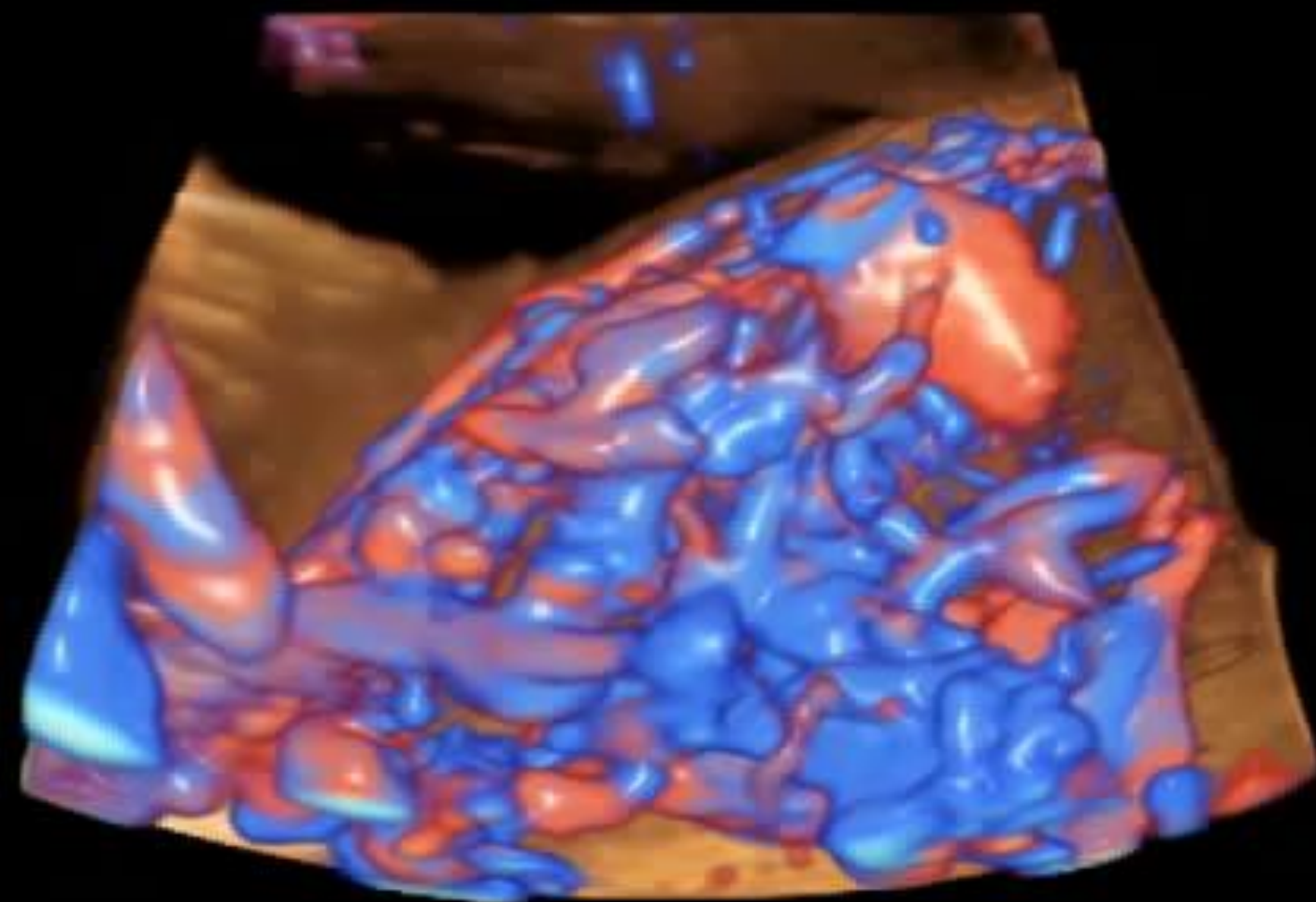


Sonographic Markers of Placenta Accreta Spectrum



Wesley Lee, M.D.,
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Friday, May 31, 2024
Placenta Accreta Spectrum Workshop

Disclosures

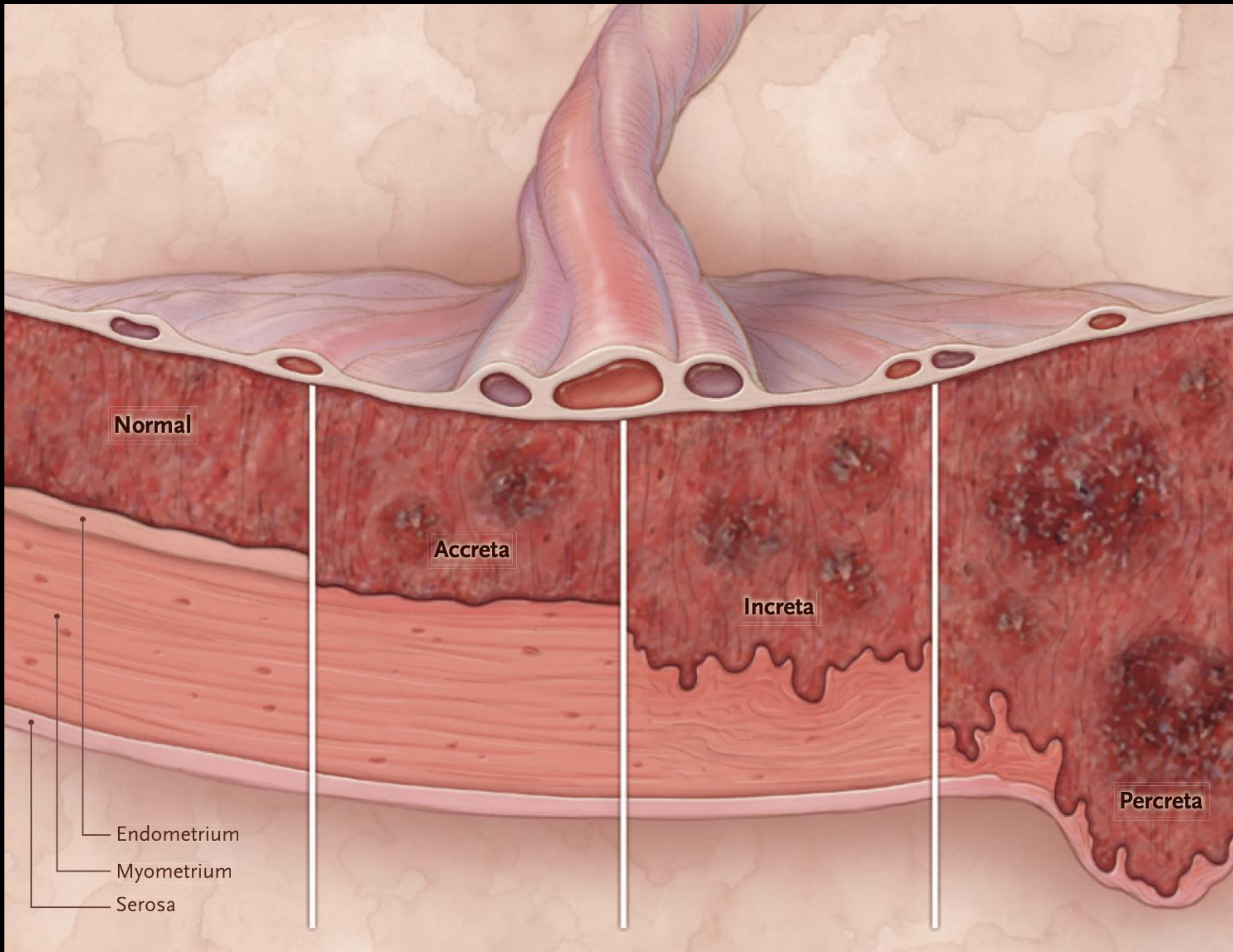
GE Healthcare

Limited research support

Learning Objectives

Upon conclusion of this activity, participants will be better able to:

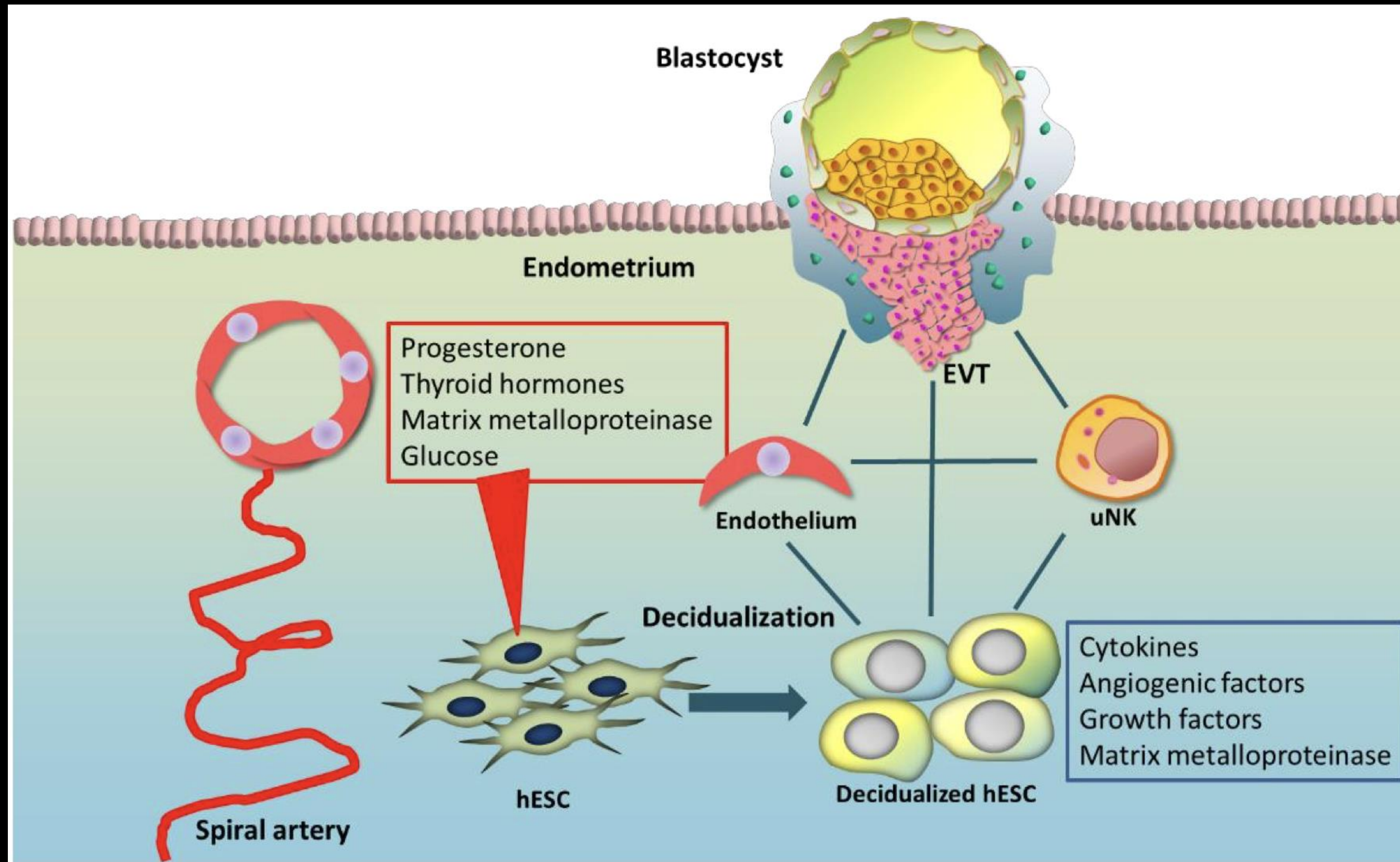
1. list 3 maternal historical risk factors for placenta accreta spectrum
2. recognize at least 3 ultrasound findings for placenta accreta spectrum
3. describe how ultrasound findings can be scored for placenta accreta risk



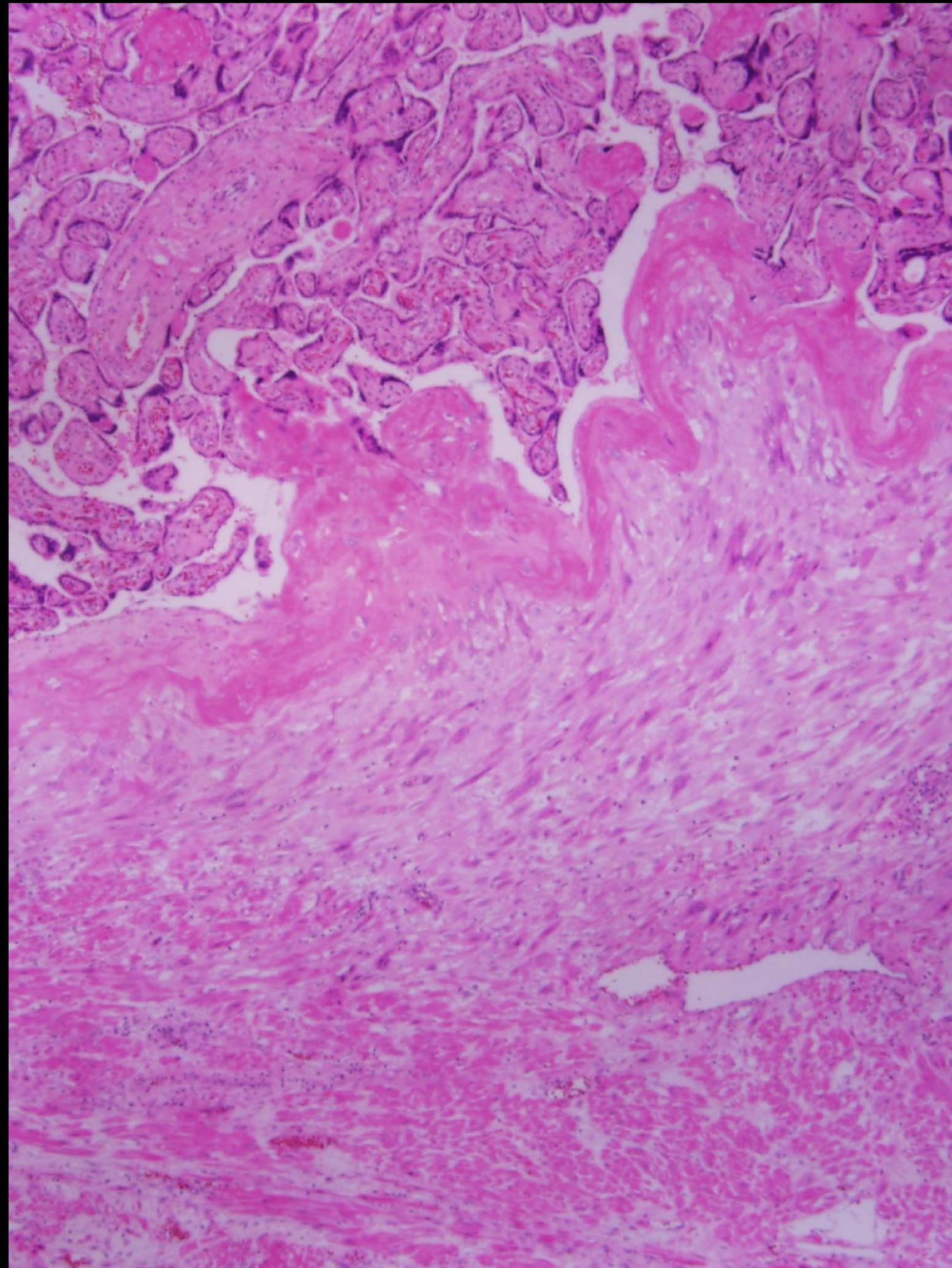
Placental Accreta Spectrum

Silver, RM et al. N Engl J
Med 2018;378:1529-1536

Endometrial Decidualization

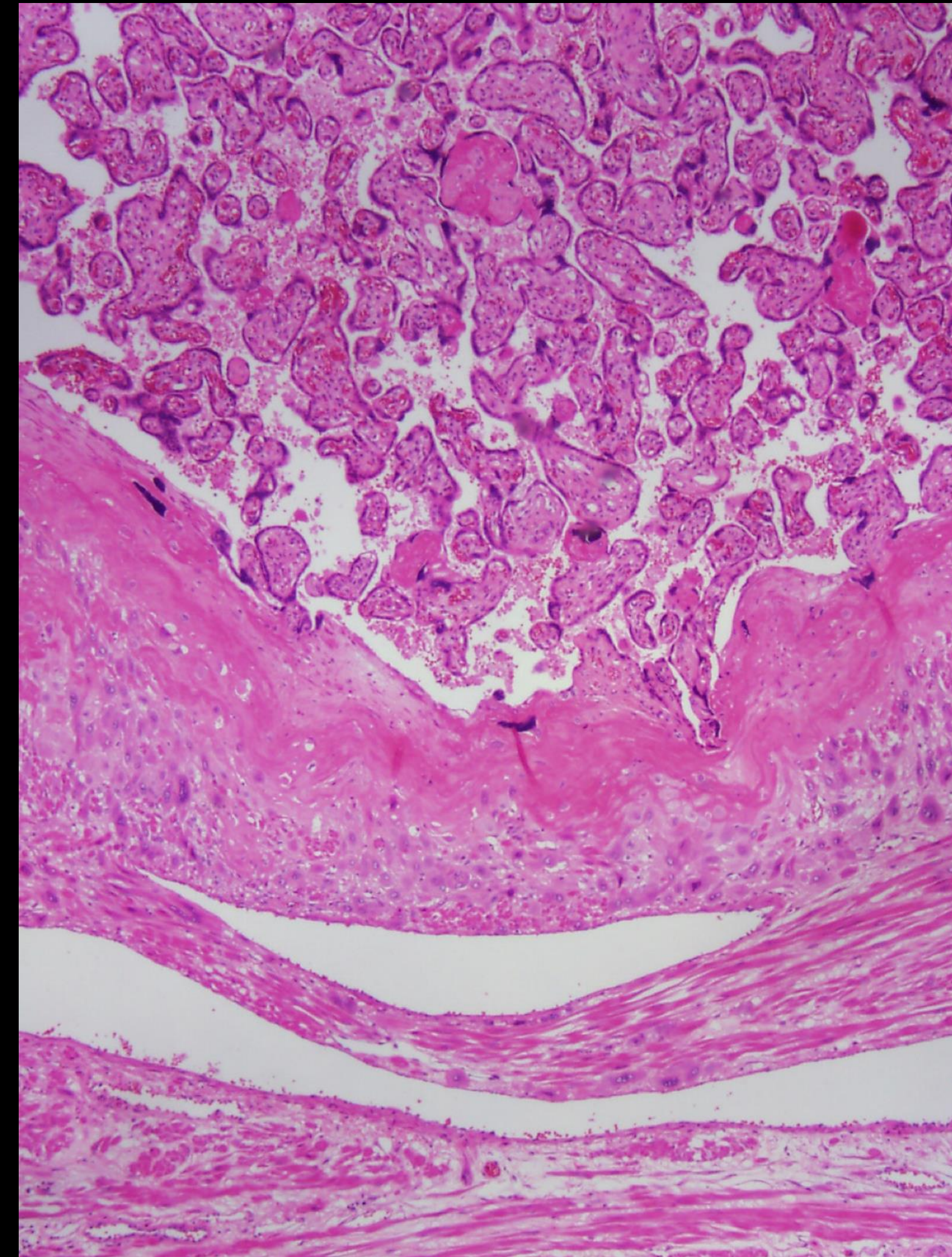


Normal Placenta



Decidualized Myometrium Present

Creta (Abnormal Implantation)



Deficient or Absent Decidualized Myometrium

Placenta Accreta - Risk Factors

Common Risk Factors

- placenta previa
- previous cesarean section
- maternal age
- in-vitro fertilization

Infrequent Risk Factors

- Asherman's syndrome
- prior endometrial ablation
- prior uterine surgery

Clark SL, et al. Obstet Gynecol 1985;66:89-92

Silver RM, et al. Obstet Gynecol 2006;107:1226-32

Salmanian B, et al. Am J Obstet Gynecol 2020;223:568.e1-e5

Jewelewicz R, et al. Obstet Gynecol 1976;47:701-5.

