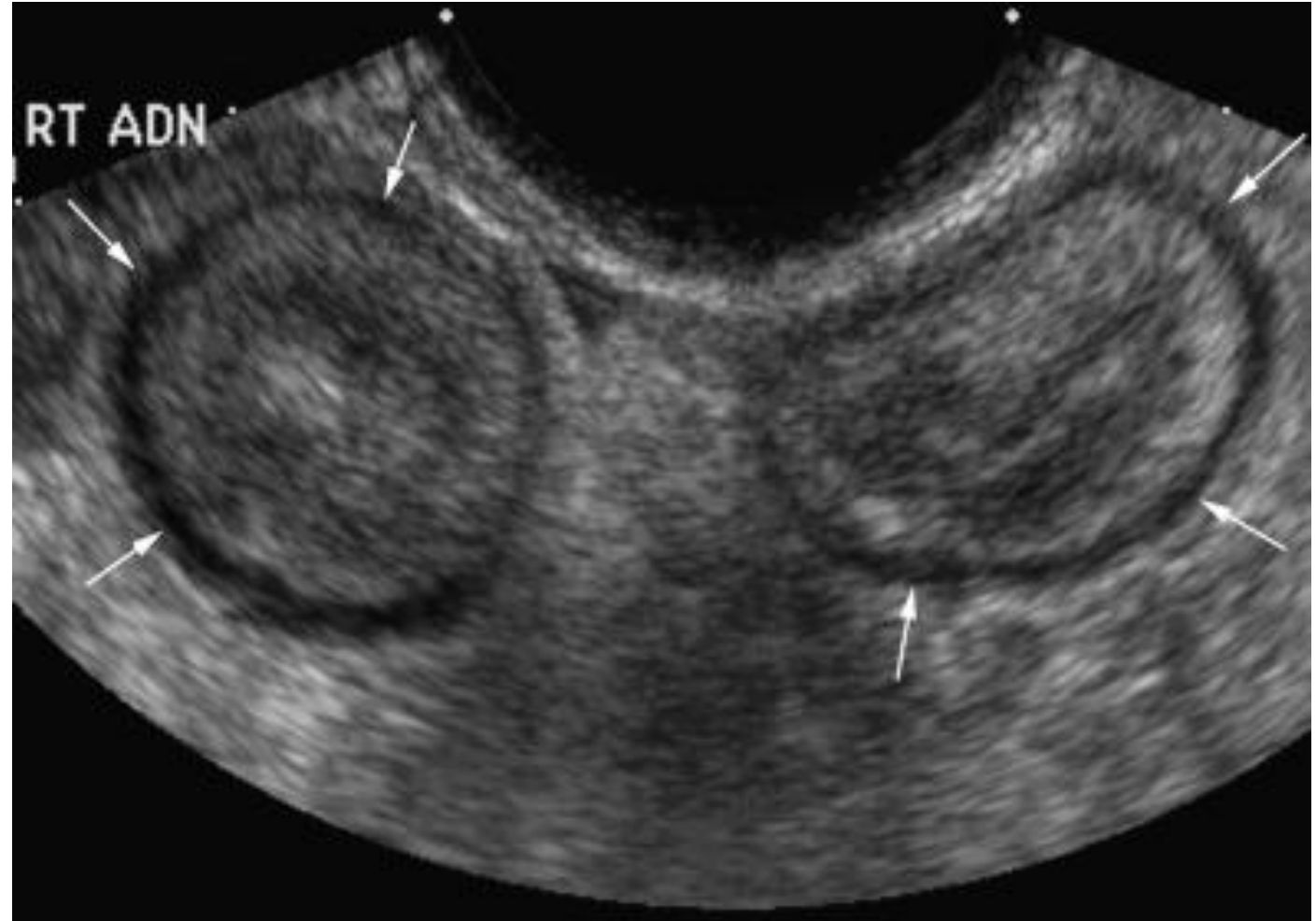
Bowel simulating an ovarian cystic teratoma (dermoid).

