Embolization for Placenta Accreta Spectrum

JONATHAN GROSS, MD

Texas Children's Hospital®

- No relevant disclosures

Embolization for Uterine Pathology

- *Reactive* measure to treat hemorrhage
  - Malignancy
  - Arteriovenous malformations
  - Retained products of conception
  - Fibroids

Transarterial Embolization for PAS

- *Prophylactic* measure
  - Control hemorrhage
    - Immediate hysterectomy
    - Delayed hysterectomy

Transarterial Embolization for PAS

- *Prophylactic* measure
  - Control hemorrhage
    - Immediate hysterectomy
    - Delayed hysterectomy
  - Decrease need for hysterectomy
    - Preserve fertility

- Evidence is limited and of low quality
  - Small case series
  - Retrospective
  - Few include well matched control group

- Evidence is limited and of low quality
  - Do not distinguish between
    - Patients with different severity of invasion
    - Elective vs emergent procedures

- Evidence is limited and of low quality
  - Do not distinguish between different approaches to embolization
    - Vessels embolized
    - Embolic agent used

Transarterial Embolization for PAS

- Does embolization improve outcomes for patients who undergo cesarian hysterectomy?
  - Decrease blood loss and need for transfusion during surgery?

Transarterial Embolization for PAS

- Does embolization improve outcomes for patients who *do not* undergo cesarian hysterectomy?
  - Delayed interval hysterectomy
  - Preservation of uterus and fertility

SMFM Papers

ajog.org

Placenta Accreta Spectrum Treatment With Intraoperative Multivessel Embolization: the PASTIME protocol

Dora J. Melber, MD; Zachary T. Berman, MD; Marni B. Jacobs, PhD, MPH; Andrew C. Picel, MD; Charlotte L. Conturie, MD; Kathy Zhang-Rutledge, MD; Pratibha S. Binder, MD; Ramez N. Eskander, MD; Anne C. Roberts, MD; Michael T. McHale, MD; Gladys A. Ramos, MD; Jerasimos Ballas, MD, MPH; Thomas F. Kelly, MD