Herath RP, et al. J Obstet Gynaecol 2011;31:82-3.

Esh-Broder E, et al. BJOG 2011;118:1084-9.

Einerson B, et al. Obstet Gynecol 2023;142:31-50.

Prospective Observational Cohort of 30,142 Women with Cesarean Section 19 Academic Centers (1999-2002)

Table 3. Odds Ratios With 95% Confidence Intervals for Placenta Accreta and Hysterectomy by Number of Cesarean Deliveries Compared With First Cesarean Delivery

Cesarean Delivery	Accreta [n (%)]	OR (95% CI)	Hysterectomy [n (%)]	OR (95% CI)
First*	15 (0.2)	—	40 (0.7)	—
Second	49 (0.3)	1.3 (0.7–2.3)	67 (0.4)	0.7 (0.4–0.97)
Third	36 (0.6)	2.4 (1.3–4.3)	57 (0.9)	1.4 (0.9–2.1)
Fourth	31 (2.1)	9.0 (4.8–16.7)	35 (2.4)	3.8 (2.4–6.0)
Fifth	6 (2.3)	9.8 (3.8–25.5)	9 (3.5)	5.6 (2.7–11.6)
≥ 6	6 (6.7)	29.8 (11.3–78.7)	8 (9.0)	15.2 (6.9–33.5)

OR, odds ratio; CI, confidence interval.

* Primary cesarean delivery.

Placenta Previa and Placenta Accreta by Number of Cesarean Deliveries

Cesarean Delivery	Previa	Previa*:Accreta [†] [n (%)]	No Previa [‡] :Accreta [†] [n (%)]
First [§]	398	13 (3.3)	2 (0.03)
Second	211	23 (11)	26 (0.2)
Third	72	29 (40)	7 (0.1)
Fourth	33	20 (61)	11 (0.8)
Fifth	6	4 (67)	2 (0.8)
≥ 6	3	2 (67)	4 (4.7)

* Percentage of accreta in women with placenta previa.

† Increased risk with increasing number of cesarean deliveries; $P < .001$.

‡ Percentage of accreta in women without placenta previa.

§ Primary cesarean.

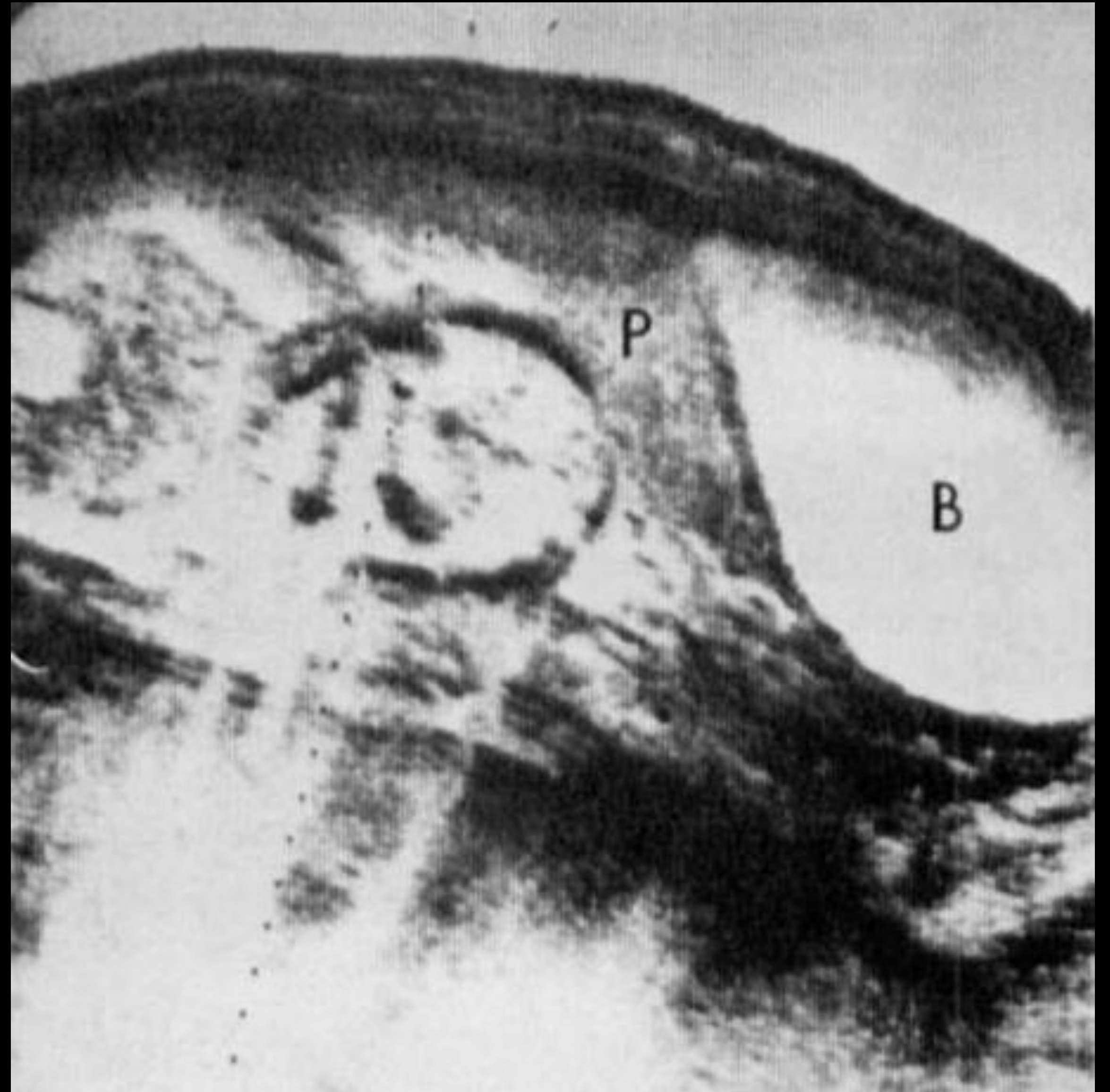
Ultrasound Diagnosis of Placenta Increta

Khalil M. A. Tabsh, MD, Charles R. Brinkman, III, MD, and William King, MD

Placenta accreta, increta, and percreta represent an abnormality of placentation in which the placental villi attach directly to, invade, or penetrate the uterine wall, respectively. These types of placentation are extremely rare, occurring in one in 7,000 deliveries.¹ The essential feature for the diagnosis of placenta increta is histologic demonstration of placental villi invading the myometrium. This case report describes the ultrasound features of placenta increta.

cal diagnosis of placenta accreta or increta, bilateral hypogastric artery ligation was performed, followed by a total hysterectomy. During the first postoperative day, the patient had a persistent, consumptive coagulopathy and intraperitoneal bleeding. She required a second laparotomy to establish hemostasis. Subsequently, she made an uneventful recovery and was discharged home.

Grossly, the surgical specimen consisted of postpartum uterus with an attached placenta that



Placenta Accreta: Prospective Sonographic Diagnosis in Patients with Placenta Previa and Prior Cesarean Section

Harris J. Finberg, MD, James W. Williams, MD*

Prospective evaluation of 34 women with previa and history of one or more cesarean section

Diagnostic Criteria

1. loss of normal hypoechoic retroplacental myometrial zone
2. thinning/disruption of hyperechoic uterine serosa-bladder interface
3. presence of focal exophytic masses
4. intraplacental vascular lacunae present

0	none
1+	1-3
2+	4-6
3+	many

Study Results - Placenta Accreta

Pregnant women with previa and one or more cesarean section

18 women with + US findings, 14 confirmed accreta
16 of these patients underwent hysterectomy

16 women with - US findings, only 1 confirmed accreta
2 of these patients underwent hysterectomy

7 Key US Findings - Placenta Accreta Spectrum - Delphi Consensus

Loss of 'clear zone'

Myometrial thinning

Bladder-wall interruption

Placental bulge

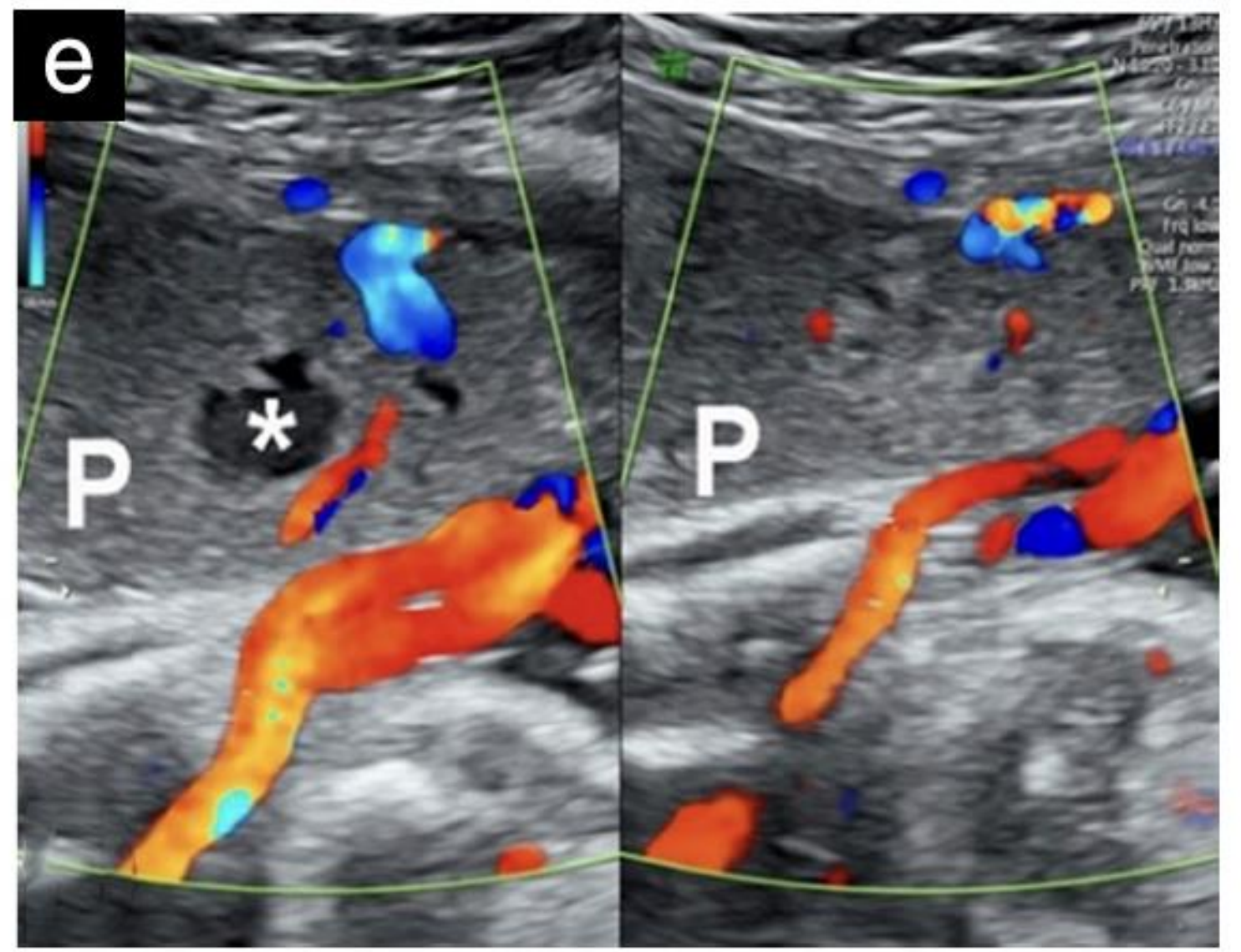
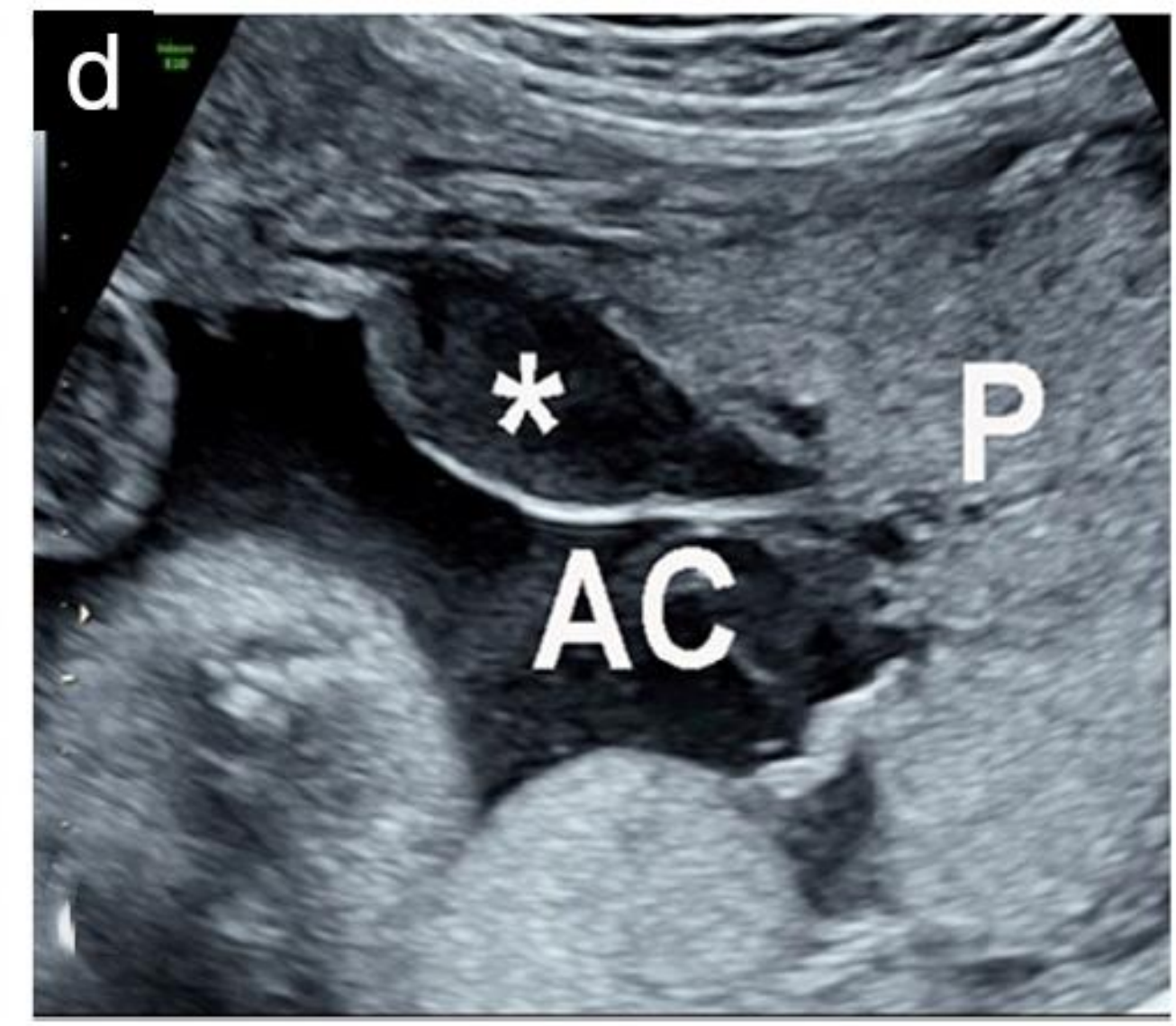
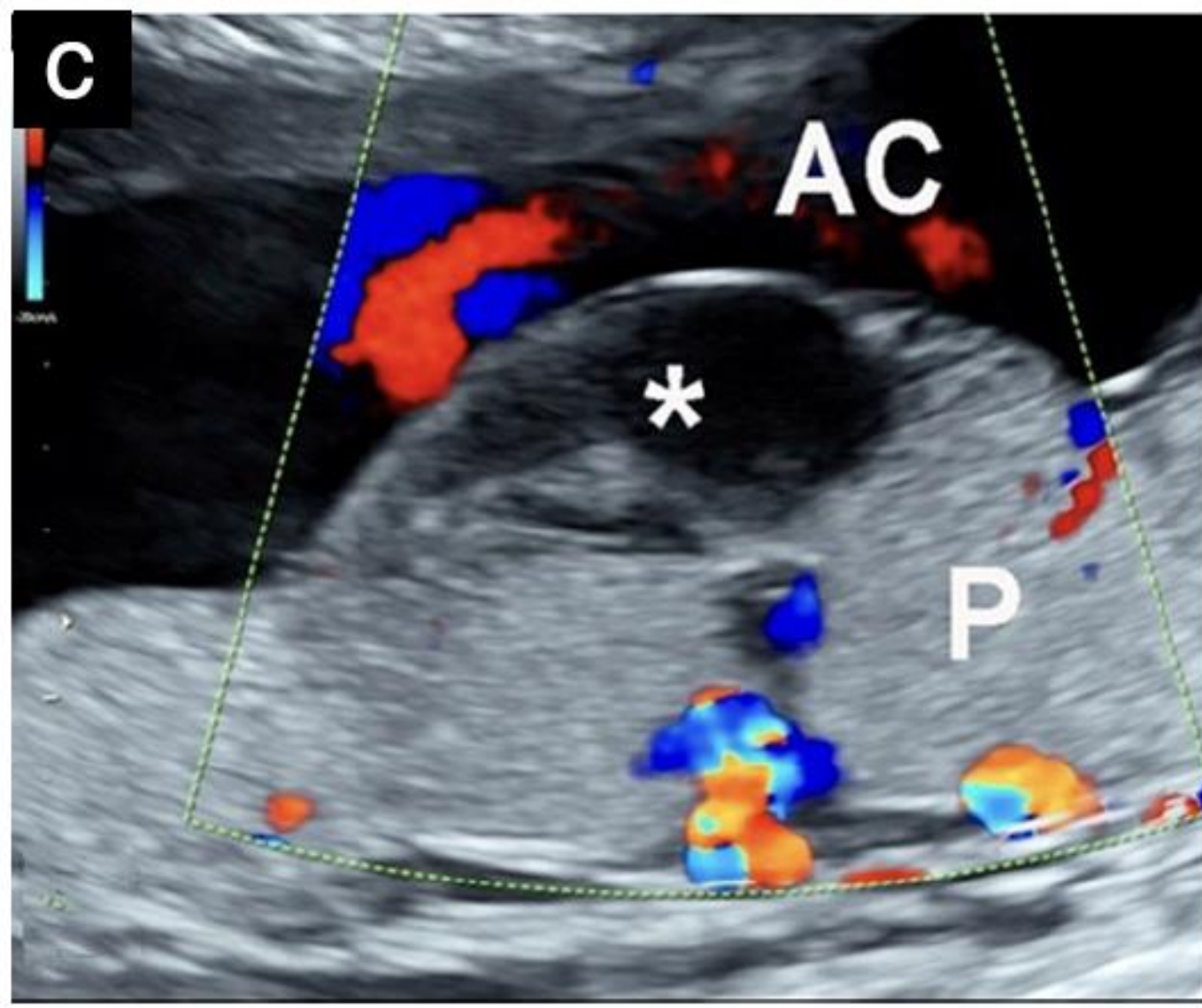
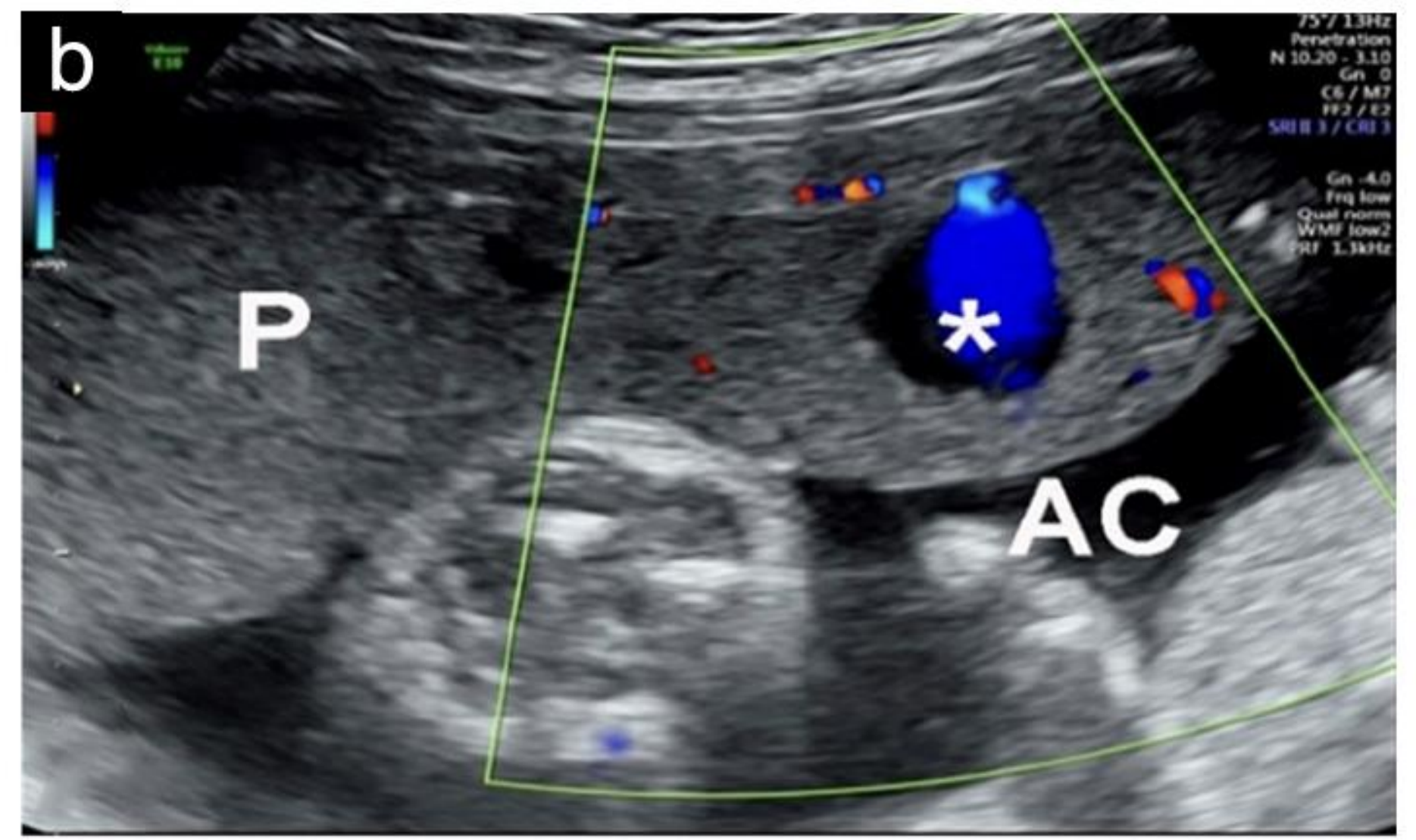
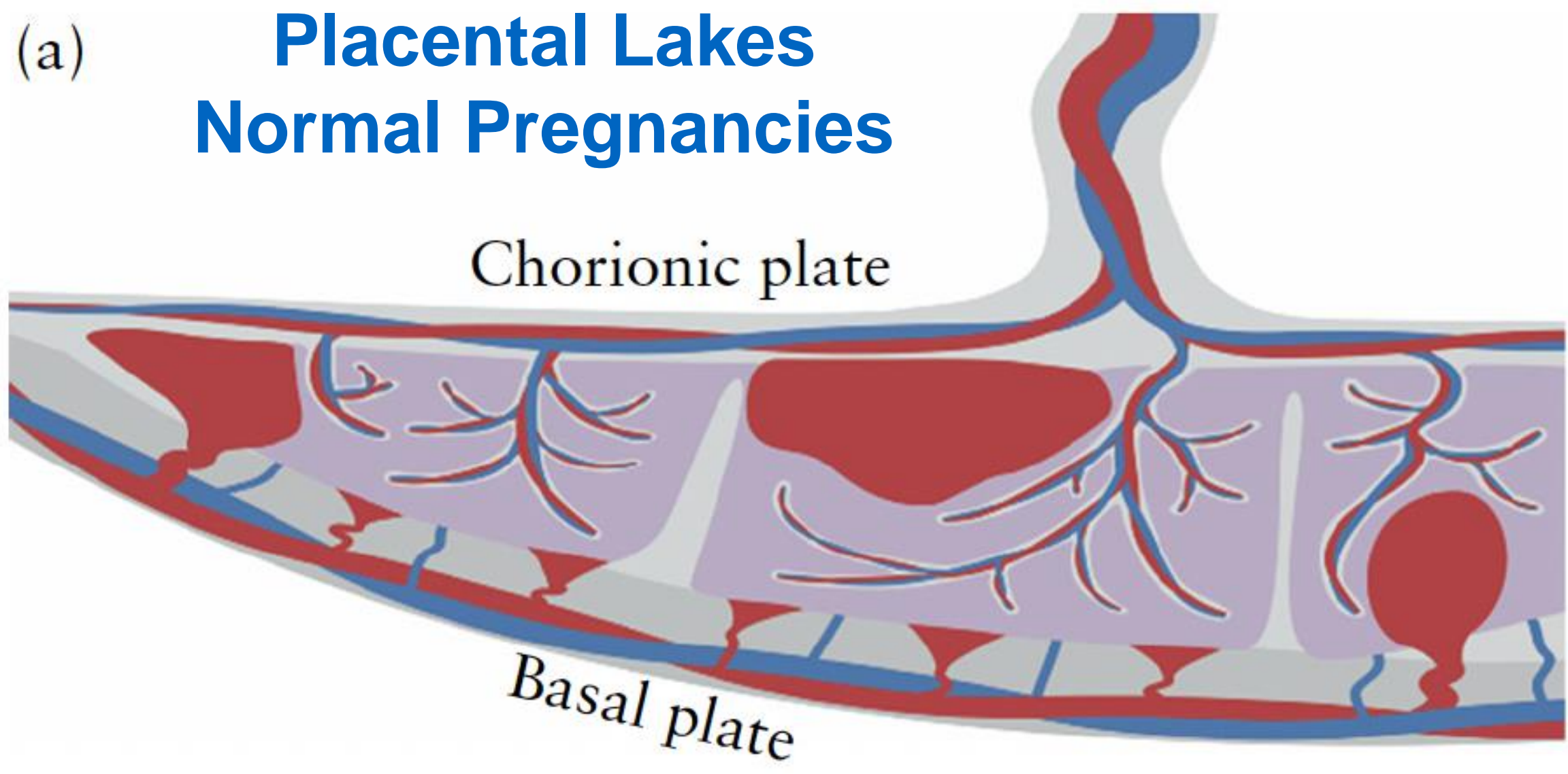
Uterovesical hypervascularity

