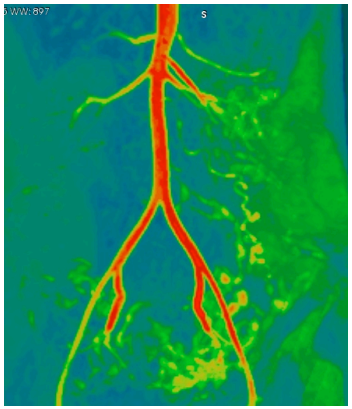
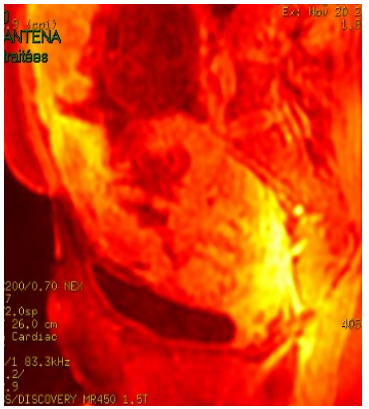
Placenta accreta: US and MRI

AE Millischer

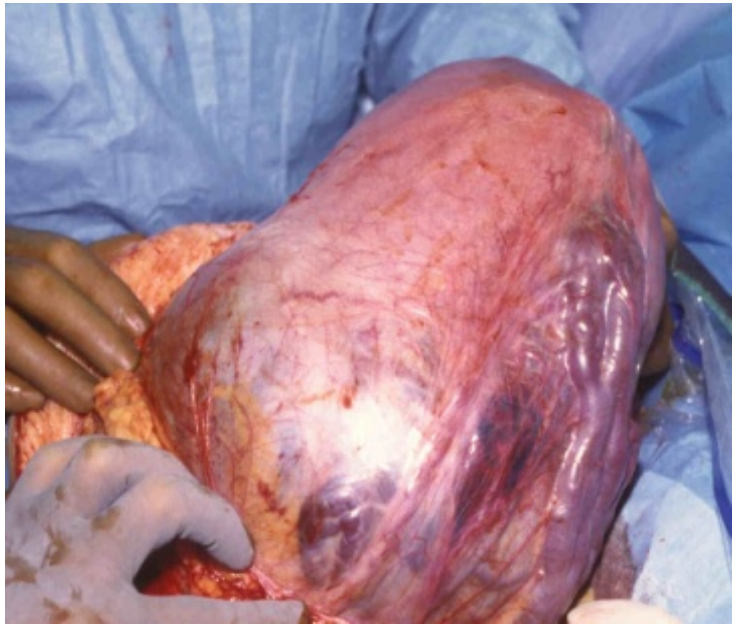
P Sonigo- N Boddaert- LJ Salomon

Paris Necker Hospital





Placenta accreta or
Abnormal Invasive Placenta (AIP)

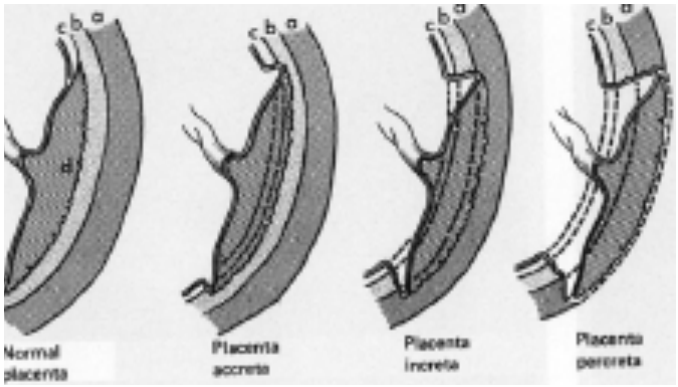


Kayem et al 2005

Placenta.2012 **Placenta accreta: pathogenesis of a 20th century iatrogenic uterine disease.** Jauniaux E, Jurkovic D

Spectrum of
Abnormal Invasive Placenta (AIP)

- Accreta: attached to the decidual surface of the myometrium
- Increta: more deeply invading into the myometrium
- Percreta: through the myometrium and the uterine serosa +/- adjacent organs



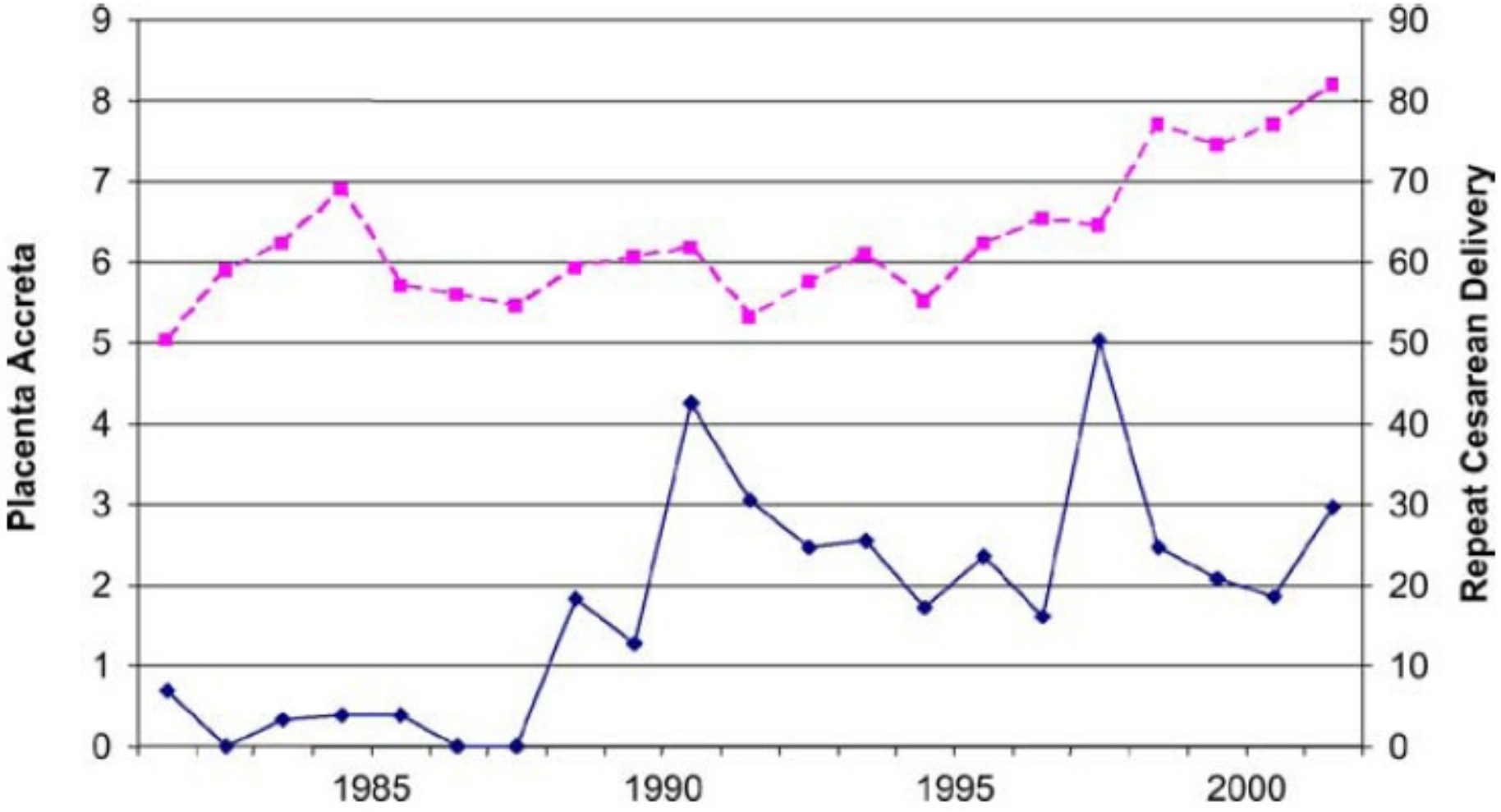
.

Risk Factors

- Placenta praevia – 75%: Risk of hysterectomy with placenta previa (adjusted for prior C/S) is 100 x that with normal placentation
- Prior cesarean section – 66% and prior myomectomy, manual removal of placenta, D+C, cornual resection (even endometritis)

Clark AJOG 1985; Miller AJOG 1997; Wu AJOG 2005.

AIP and C section



Wu AJOG 2005

Risk Factors

- Placenta **praevia** – 75%: Risk of hysterectomy with placenta previa (adjusted for prior C/S) is 100 x that with normal placentation
- **Prior cesarean section** – 66% and prior myomectomy, manual removal of placenta, D+C, cornual resection (even endometritis)
- Maternal **Age** > 35 years

Clark AJOG 1985; Miller AJOG 1997; Wu AJOG 2005.

1st step : Ultrasound

US: overall accuracy

	% accreta	Se	PPV	NPV
Warshak	9%	77%	65%	98%
Chou	21%	82%	87%	95%
Levine	37%	86%	86%	92%
Finberg	44%	93%	77%	94%

Ultrasound
Imaging Accuracy

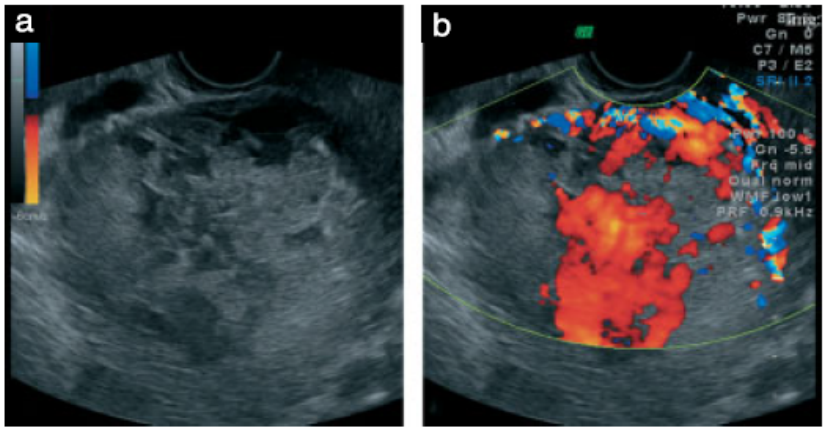


Figure 3 Intraplacental lacunae on gray-scale (a) and color Doppler (b) ultrasound imaging at 12 + 0 weeks' gestation.

