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How should we use ultrasonography to predict successful VBAC?

Prof Tullio Ghi phD
Department of Obstetrics
University of Parma
tullio.ghi@unipr.it

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TOLAC vs elective repeated Cesarean (ERCD)

Table 2. Summary of Strength of Evidence and Findings for Maternal Outcomes for Trial of Labor Compared With Elective Repeat Cesarean Delivery

Maternal Outcome	Number of Studies/Subjects	Grade of Evidence	Direction of Effect	Magnitude of Effect Absolute Risk (95% CI)
Maternal death	12/402,883	High	Significantly reduced by TOL (P=.027)	TOL: 0.004% (0.001–0.015%) ERCD: 0.013% (0.004–0.042%)
Uterine rupture	8/63,499	Moderate	Significantly increased by TOL (P<.001)	TOL: 0.47% (0.28–0.77%) ERCD: 0.026% (0.009–0.082%)
Hysterectomy	8/402,059	Moderate	No significant difference (P=.50)	TOL: 0.17% (0.12–0.26 %) ERCD: 0.28% (0.12–0.67%)
Hemorrhage	6/47,754	Low	Insufficient data to evaluate	Insufficient data to evaluate
Transfusion	9/401,307	Moderate	No significant difference (P=.25)	TOL: 0.9% (0.4–2.0%) ERCD: 1.2% (0.5–2.6%)
Infection	22/354,060	Low	No significant difference	TOL: 4.6% (1.5–13.5%) ERCD: 3.2% (1.3–7.3%)
Surgical injury	4/53,282	Low	Insufficient data to evaluate	Insufficient data to evaluate

CI, confidence interval; TOL, trial of labor; ERCD, elective repeat cesarean delivery.

Guise et al. Obstet Gynecol 2010;115:1267-78.

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TOLAC vs elective repeated Cesarean (ERCD)

Table 3. Summary of Strength of Evidence and Findings for Neonatal Outcomes for Trial of Labor Compared With Elective Repeat Cesarean Delivery

Neonatal Outcome	Number of Studies/Subjects	Grade of Evidence	Direction and Magnitude of Effect (95% CI)
Perinatal death	5/76,899	Moderate	Significantly increased by TOL (*P*=.002) TOL: 0.13% (0.06–0.30%) ERCD: 0.05% (0.007–0.38%)
Neonatal death	6/108,328	Moderate	Significantly increased by TOL (*P*=.001) TOL: 0.11% (0.06–0.20%) ERCD: 0.06% (0.02–0.15%)
Respiratory conditions	4/5,599	1. Bag/mask ventilation: Low 2. Transient tachypnea of the newborn (TTN): Low	1. TOL 5.4% (3.5–7.6) vs ERCD 2.5% (1.6–1.6%) 2. TOL: 3.6% (0.9–8%) ERCD: 4.2% (1.9–7.3%)
Hypoxic–ischemic encephalopathy	3/62,829	Low	Insufficient data to evaluate direction of risk
Sepsis	3/2,846	Low	Insufficient data to evaluate direction of risk
Trauma	2/41,899	Insufficient	Insufficient data to evaluate direction of risk
NICU admissions	8/65,121	Low	Insufficient data to evaluate direction of risk
Neurological outcomes	0	Insufficient	Insufficient data to evaluate direction of risk
Breastfeeding outcomes	0	Insufficient	Insufficient data to evaluate direction of risk

CI, confidence interval; TOL, trial of labor; ERCD, elective repeat cesarean delivery; NICU, neonatal intensive care unit.

Guise et al. Obstet Gynecol 2010;115:1267-78.

Trial of Labor after Cesarean (TOLAC)

Two major clinical questions:

1. Risk of uterine rupture
2. Probability of vaginal delivery (VBAC)

Trial of Labor after Cesarean (TOLAC)

Two major clinical questions:

1. Risk of uterine rupture
2. Probability of vaginal delivery (VBAC)

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Predictive models of uterine rupture based on clinical factors

	AUC
Macones 2006	
Model 1 (maternal age; gestational age, ethnicity, previous vaginal delivery)	0,68
Model 2 (maternal age; gestational age, ethnicity, previous vaginal delivery, cervical dilatation, labor induction)	0,70
Grobman 2008	
Previous vaginal delivery (<), labor induction (>)	0,60

Macones et al. Am J Obstet Gynecol 2006;195:1148–1152
Grobman et al. Am J Obstet Gynecol 2008;199:30.e1–30.e5

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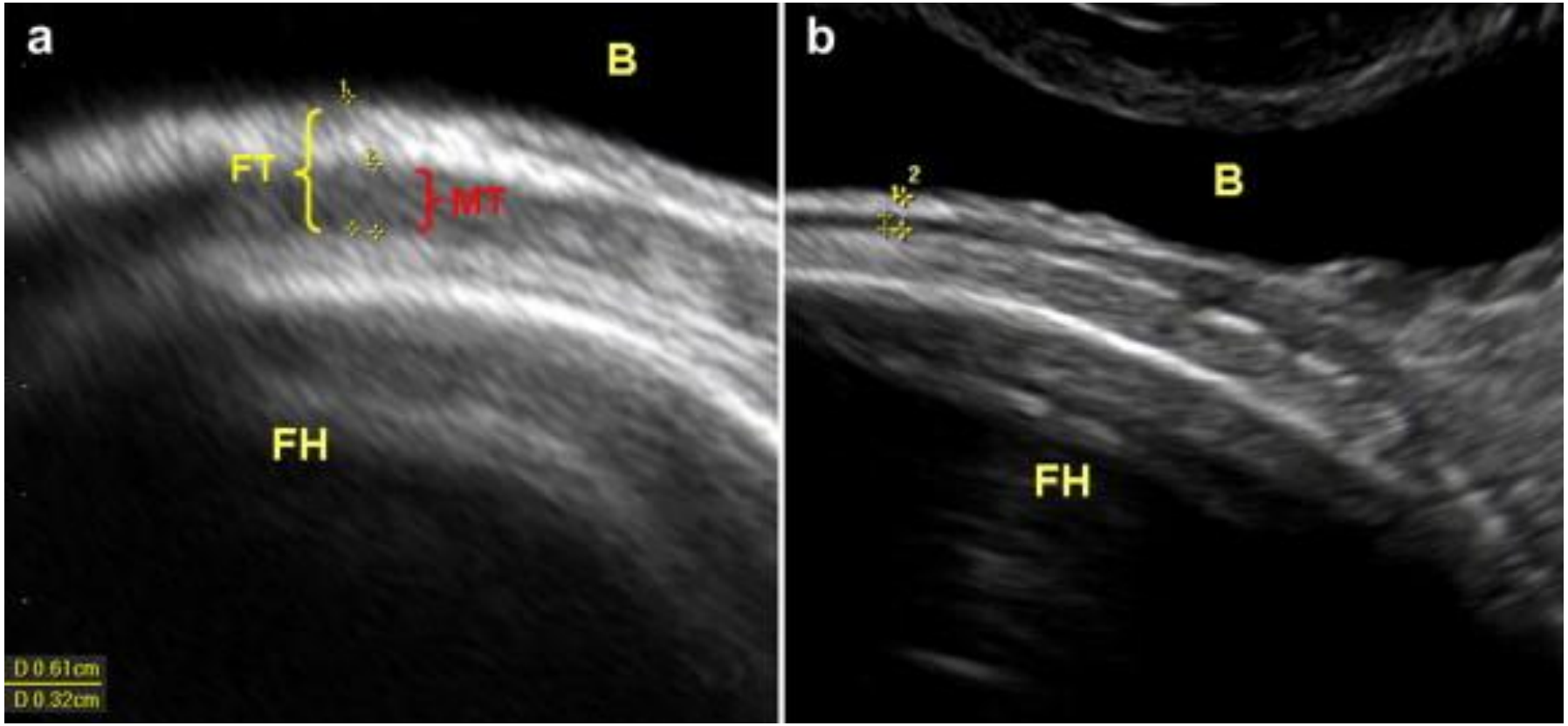
Ultrasound and uterine scar