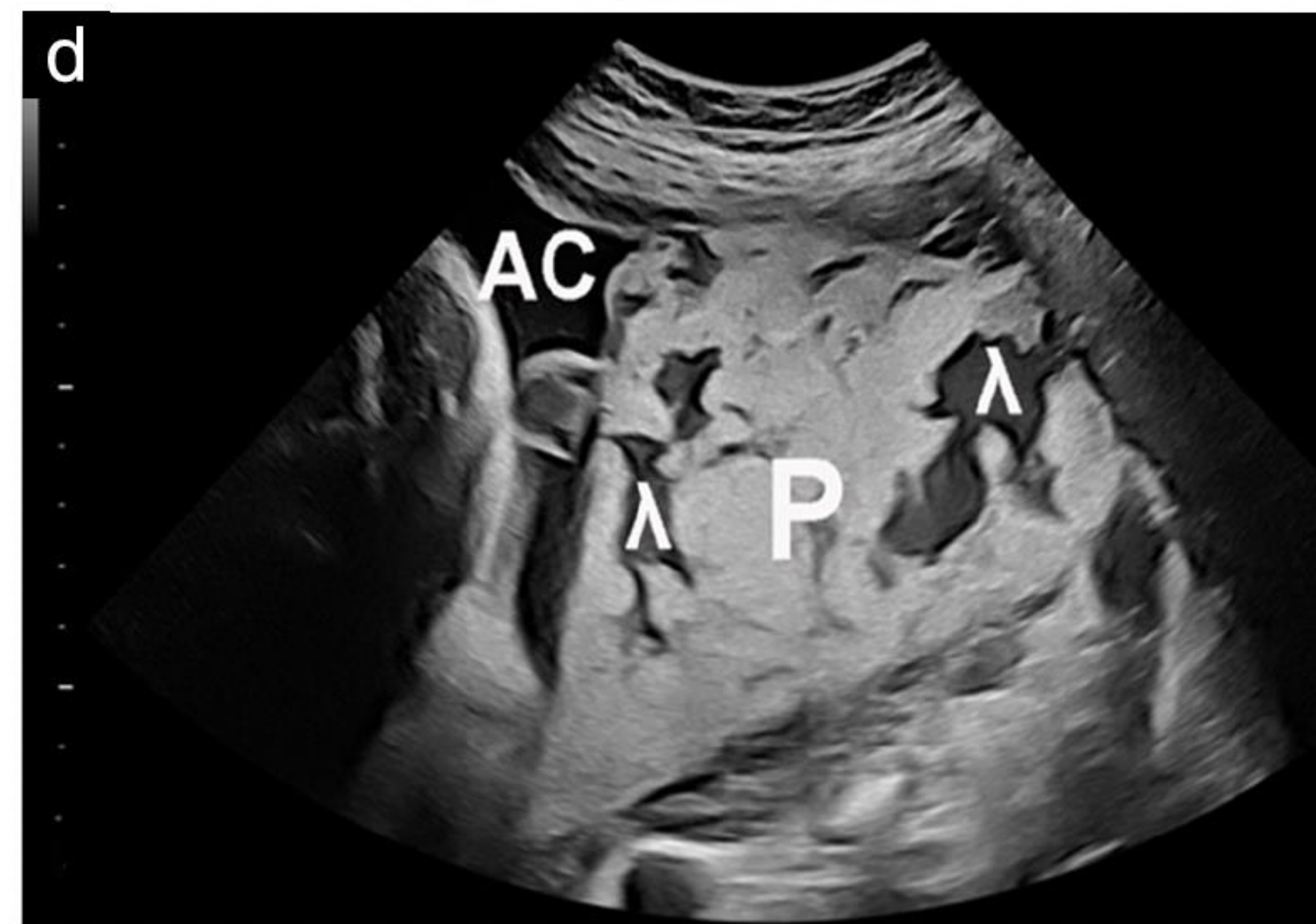
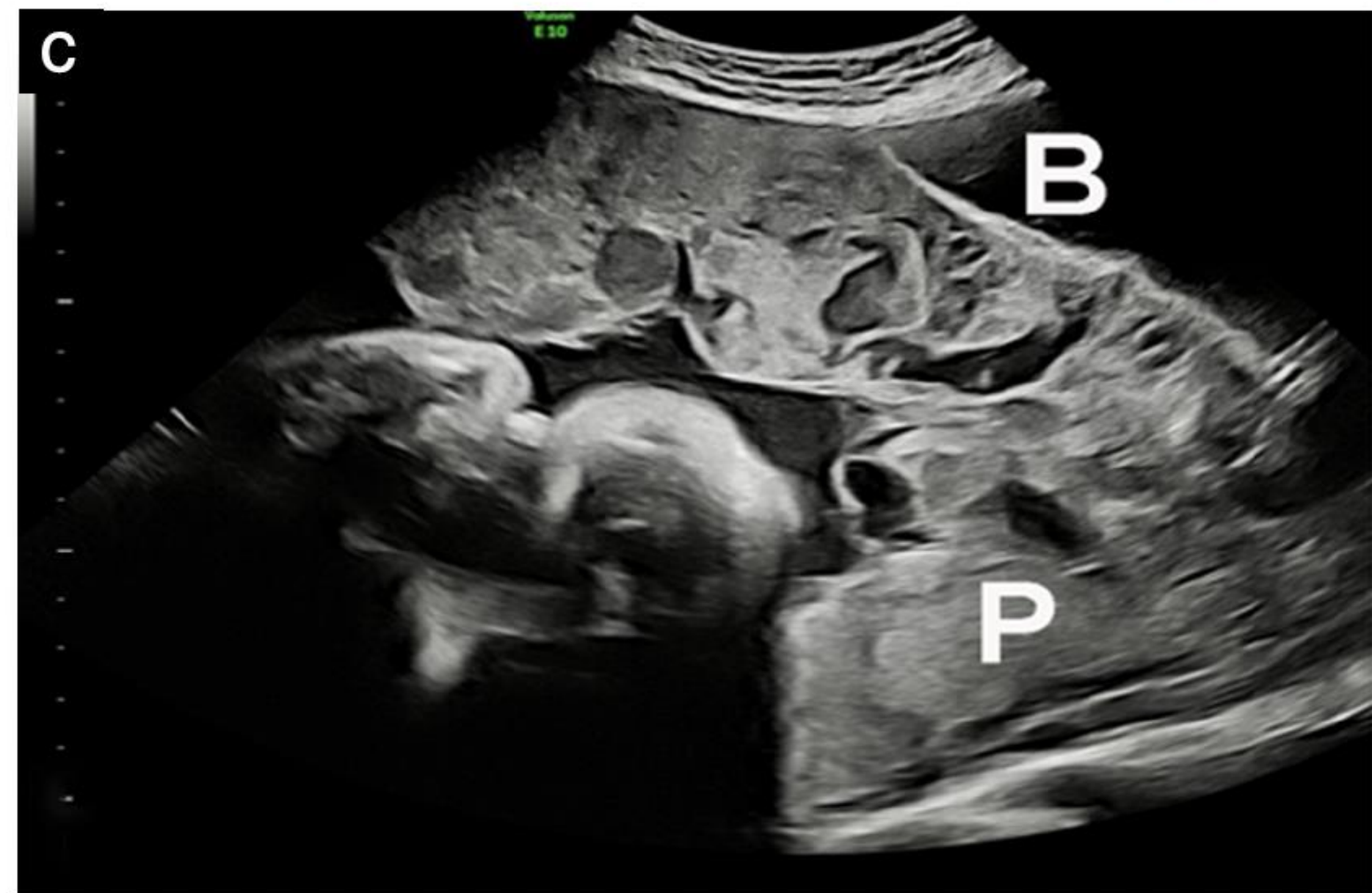
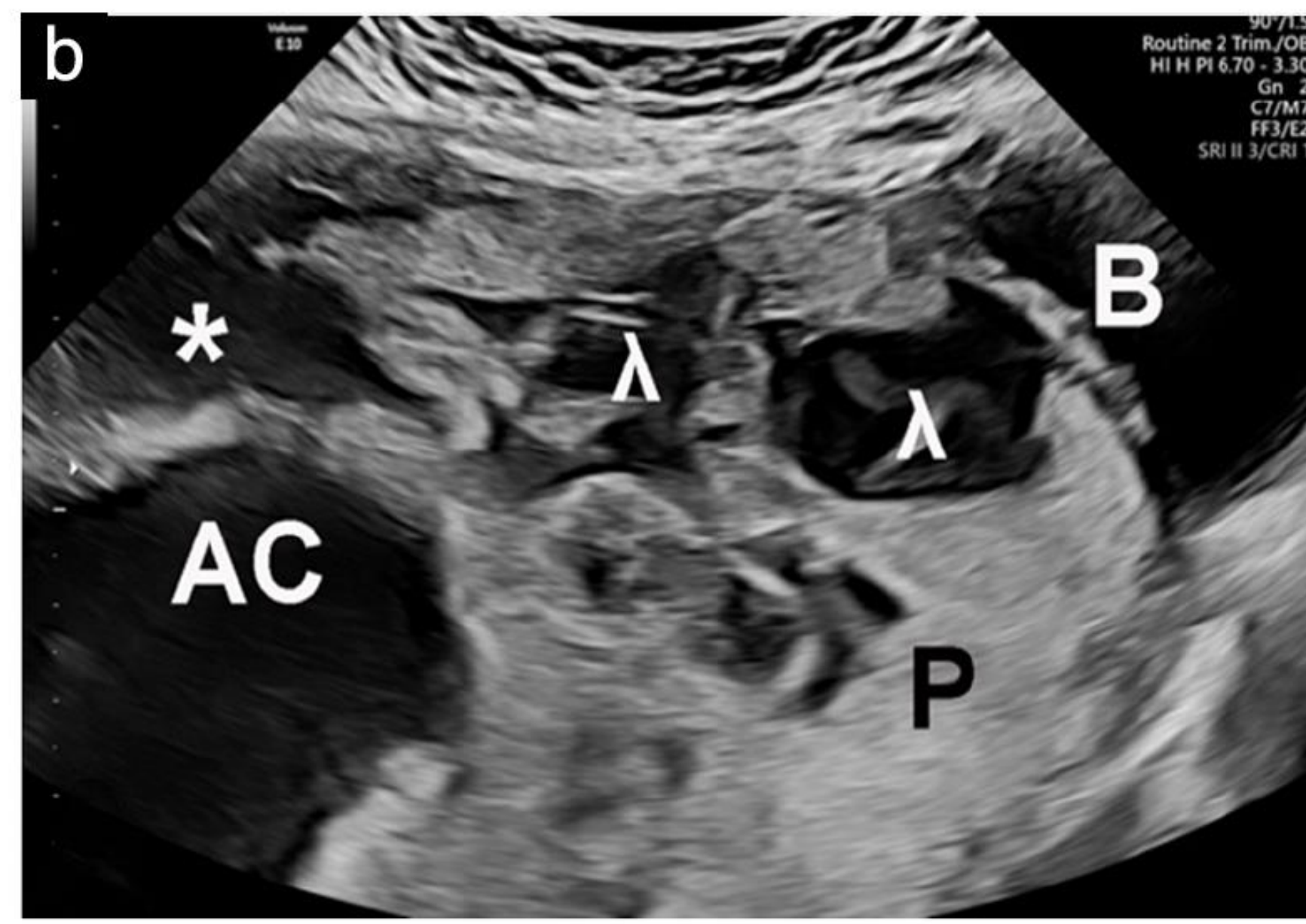
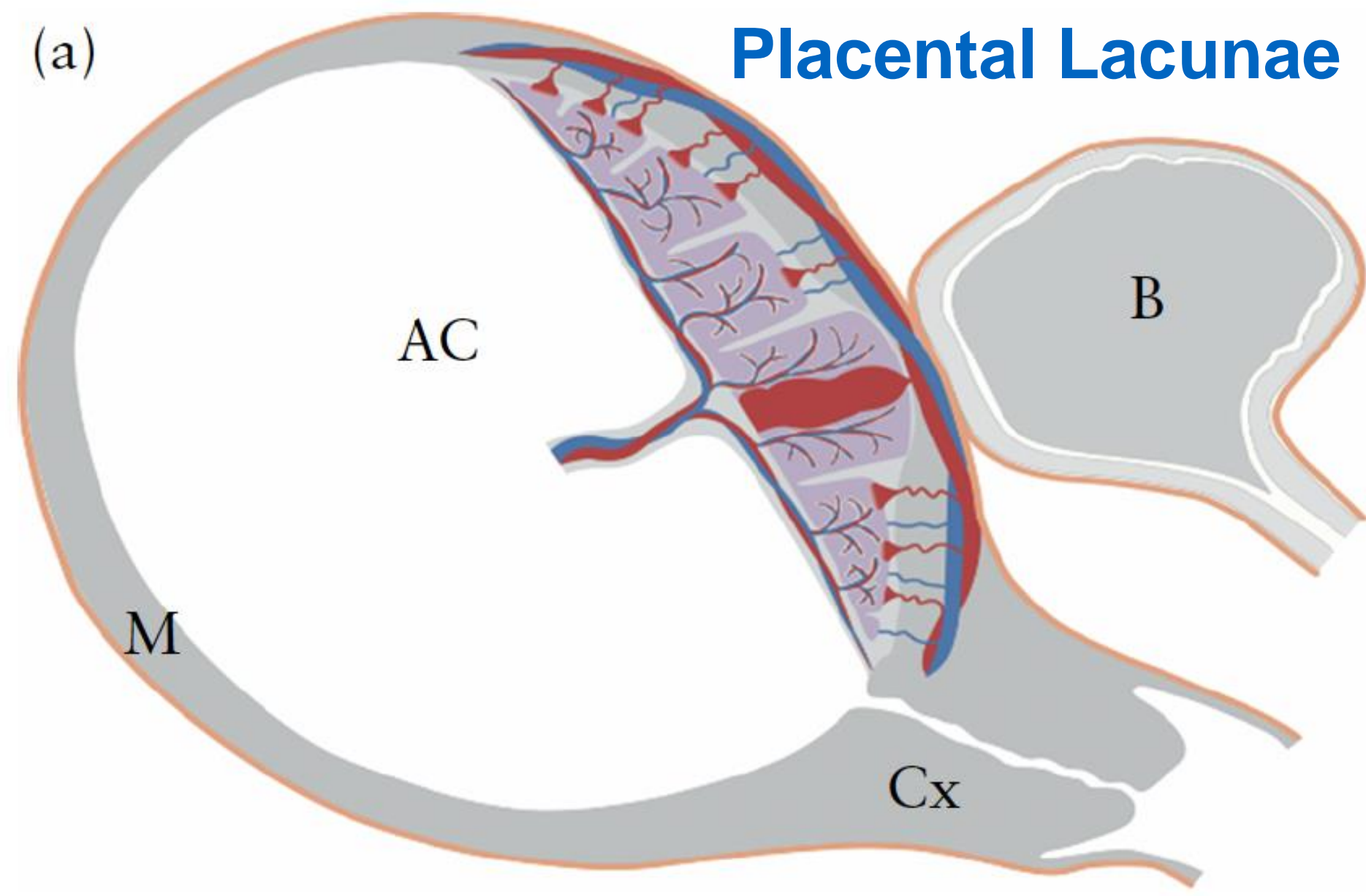
Placental lacunae