Diagnosis in the first trimester of placenta accreta with previous Cesarean section

J. I. YANG, H. Y. KIM, H. S. KIM and H. S. RYU

Department of Obstetrics & Gynecology, Ajou University School of Medicine, Suwon, Republic of Korea

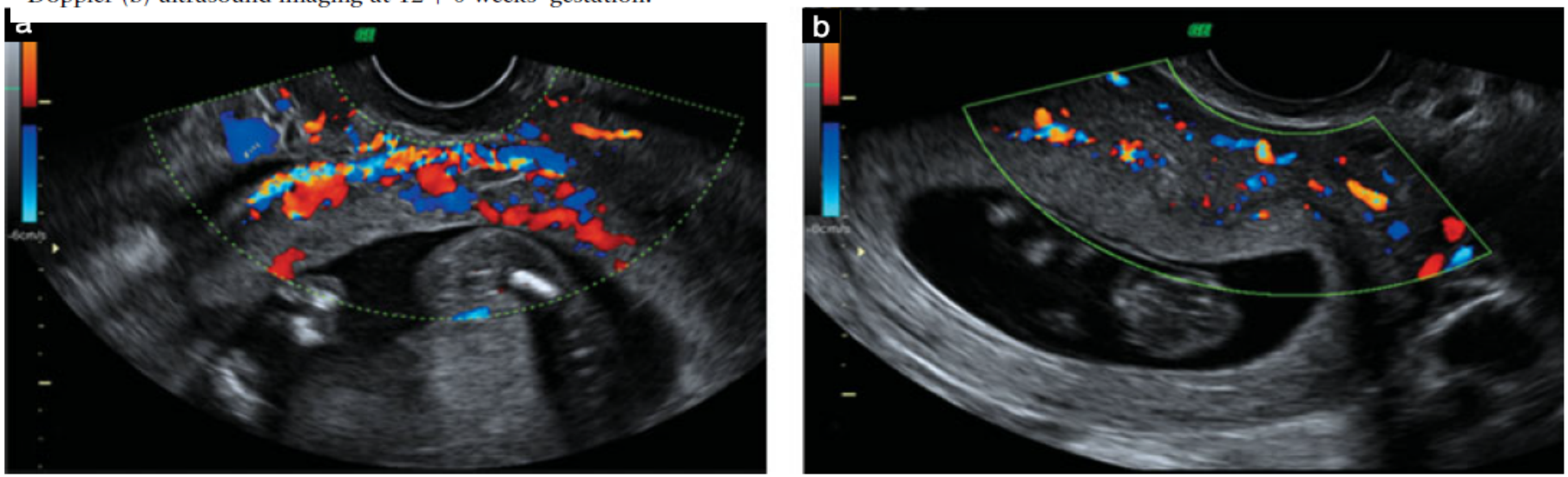
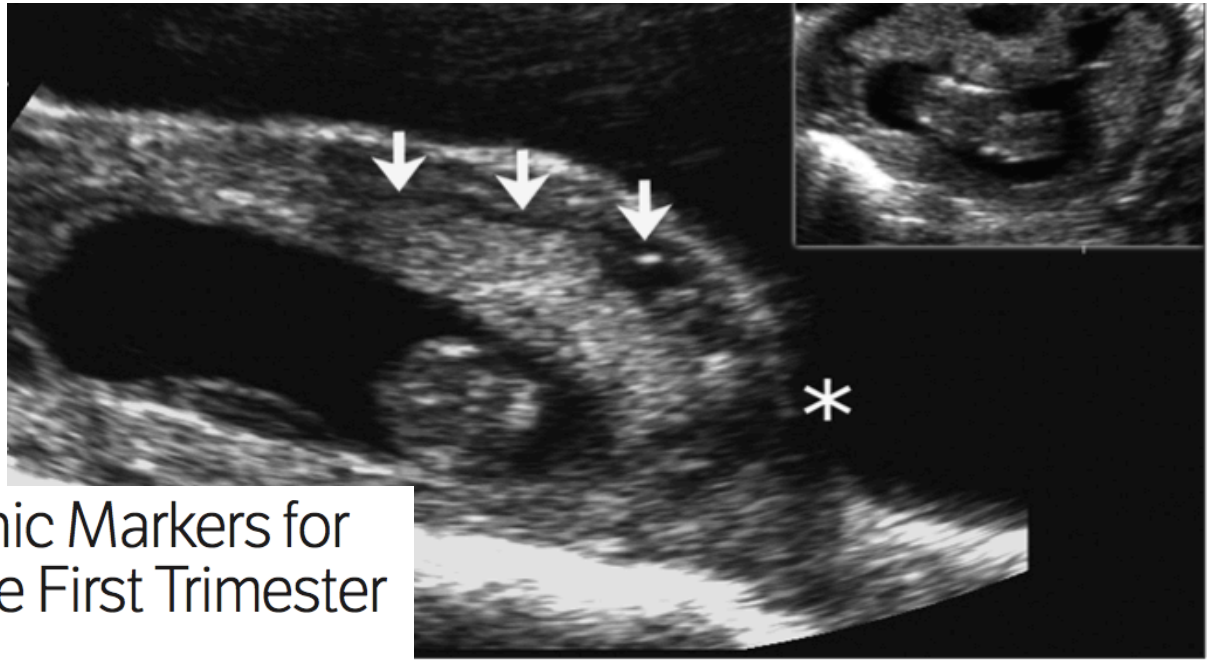
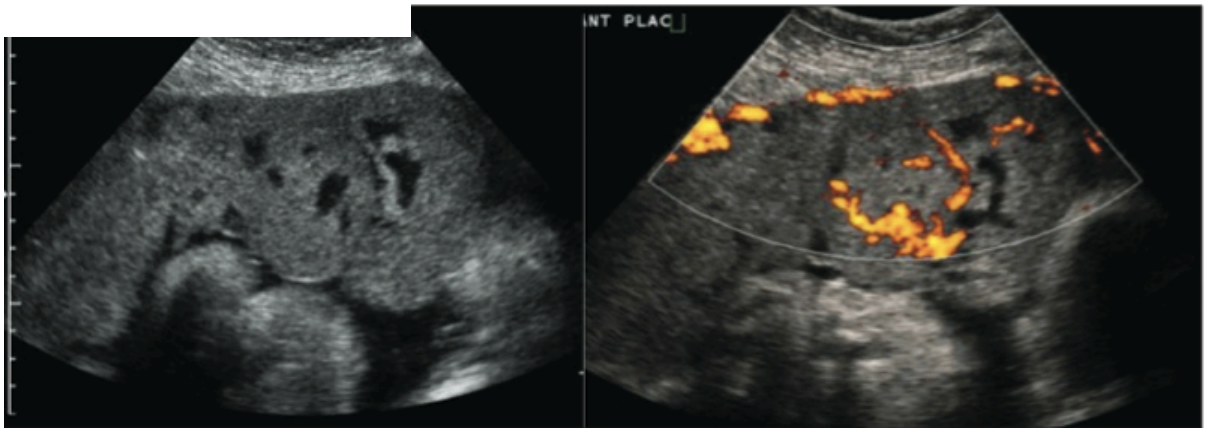


Figure 2 Color Doppler images showing diffuse dilated intraplacental vasculature and marked periplacental vascularity between bladder and uterine serosa (a), compared with a normal placenta at the same gestational age (b).

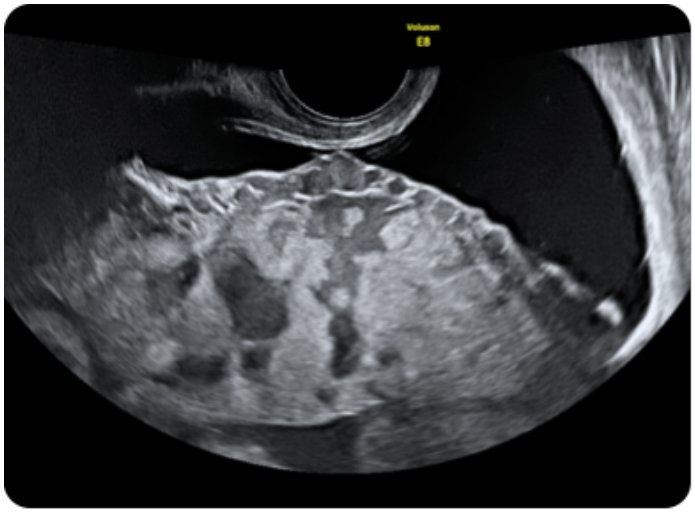


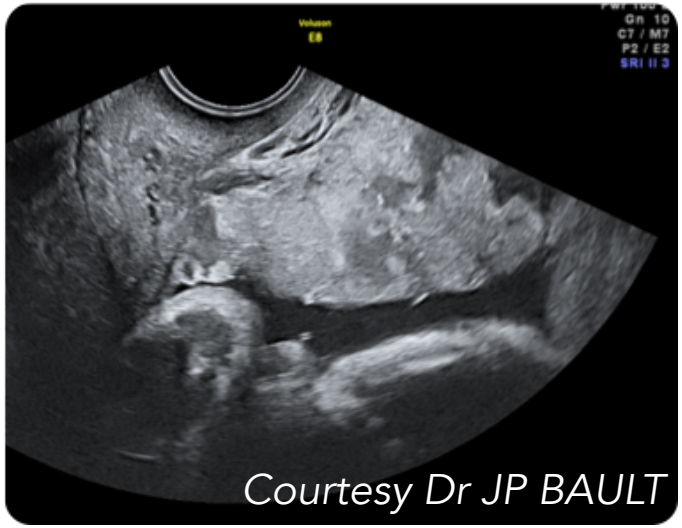
Identifying Sonographic Markers for Placenta Accreta in the First Trimester

Jerasimos Ballas, MD, MPH, Dolores Pretorius, MD, Andrew D. Hull, MD, Robert Resnik, MD, Gladys A. Ramos, MD