Third trimester



Bujold et al. Am J Obstet Gynecol 2009; 201: 320.e1–320.e6

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Ultrasound and uterine scar

Third trimester

	Thickness of lower uterine segment							
	>4·5 mm		3·6–4·5 mm		2·6–3·5 mm		1·6–2·5 mm	
	Number of patients	Number with defect	Number of patients	Number with defect	Number of patients	Number with defect	Number of patients	Number with defect
Delivery								
Vaginal*	203	0	108	1 (1%)	61	3 (5%)	14	0
Emergency caesarean	54	0	49	0	22	6 (27%)	6	2 (33%)
Elective caesarean	21	0	20	2 (10%)	53	5 (10%)	31	6 (19%)
Total	278	0	177	3 (2%)	136	14 (10%)	51	8 (16%)

Rozenberg et al. Lancet 1996;347:281-4

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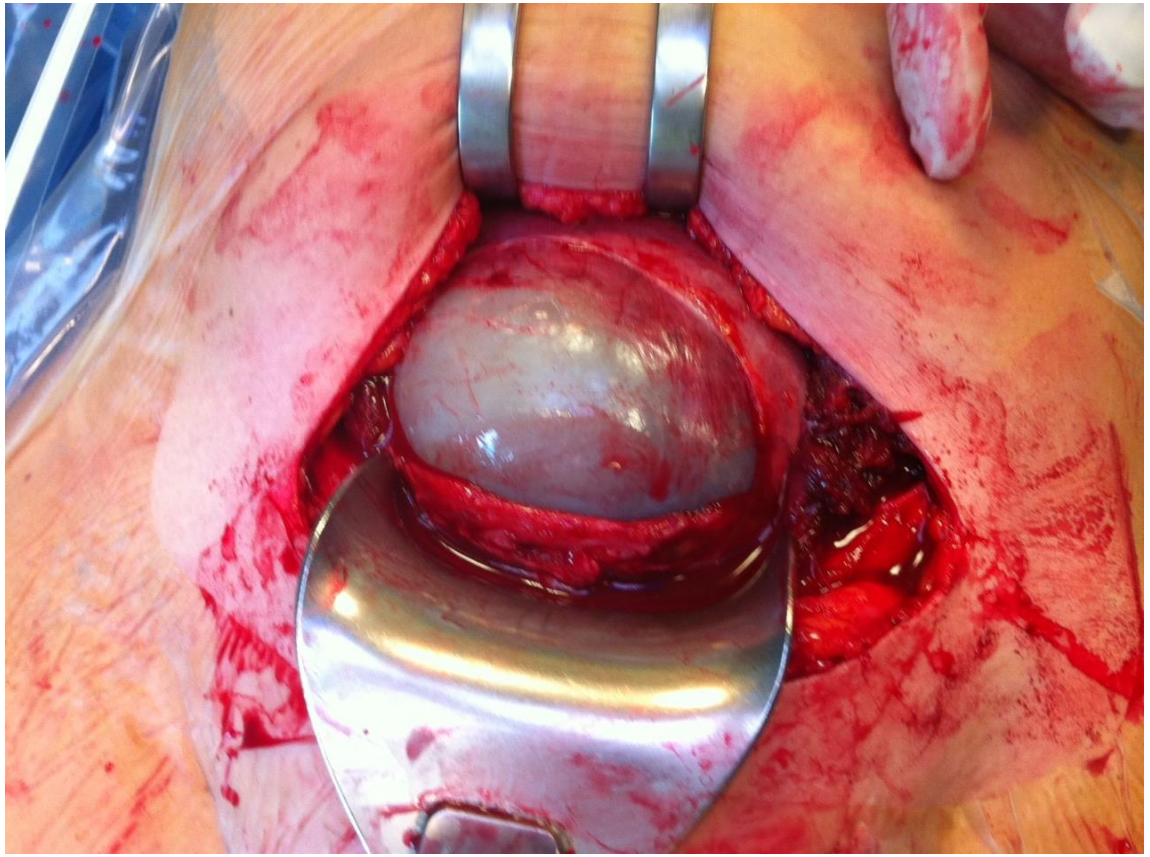
Ultrasound and uterine scar

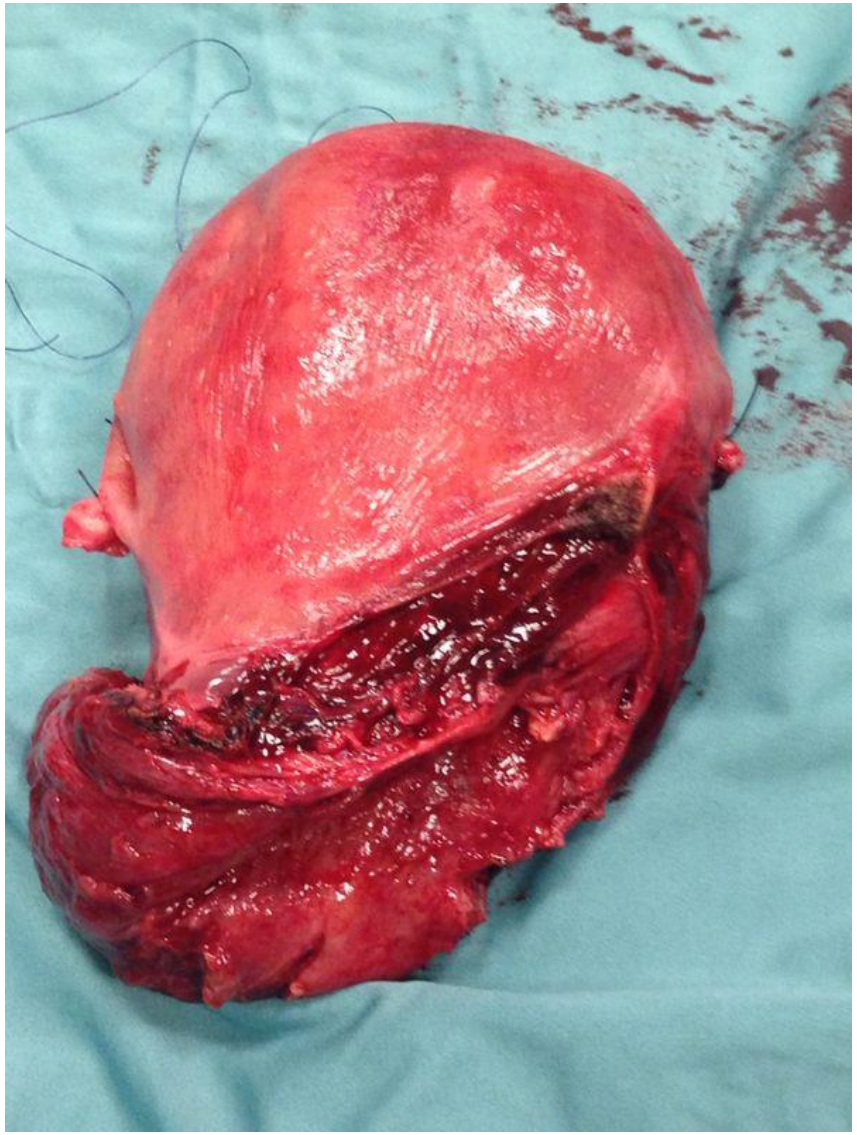
Third trimester

	Sensitivity	Specificity	Positive predictive value	Negative predictive value
≤4·5 mm	100%	45·0%	6·9%	100%
≤3·5 mm	88·0%	73·2%	11·8%	99·3%
≤2·5 mm	32·0%	93·0%	15·7%	97·1%

"Defect", symptomatic (rupture) or asymptomatic (dehiscence)

Rozenberg et al. Lancet 1996;347:281-4





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isuog.org

Sonographic measurement of lower uterine segment thickness to predict uterine rupture during a trial of labor in women with previous Cesarean section: a meta-analysis

N. Kok, I. C. Wiersma, B. C. Opmeer, I. M. De Graaf, B. W. Mol, E. Pajkrt

Volume 42, Issue 2, Date: August 2013, pages 132–139

Journal Club slides prepared by Dr Tommaso Bignardi
(UOG Editor for Trainees)

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isuog.org

Objective

To evaluate the accuracy of antenatal sonographic measurement of lower uterine segment (LUS) thickness in the prediction of risk of uterine rupture during a trial of labor (TOL) in women with a previous Cesarean section (CS).