Bridging vessels

“Prior history of ≥ 1 Cesarean delivery, myomectomy or PAS should be an indication for detailed PAS ultrasound assessment”

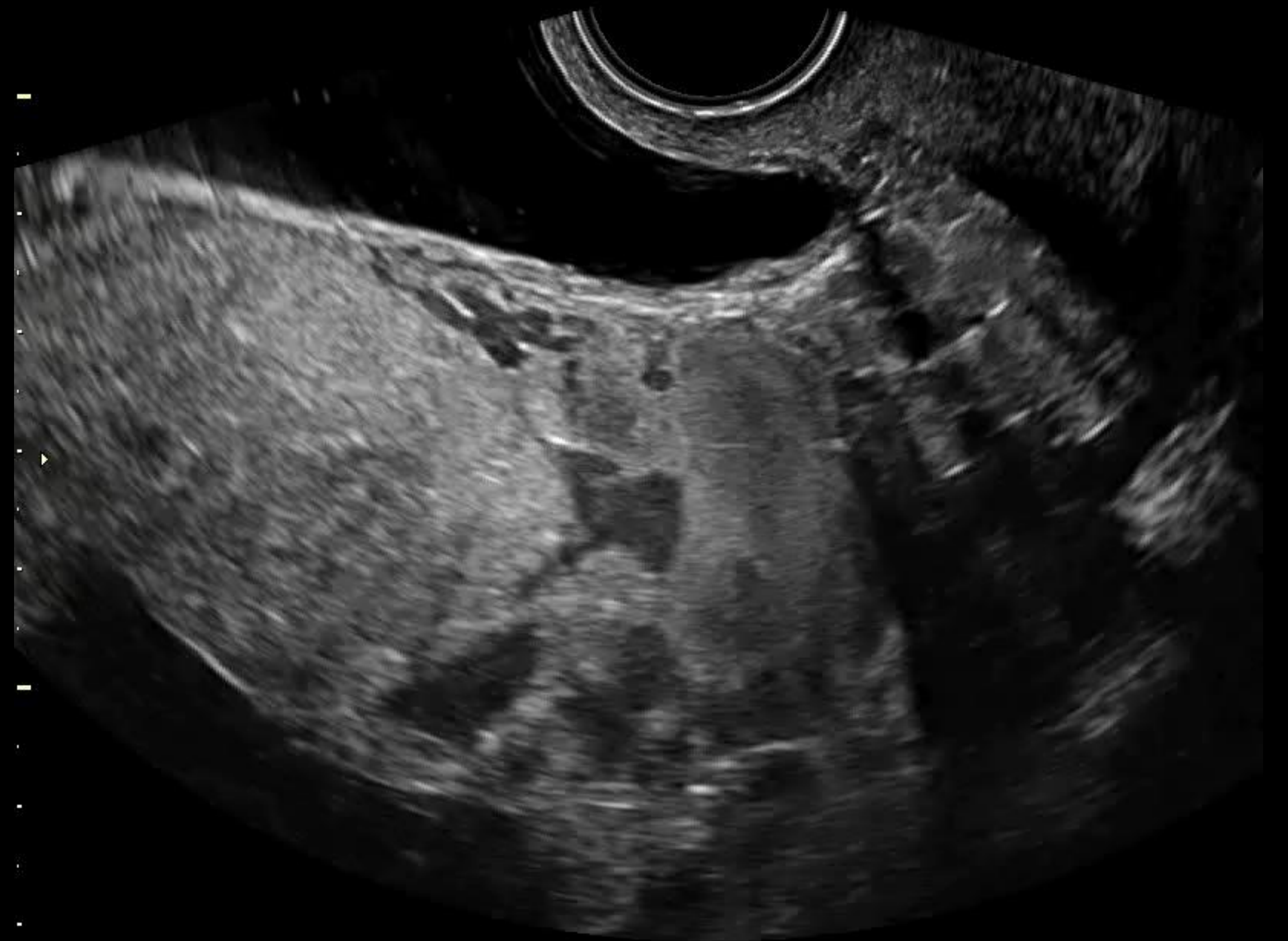
(a) **Placental Lakes**
Normal Pregnancies





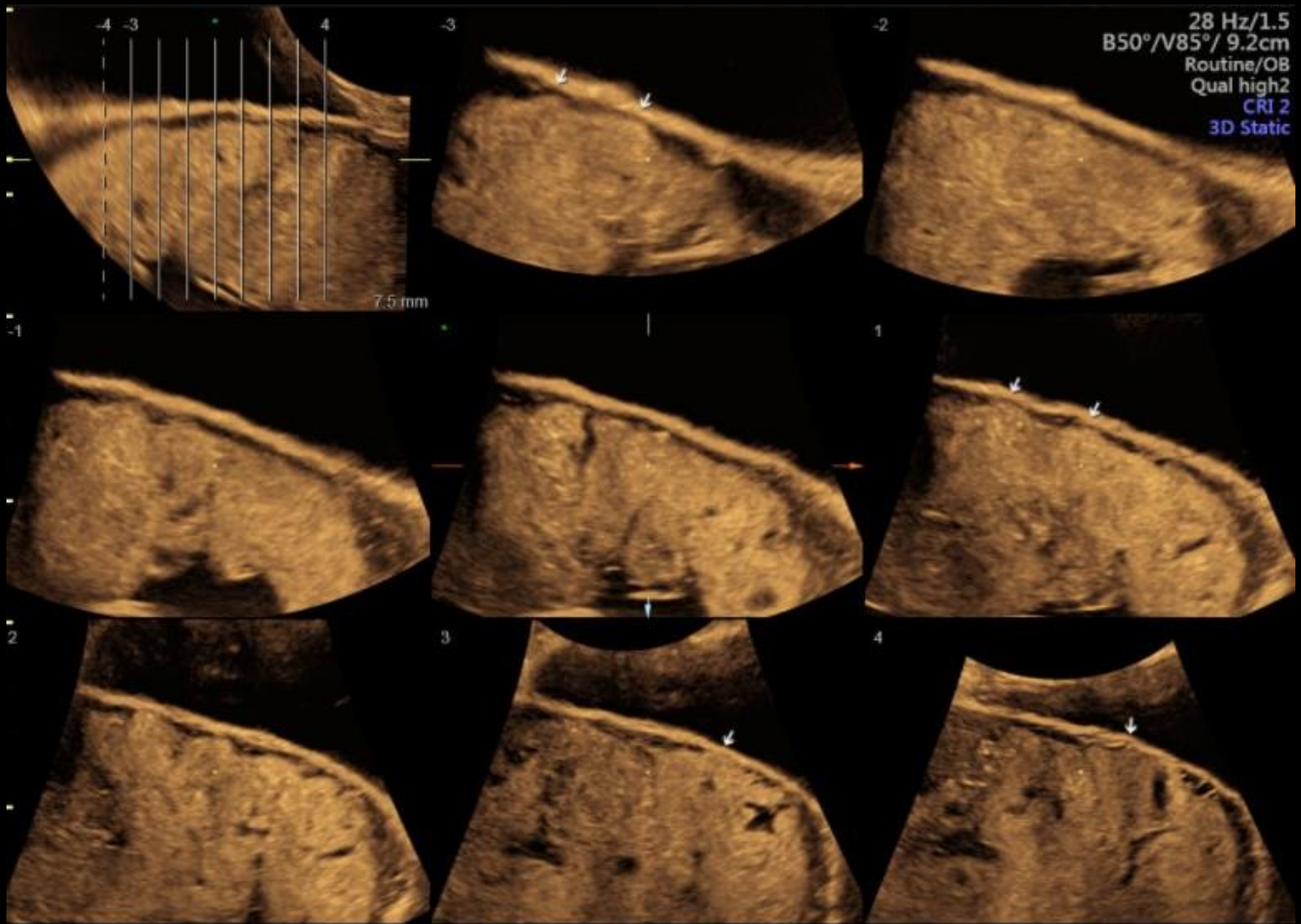
Placental Lacunae

SAG ML



Loss of Retroplacental Clear Zone

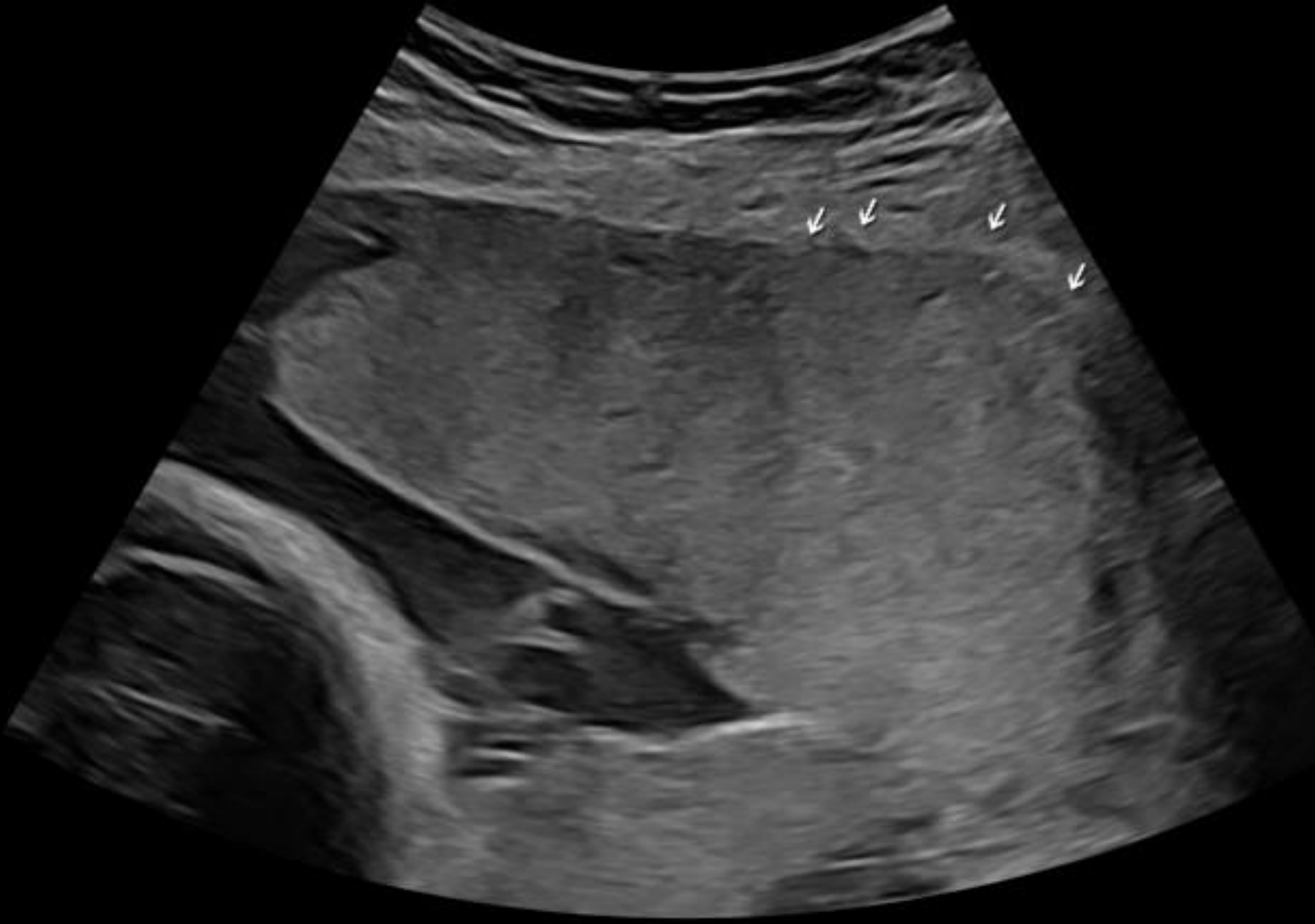
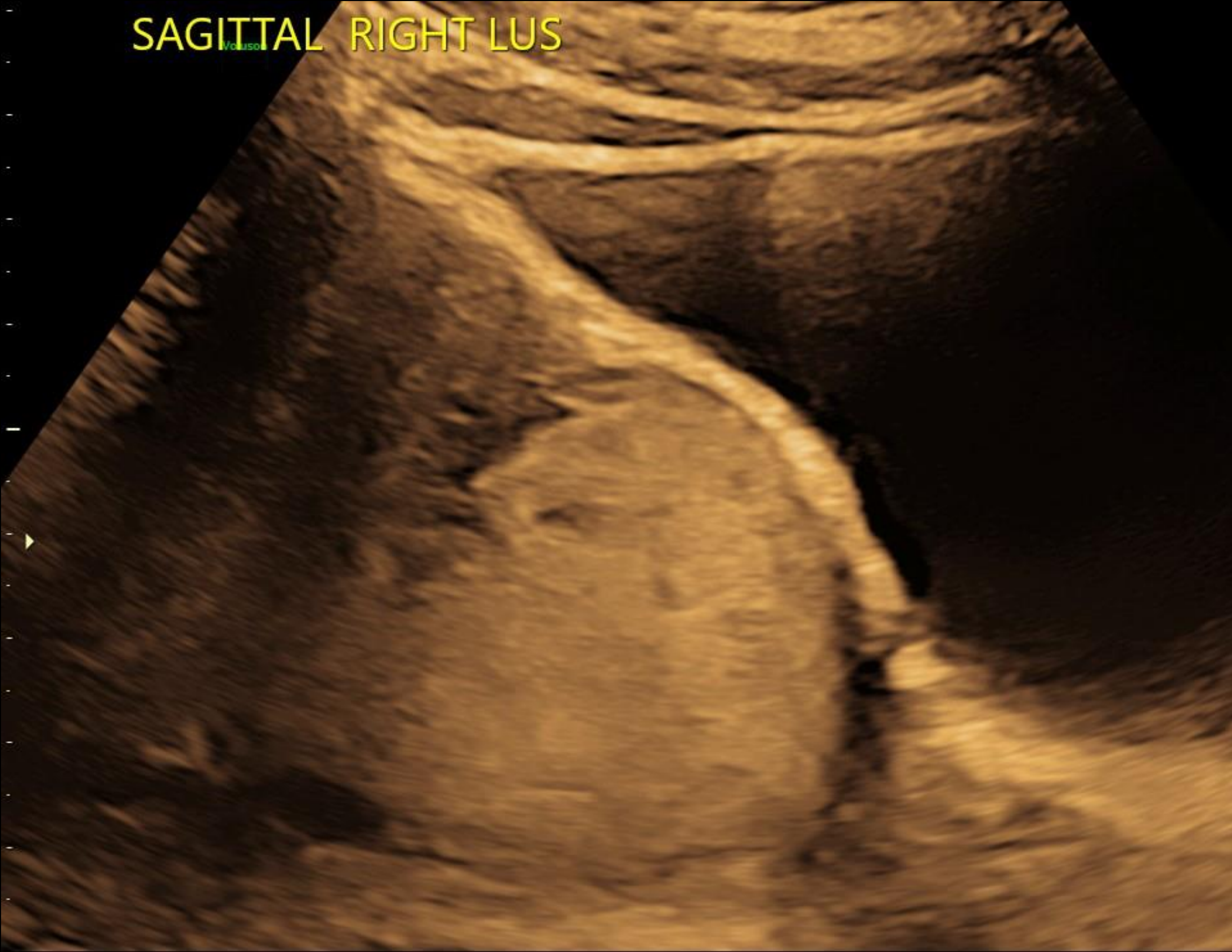