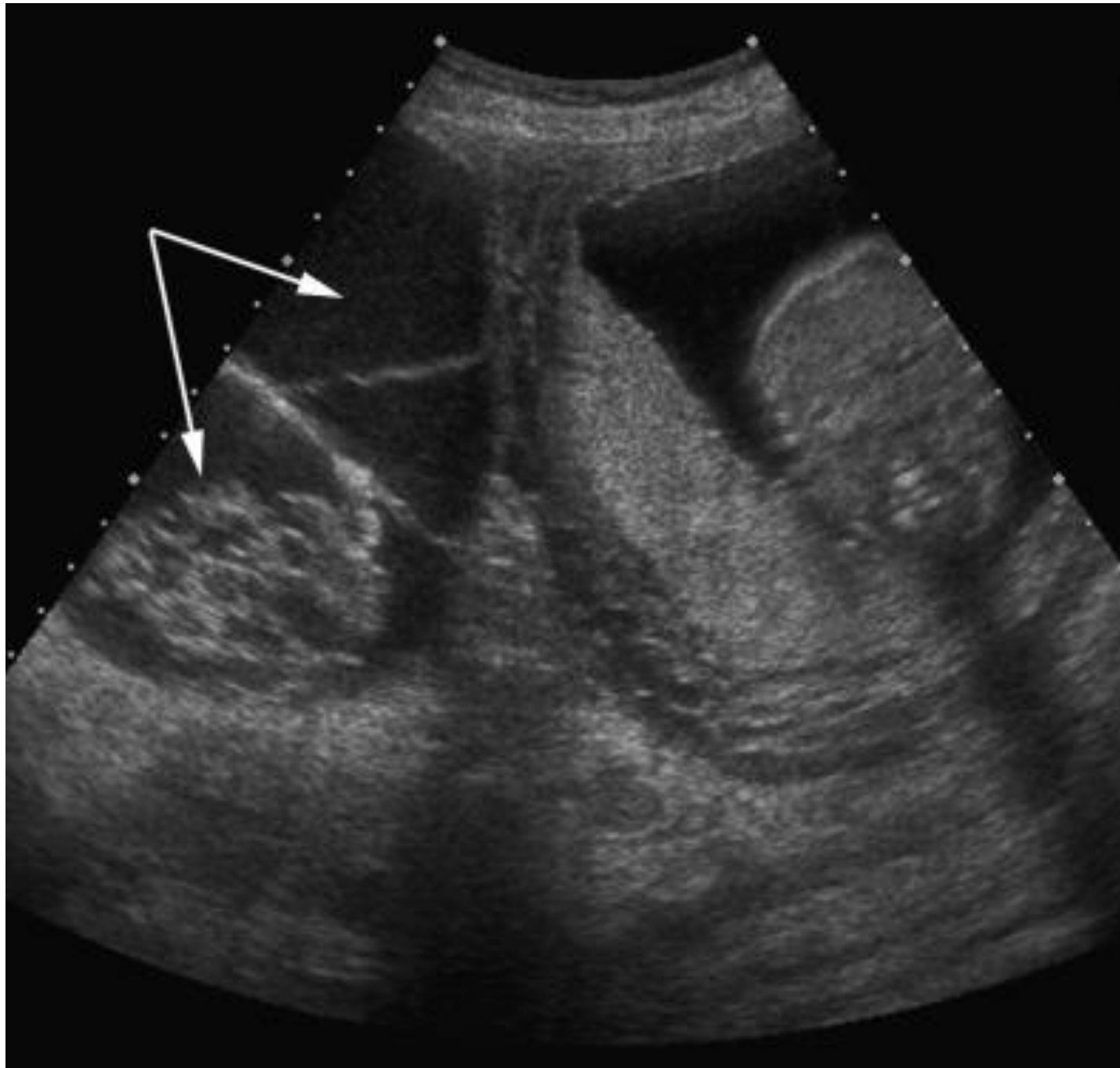
A, A large shadowing mass (*asterisk*) is seen adjacent to or possibly emanating from the ovary (Ov).