1- Intra-placental lacunae

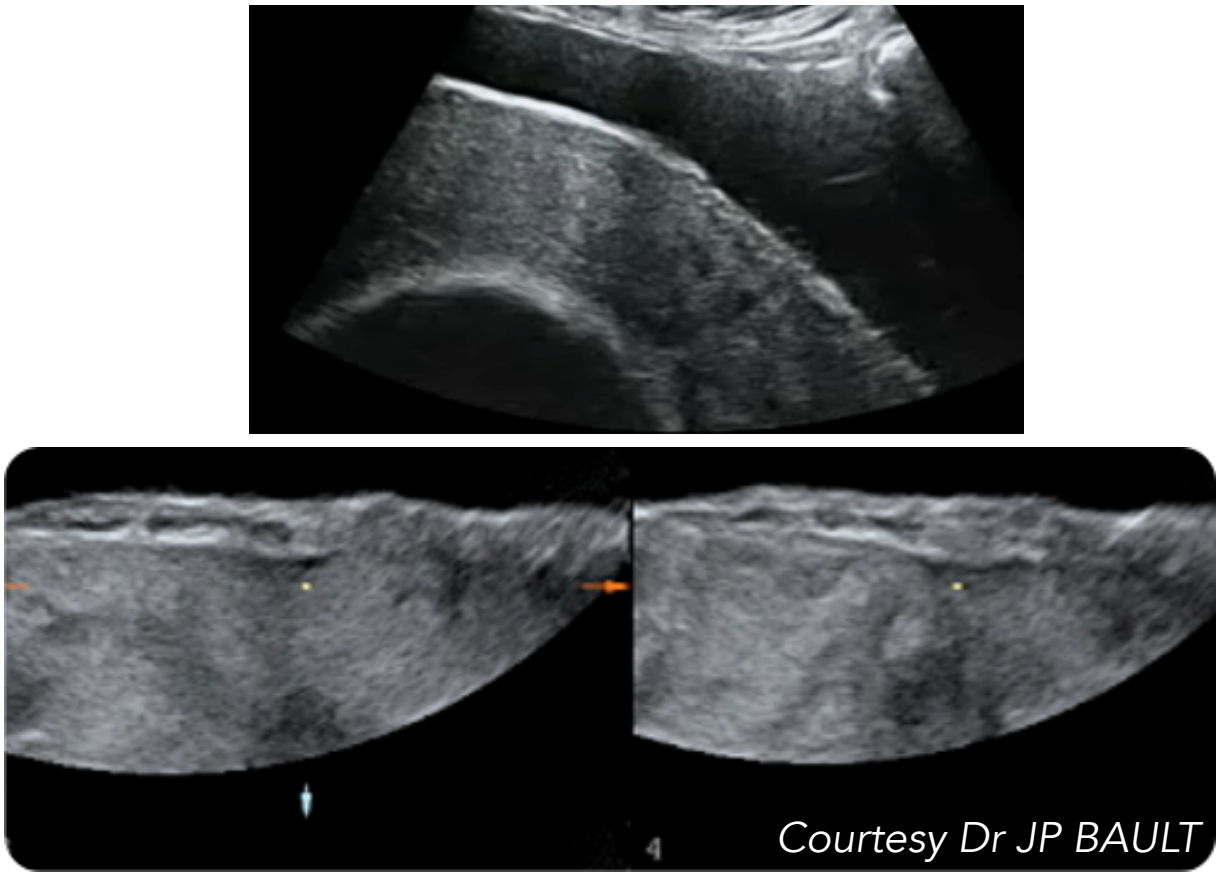




Grade 3: many throughout the placenta and appearing large and bizarre

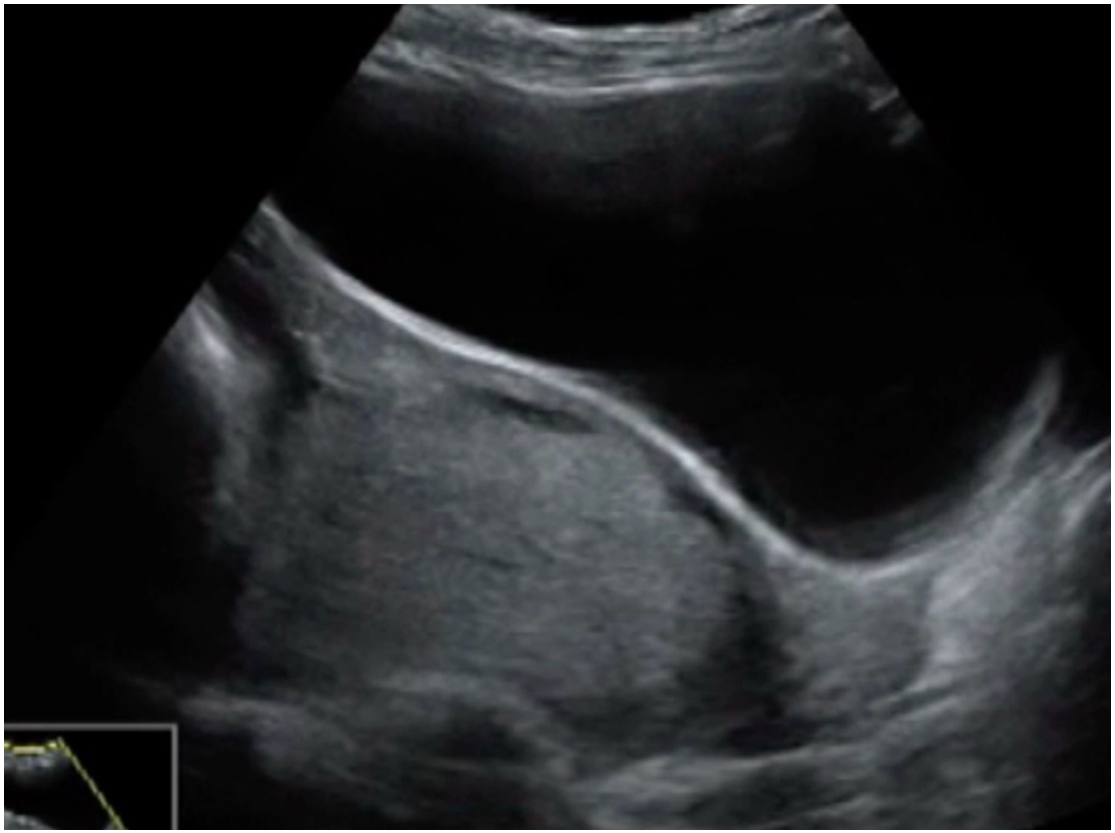
Hypoechoic irregular vascular spaces within the placental parenchyma

2- Loss of the hypoechoic retro placental space:



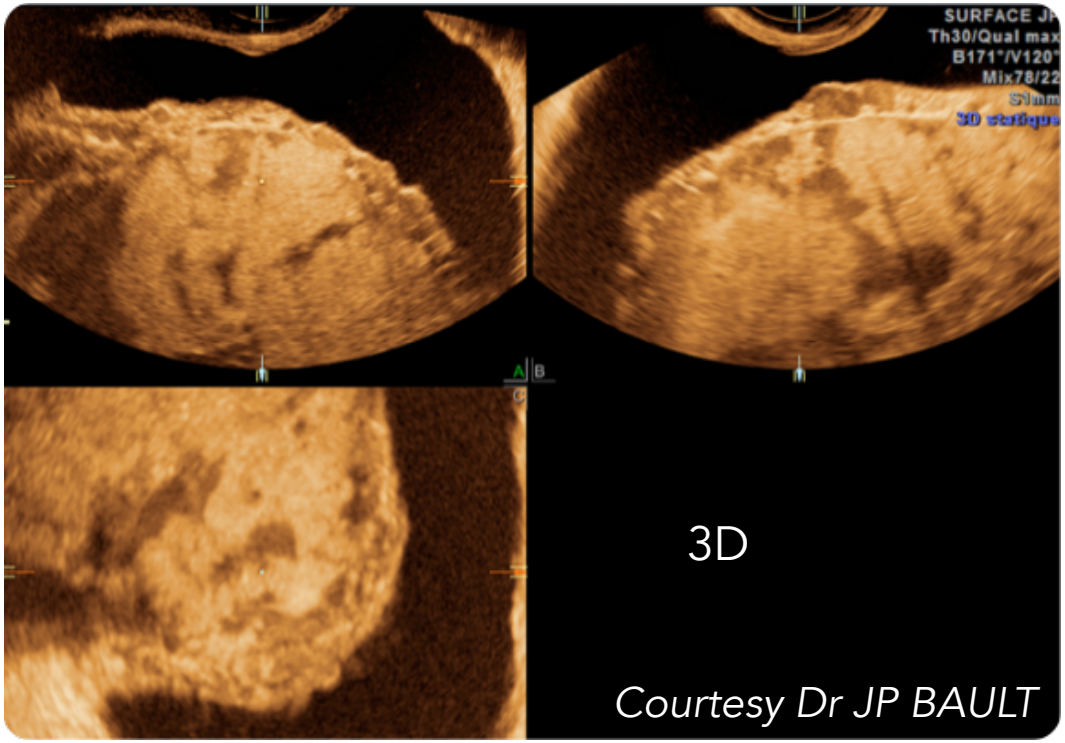
Direct invasion of the trophoblastic tissue trough the myometrium. (the decidua basalis is thought to be represented by the hypoechoic space between the placenta and the underlying myometrium)

3- Myometrium thinning



direct invasion of the trophoblastic tissue trough the myometrium. (the decidua basalis is thought to be represented by the hypoechoic space between the placenta and the underlying myometrium)

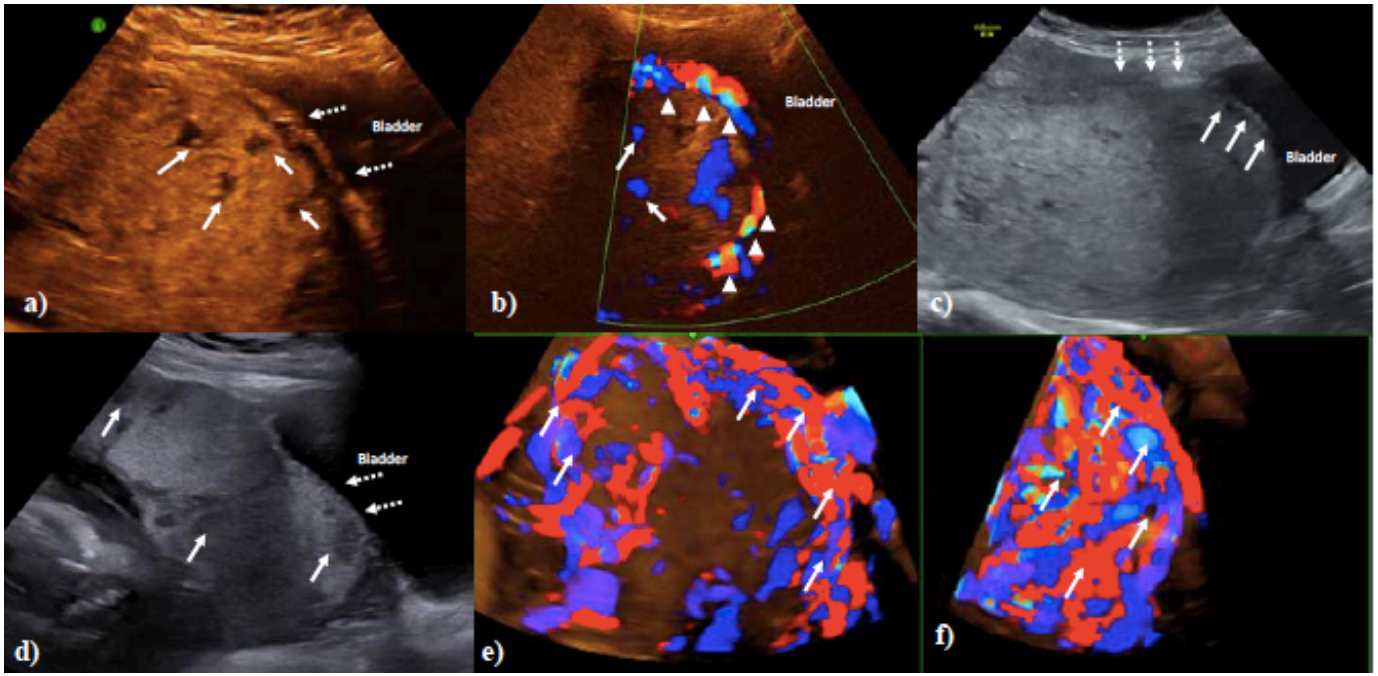
4- Bladder wall abnormalities



- focal defects in the echogenic bladder border
- bulging of the bladder itself induce by aberrant vessels running at the bladder uterine interface.