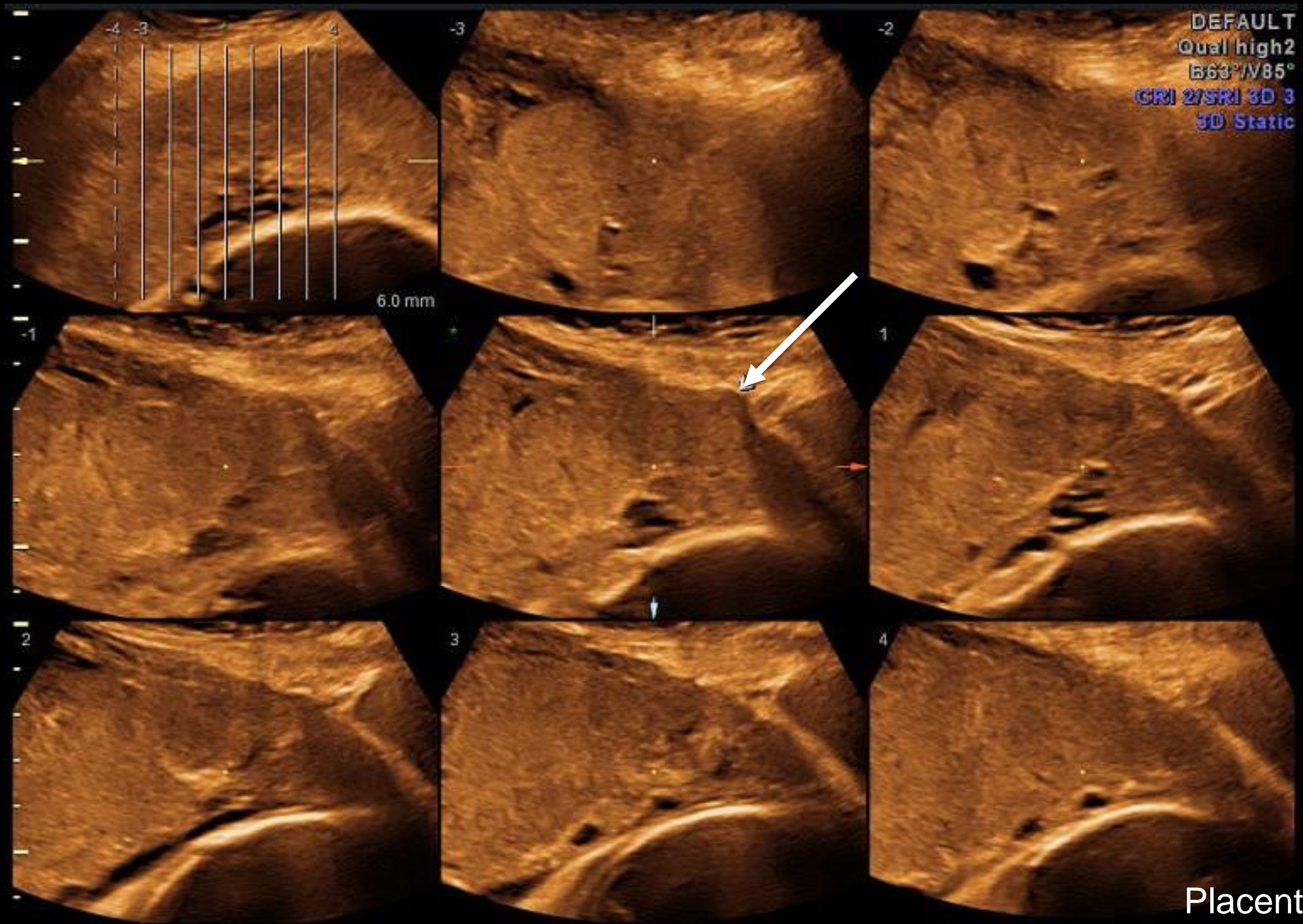


3D Ultrasound Tomographic US Imaging

Placental Bulging

SAGITTAL RIGHT LUS

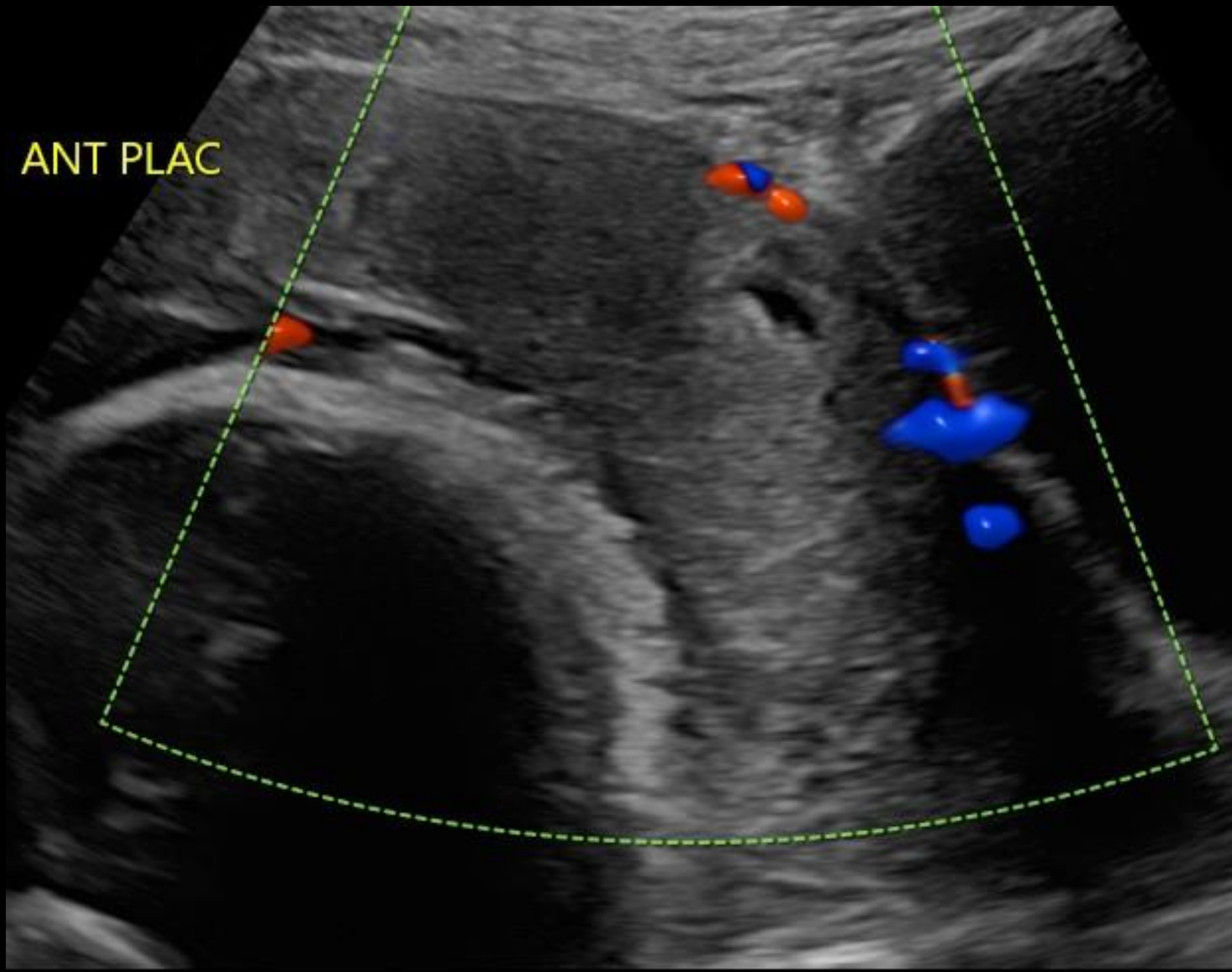




Bladder-Uterine Wall Interruption



Bridging Vessels Across Uterine Wall



Morbidly adherent placenta: evaluation of ultrasound diagnostic criteria and differentiation of placenta accreta from percreta

G. CALÌ*, L. GIAMBANCO*, G. PUCCIO† and F. FORLANI‡

**Department of Obstetrics and Gynecology, ARNAS Civico, Di Cristina e Benfratelli, Palermo, Italy; †Operative Unit of Pediatrics and Neonatal Intensive Therapy, Mother and Child Department, University of Palermo, Palermo, Italy; ‡Department of Obstetrics and Gynecology, University Hospital 'Paolo Giaccone', Palermo, Italy*

187 pregnant women with previa with prior uterine surgery
41 women (22%) had placenta accreta spectrum

Objectives

- determine diagnostic accuracy
2DUS, color Doppler US, 3DUS
- identify criteria to distinguish accreta from percreta

Diagnostic Criteria - Cali et al.

2D US (abdominal and transvaginal) and Doppler

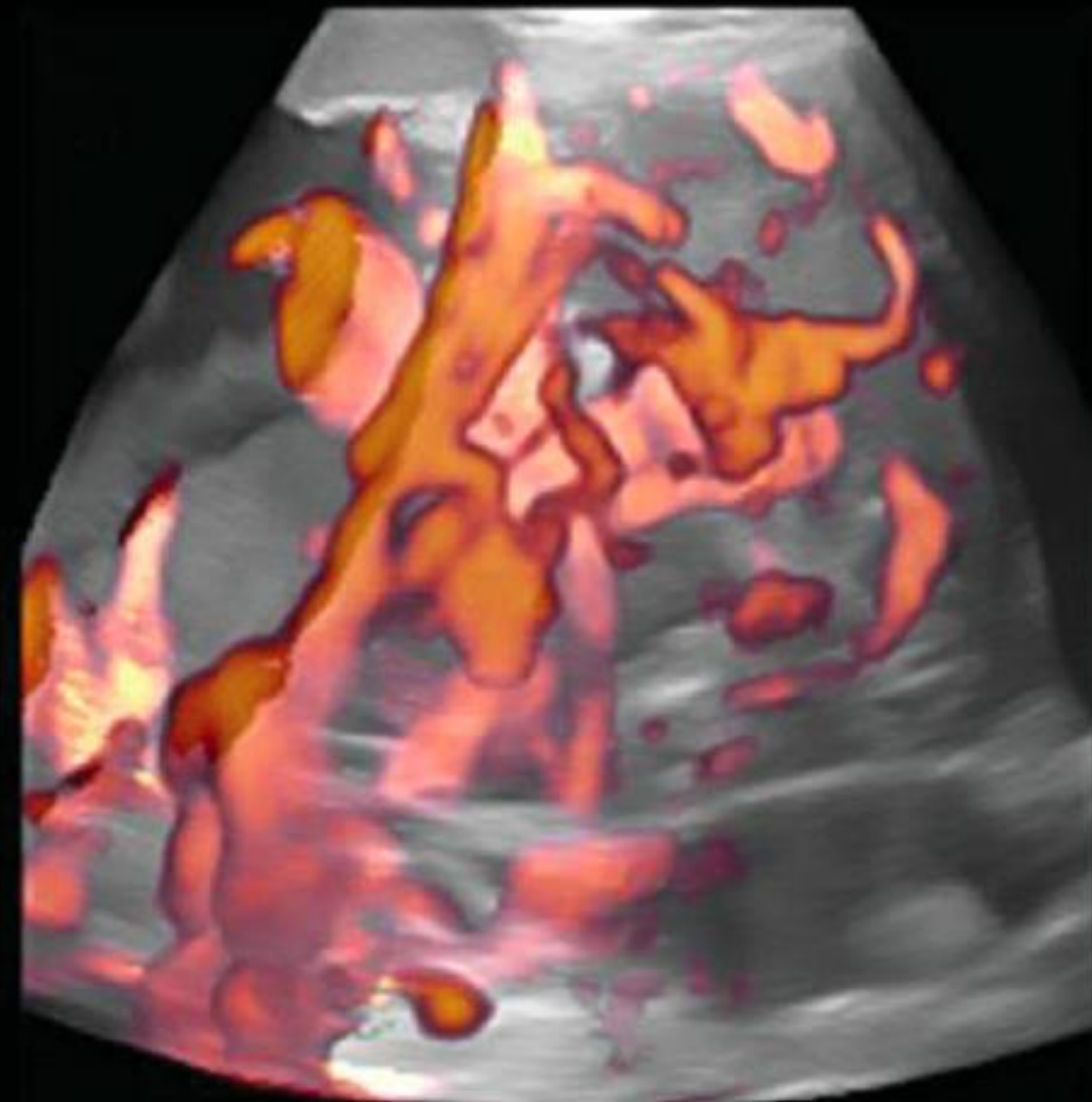
- loss/irregularity of retroplacental echolucent area
- abnormal hyperechoic interface (bladder and uterus)
- turbulent placental lacunae with high flow (> 15 cm/s)

Transabdominal 3D power Doppler US

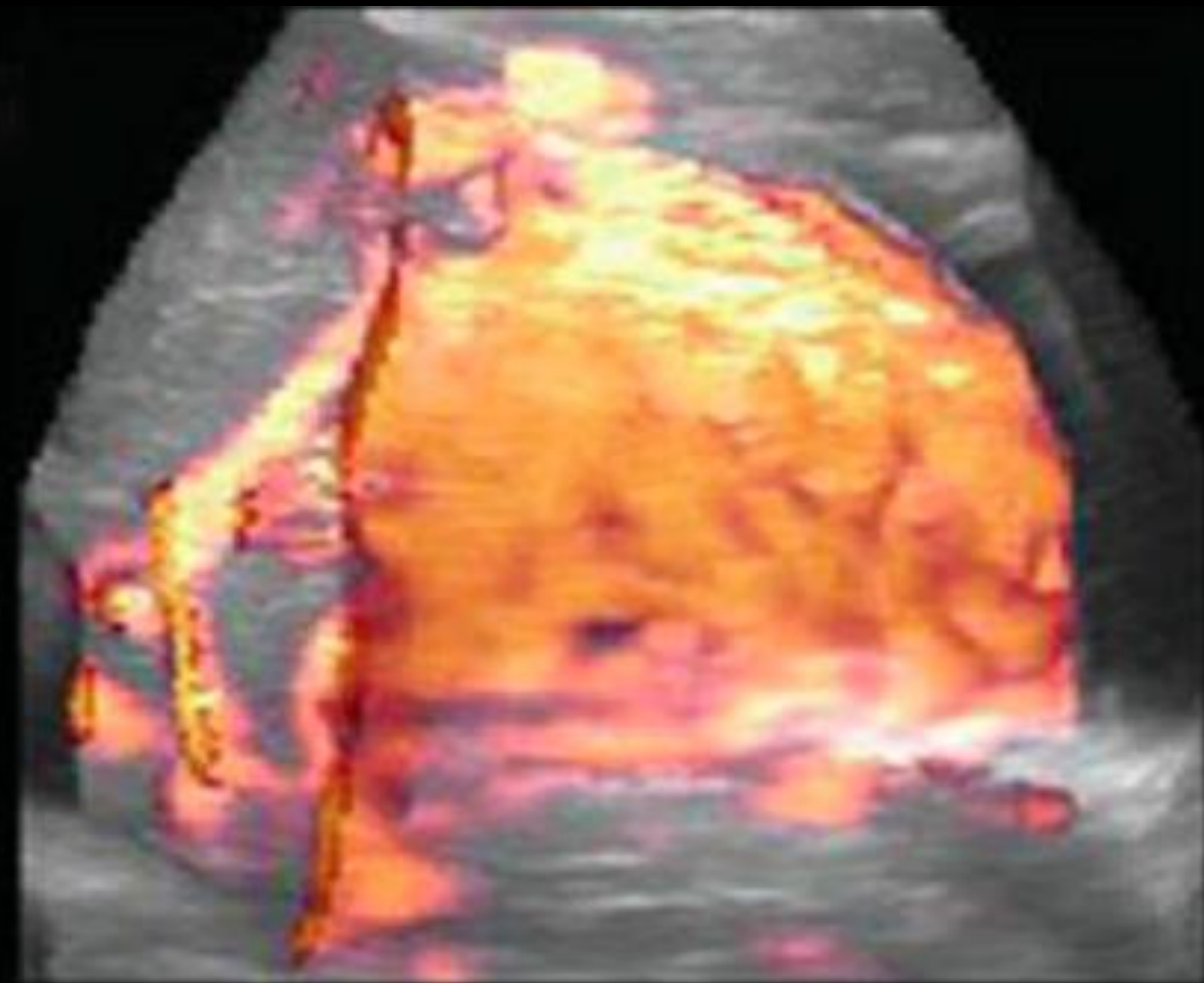
- hypervascularity of uterine serosa-bladder wall interface
- irregular intraplacental vascularization

“In the 16 of 17 cases of percreta, the serosa-bladder interface hypervascularity was associated with vascularization of the entire placental width.”