Inclusion criteria

- Studies on pregnant women with at least one previous CS
- Studies that reported on sonographic appearance of LUS during pregnancy in relation to uterine defects observed during or immediately after delivery
- Studies that allowed construction of 2×2 tables comparing LUS thickness measurement and the occurrence of uterine scar defects (uterine scar dehiscence or uterine scar rupture)
- 1980 – December 2011

Definitions

- Uterine scar dehiscence: loss of continuity of myometrial layer without complete rupture of LUS
- Uterine rupture: complete separation of the uterine scar resulting in communication between the uterine and peritoneal cavities
- Full LUS thickness: distance between bladder wall and amniotic cavity
- Myometrial thickness: minimum thickness overlying amniotic cavity at the level of uterine scar (only myometrium is measured)

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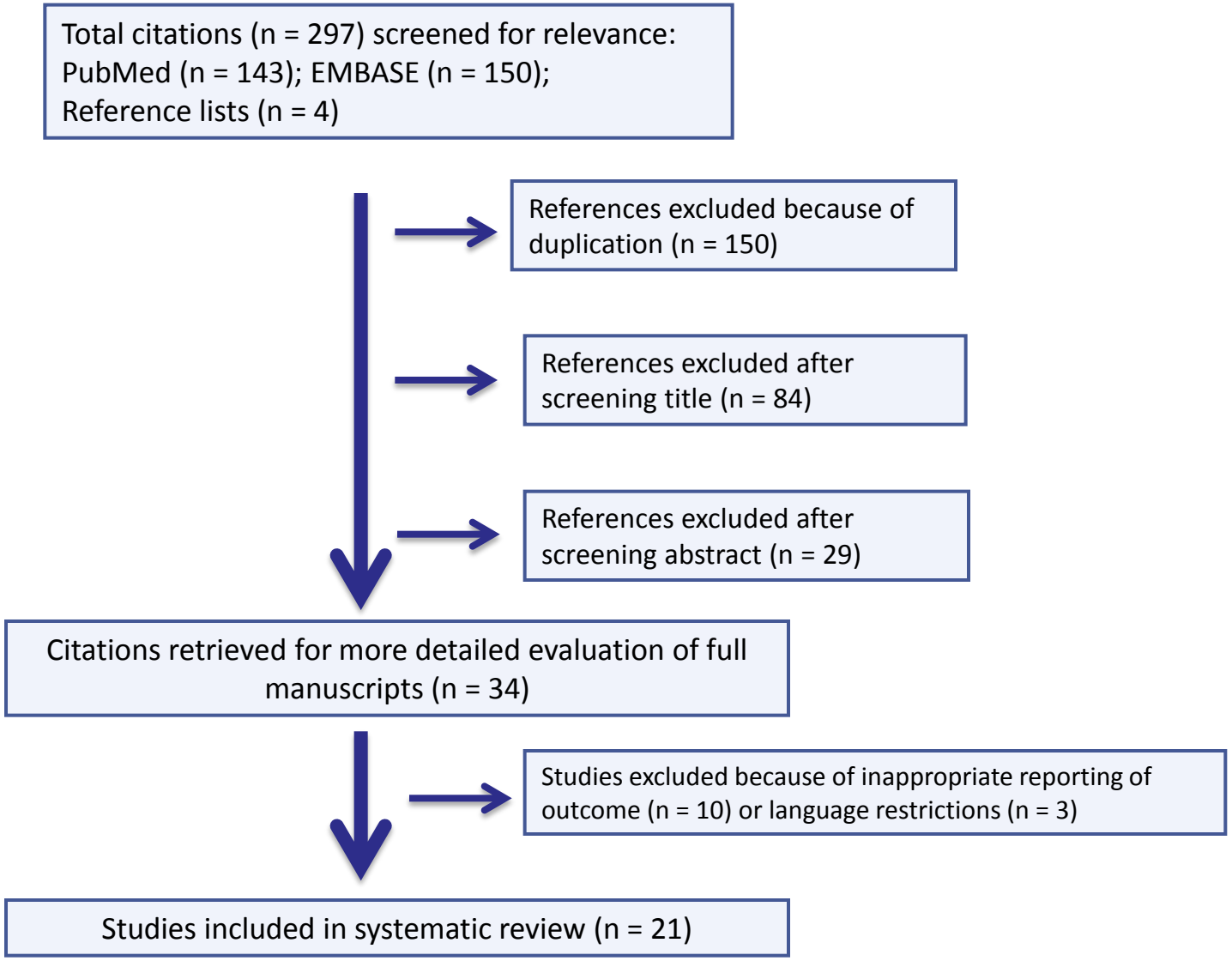

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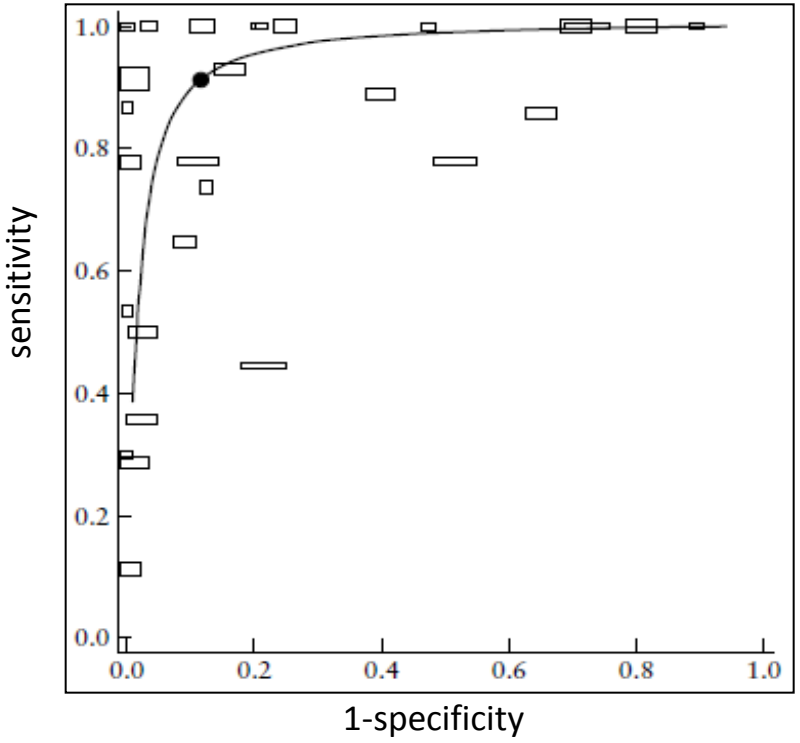
Results: characteristics of studies included