Melber, et al. Am J Ob Gyn 2021

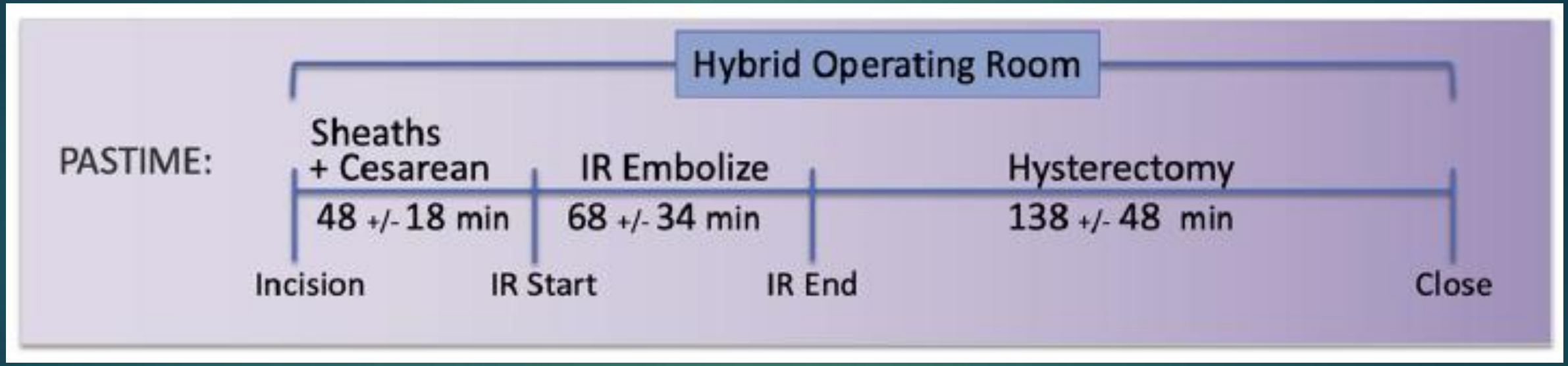
PASTIME Study

- Compare outcomes
  - Embolization

    vs
  - Internal iliac artery occlusion balloons

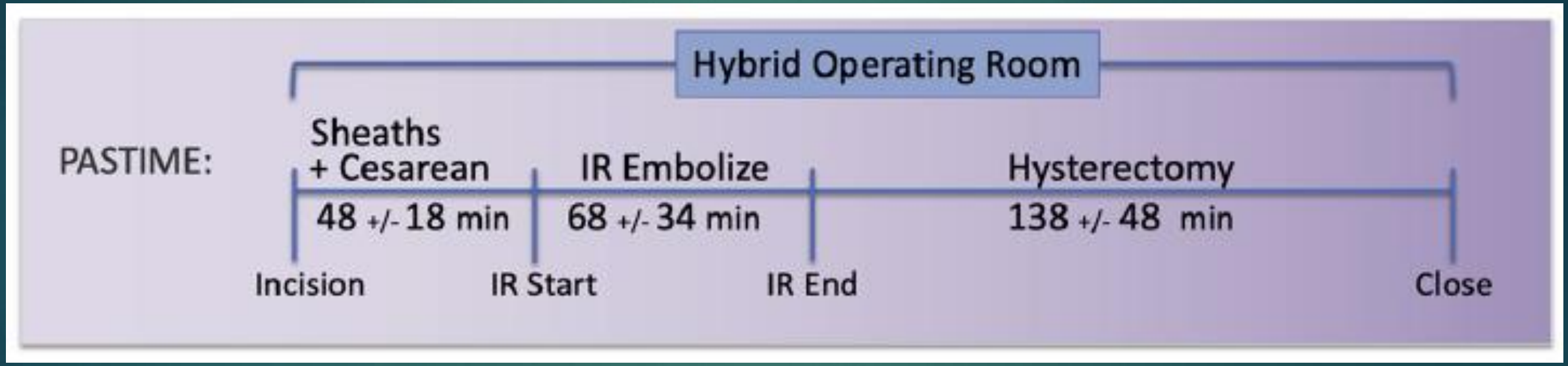
Placenta Accreta Spectrum Treatment With Intraoperative Multivessel Embolization: the PASTIME protocol