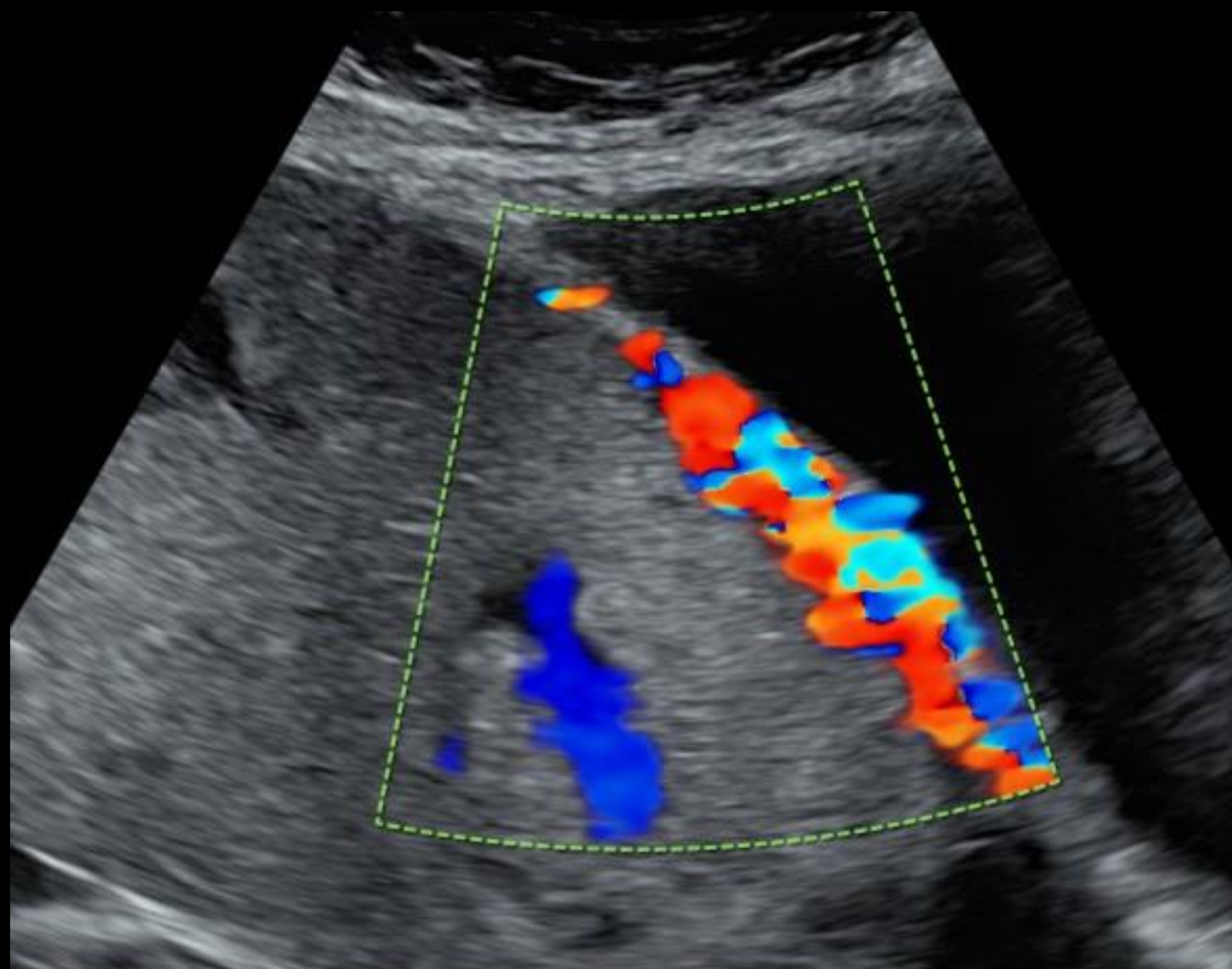
b



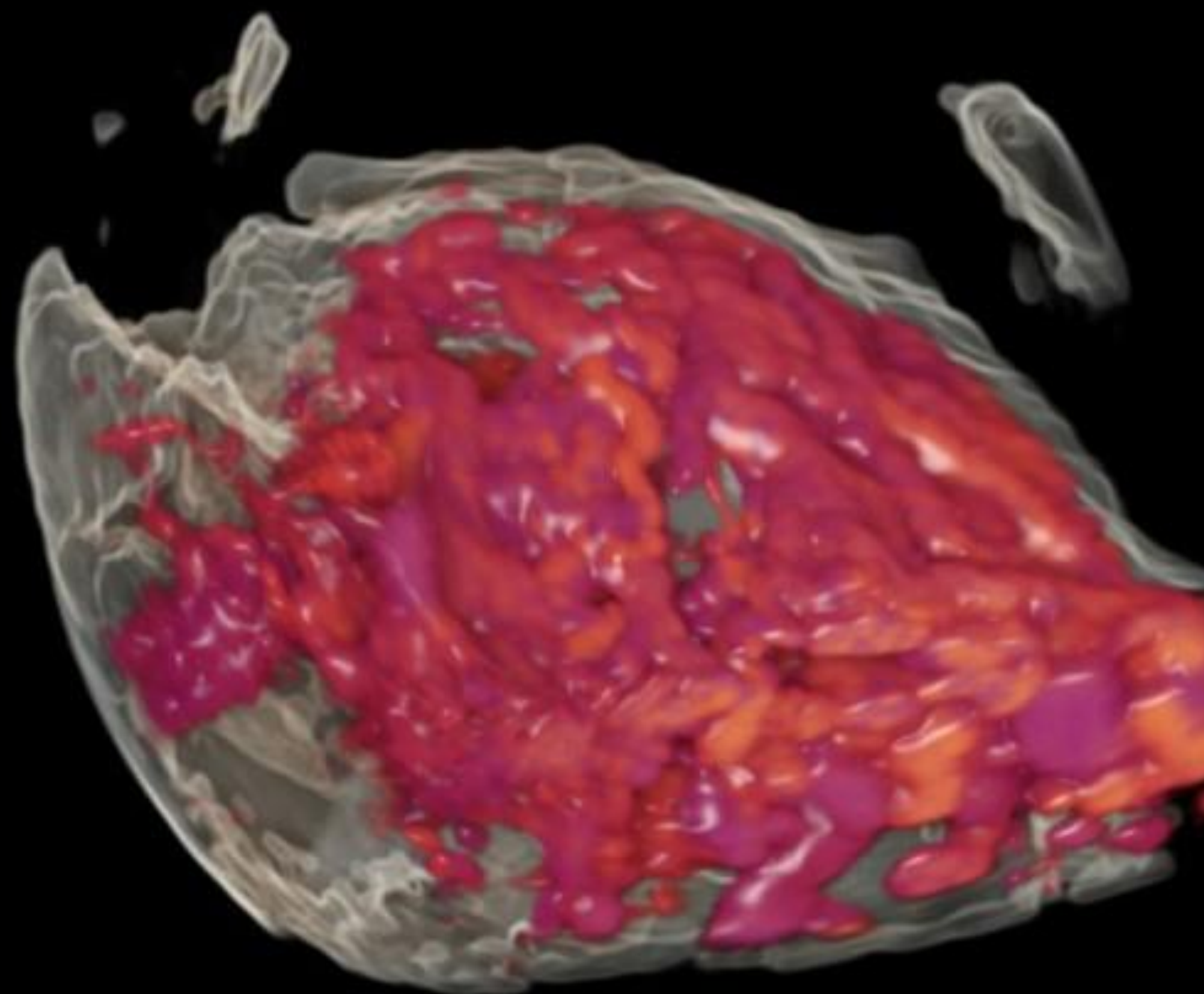
Previa with No Accreta



Placenta Percreta



2D color Doppler US

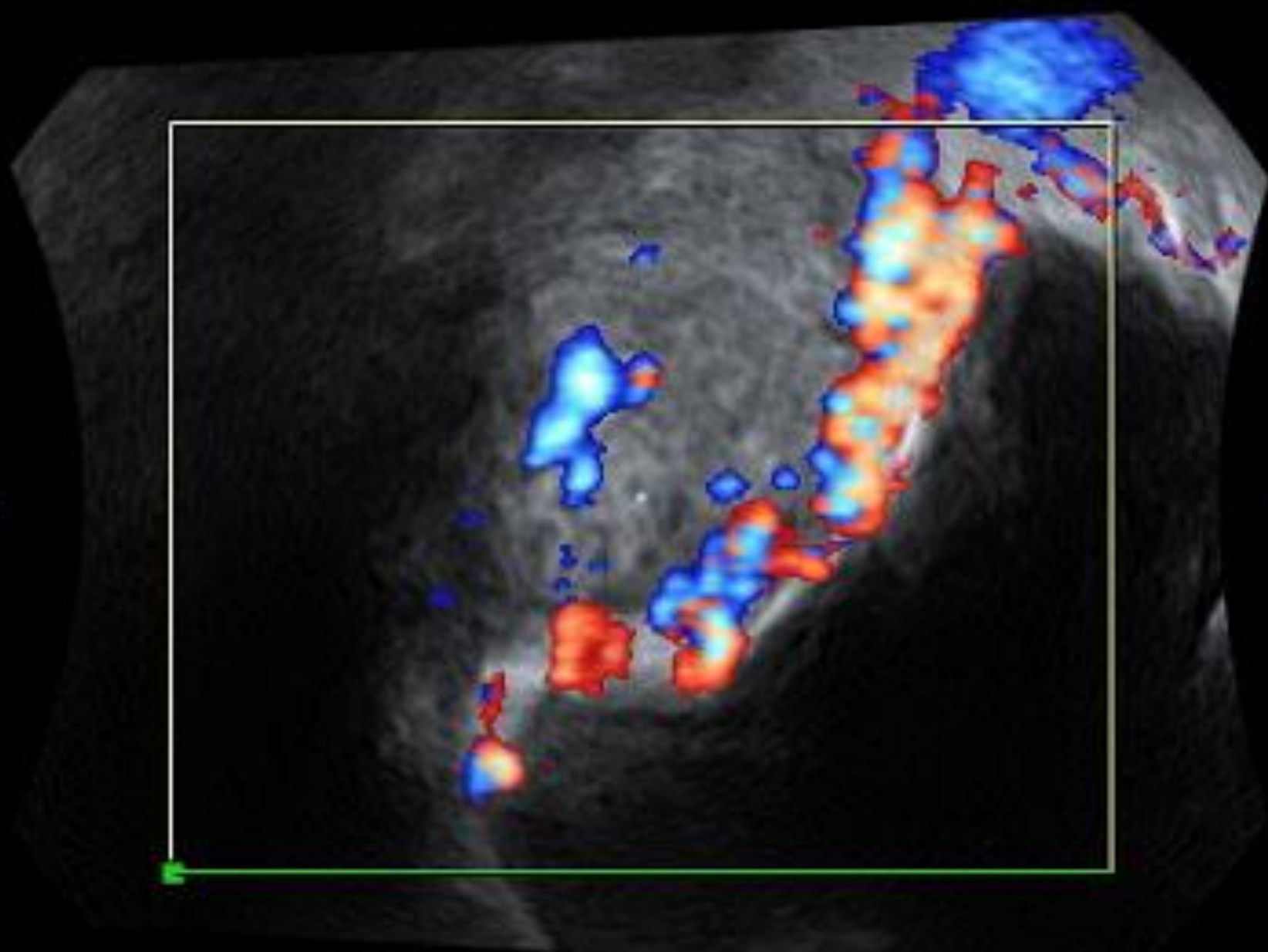
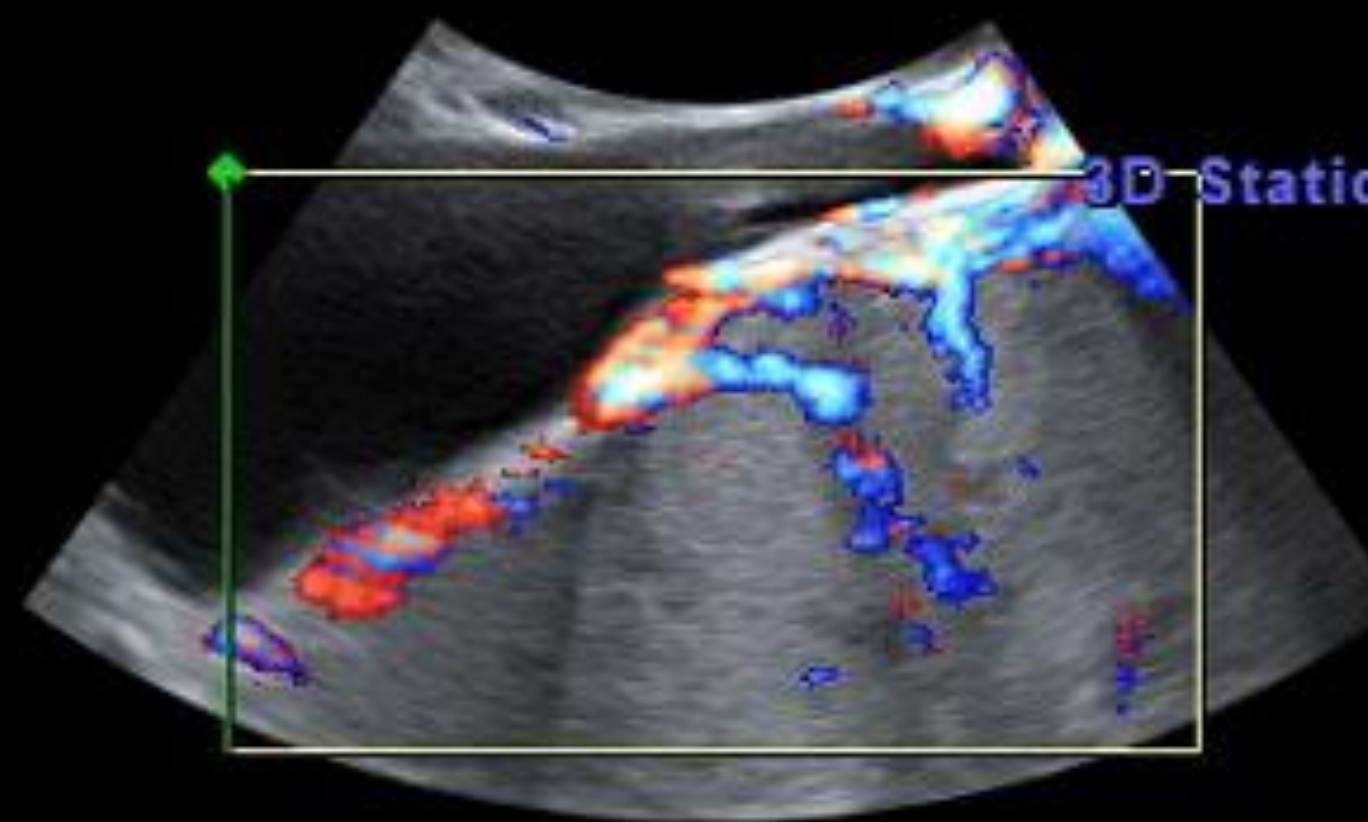
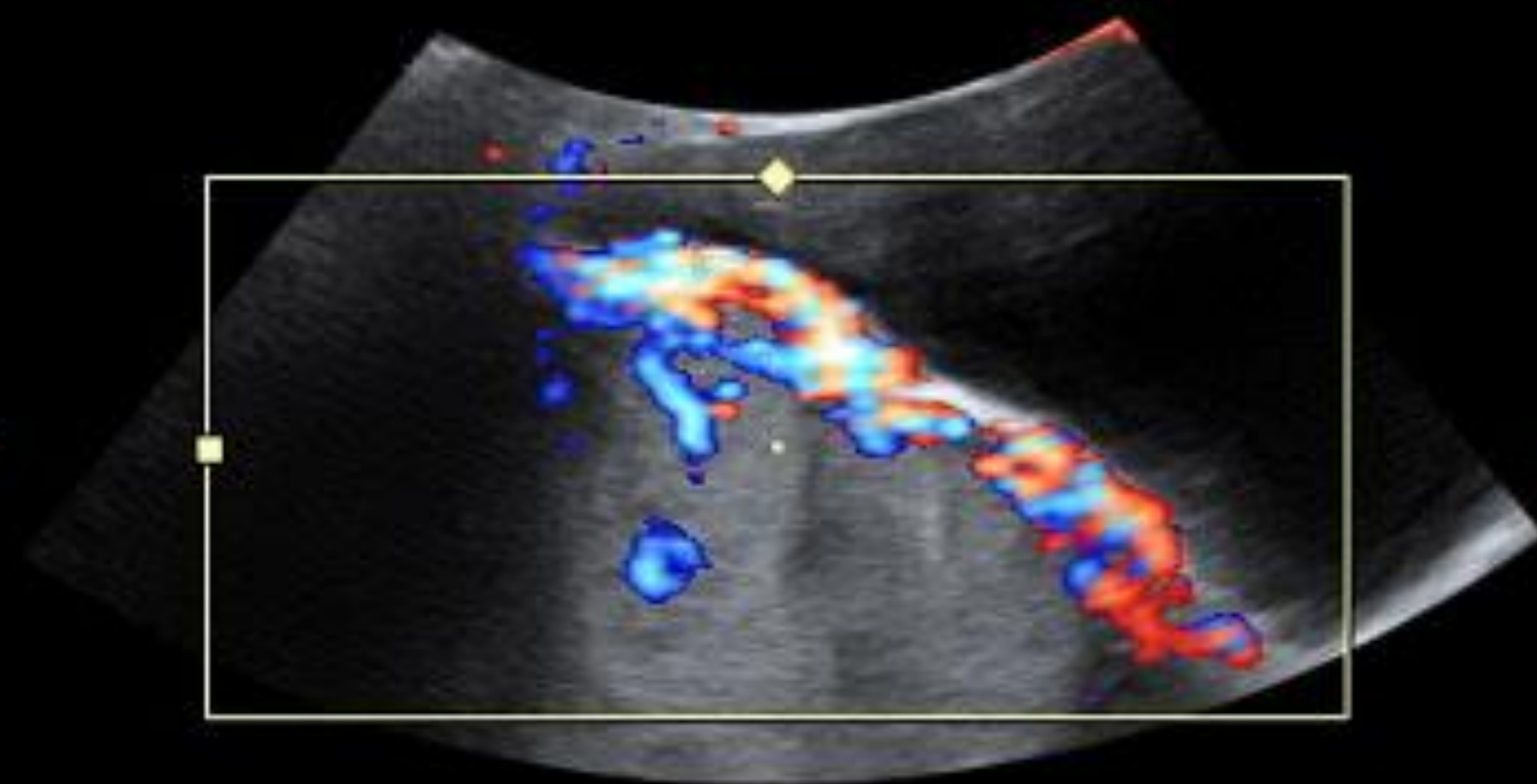