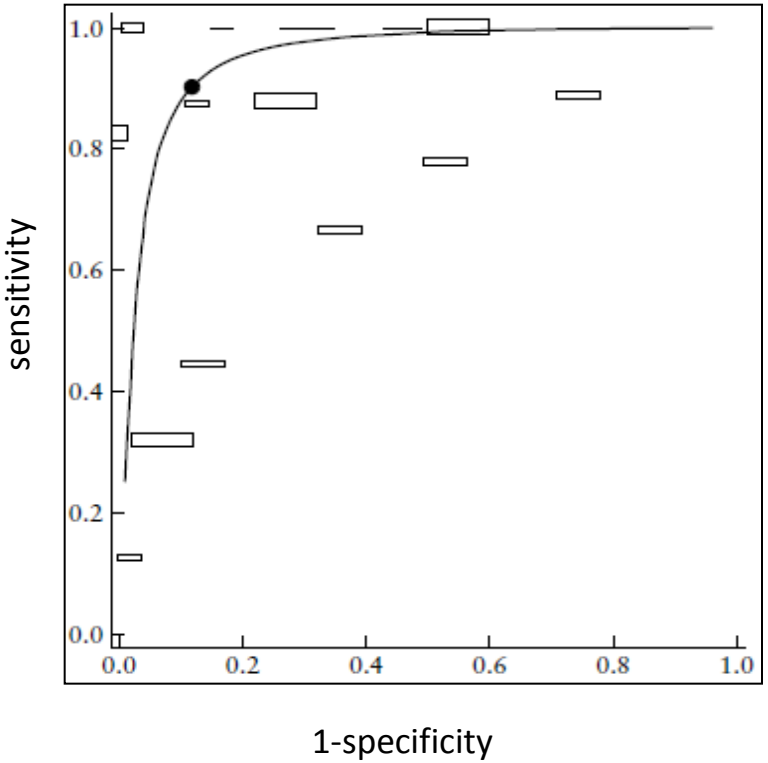
Study	Country	Study duration (years)	Study design	Blinding	Participants with analyzable data (n)	Sonographic approach	LUS measurement	Reported outcome
Valclavinkova (1984)[33]	Sweden	0.3	Prosp.	NR	68	NR	Myometrium	Thinning
Michaels (1988)[16]	USA	3.0	Prosp.	None	58	TAS	Full	Thinning
Fukuda (1988)[22]	Japan	4.7	NR	NR	84	TAS	Myometrium	Thinning
Fukuda (1991)[15]	Japan	5.4	NR	NR	216	TAS/TVS	Myometrium	Thinning
Popov (1994)[27]	Bulgaria	2.9	Retro.	None	26	TAS	NR	NR
Hebisch (1994)[23]	Germany	NR	Prosp.	Single	10	TAS/TVS	Myometrium	Thinning
Tanik (1996)[32]	Turkey	0.4	NR	NR	50	TAS	Full	Thinning
Rozenberg (1996)[14]	France	5.7	Prosp.	NR	642	TAS	Full	Dehiscence/ rupture
Qureshi (1997)[28]	Japan	1.9	Prosp.	NR	43	TVS	Myometrium	Dehiscence/ rupture
Montanari (1999)[25]	Italy	2.8	Prosp.	None	61	TVS	Myometrium	Dehiscence
Rozenberg (1999)[29]	France	1.9	Prosp.	None	198	TAS	Full	Dehiscence
Gotoh (2000)[13]	Japan	3.9	Prosp.	Single	348	TVS	Myometrium	Incomplete rupture
Suzuki (2000)[31]	Japan	3.0	NR	NR	83	TAS	Myometrium	Dehiscence
Asakura (2000)[17]	Japan	4.1	NR	Single	186	TVS	Myometrium	Dehiscence
Sen (2004)[30]	India	1.1	Prosp.	Double	71	TAS/TVS	Full	Dehiscence
Cheung (2004)[19]	Canada	0.7	Prosp.	None	53	TAS	Myometrium	Dehiscence
Cheung (2005)[20]	Canada	1.9	NR	None	102	TVS/TAS	Myometrium	Dehiscence
Bujold (2009)[18]	Canada	2.5	Prosp.	None	236	TAS/TVS	Full/ Myometrium	Dehiscence/ rupture
Mohammed (2010)[26]	Egypt	0.7	Prosp.	None	100	TAS/TVS	Myometrium	Dehiscence
Dane (2010)[21]	Turkey	0.7	Prosp.	Single	35	TVS	Myometrium	Dehiscence/ rupture
Kushtagi (2011)[24]	India	NR	Prosp.	None	106	TAS	Full	Dehiscence

NR, not reported; Prosp., prospective cohort; Retro., retrospective cohort; TAS, transabdominal sonography; TVS, transvaginal sonography

Results: sROC curves (–) and pooled sensitivity and specificity (●) for prediction of uterine defects*



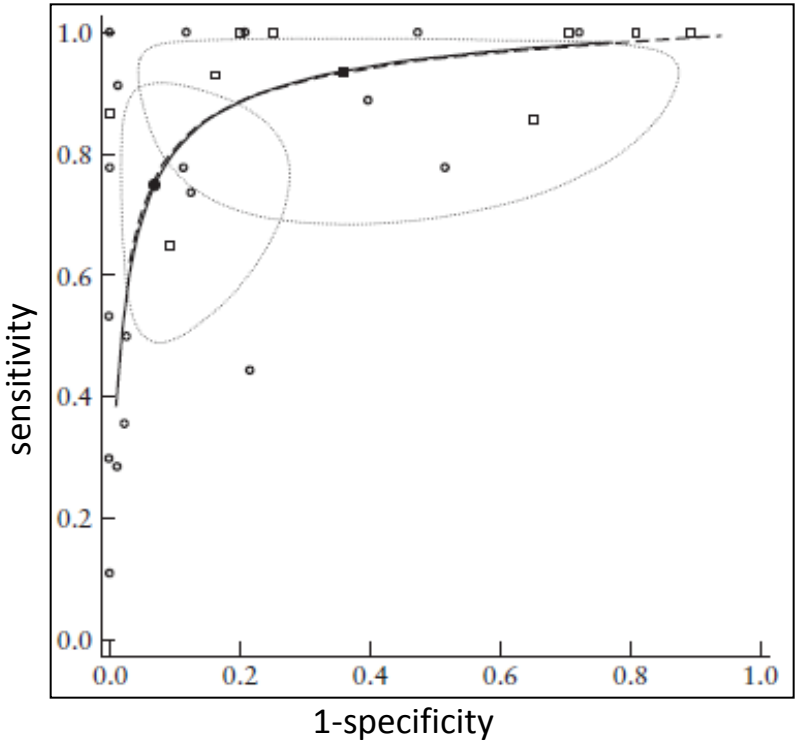
Myometrial lower uterine segment (LUS) thickness

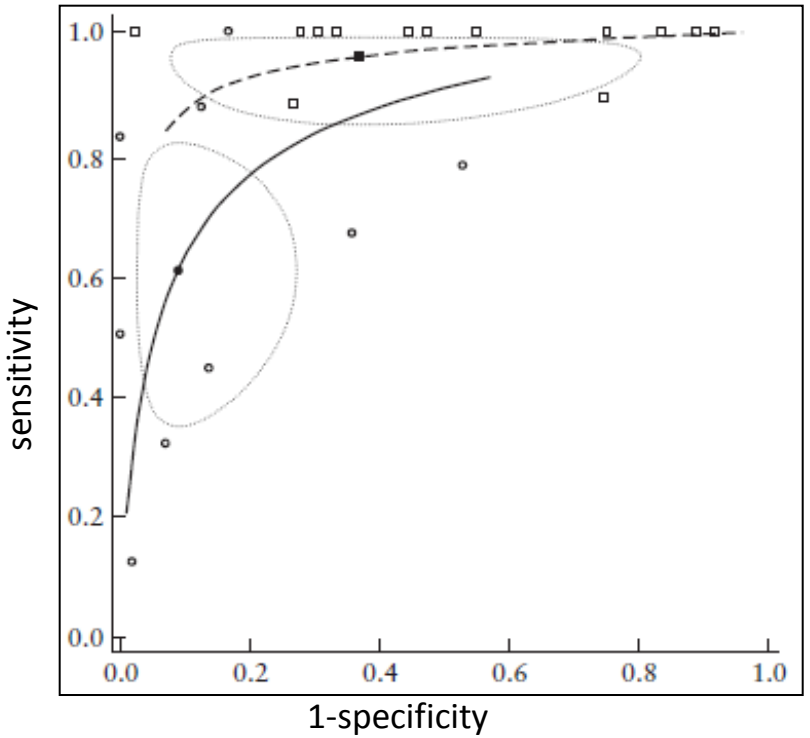


Full lower uterine segment (LUS) thickness

*Rectangles show the observed accuracy for each cut-off point in each study

Results





Myometrial LUS thickness
cut-off ranges
0.6–2.0 mm: ○ observed accuracy;
● pooled sens/spec; – sROC curve
2.1–4.0 mm: □ observed accuracy;
■ pooled sens/spec; - - sROC curve

Full LUS thickness
cut-off ranges
2.0–3.0 mm: ○ observed accuracy;
● pooled sens/spec; – sROC curve **3.1–5.1 mm:** □ observed accuracy;
■ pooled sens/spec; - - sROC curve

Sonographic measurement of lower uterine segment thickness to predict uterine rupture during a trial of labor in women with previous Cesarean section: a meta-analysis
Kok et al., UOG 2013

Results

- **Full LUS thickness measurement** between **2.0 and 3.0 mm** reached a specificity of **0.91** (95% CI, 0.80–0.96) at a sensitivity of **0.61** (95% CI, 0.42–0.77).