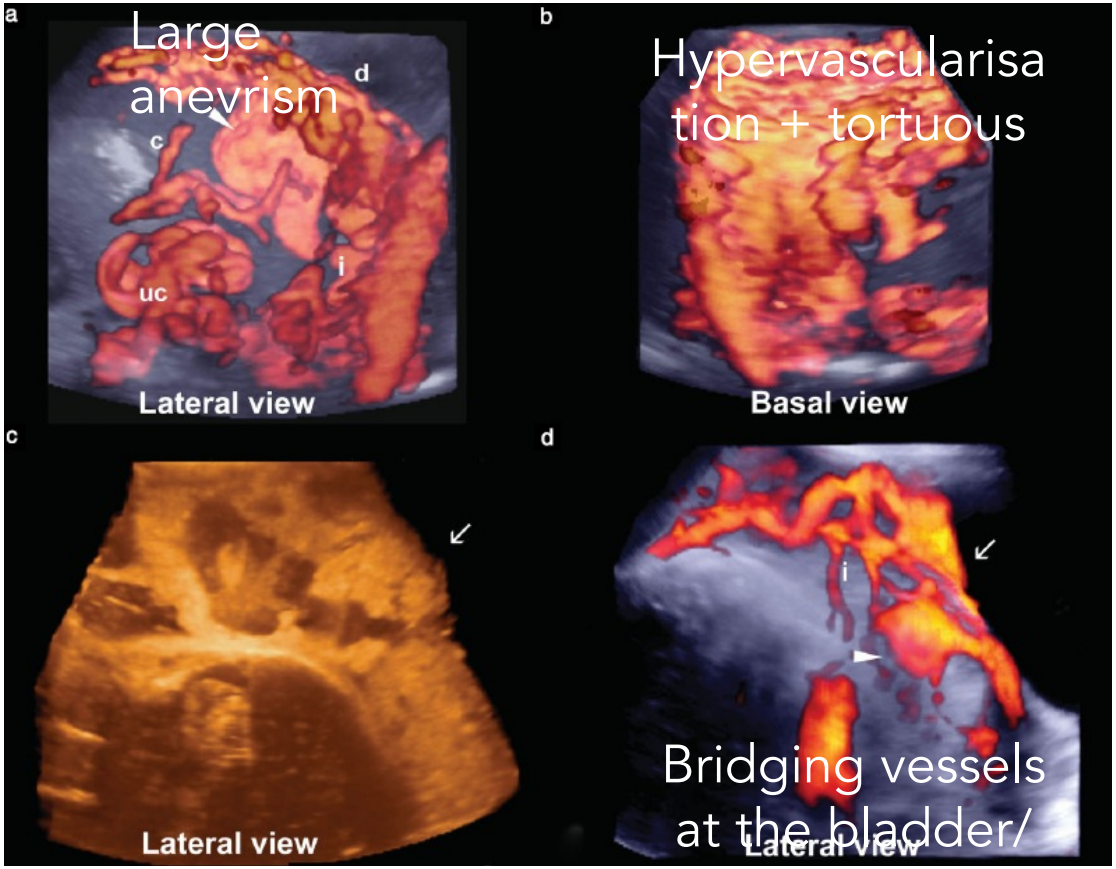
Exophytic masses within the bladder can be present in higher degrees of invasive placentation, such as placenta percreta

B- Colour Doppler



- Placental vascular flow (within lacunae): **turbulent flow**
- Increase sub-placental vascularity,
- Bladder uterine-serosa interface hyper-vascularity,
- Vessels extending from the placenta to the bladder, and vessels crossing the interface disruption site.

D'Antonio 2015



Shih UOG 2009

Placenta accreta Index

TABLE 3

OR estimates and CIs of each parameter used in Placenta Accreta Index

Parameter	OR	95% CI
Grade-3 lacunae	10.8	1.4–83
No. of cesarean deliveries	9.6	2.5–37.1
Placental location	3.9	1.1–14.1
Grade-2 lacunae	2.9	0.6–12.7
Bridging vessels	2.3	0.6–8.7
Sagittal smallest myometrial thickness	1.0	0.8–1.2

CI, confidence interval; *OR*, odds ratio.

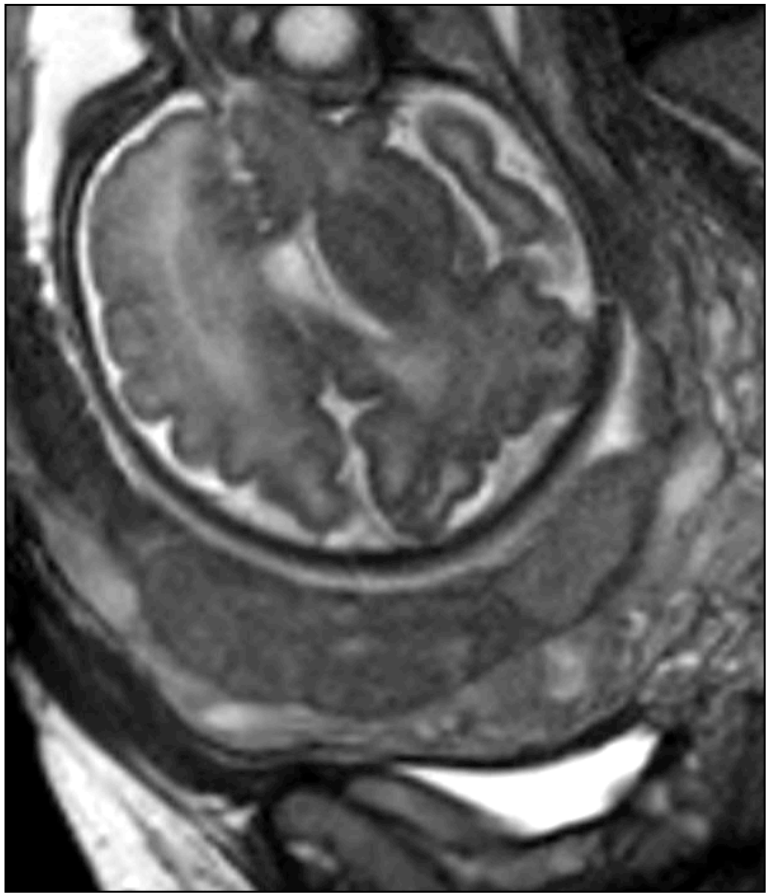
Rac. Placenta Accreta Index. Am J Obstet Gynecol 2015.

54 historical specimen

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- AJOG March 2015

2nd step: MRI

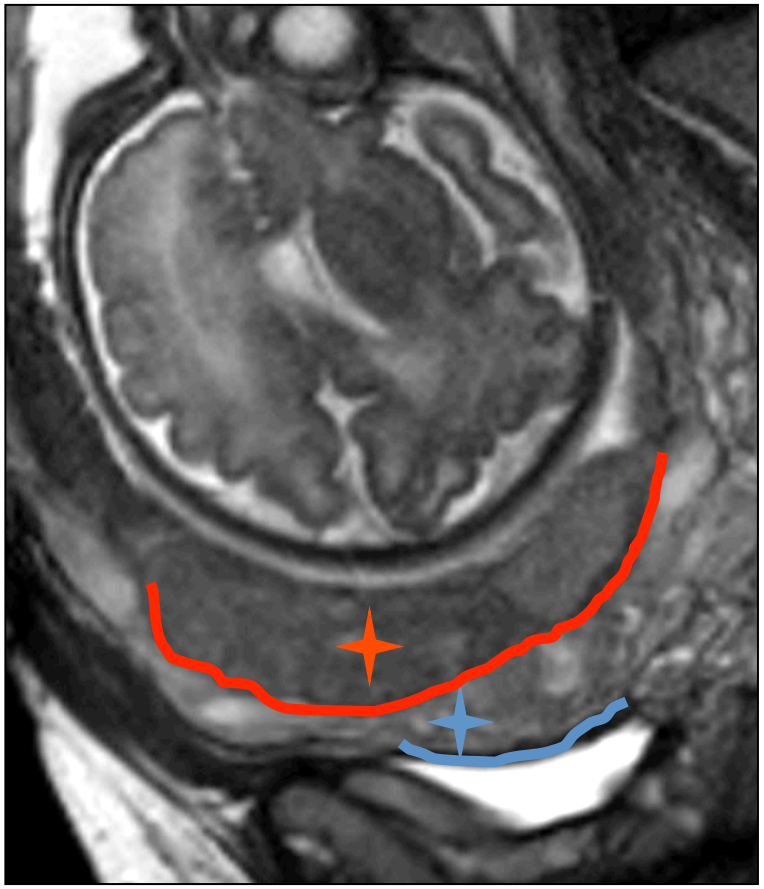
MRI normal appearance of the placenta



Ultrafast Sequences SSFP:
Steady State Free Precession

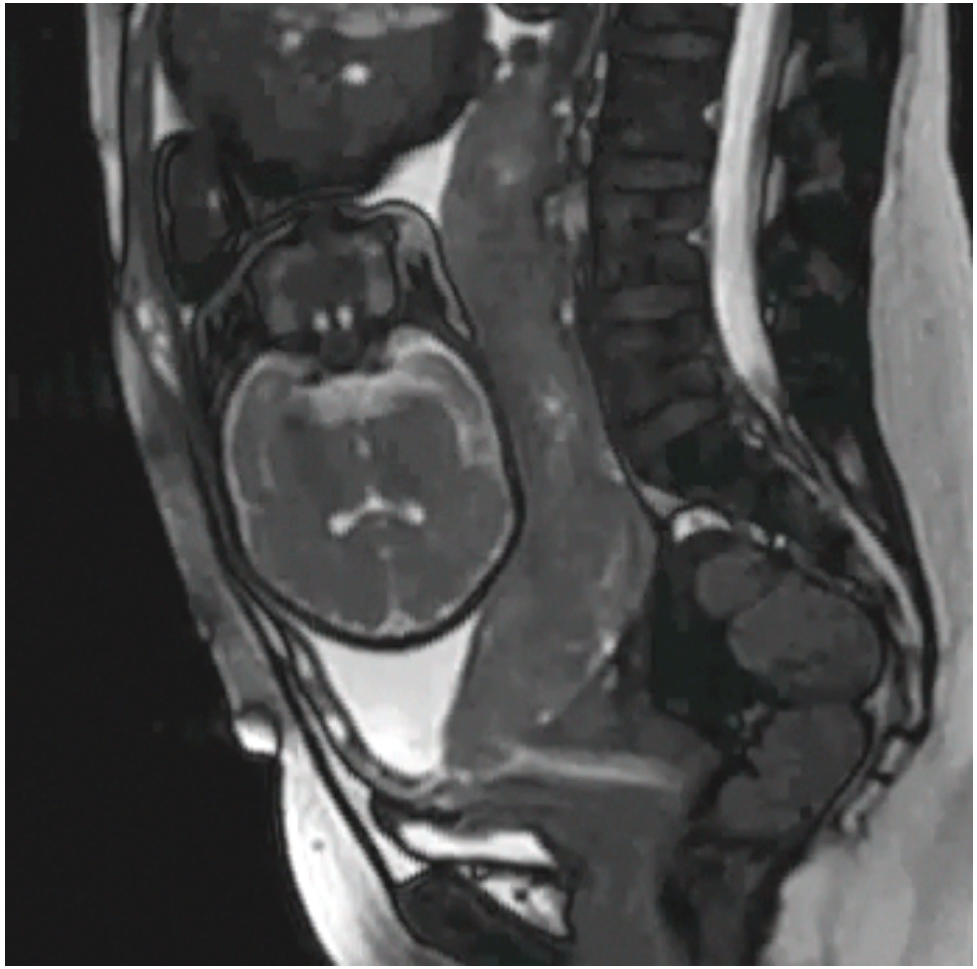
- intermediate signal, hypo- or isointense with respect to the surrounding myometrium

- thin line of separation between the myometrium and the placenta: placental– myometrial interface.