B, Minutes later the normal ovary and adnexal structures are well seen. The bowel, which was the cause of the shadowing, was not seen.

Two round and oval structures are seen in the right adnexa.

Although they might be mistaken for abnormal ovaries or paraovarian masses, they represent normal prominent bowel. Typical hypoechoic muscularis (*arrows*) is seen.

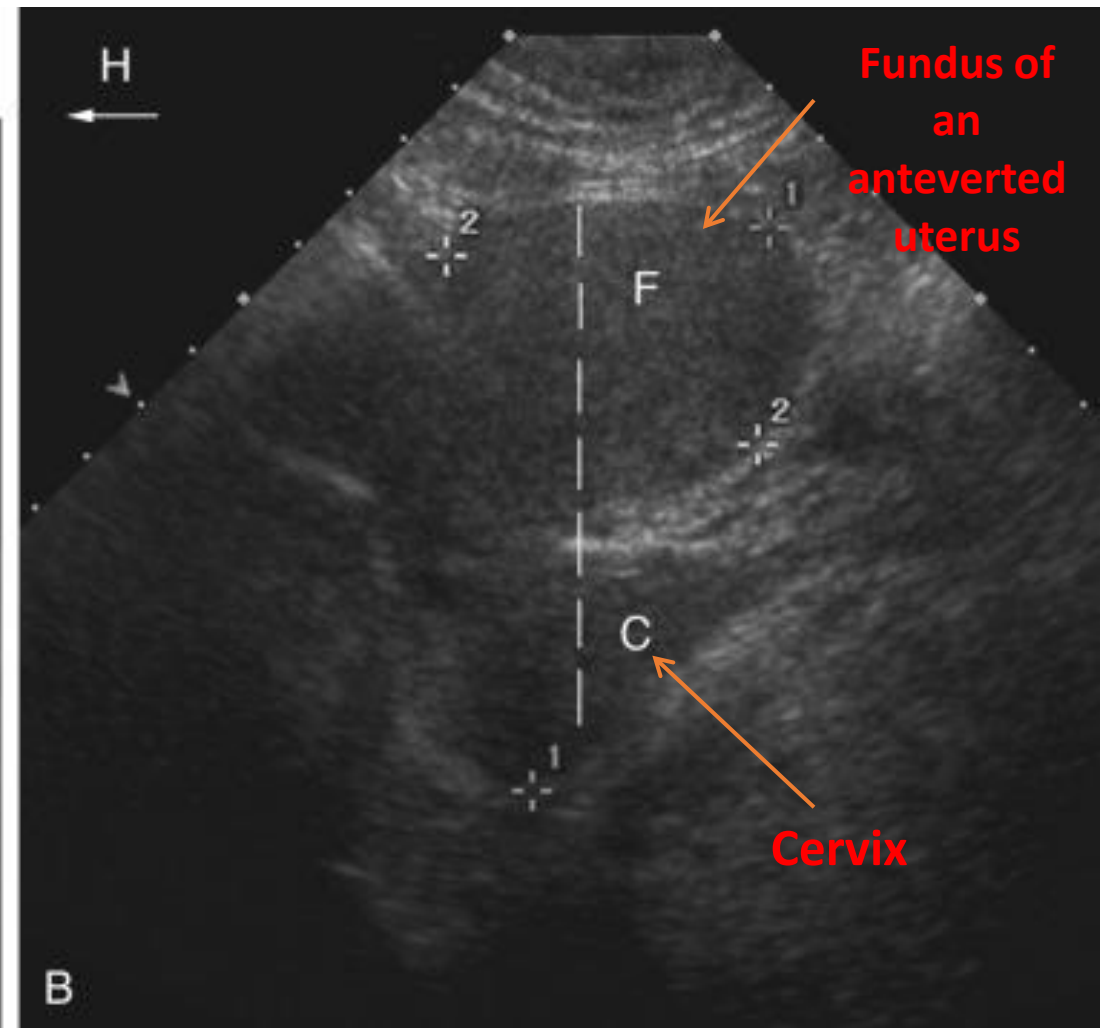
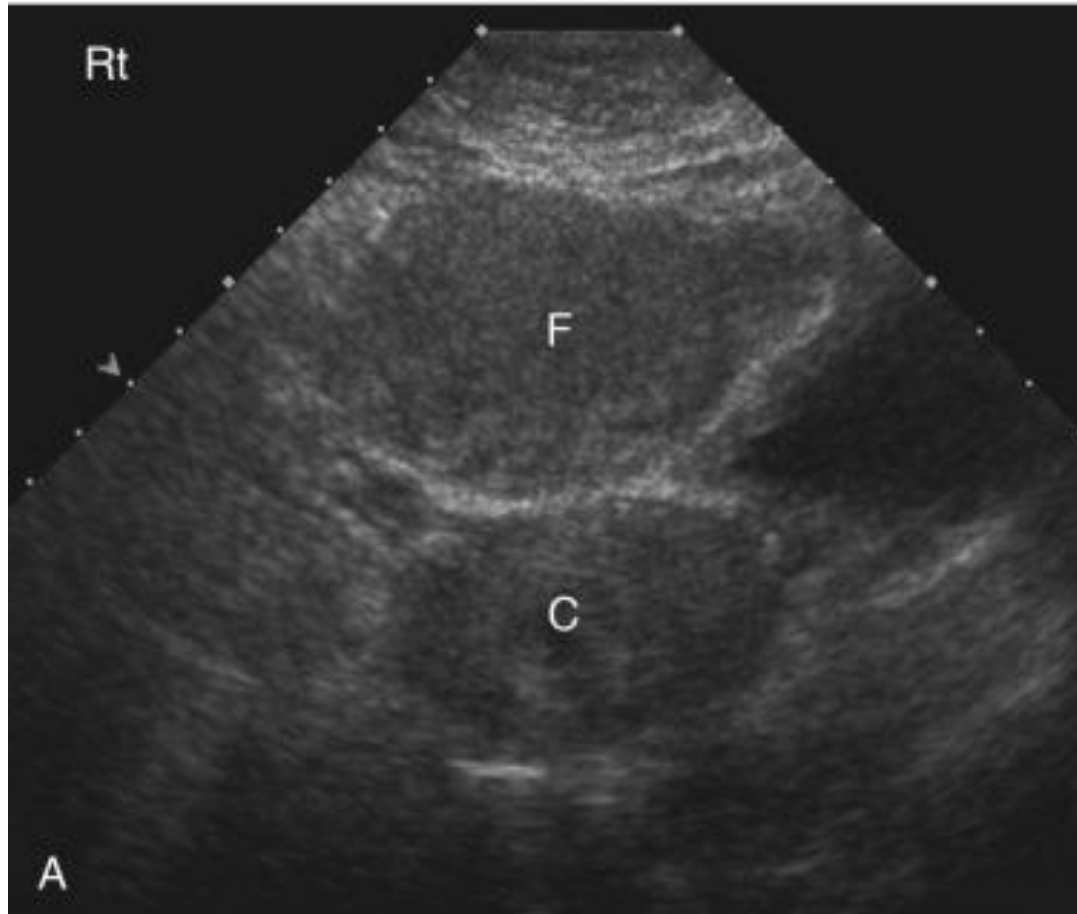