- **Full LUS thickness measurement** between **3.1 and 5.1 mm** reached a specificity of **0.63** (95% CI, 0.30–0.87) at a sensitivity of **0.96** (95% CI, 0.89–0.98)

- The accuracy of TVS and TAS could not be compared statistically

Summary…

‘Thick’ lower uterine segment:

- *low risk of uterine rupture (high NPV)*

‘Thin’ lower uterine segment:

- *low risk of uterine rupture (low PPV)*

Trial of Labor after Cesarean (TOLAC)

Two major clinical questions:

1. Risk of uterine rupture
2. Probability of vaginal delivery (VBAC)

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Predictive models of vaginal birth (VBAC) based on clinical factors

VAGINAL BIRTH AFTER CESAREAN

Height & weight optional; enter them to automatically calculate BMI

Maternal age	25	years
Height (range 54-80 in.)		in
Weight (range 80-310 lb.)		lb
Body mass index (BMI, range 15-75)	26	kg/m^2
African-American?	no	
Hispanic?	no	
Any previous vaginal delivery?	no	
Any vaginal delivery since last cesarean?	no	
Indication for prior cesarean of arrest of dilation or descent?	no	

Calculate

VAGINAL BIRTH AFTER CESAREAN

Predicted chance of vaginal birth after cesarean: **77.3%**

95% confidence interval: [**75.2%**, **79.2%**]

Recalculate

Grobman et al. Obstet Gynecol 2007;109:806–12

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Predictive models of vaginal birth (VBAC) based on clinical factors

VAGINAL BIRTH AFTER CESAREAN

Height & weight optional; enter them to automatically calculate BMI

Maternal age	25 years
Height (range 54-80 in.)	in
Weight (range 80-310 lb.)	lb
Body mass index (BMI, range 15-75)	26 kg/m^2
African-American?	no
Hispanic?	no
Any previous vaginal delivery?	no
Any vaginal delivery since last cesarean?	no
Indication for prior cesarean of arrest of dilation or descent?	no
Estimated gestational age at delivery	39 weeks
Hypertensive disease of preganancy	no
Effacement	50 %
Dilation	1 cm
Station (0:Floating/Ballotable, 1:-5, 2:-4, 3:-3, 4:-2, 5:-1, 6:0, 7:+1, 8:+2, 9:+3)	5
Labor induction	no

Calculate

VAGINAL BIRTH AFTER CESAREAN

Predicted chance of vaginal birth after cesarean: **81.4%**

Warning: The confidence interval cannot be provided since the model was fitted by a pseudo likelihood approach.

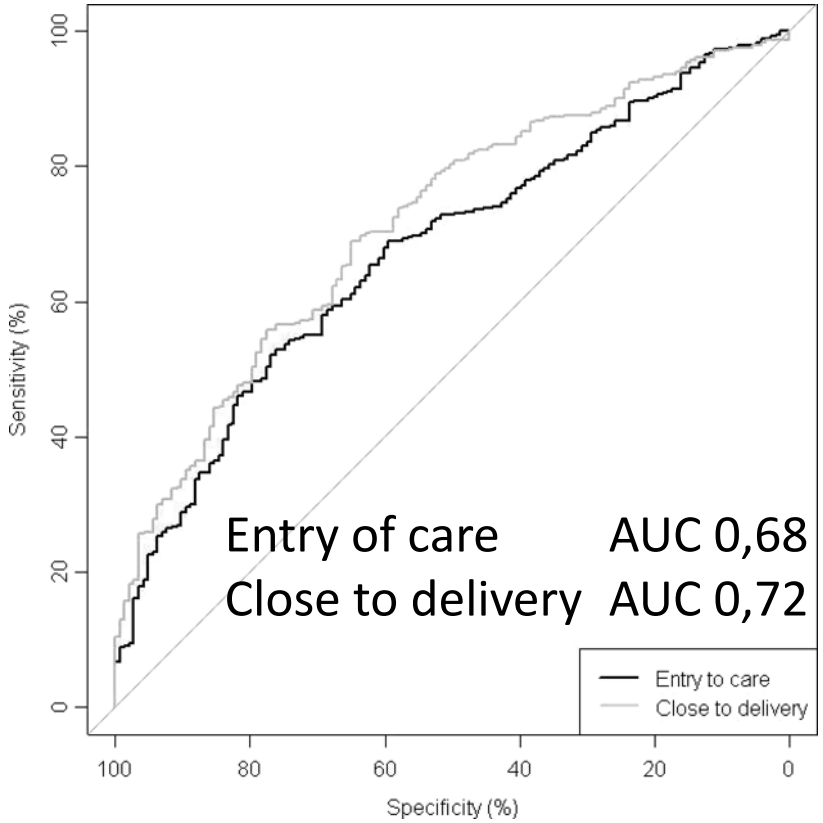
Recalculate

Grobman et al. Am J Perinatol 2009;26:693–701

Predictive models of vaginal birth (VBAC)

https://mfmu.bsc.gwu.edu/PublicBSC/MFMU/VGBirthCalc/vagbirth.html

Grobman et al. Obstet Gynecol 2007;109:806–12
Grobman et al. Am J Perinatol 2009;26:693–701



Schhorel et al. BJOG 2014;121:840-7

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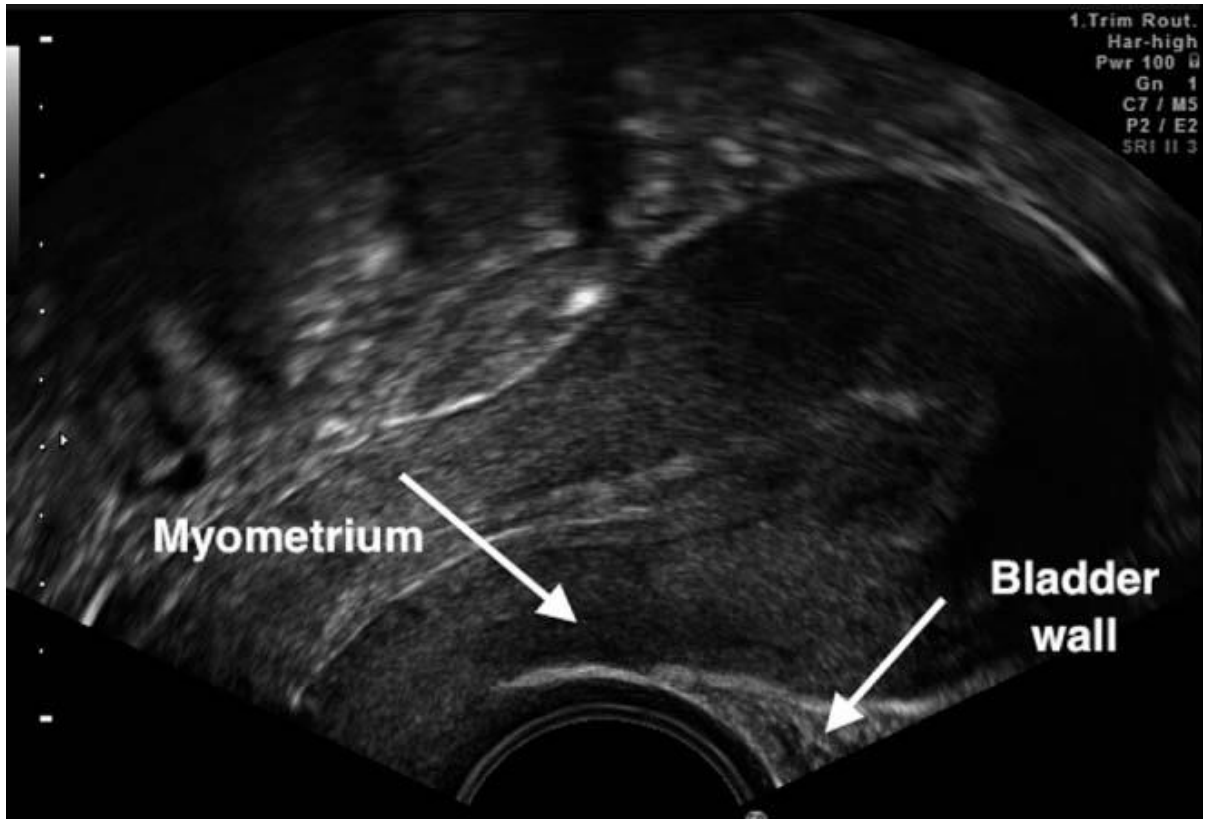
Ultrasound and uterine scar