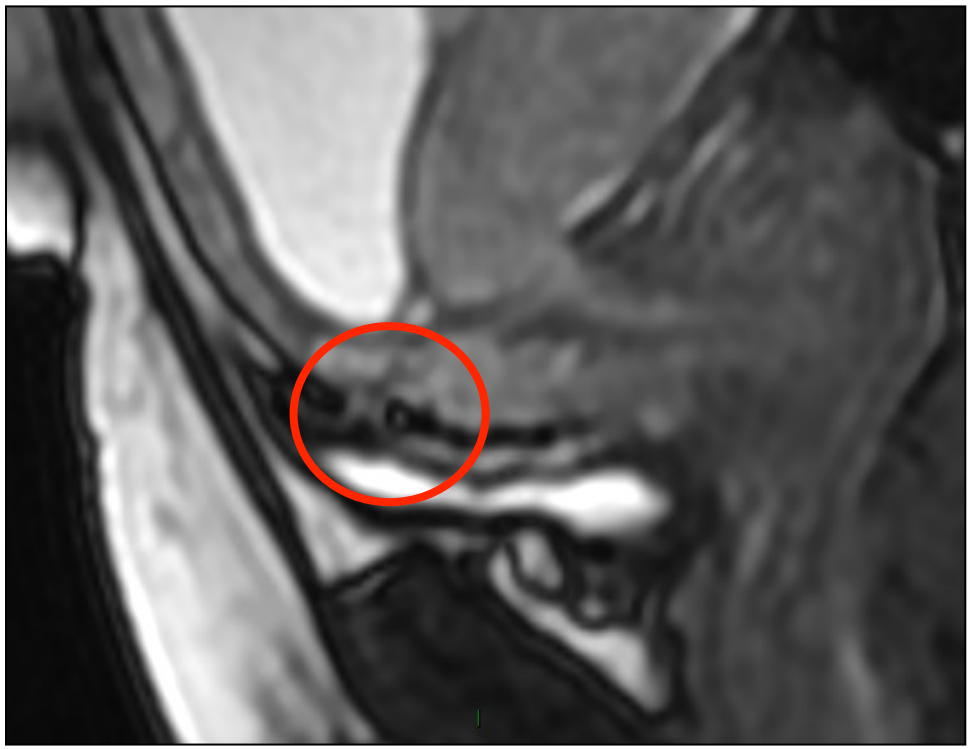


SSFP

Cine MRI sequence

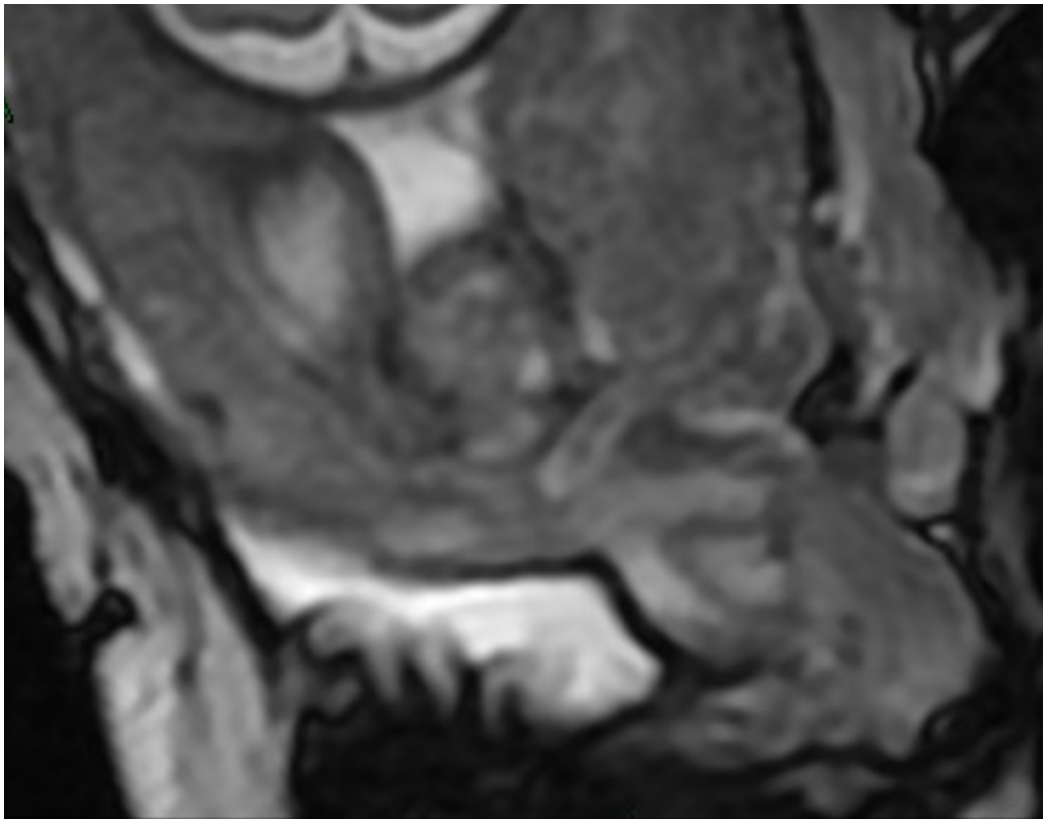


CAESARIAN SCAR



locate the caesarian scar area

5 Morphological criteria



1- bulging placenta

Levine D- Radiology 1997 Palacios- Acta ObstGynecol 2005Lax- MagnReson Imaging 2007

5 Morphological criteria

2- Heterogeneous intensity

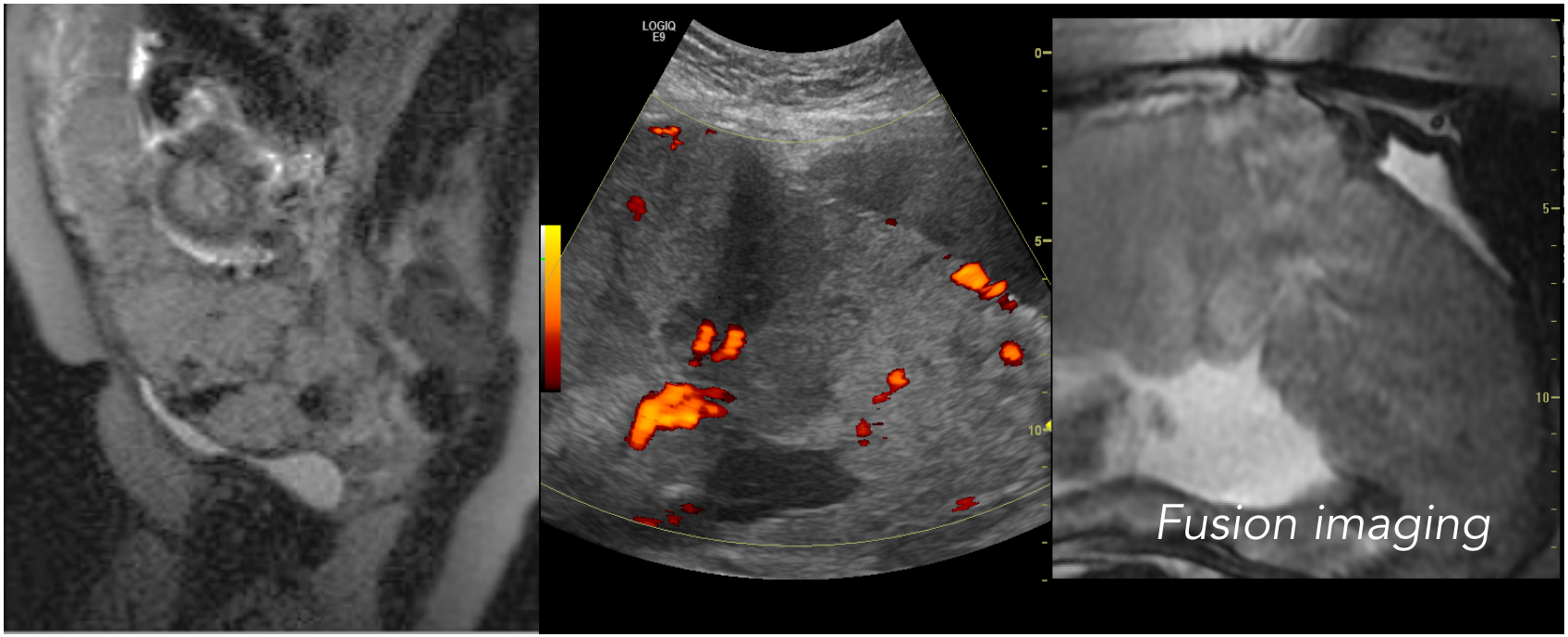
Levine D- Radiology 1997 Palacios- Acta ObstGynecol 2005 Lax- MagnReson Imaging 2007 Baughman Radiographics 2008