3D Power Doppler US

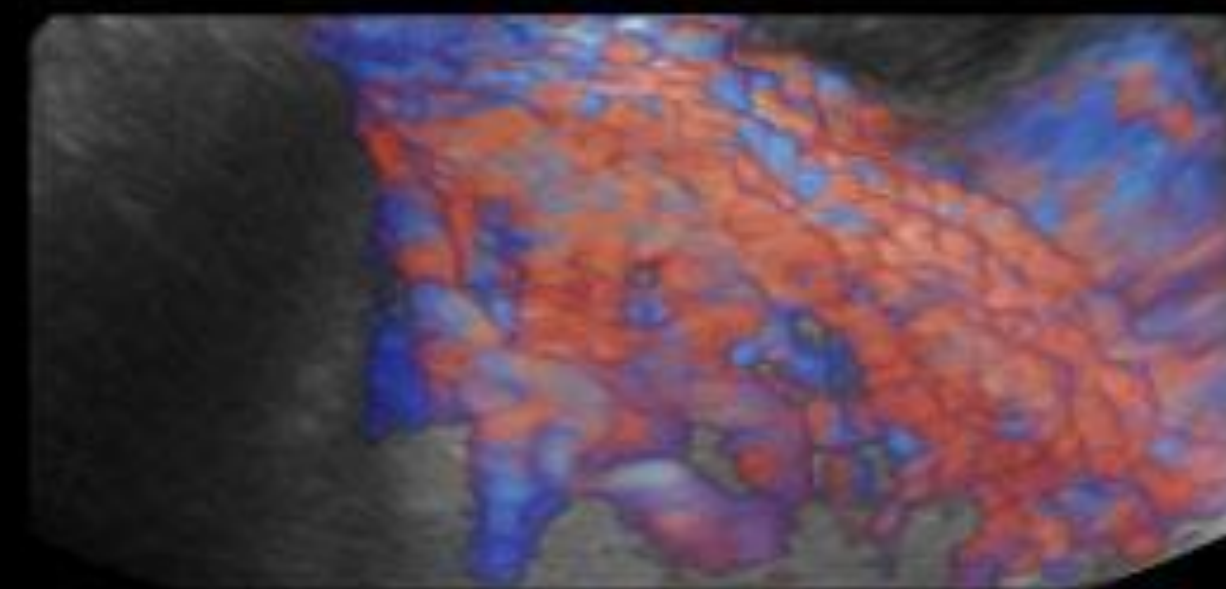
17cm/s



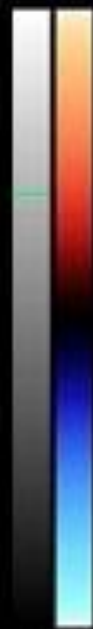
-17cm/s



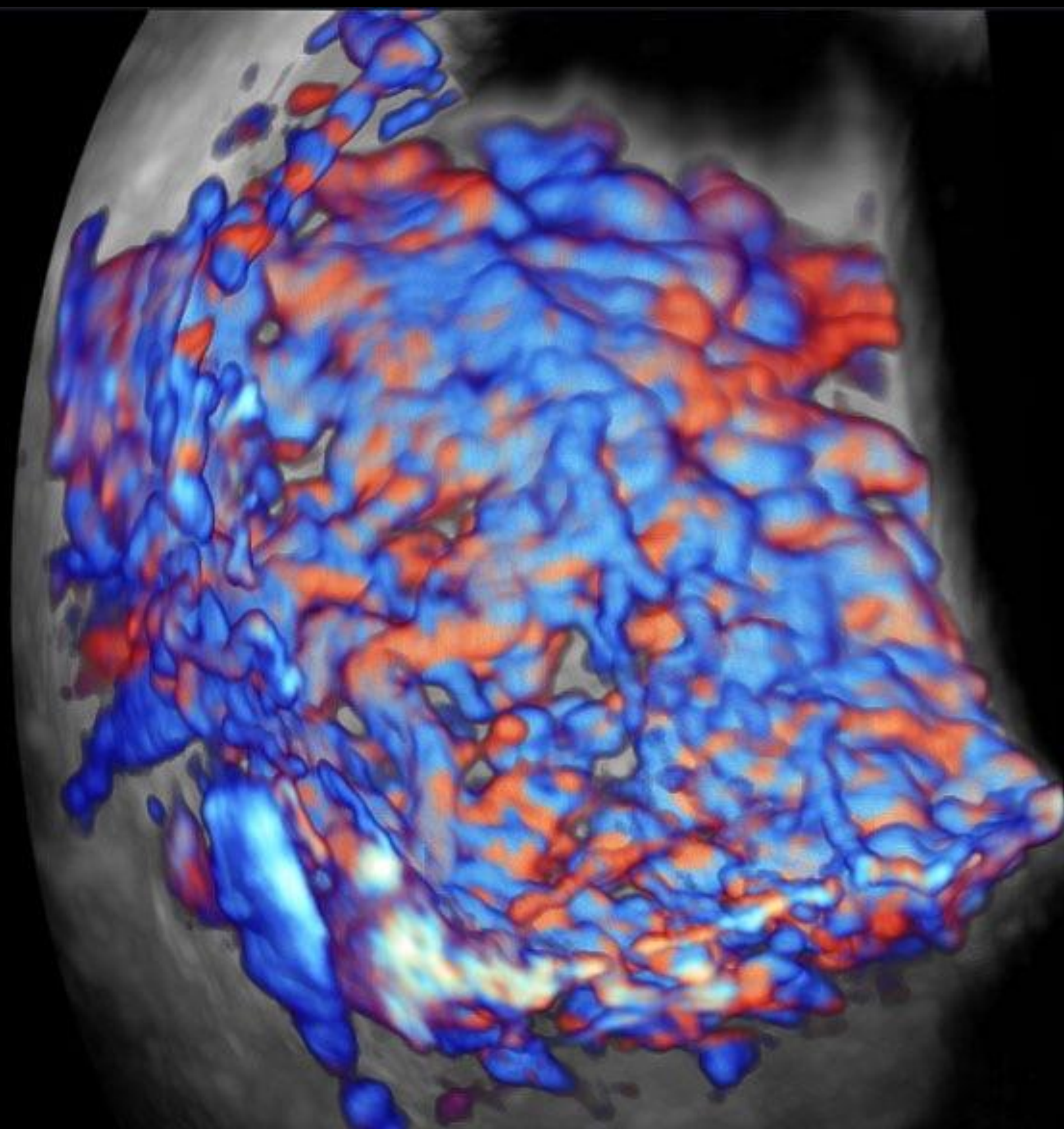
A | B
C | 3D



14cm/s

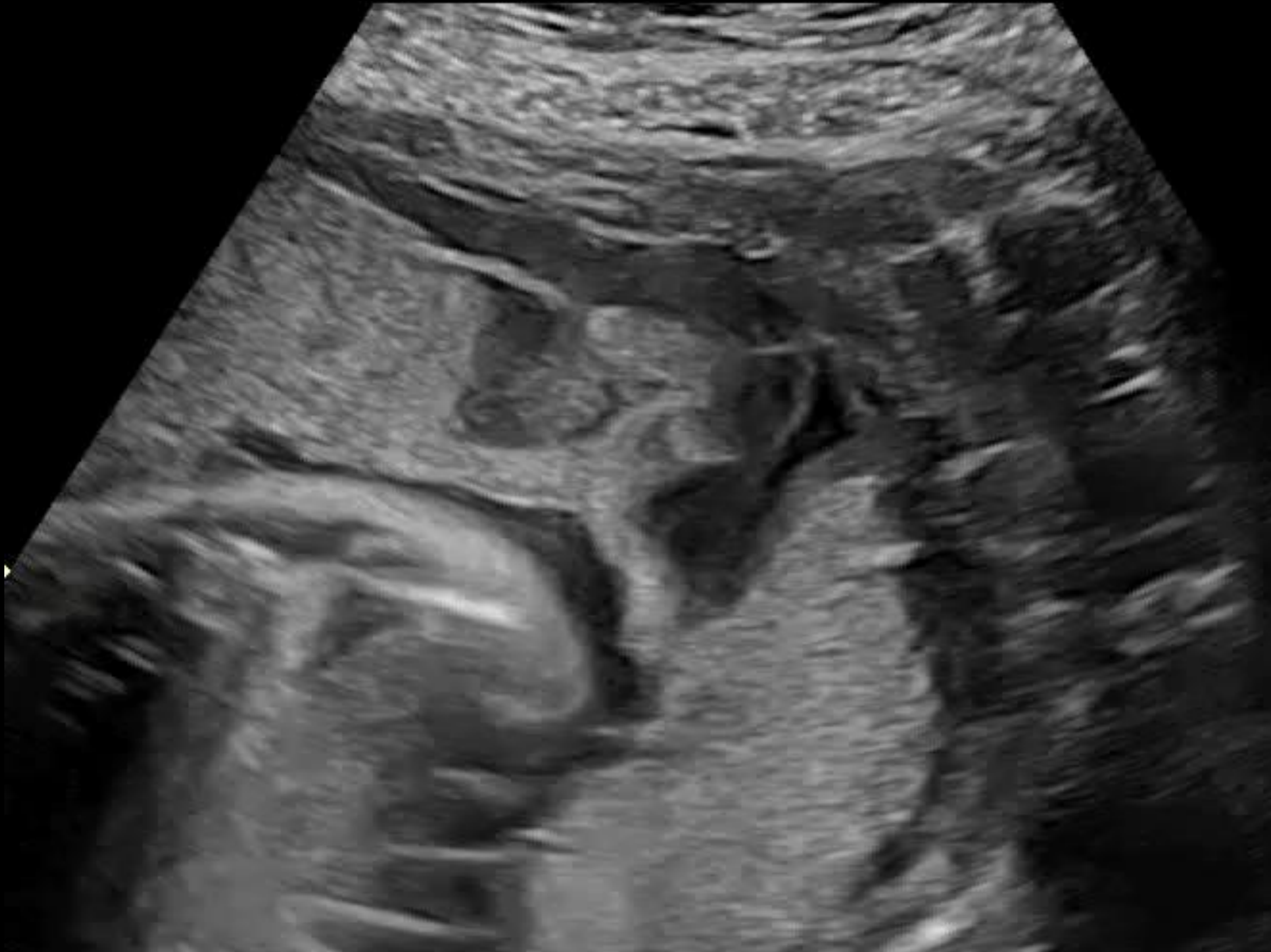


-14cm/s

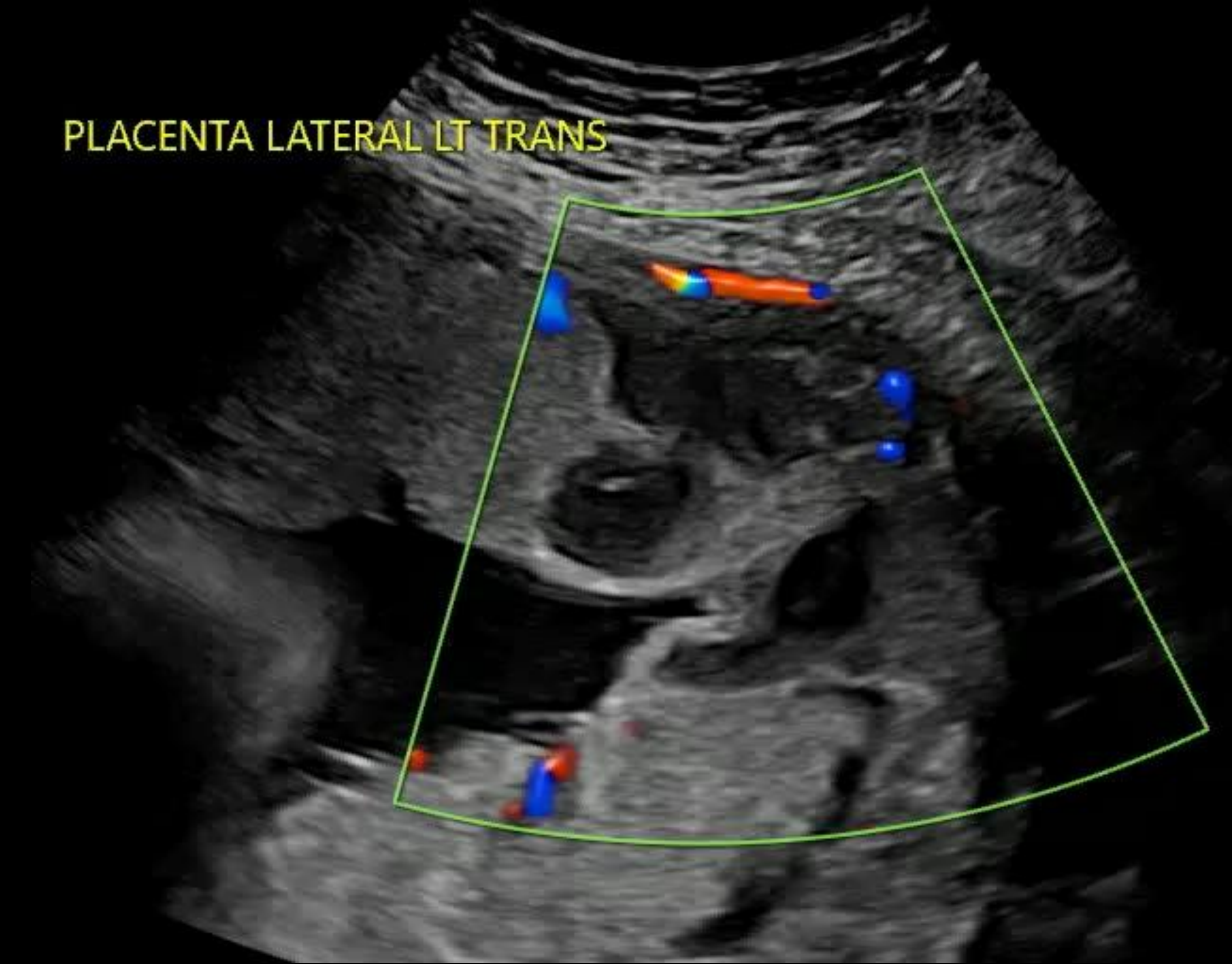


31

Parametrial Extension



PLACENTA LATERAL LT TRANS



First-trimester ultrasound diagnostic features of placenta accreta spectrum in low-implantation pregnancy

R. R. ABINADER[Ⓞ], N. MACDISI, I. EL MOUDDEN and A. ABUHAMAD

Department of Obstetrics and Gynecology, Eastern Virginia Medical School, Norfolk, VA, USA

21 Cases
46 Controls

Placental lacunae	86%
Abnormal uteroplacental interface	85%
Retroplacental myometrium absence	67%
Lower uterine hypervascularity	100%



Cesarean Section Scar Ectopic Pregnancy



6 weeks gestation

Cesarean scar pregnancy and early placenta accreta share common histology

I. E. TIMOR-TRITSCH*, A. MONTEAGUDO*, G. CALI†, J. M. PALACIOS-JARAQUEMADA‡, R. MAYMON§, A. A. ARSLAN¶, N. PATIL**, D. POPIOLEK†† and K. R. MITTAL††

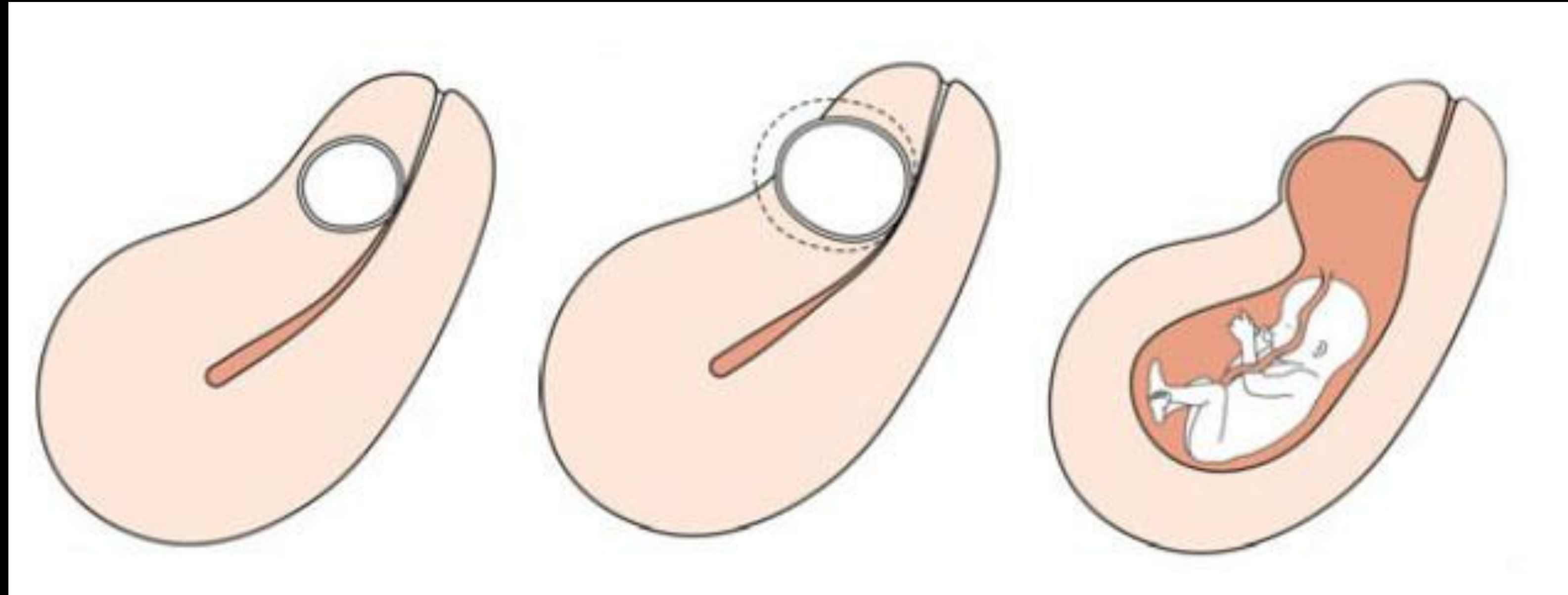
*Department of Obstetrics and Gynecology, Division of Maternal-Fetal Medicine, New York University SOM, New York, NY, USA; †Department of Obstetrics and Gynecology, Arnas Civico Hospital, Palermo, Italy; ‡Centre for Medical Education and Clinical Research (CEMIC), University Hospital, Buenos Aires, Argentina; §Department of Obstetrics and Gynecology, Assaf Harofeh Medical Center, Zrifin and Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel; ¶Departments of Population Health, Obstetrics and Gynecology and Environmental Medicine, New York University SOM, New York, NY, USA; **Department of Pathology, Mount Sinai Medical Center, New York, NY, USA; ††Department of Pathology, New York University SOM, New York, NY, USA

Cesarean scar pregnancy is a precursor of morbidly adherent placenta

I. E. TIMOR-TRITSCH*, A. MONTEAGUDO*, G. CALI†, A. VINTZILEOS‡, R. VISCARELLO§, A. AL-KHAN¶, S. ZAMUDIO¶, P. MAYBERRY§, M. M. CORDOBA* and P. DAR**

*NYU School of Medicine, Department of Obstetrics and Gynecology, Division of Maternal Fetal Medicine, New York, NY, USA; †Department of Obstetrics and Gynecology, Arnas Civico Hospital, Palermo, Italy; ‡Winthrop University Hospital, Department of Obstetrics and Gynecology, Division of Maternal Fetal Medicine and Surgery, Mineola, NY, USA; §Maternal Fetal Care PC, Stamford, CT, USA; ¶Hackensack University Medical Center, Department of Obstetrics and Gynecology, Hackensack, NJ, USA; **Albert Einstein College of Medicine, Department of Obstetrics and Gynecology and Women's Health, Bronx, NY, USA

Evolution: Small Scar Pregnancy → Placenta Accreta



Proposal: “All women with prior cesarean section should have a 6- to 8- week scan to predict placenta accreta”

Adapted from El-Refaey H, et al. BJOG 2014;121:181

PAS Risk Prediction Models

Gilboa Y, Spira M, Mazaki-Tovi S, Schiff E, Sivan E, Achiron R. A novel sonographic scoring system for antenatal risk assessment of obstetric complications in suspected morbidly adherent placenta. *J Ultrasound Med* 2015; 34:561–567.