Before pregnancy–First and second trimester



Naji et al. Ultrasound Obstet Gynecol 2012;39:252-9

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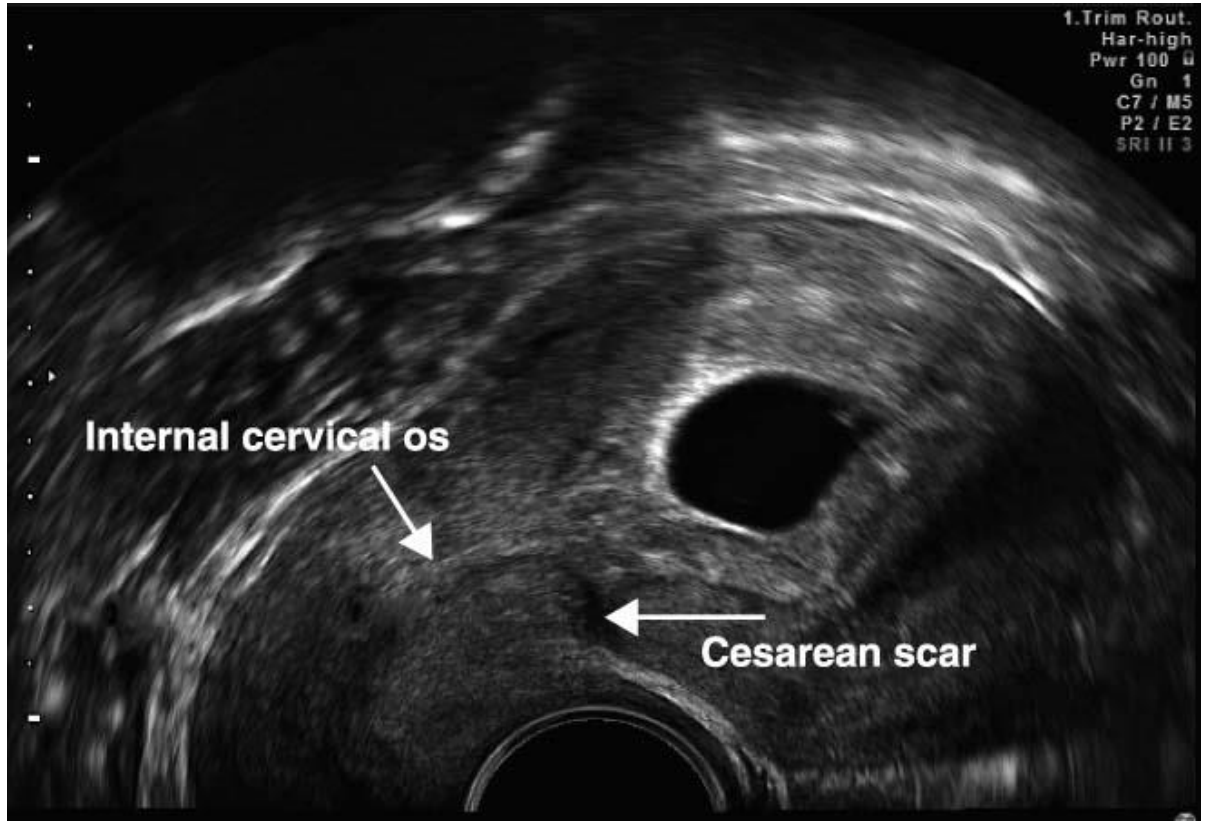
Ultrasound and uterine scar

Before pregnancy–First and second trimester



Naji et al. Ultrasound Obstet Gynecol 2012;39:252-9

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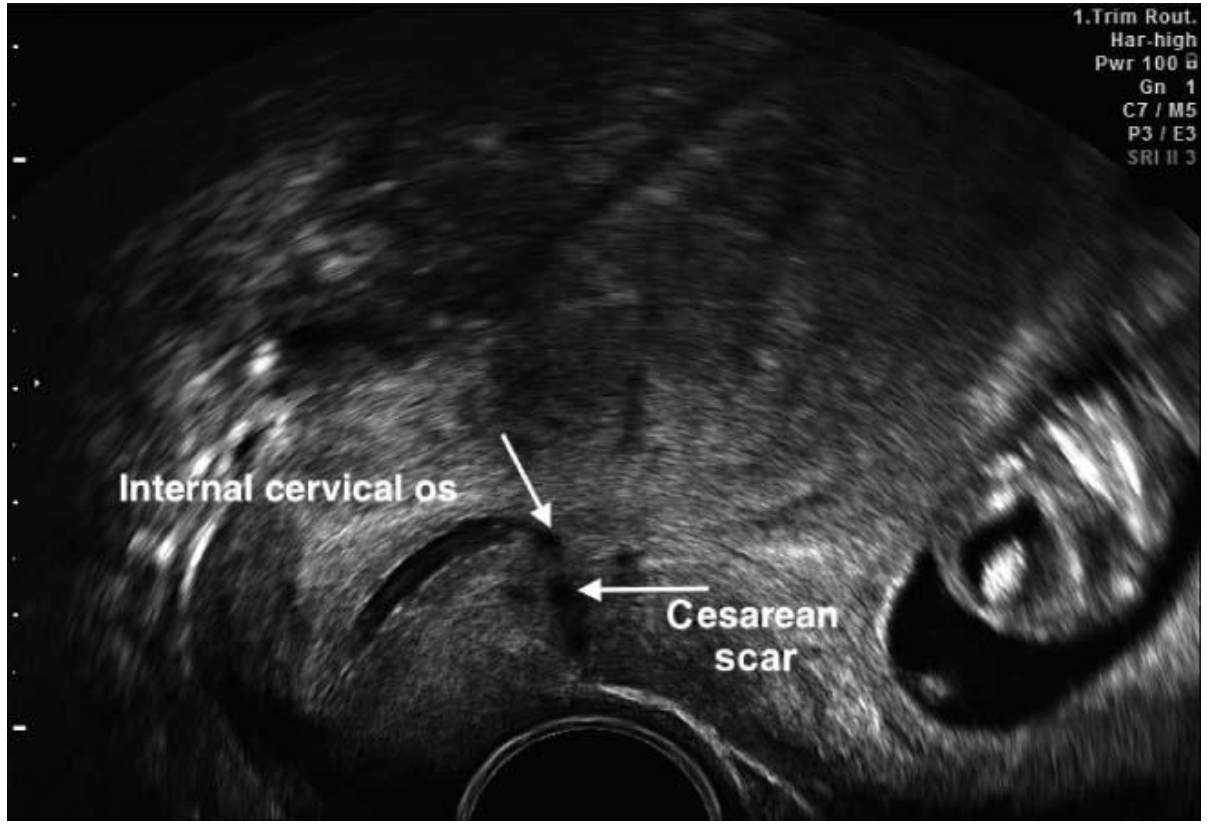
Ultrasound and uterine scar

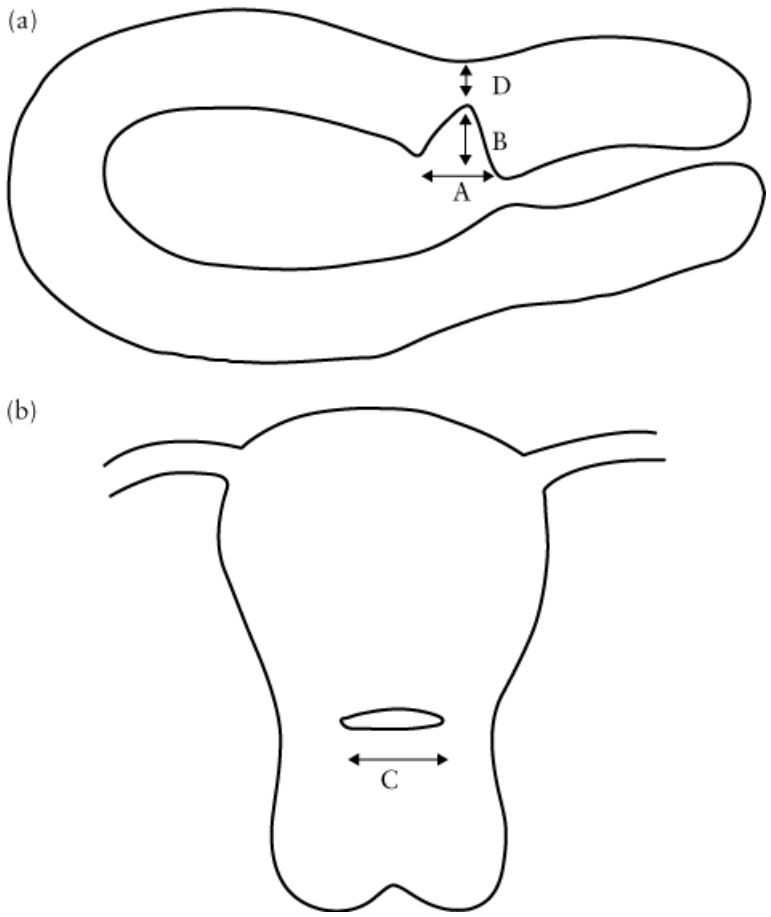
Before pregnancy–First and second trimester



Naji et al. Ultrasound Obstet Gynecol 2012;39:252-9

Ultrasound and uterine scar

Before pregnancy–First and second trimester



D=Residual myometrial thickness (RMT)

Naji et al. Ultrasound Obstet Gynecol 2012;39:252-9

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Ultrasound and uterine scar

Before pregnancy–First and second trimester

Currently, it is not known if the appearances of CS scars using ultrasound relate to the functional integrity of the uterus, the risk of scar ectopic pregnancy, pathological placentation, uterine rupture or performance in labor.