5 Morphological criteria

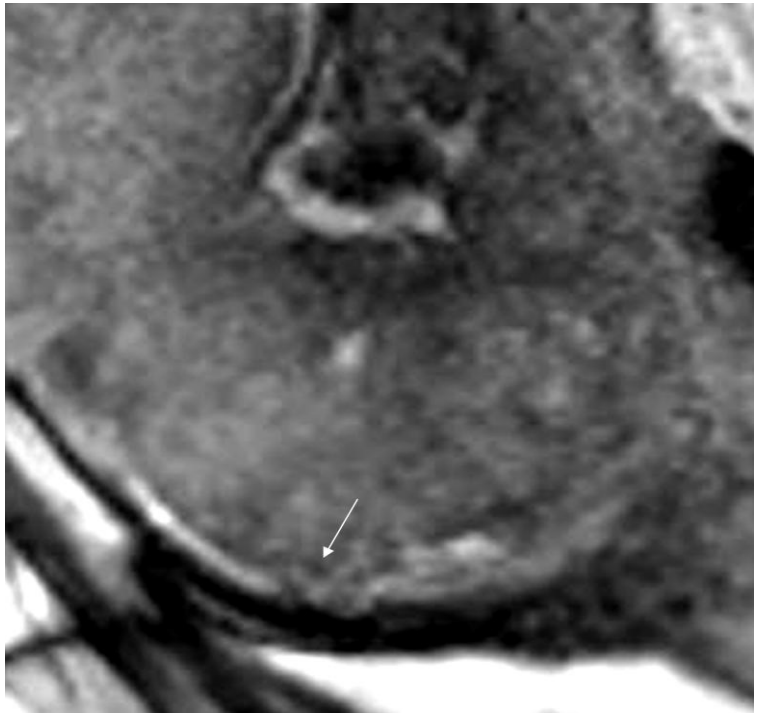
3- Dark intraplacental bands

- Increased vascularity or caused
- Fibrin deposition
- *Best MRI feature*

5 Morphological criteria



5 Morphological criteria



4- Focal interruption of the myometrium

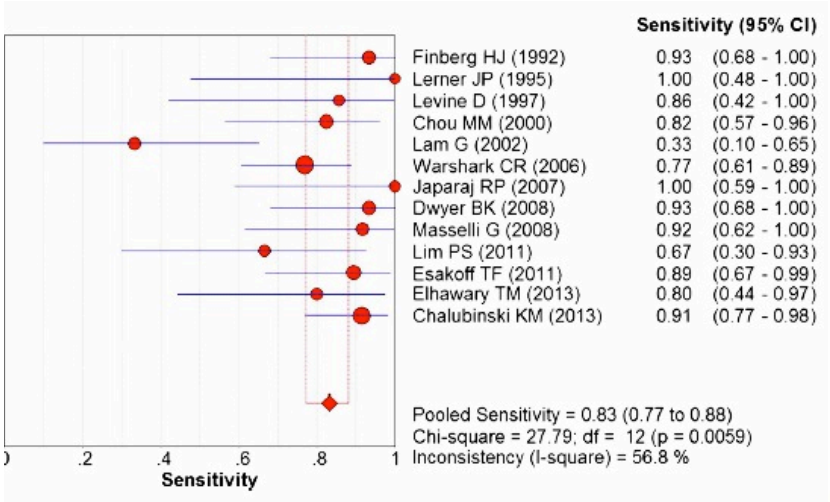
Highest interobserver variability

5 Morphological criteria

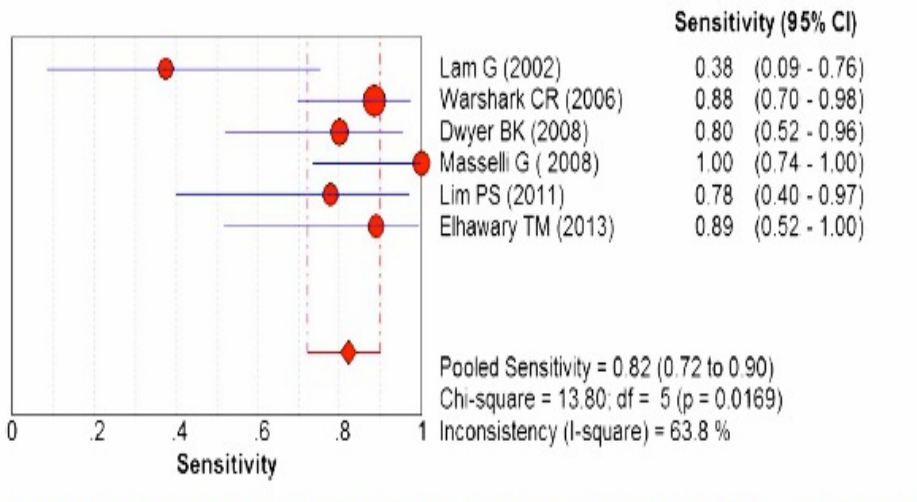
5- Tenting of the bladder

Direct visualization of the invasion of pelvic structures by placental tissue

Placenta accreta:
US/MRI
Imaging Accuracy



Ultrasound



MRI

COMPARING THE DIAGNOSTIC VALUE OF ULTRASOUND AND MAGNETIC RESONANCE IMAGING FOR PLACENTA ACCRETA: A SYSTEMATIC REVIEW AND META-ANALYSIS

XINYUE MENG,* LIMEI XIE,* and WEIWEI SONG *Ultrasound in Med. & Biol., Vol. -, No. -, pp. 1–8, 2013*

Placenta accreta:
US/MRI
Imaging Accuracy

Table 2 Summary estimates of sensitivity, specificity, positive and negative likelihood ratios (LR+, LR−) and diagnostic odds ratio (DOR) of magnetic resonance imaging (MRI) for detection of presence, degree and topography of placental invasion and for comparison between MRI and ultrasound (US) for detection of invasive placentation

Parameter	*Studies (n)*	*Total sample (n)*	*Sensitivity (%) (95% CI)*	*Specificity (%) (95% CI)*	*DOR (95% CI)*	*LR+ (95% CI)*	*LR− (95% CI)*
MRI							
Detection of invasive placentation	18*	1010	94.4 (86.0–97.9)	84.0 (76.0–89.8)	89.0 (22.8–348.1)	5.91 (3.73–9.39)	0.07 (0.02–0.18)
Depth of placental invasion	3†	62	92.9 (72.8–99.5)	97.6 (87.1–99.9)	44.2 (1.95–1001)	6.24 (0.43–89.7)	0.18 (0.06–0.54)
Topography of placental invasion	2†	428	99.6 (98.4–100)	95.0 (83.1–99.4)	803 (9.0–71 411)	15.8 (4.74–52.6)	0.02 (0.0–1.37)
Direct comparison, MRI *vs* US							
All studies	8*	255					
MRI			90.2 (81.3–95.1)	88.2 (76.7–94.4)	68.8 (19.7–239.8)	7.63 (3.63–16.1)	0.11 (0.05–0.23)
US			85.7 (77.2–91.4)	88.6 (73.0–95.7)	46.5 (13.4–161.0)	7.52 (2.92–19.4)	0.16 (0.10–0.27)
Only studies with blinding‡	4*	164					
MRI			92.9 (82.4–97.3)	93.5 (82.2–97.8)	186.0 (40.0–864.5)	14.22 (4.92–41.1)	0.08 (0.03–0.20)
US			87.8 (75.8–94.3)	96.3 (74.4–99.6)	189.2 (15.8–2269)	24.0 (2.81–205.0)	0.13 (0.06–0.27)

Prenatal identification of invasive placentation using magnetic resonance imaging: systematic review and meta-analysis
F. D'ANTONIO*, C. IACOVELLA*, J. PALACIOS-JARAQUEMADA†, C. H. BRUNO‡, L. MANZOLI –*UOG 2014*

Ultrasound Obstet Gynecol 2014; 44: 8–16
Published online 2 June 2014 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/uog.13327

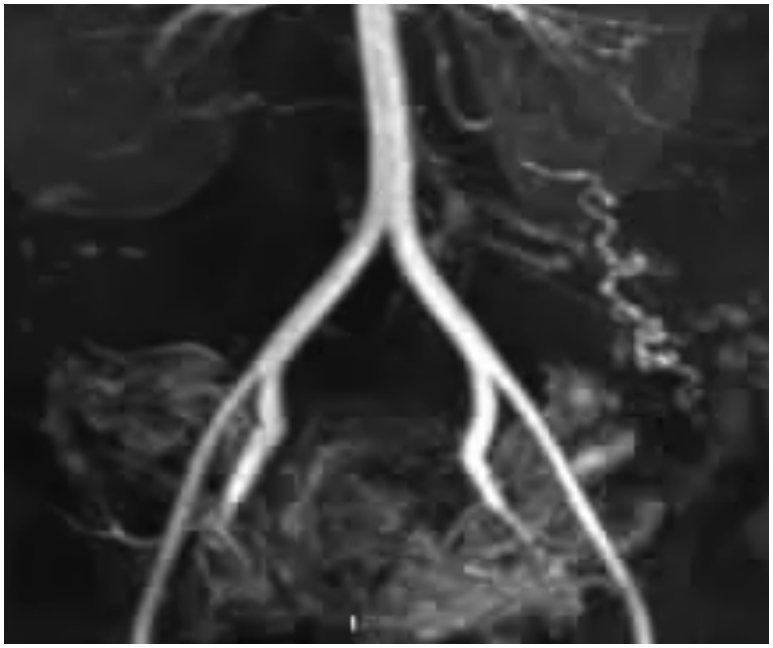
Prenatal identification of invasive placentation using magnetic resonance imaging: systematic review and meta-analysis

F. D'ANTONIO*, C. IACOVELLA*, J. PALACIOS-JARAQUEMADA†, C. H. BRUNO‡, L. MANZOLI§¶ and A. BHIDE*

**Fetal Medicine Unit, Division of Developmental Sciences, St George's University of London, London, UK; †Centre for Medical Education and Clinical Research, Department of Gynecology and Obstetrics, Buenos Aires, Argentina; ‡South Scientific Foundation, MRI Department Diagnosis, Lomas de Zamora, Buenos Aires, Argentina; §Department of Medicine and Aging Sciences, University of Chieti-Pescara, Italy; ¶CeSI Biotech, Chieti, Italy*

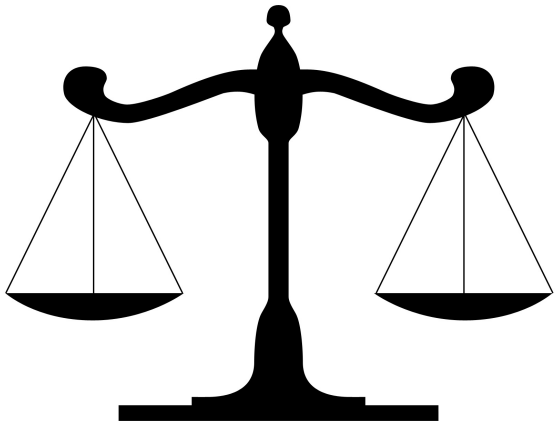
In conclusion, prenatal MRI is highly accurate in diagnosing disorders of invasive placentation, and all the commonly reported signs show an overall good predictive accuracy in the detection of these disorders. Although there is no difference between ultrasound and MRI in diagnosing these conditions, MRI should be considered in order to assess the depth and topography of placental invasion if hysterectomy is planned and lateral invasion is suspected at ultrasound. This can help in tailoring the

With gadolinium contrast?



Gadolinium toxicity?

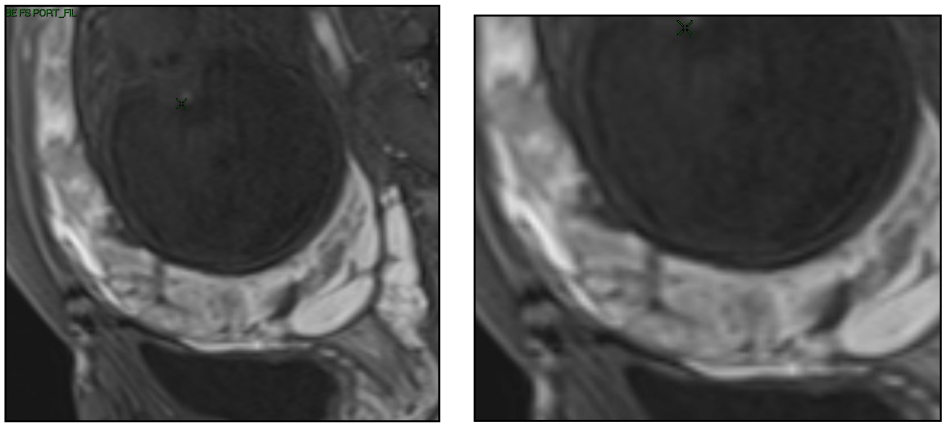
- 2005: *Webb et al. European radiology. 2005*
  - "gadolinium is probably safe during pregnancy, as excessive quantities are not expected to cross the placenta or to be toxic to the fetus if they do »
  - a single dose of 0.1 mmol/kg body weight