Rac MWF, Dashe JS, Wells CE, Moschos E, McIntire DD, Twickler DM. Ultrasound predictors of placental invasions: the Placenta Accreta Index. *Am J Obstet Gynecol* 2015; 212:343.e1–343.e7.

Tovbin J, Melcer Y, Shor S, et al. Prediction of morbidly adherent placenta using a scoring system. *Ultrasound Obstet Gynecol* 2016;48:504–510.

Pain F, Dohan A, Grange et al. Percreta score to differentiate between placenta accreta and placenta percreta with ultrasound and MR imaging. *Acta Obstet Gynecol* 2022;101:1135-1145.

OBSTETRICS

Am J Obstet Gynecol 2015;212:343.e1-7

Ultrasound predictors of placental invasion: the Placenta Accreta Index

Martha W. F. Rac, MD; Jodi S. Dashe, MD; C. Edward Wells, MD; Elysia Moschos, MD;
Donald D. McIntire, PhD; Diane M. Twickler, MD

retrospective review of 184 gravidas \geq 1 prior cesarean section
with previa or low-lying placenta (1997-2011)

composite score:

- smallest myometrial thickness
- lacunar spaces
- presence of bridging vessels
- number of prior cesarean deliveries
- placental location

TABLE 4

Value of each parameter is added together to generate Placenta Accreta Index score

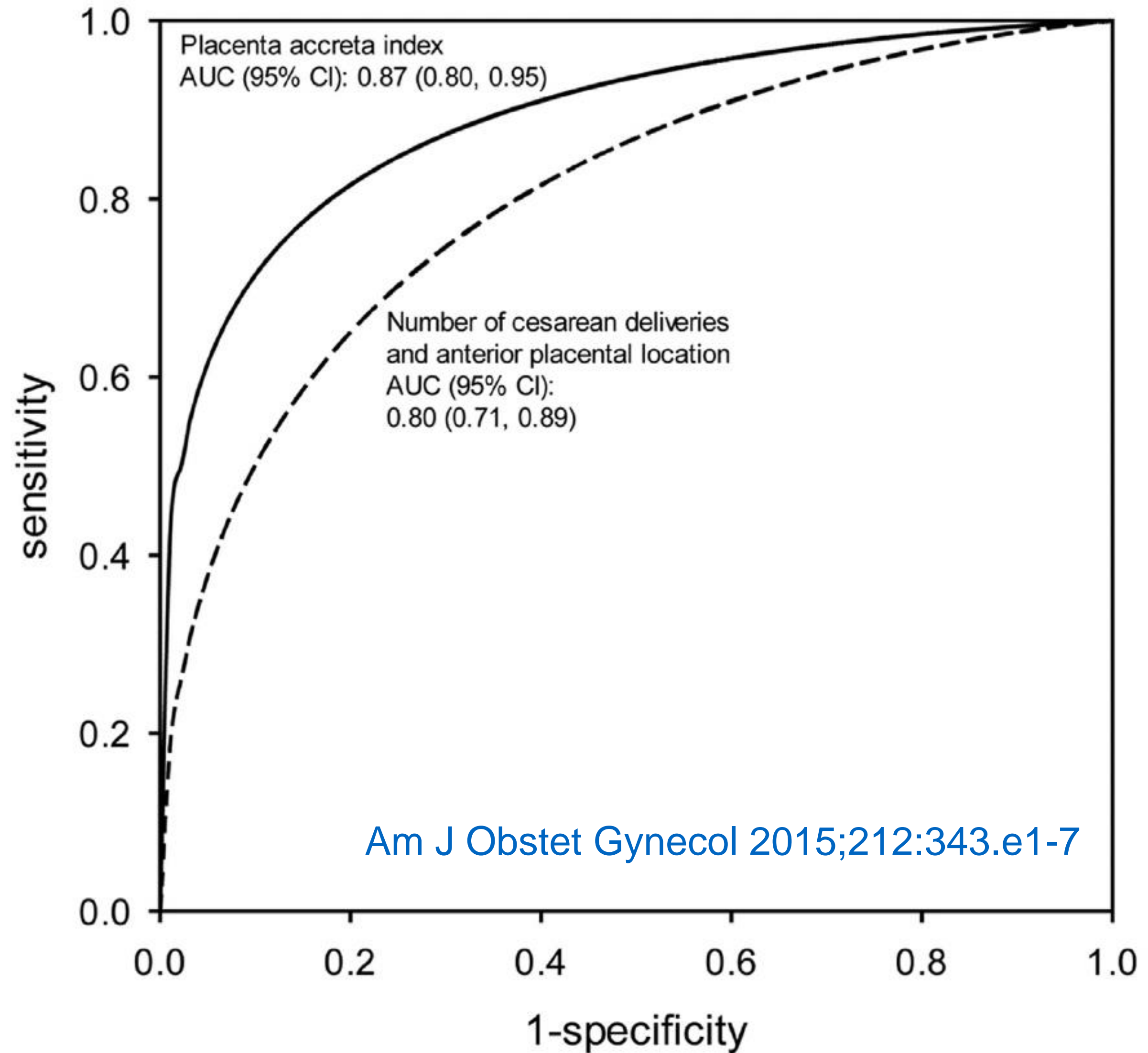
Parameter ^a	Value
≥2 cesarean deliveries	3.0
Lacunae	
Grade 3	3.5
Grade 2	1.0
Sagittal smallest myometrial thickness ^b	
≤1 mm	1.0
<1 but ≥3 mm	0.5
>3 but ≤5 mm	0.25
Anterior placenta previa ^c	1.0
Bridging vessels	0.5

^a If parameter is not present, then value is 0; ^b Measured in sagittal plane; ^c If any portion of placenta is anterior.

Rac. Placenta Accreta Index. Am J Obstet Gynecol 2015.

FIGURE 8

Receiver operator curves for prediction of placental invasion



Placenta Accreta Index

TABLE 5

Sensitivity, specificity, and positive and negative predictive values at each PAI score

PAI	n	Probability of invasion, % (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
>0	1	5 (1–15)	100 (88–100)	19 (10–31)	38 (27–49)	100 (72–100)
>1	1	10 (4–22)	97 (82–100)	47 (34–61)	47 (34–61)	97 (82–100)
>2	2	19 (10–32)	93 (77–99)	58 (44–70)	52 (38–66)	94 (81–99)
>3	4	33 (22–47)	86 (68–96)	68 (54–79)	57 (41–72)	91 (78–97)
>4	6	51 (36–66)	72 (53–87)	85 (73–93)	70 (51–85)	86 (75–94)
>5	6	69 (50–83)	52 (33–71)	92 (81–97)	75 (51–91)	79 (68–88)
>6	2	83 (63–93)	31 (15–51)	100 (94–100)	100 (66–100)	75 (64–84)
>7	2	91 (73–97)	24 (10–44)	100 (94–100)	100 (59–100)	73 (62–82)
>8	5	96 (81–99)	17 (6–36)	100 (94–100)	100 (48–100)	71 (60–81)

CI, confidence interval; *NPV*, negative predictive value; *PAI*, Placenta Accreta Index; *PPV*, positive predictive value.

Rac. Placenta Accreta Index. Am J Obstet Gynecol 2015.

Placenta Accreta Index

PAI stratifies individual risk of invasion above the *apriori* risk based on number of prior cesarean deliveries and placental location.

Composite score from 5 ultrasound parameters + number of cesarean sections and placental location was highly predictive of placental invasion in pregnancies at increased risk.

Predicting Placenta Accreta Spectrum

Validation of the Placenta Accreta Index

Sarah K. Happe, MD , *Casey S. Yule, MD* , *Catherine Y. Spong, MD*, *C. Edward Wells, MD*,
Jodi S. Dashe, MD , *Elysia Moschos, MD*, *Martha W. F. Rac, MD*, *Donald D. McIntire, PhD*,
Diane M. Twickler, MD

Retrospective Cohort Study

194 pregnancies

≥ 1 prior cesarean section

Placenta previa or low-lying placenta

J Ultrasound Med 2021;40:1523-1532

Most Frequent US Findings Associated with Cesarean Hysterectomy

- Smallest myometrial thickness ≤ 1 mm 88%
- Anterior placenta previa 86%
- Bridging vessels 84%

PAI score > 4 was highly predictive of PAS that ultimately required hysterectomy with a PPV of 81%

PAS Ultrasound Worksheet

		Yes	No
A. Historical Risk Factors	advanced maternal age	<input type="checkbox"/>	<input type="checkbox"/>
	previous cesarean section (s) and number _____	<input type="checkbox"/>	<input type="checkbox"/>
	prior uterine surgery	<input type="checkbox"/>	<input type="checkbox"/>
	congenital uterine anomaly	<input type="checkbox"/>	<input type="checkbox"/>
	assisted reproductive technology	<input type="checkbox"/>	<input type="checkbox"/>
	prior pregnancy with suspected accreta	<input type="checkbox"/>	<input type="checkbox"/>
B. 1st Trimester Ultrasound Findings	low implanted gestational sac	<input type="checkbox"/>	<input type="checkbox"/>
	placental lacunae (increased size/number)	<input type="checkbox"/>	<input type="checkbox"/>
	abnormal uteroplacental interface	<input type="checkbox"/>	<input type="checkbox"/>
	lower uterine segment hypervascularity	<input type="checkbox"/>	<input type="checkbox"/>
C. 2nd - 3rd Trimester Ultrasound Findings	placenta previa	<input type="checkbox"/>	<input type="checkbox"/>
	loss of 'clear zone'	<input type="checkbox"/>	<input type="checkbox"/>
	myometrial thinning	<input type="checkbox"/>	<input type="checkbox"/>
	bladder-wall interruption	<input type="checkbox"/>	<input type="checkbox"/>
	placental bulge	<input type="checkbox"/>	<input type="checkbox"/>
	uterovesical hypervascularity	<input type="checkbox"/>	<input type="checkbox"/>
	placental lacunae	<input type="checkbox"/>	<input type="checkbox"/>
	bridging vessels	<input type="checkbox"/>	<input type="checkbox"/>

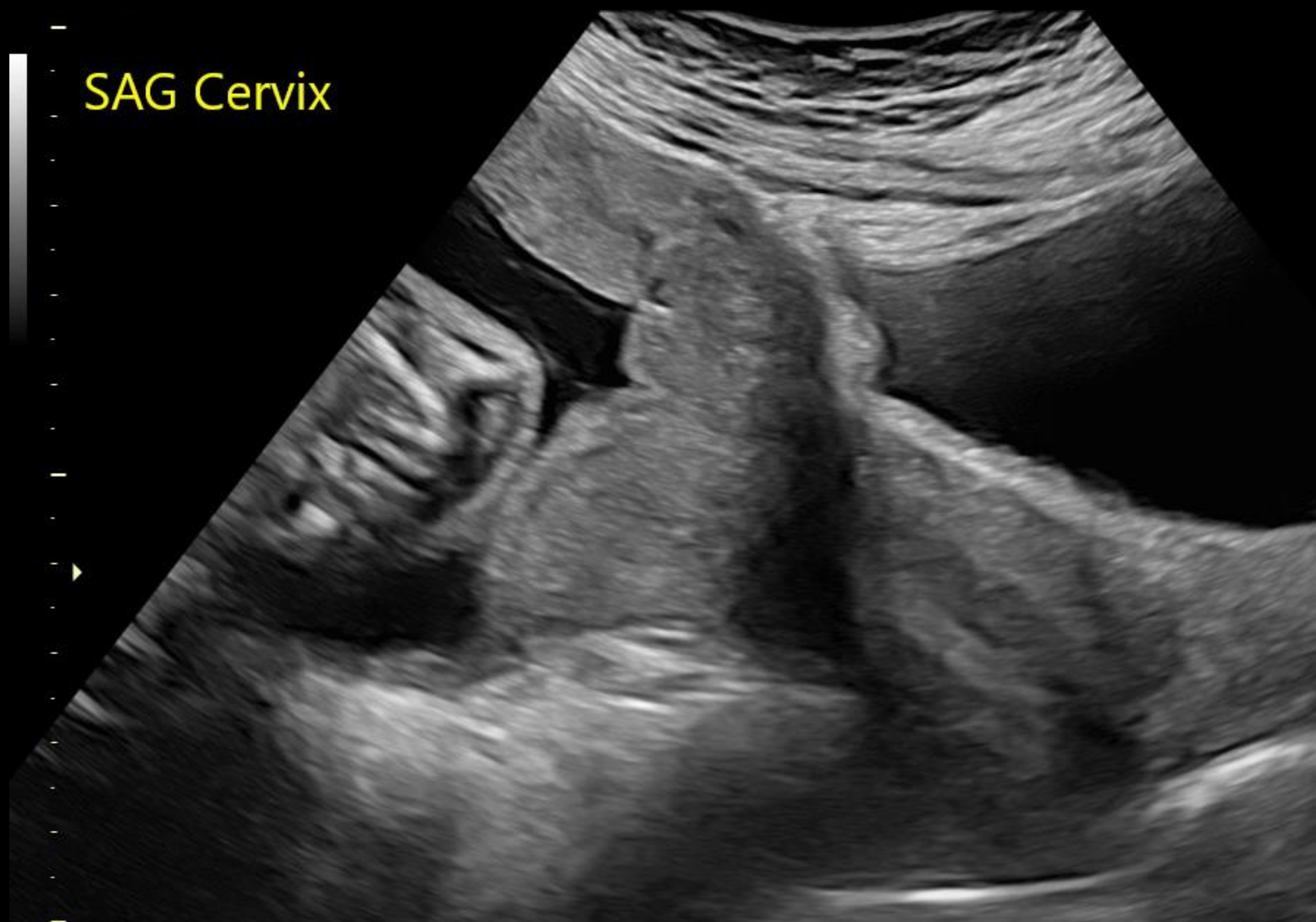
Remember Maternal Bladder Filling



Beware of Uterine Contractions

8:21:51

SAG Cervix



9:18:57



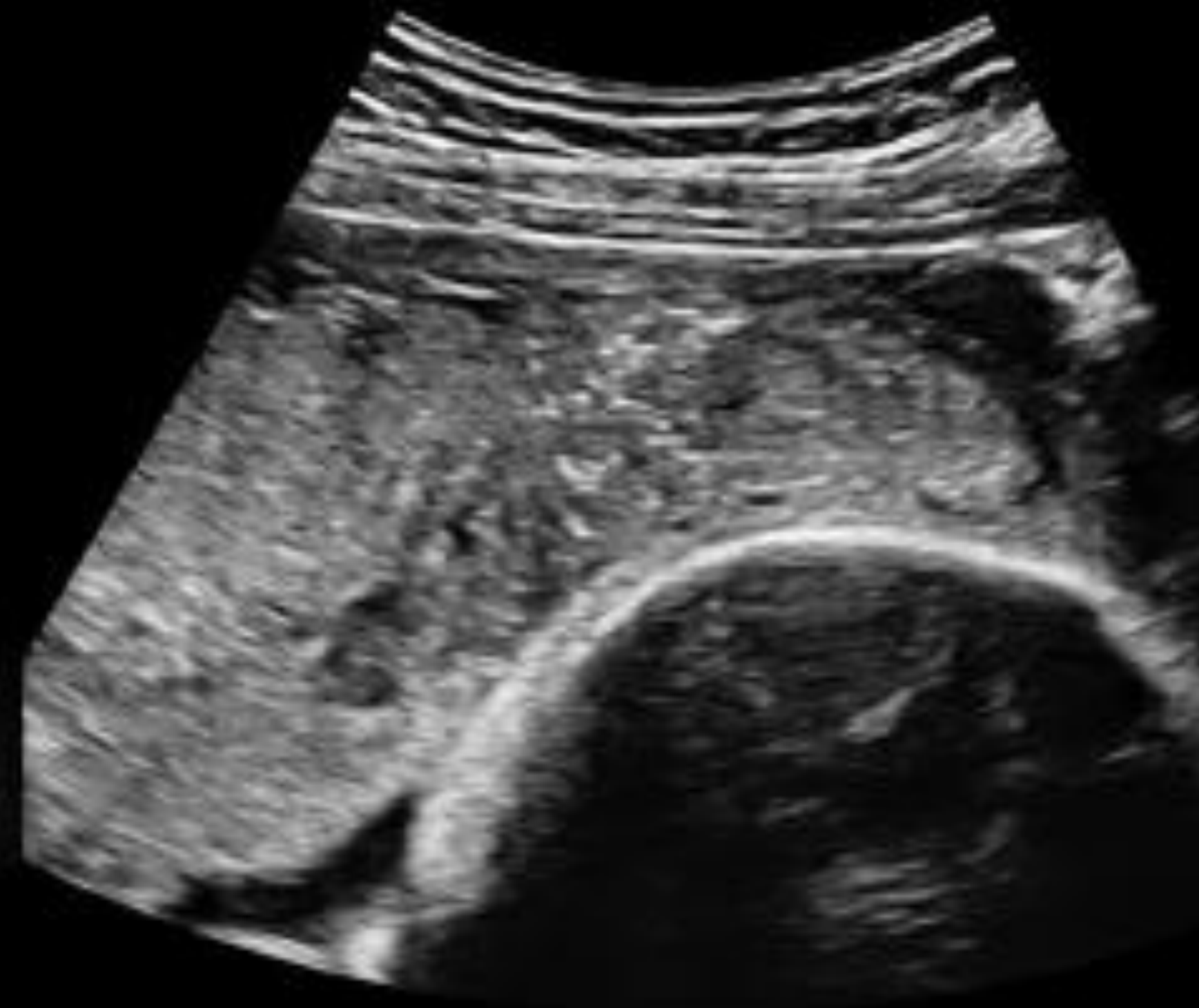
20 weeks, 3 days

Retroplacental Clear Zone and Probe Pressure

No Transducer Pressure



Transducer Pressure



Adapted from Jauniaux E, et al. Am J Obstet Gynecol 2018;218:75-87

Ultrasound Assessment of PAS - Key Points

- ✓ Encourage adequate maternal bladder filling
- ✓ Use high frequency ultrasound transducers when appropriate
- ✓ Add vaginal scan to evaluate maternal bladder - uterine wall interface
- ✓ Optimize color Doppler ultrasound settings
- ✓ 3D ultrasound can be used to complement 2D imaging

Placenta Accreta Spectrum - Future Directions

- Continuing technical improvements in ultrasound imaging
- Comprehensive predictive models (history, US, MRI, biomarkers)
- Novel diagnostic imaging tools based on AI and machine learning
- Magnetic resonance imaging as a complementary diagnostic tool