Naji et al. Ultrasound Obstet Gynecol 2012;39:252-9

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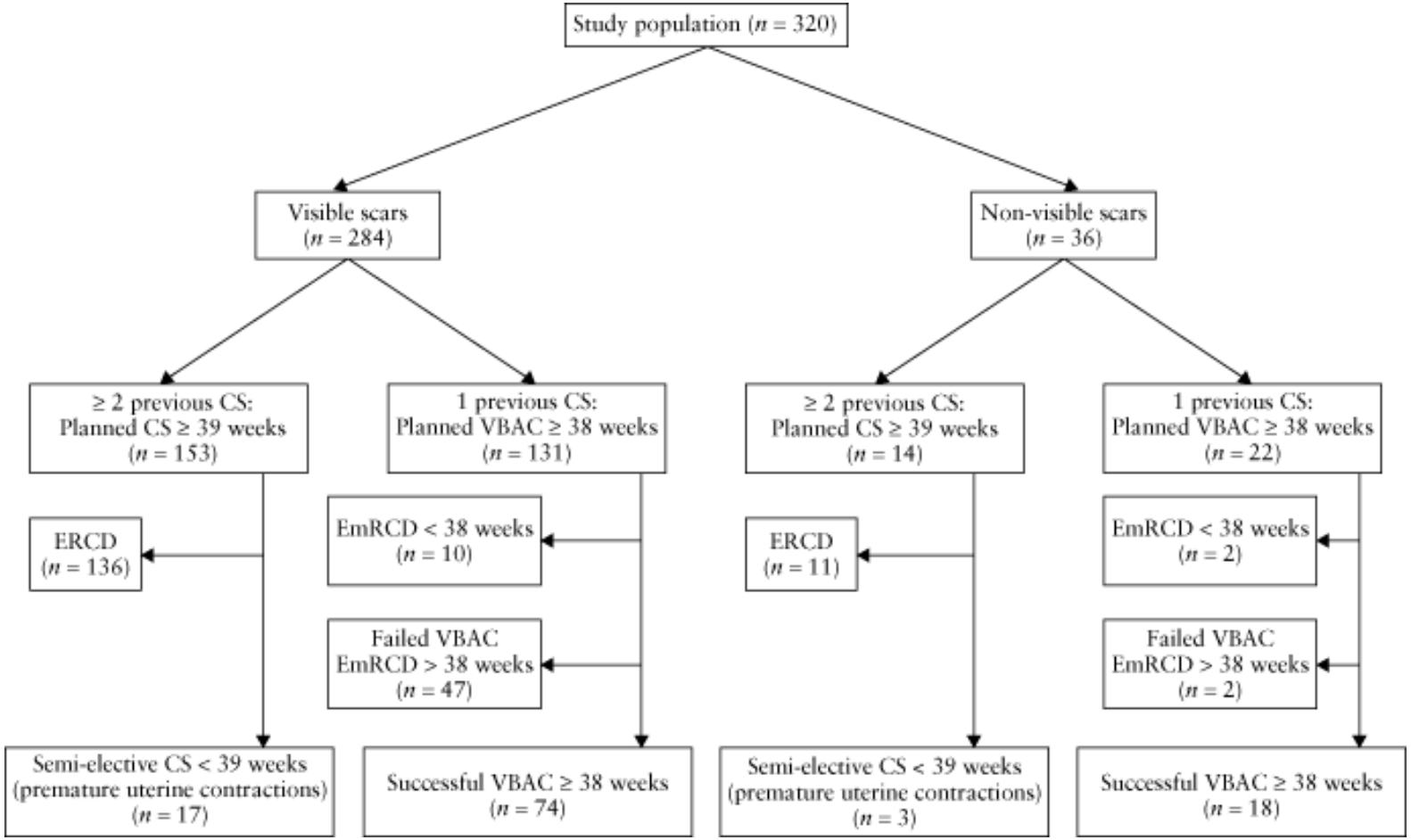
Predicting successful VBAC using a model based on Cesarean scar features examined by TV US



Naji et al. Ultrasound Obstet Gynecol 2013;41:672-8

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Predictive models of VBAC

Parameter	Failed VBAC (*n* = 47)	Successful VBAC (*n* = 74)
Age (years)	33 (20, 28, 35, 43)	32 (21.0, 29.0, 34.0, 39.0)
Body mass index (kg/m2)	25 (19, 23, 29, 40)	27 (18.0, 24.0, 30.0, 41.0)
Previous VBAC	3 (6.4)	25 (33.8)
RMT (mm)		
First trimester	5.5 (3.0, 4.8, 6.4, 9.1)	5.9 (2.8, 3.5, 5.9, 7.6)
Second trimester	2.8 (0.5, 2.6, 3.1, 4.2)	4.2 (2.6, 3.0, 4.6, 6.3)
Third trimester	2.5 (0.5, 2.4, 2.6, 3.8)	3.6 (3.2, 2.6, 3.9, 5.9)
ΔRMT: first trimester – second trimester (mm)	2.8 (0.1, 2.1, 3.4, 6.2)	0.8 (0.1, 0.4, 1.2, 4.7)

Naji et al. Ultrasound Obstet Gynecol 2013;41:672-8

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Predictive models of VBAC

Effect	OR (95% CI)	*P*
Age (per 5 year increase)	0.70 (0.35–1.37)	0.2957
RMT II trim (per mm increase)	6.26 (2.12–18.52)	0.0009
ΔRMT (per mm decrease)	0.25 (0.13–0.48)	< 0.0001
Previous VBAC (yes/no)	3.28 (0.50–21.47)	0.2157

Naji et al. Ultrasound Obstet Gynecol 2013;41:672-8

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Validation of a prediction model for successful vaginal birth after Cesarean delivery based on sonographic assessment of a hysterotomy scar

Predicted VBAC probability deciles, %	All women who underwent TOLAC (n=80)		Women with sonographically visible scar (n=54)	
	N	Observed VBAC rate, % (n)	N	Observed VBAC rate, % (n)
0 – 9.9	22	95 (21)	14	93 (13)
10.0 – 19.9	5	80 (4)	2	100 (2)
20.0 – 29.9	5	80 (4)	2	50 (1)
30.0 – 39.9	6	83 (5)	5	80 (4)
40.0 – 49.9	3	100 (3)	2	100 (2)
50.0 – 59.9	2	50 (1)	2	50 (1)
60.0 – 69.9	7	86 (6)	5	80 (4)
70.0 – 79.9	1	100 (1)	0	n/a
80.0 – 89.9	6	100 (6)	2	100 (2)
90.0 – 100	23	83 (19)	20	90 (18)

VBAC, vaginal birth after Cesarean delivery; TOLAC, trial of labor after Cesarean delivery; CI, confidence interval; n/a, not applicable

Baranov et al. Ultrasound Obstet Gynecol 2017 epud ahead of print

Take home messages

Ultrasound of lower uterine segment in women with previous cesarean delivery is technically feasible at during pregnancy

Its clinical role in the admitting the women to TOLAC or predicting VBAC is still debated

Contents lists available at SciVerse ScienceDirect

European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: www.elsevier.com/locate/ejogrb

Review

Delivery for women with a previous cesarean: guidelines for clinical practice from the French College of Gynecologists and Obstetricians (CNGOF)

Loïc Sentilhes [a,*], Christophe Vayssière [b,c], Gael Beucher [d], Catherine Deneux-Tharaux [e], Philippe Deruelle [f,g], Pierre Diemunsch [h], Denis Gallot [i,j], Jean-Baptiste Haumonté [k], Sonia Heimann [l], Gilles Kayem [m], Emmanuel Lopez [n], Olivier Parant [b,c], Thomas Schmitz [o], Yann Sellier [p], Patrick Rozenberg [q], Claude d'Ercole [k]

- Ultrasound assessment of the risk of uterine rupture in women with uterine scars has not been shown to have any clinical utility and is therefore not recommended during pregnancy to help decide the mode of delivery (professional consensus).