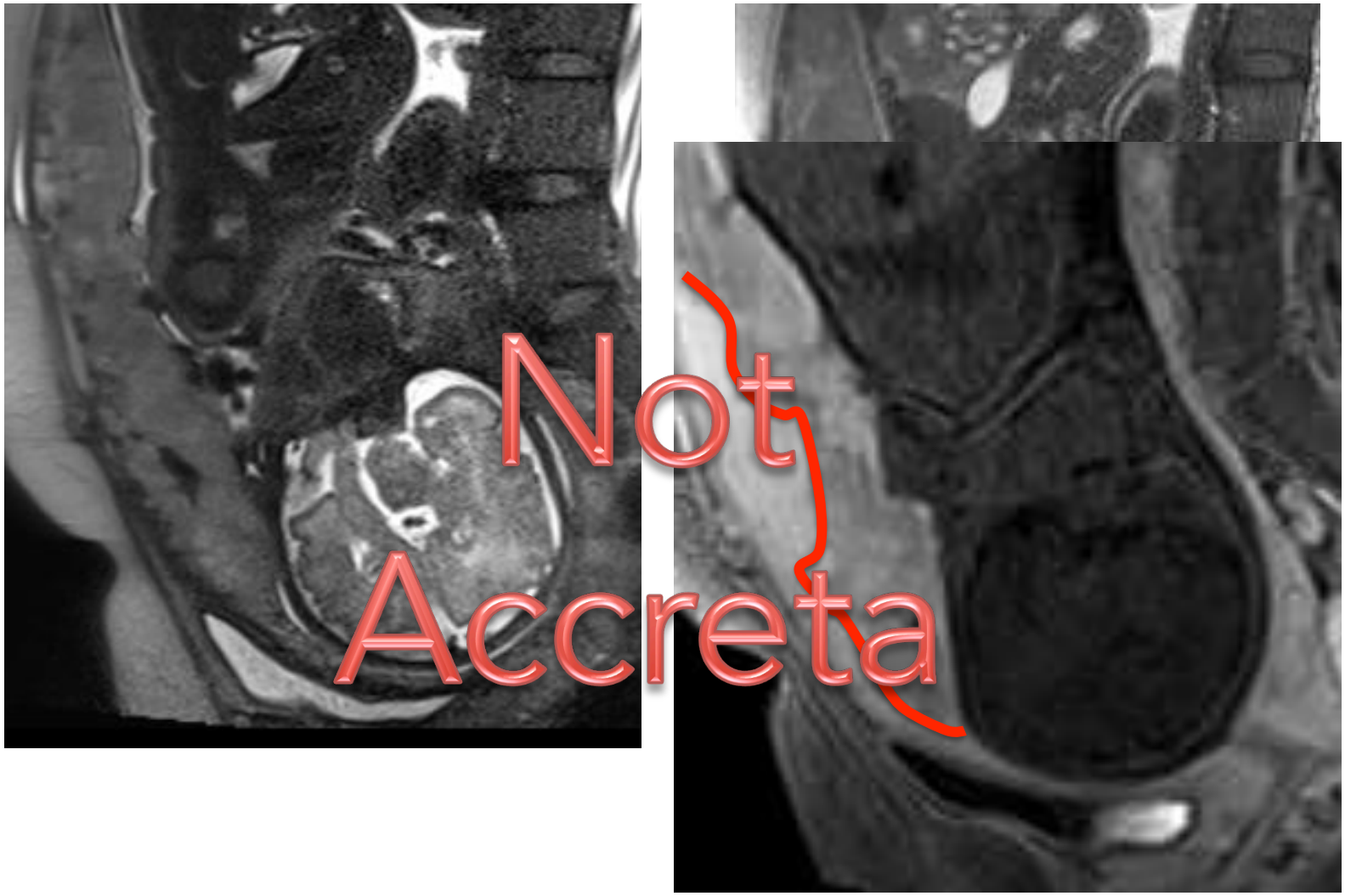
MRI accuracy with Gadolinium contrast

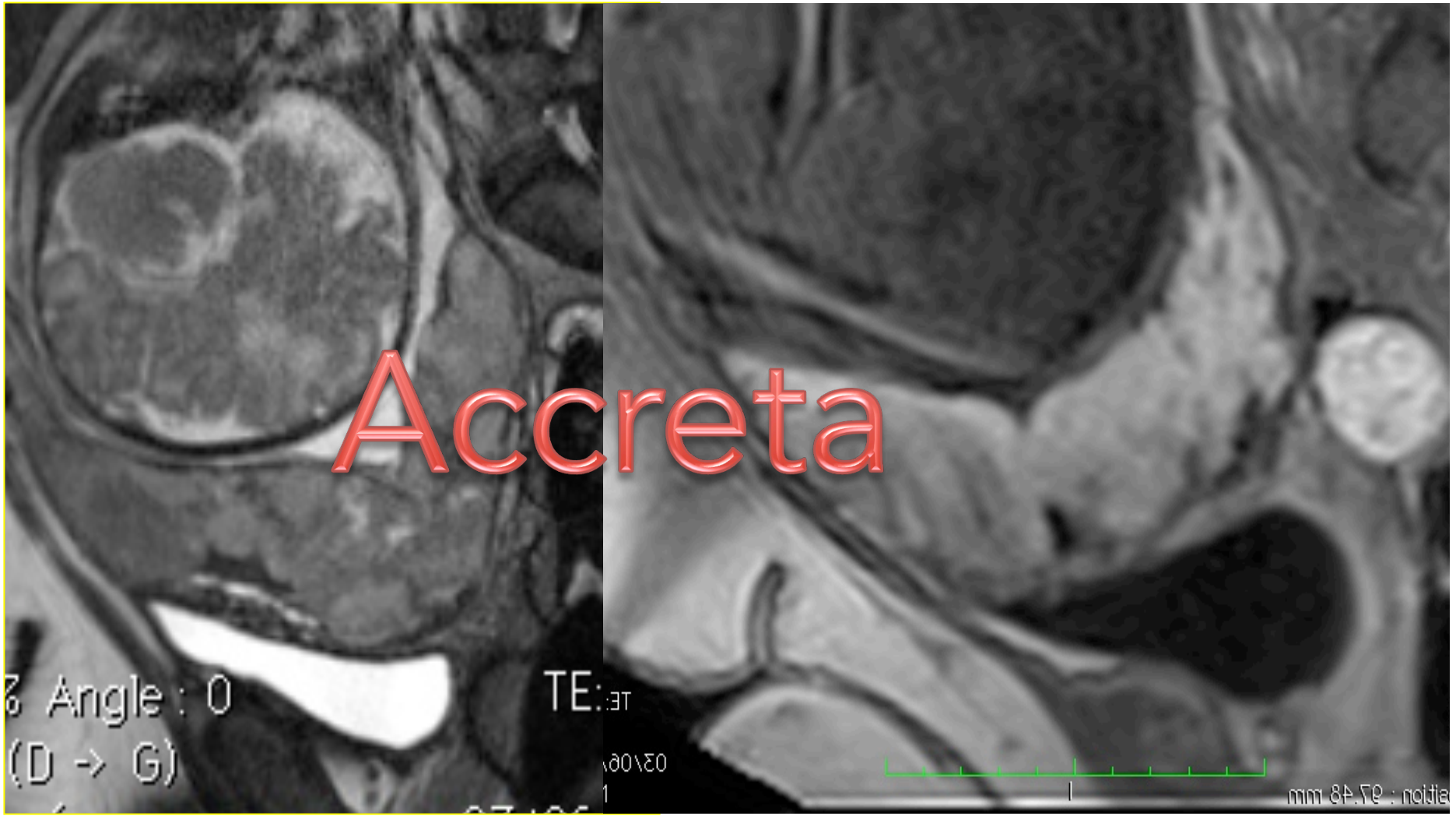
Study	Average gestational age (wk)	Number of patients	TP	FP	FN	TN	Gadolinium contrast material	Field strength (T)	Image interpretation
Lam et al. (2002)*	—	9	3	1	5	0	Used	1.5	Blind
Warshak et al. (2006)*	28 (18–37)	40	23	0	3	14	Used	1.5	Blind
Dwyer et al. (2008)*	—	32	12	6	3	11	Not used	1.5	Blind
Masselli et al. (2008)*	30 (22–37)	50	12	0	0	38	—	1.5	Blind
Lim et al. (2011)*	Second trimester	13	7	1	2	3	Not used	1.5	Not blind
Elhawary et al. (2013)†	29.3 (26–32)	39	8	4	1	26	Not used	1.5	Blind

TP = true-positive; FP = false-positive; FN = false-negative; TN = true-negative.
* Retrospective study design.
† Unknown study design.



COMPARING THE DIAGNOSTIC VALUE OF ULTRASOUND AND MAGNETIC RESONANCE IMAGING FOR PLACENTA ACCRETA: A SYSTEMATIC REVIEW AND META-ANALYSIS
XINYUE MENG,* LIMEI XIE,* and WEIWEI SONG Ultrasound in Med. & Biol., Vol. -, No. -, pp. 1–8, 2013


Not
Accreta

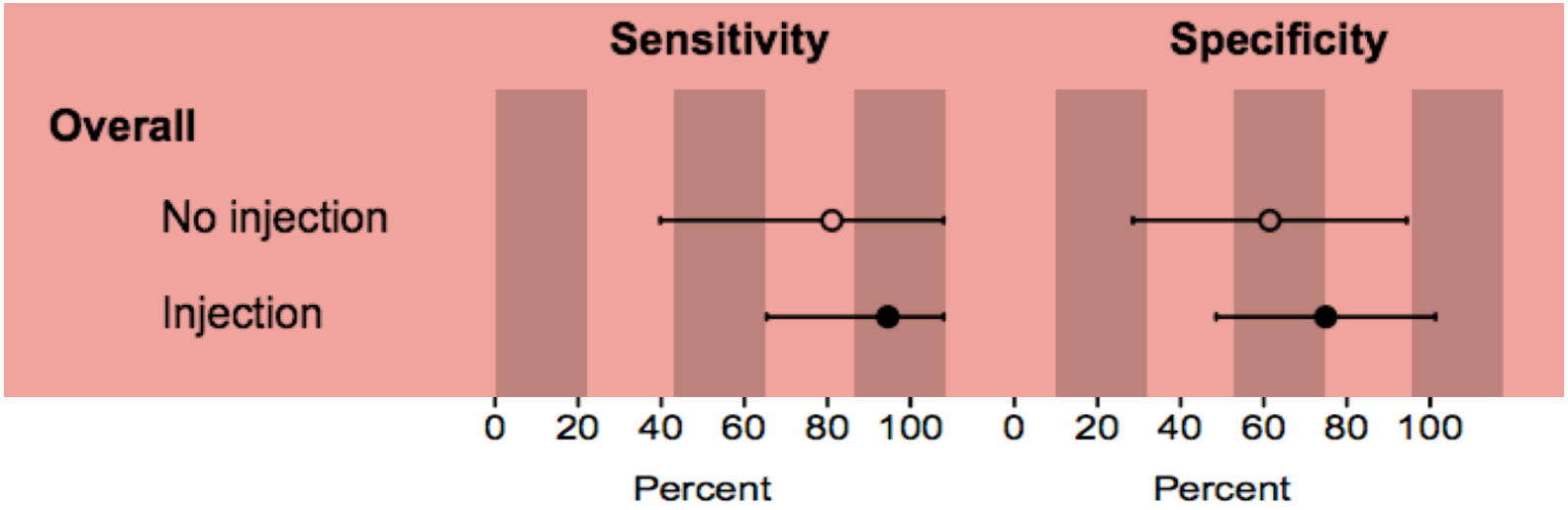

Accreta
% Angle : 0
(D -> G)
TE:

Necker-Port Royal 2009-2012
Partenariat avec GHU Angers et Rouen
(on press)

- 20 pregnant women who had undergone one or more previous cesarean sections with a placenta praevia were examined at 30–35 weeks of gestation
- Retrospective review MRI 1,5 T: 3 SSFP plans, Sag T13D sequence without and with gadolinium 0.2 mL per kilogram of body weight by means of a power injector at a rate of 2 mL/sec
- 2 sets of MRI: without and with injection of gadolinium
- MRIs analysed, independently reviewed by:
  - two seniors (S1 and S2 with practical experience in fetal and placental MRI of more than 5 years with more than 100 examinations/year)
  - two juniors radiologists (experience in fetal MRI of less than 2 years)
  - Analyse according to pregnancy outcome.