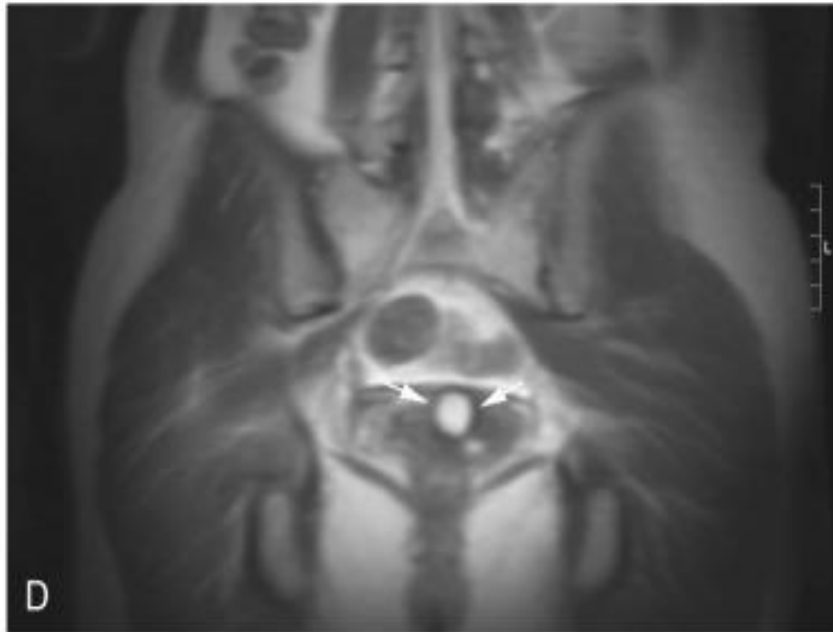
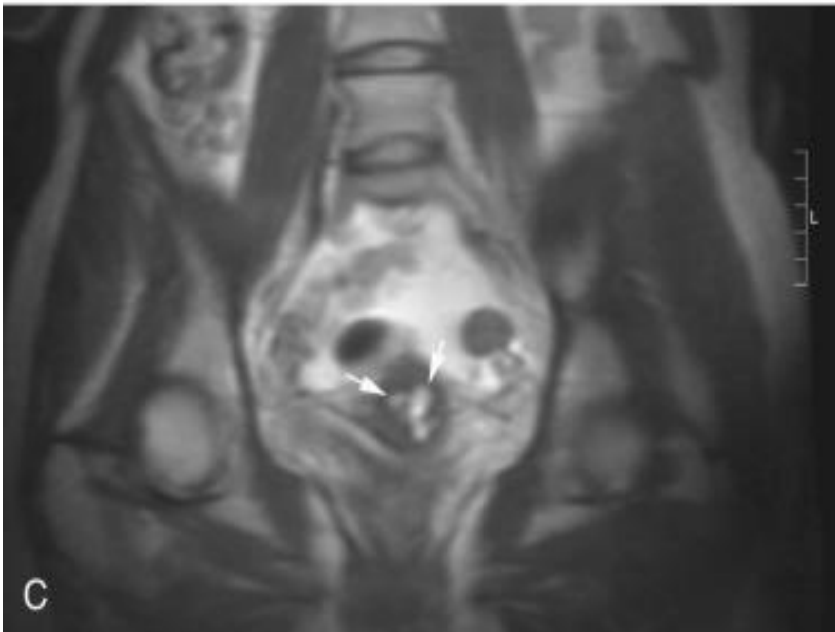
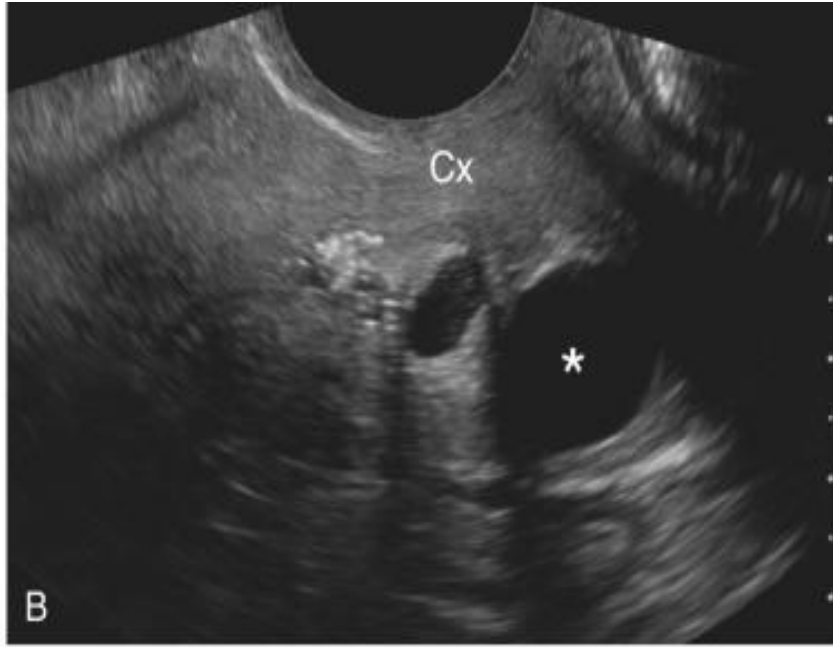
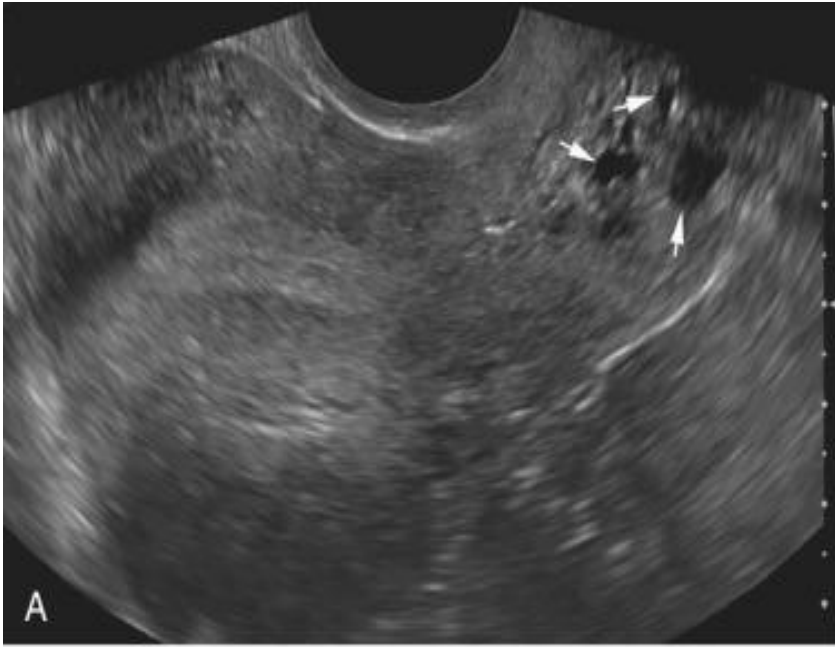
Pregnancy with coexistent ovarian carcinoma.

Unfortunately, just because a patient is pregnant does not mean that she cannot have a concomitant ovarian cancer.

A multilocular cystic mass (*arrows*) with solid components is seen adjacent to the gravid uterus.



A, Transverse axial sonogram of the pelvis in a nongravid patient. There appears to be either a duplication of the uterus or the uterus and an adjacent mass (C, F). Rt, right.
B, A sagittal scan demonstrates that what was seen in the transverse scan was the cervix (C) and fundus (F) of an anteverted uterus. The dashed line represents the plane of section in A. H, head.



Longitudinal transvaginal sonogram through the cervix of a nongravid uterus.

A and B, Multiple nabothian cysts (*arrows*) are seen in the cervix (Cx). At times these cysts can be quite large (*asterisk*). These retention cysts are quite common and should not be confused with low-implanted gestational sacs or other abnormalities.

C and D, Two coronal T2-weighted magnetic resonance images through the cervix demonstrate multiple, round, T2-weighted hyperintense structures compatible with nabothian cysts (*arrows*)

A red envelope is shown with a piece of brown paper tucked inside. The paper has the words "Thank you ..." written in a blue, cursive font. The envelope is slightly open, and the brown paper is partially visible against the red background.

Thank you ...