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Take home messages

Pro	Cons
Ultrasound of LUS is simple and reproducible If thick LUS low risk of uterine rupture and objective documentation of elegibility to TOLAC	Wide range of reference measurements Dehiscence can only be diagnosed at Cesarean <candidates to TOLAC with thin LUS who may have VBAC with spontaenous onset of labor (low PPV) No cut off can be suggested Strain better than tickness?

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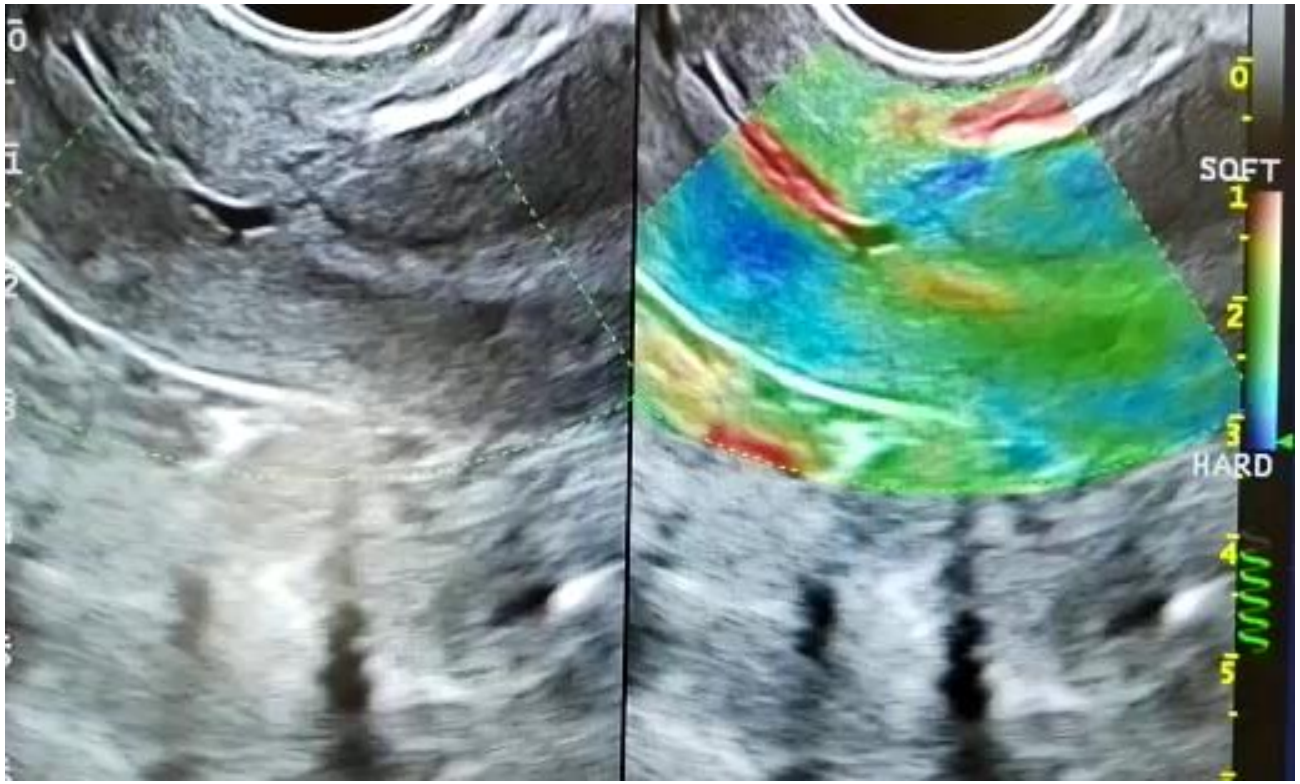
Assessment of cesarean section scar stiffness by ultrasound elastography

Ghi et al in preparation



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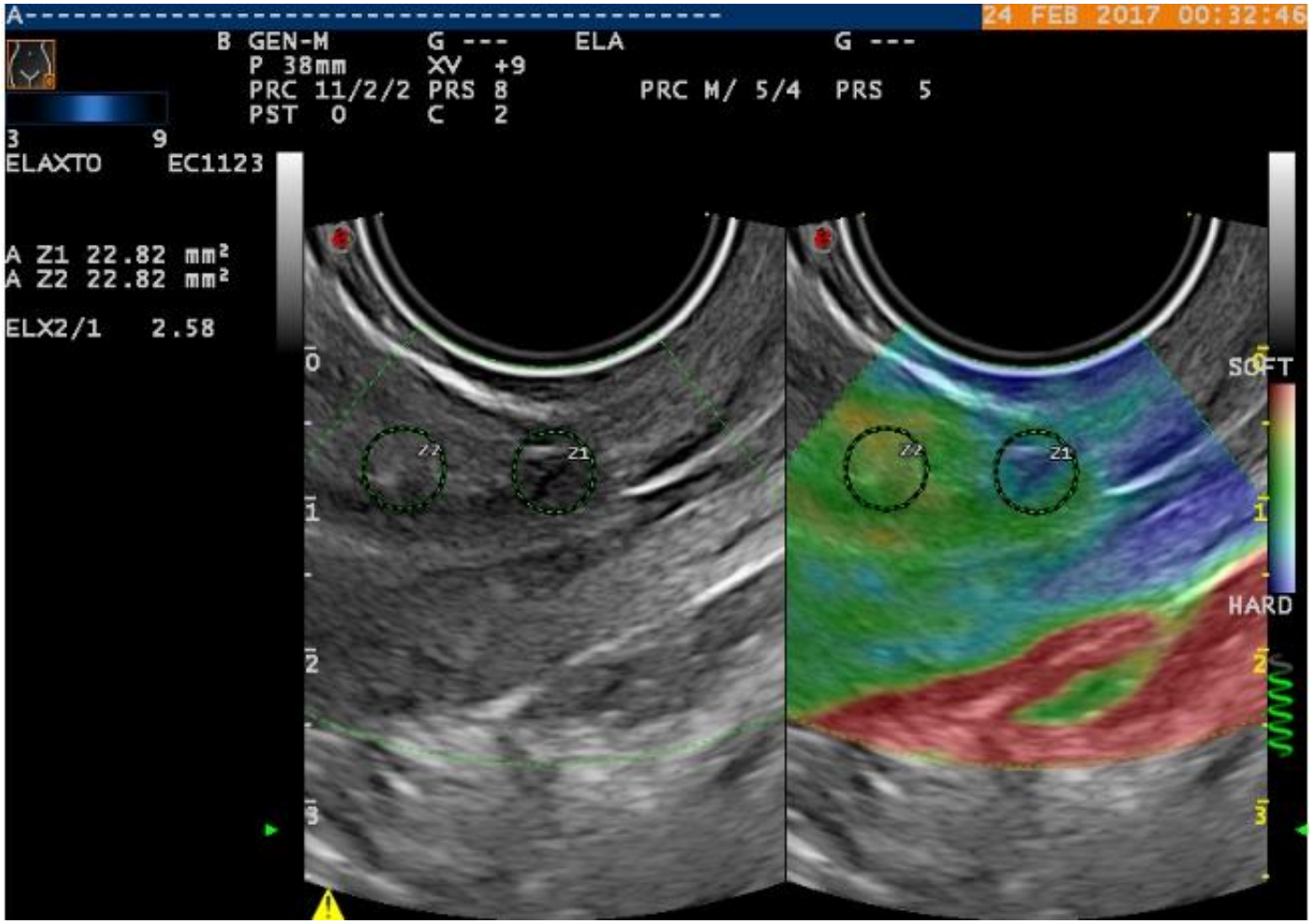
- 85 patients included (one single previous CD)
- Elastoscan at 14.1 ± 1.1 months from CD
- >stiffness of the uterine scar vs surrounding intact myometrium (strain rate 1.88 ± 0.72, p <0.001)
- strain rate of the uterine scar was comparable between women submitted to prelabor vs intrapartum cesarean delivery (1.91 + 0.72 vs 1.86 + 0.73, p 0.857).



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THE END