Results

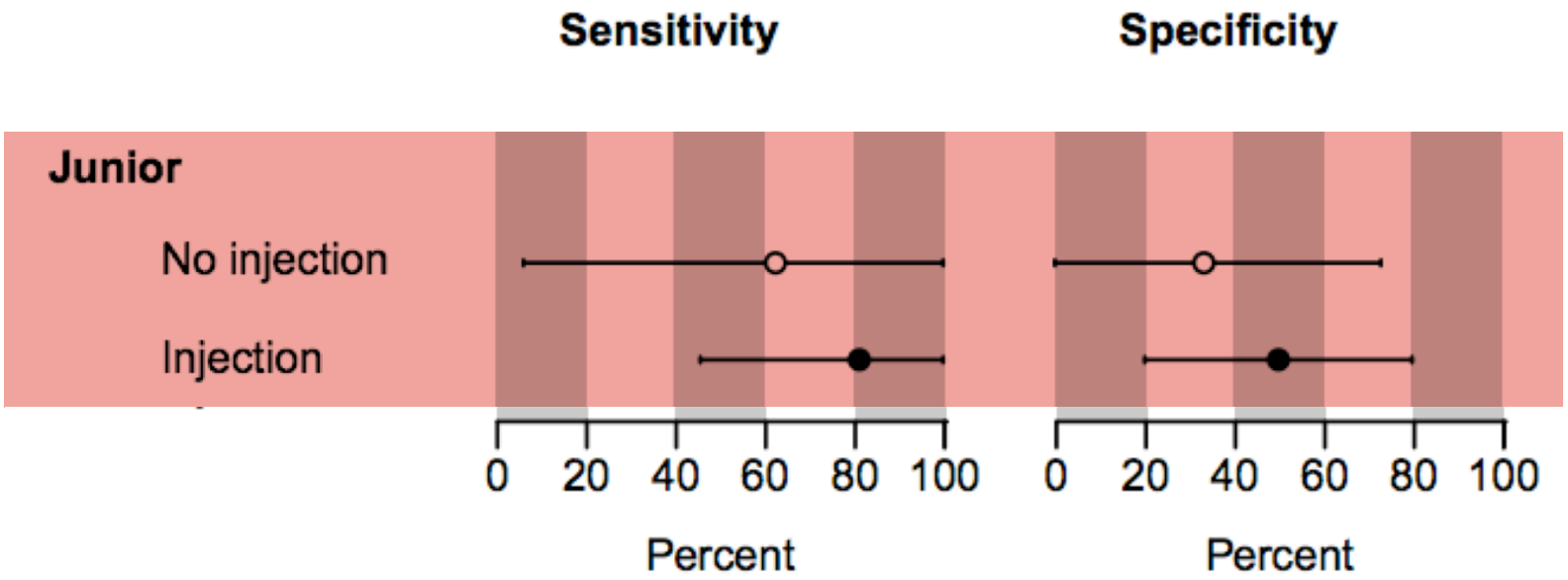
8 placentas accretas
12 placentas non accretas



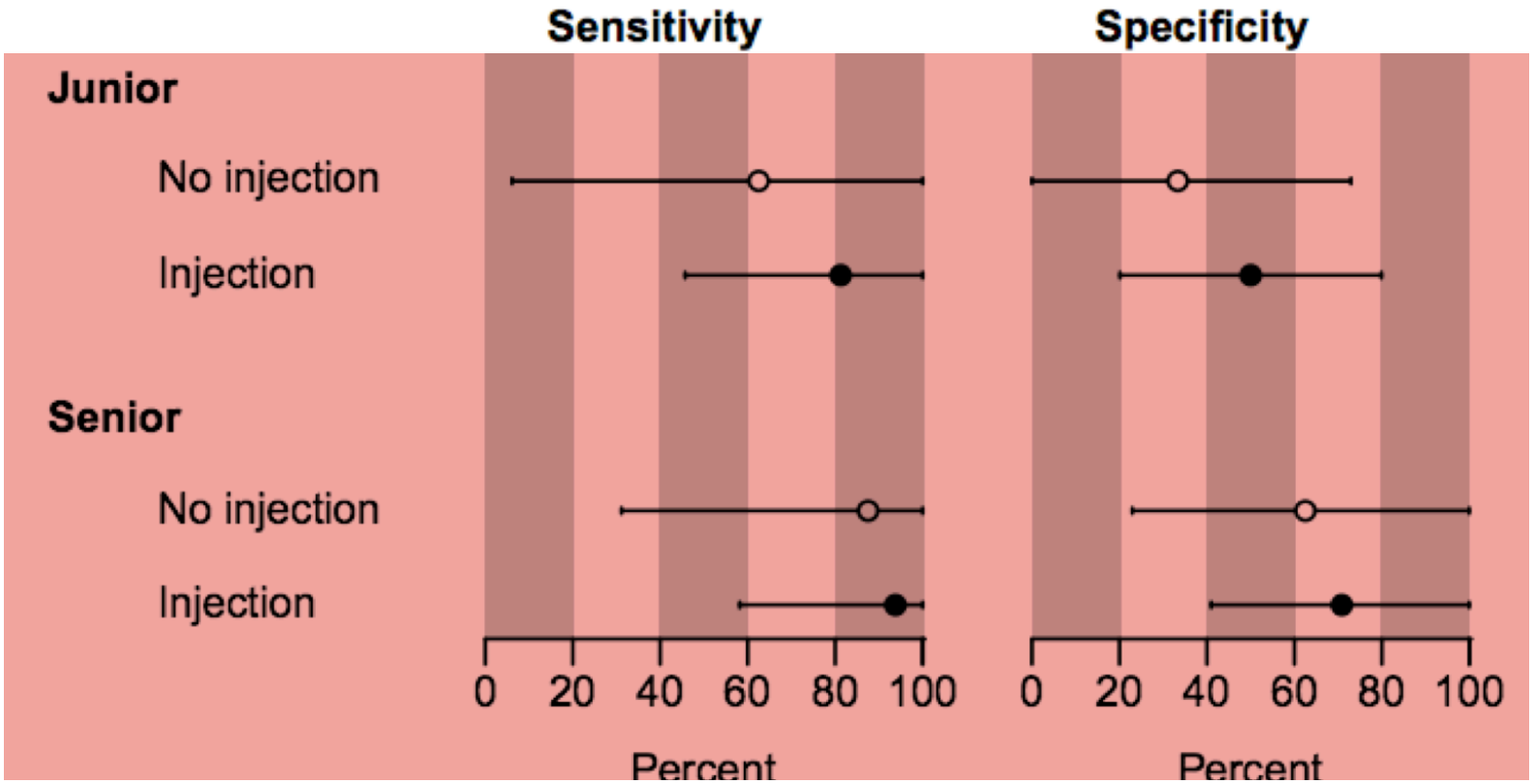
Millischer (submitted)

Results

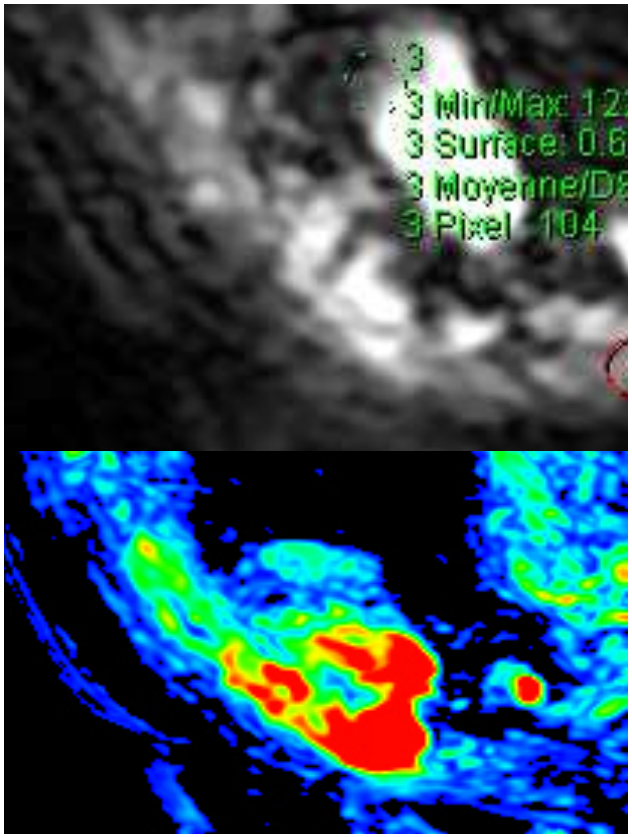
8 placentas accretas
12 placentas non accretas

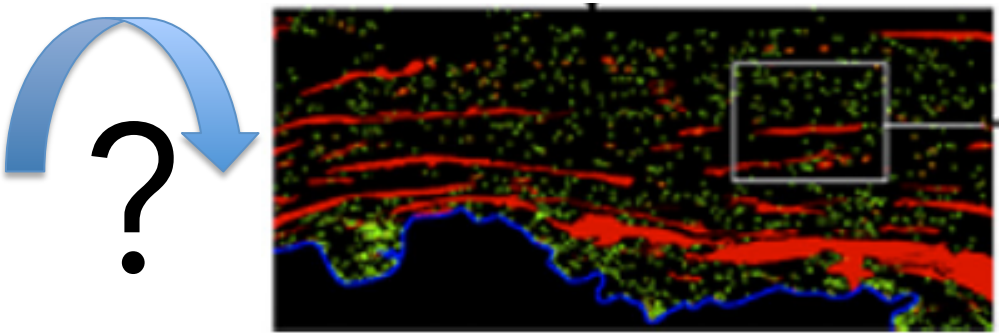


Results

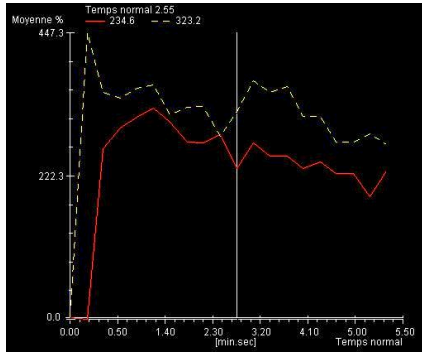


MRI with gadolinium injection improves the MRI-based diagnostic performance of both junior and senior radiologists for AIP.





Injected MRI Data :
particular hyper vascular behaviour characterizing accreta



OBSTETRICS

Abnormal vascular architecture at the placental-maternal interface in placenta increta

Frédéric Chantraine, MD; Silvia Blacher, PhD; Sarah Berndt, PhD; José Palacios-Jaraquemada, MD, PhD; Nanette Sarioglu, MD; Michelle Nisolle, MD, PhD; Thorsten Braun, MD; Carine Munaut, PhD; Jean-Michel Foidart, MD, PhD

Conclusion

- **Ultrasound and MRI** are **equally accurate**

- **MRI**:
  - better assessment for depth (percreta) and topography (mostly posterior) of placental invasion
  - Gadolinium: **improves diagnostic performance of both junior and senior radiologists.**

- Other methods: 3T MRI? Non invasive vascular sequences: ASL? IVIM?