PASTIME Study



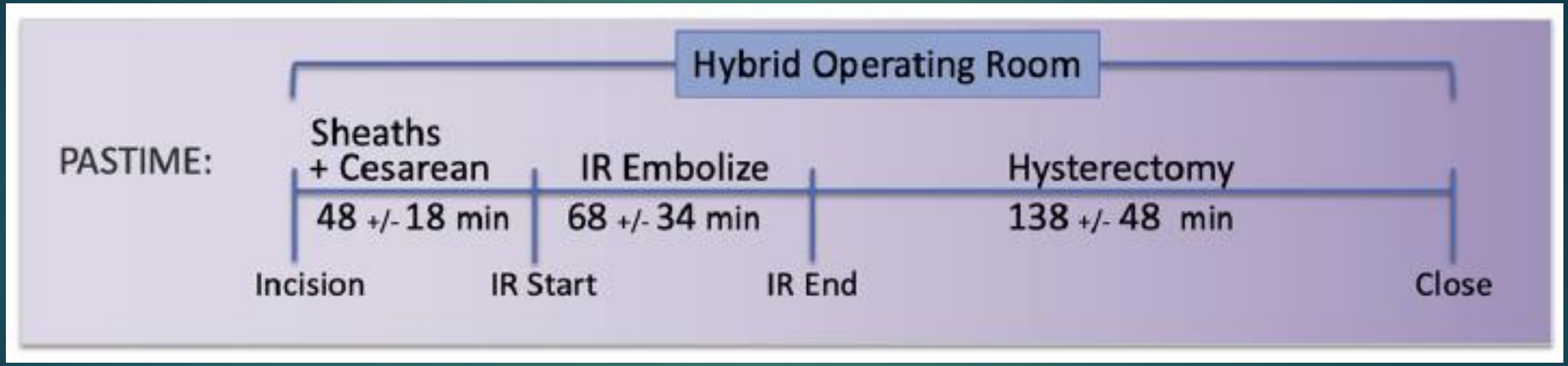
Femoral sheath

PASTIME Study



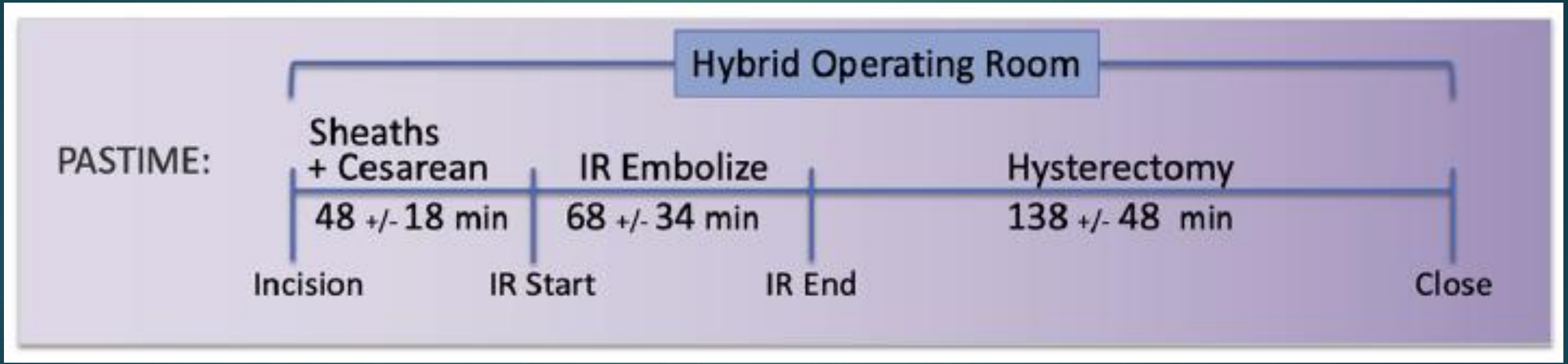
Femoral sheath → Delivery

PASTIME Study



Femoral sheath → Delivery → Embolization

PASTIME Study



Femoral sheath → Delivery → Embolization → Hysterectomy

PASTIME Study

- Control group
  - Internal iliac artery occlusion balloons
  - no embolization

Placenta Accreta Spectrum Treatment With Intraoperative Multivessel Embolization: the PASTIME protocol

TABLE 2

Surgical outcomes of the treatment groups

Surgical outcomes	PASTIME (n=15)	Historical (n=30)	*P* value
Total RBCs (units)	0 (0–2)	2 (0–5.75)	.045[a]
All blood products (units)	0 (0–2)	2 (0–10.5)	.04[a]
Transfusion (cases)	5 (33.3)	19 (63.3)	.11
Massive transfusion (≥10 units RBCs in 24 h)	0 (0.0)	5 (16.7)	.15
EBL (mL)	750 (450–1050)	1750 (1050–2500)	.003[a]
Cystotomy, intentional	4 (26.7)	4 (13.3)	.41
Superficial serosal bladder injury	0 (0.0)	1 (3.3)	1.0
Death from hemorrhagic shock	0 (0.0)	2 (6.7)	.55

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Hematoma at access site	0	3
Off-target embolization	0	0
Wound complication	5	6
Wound infection	1	3
Wound separation	4	3
Pelvic hematoma or abscess	0	3
Urologic	2	7
UTI	1	3
Urinary retention	0	2
Bladder fistula	1	1
Postoperative AKI	0	1
Gastrointestinal: ileus	0	8
VTE	0	3
PE	0	1
Ovarian vein thrombosis	0	2
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Death within 30 d	0	1
Total	7	32

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Conclusions

- Multidisciplinary care and prophylactic embolization
  - decrease blood loss

Placenta Accreta Spectrum Treatment With Intraoperative Multivessel Embolization: the PASTIME protocol

Conclusions

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  - decrease blood loss
  - decrease need for transfusion

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  - decrease blood loss
  - decrease need for transfusion
  - Do not increase complications

Placenta Accreta Spectrum Treatment With Intraoperative Multivessel Embolization: the PASTIME protocol

Embolization Prior to Hysterectomy

CLINICAL STUDY

Uterine Artery Embolization following Cesarean Delivery but prior to Hysterectomy in the Management of Patients with Invasive Placenta

Melinda Wang, BS, Deddeh Ballah, MD, Alana Wade, MD, Andrew G. Taylor, MD, PhD, Gabrielle Rizzuto, MD, Benjamin Li, MD, Jennifer Lucero, MD, Lee-May Chen, MD, and Maureen P. Kohi, MD, FSIR

Wang, et al. JVIR 2019

Embolization Prior to Hysterectomy

- Outcomes
  - 7 prophylactic embolization

    VS
  - 24 no endovascular intervention
    - No embolization
    - No occlusion balloon

Wang, et al. JVIR 2019

Subset of Patients with Most Severe Placental Invasion

	Embolization group	Control group	P value
Blood loss (mL)	1500	2500	0.004
Mean transfusion requirement (mL)	150	700	0.009
Length of ICU stay (Days)	0	1	0.04

Wang, et al. JVIR 2019

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Wang, et al. JVIR 2019

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Wang, et al. JVIR 2019

Post-Operative Complications

- Complications
  - Embolization group
    - None
  - Control group
    - 17% (4/24 patients)
      - Peritonitis
      - Ureteral injury
      - Ongoing hemorrhage

Wang, et al. JVIR 2019

Conclusions

- For patients with *high grade PAS*, prophylactic embolization prior to cesarian hysterectomy
  - Safe

Wang, et al. JVIR 2019

Conclusions

- For patients with *high grade PAS*, prophylactic embolization prior to cesarian hysterectomy
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  - Decreases blood loss

Wang, et al. JVIR 2019

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Wang, et al. JVIR 2019

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Wang, et al. JVIR 2019

Conclusions

- For patients with *high grade PAS*, prophylactic embolization prior to cesarian hysterectomy
  - Safe
  - Decreases blood loss
  - Decreases transfusion requirement
  - Decreases ICU stay
  - May improve surgical outcomes by creating a "dry" surgical field

Wang, et al. JVIR 2019

Embolization for Cesarian Hysterectomy

- Does embolization improve outcomes from cesarian hysterectomy?

Embolization for Cesarian Hysterectomy

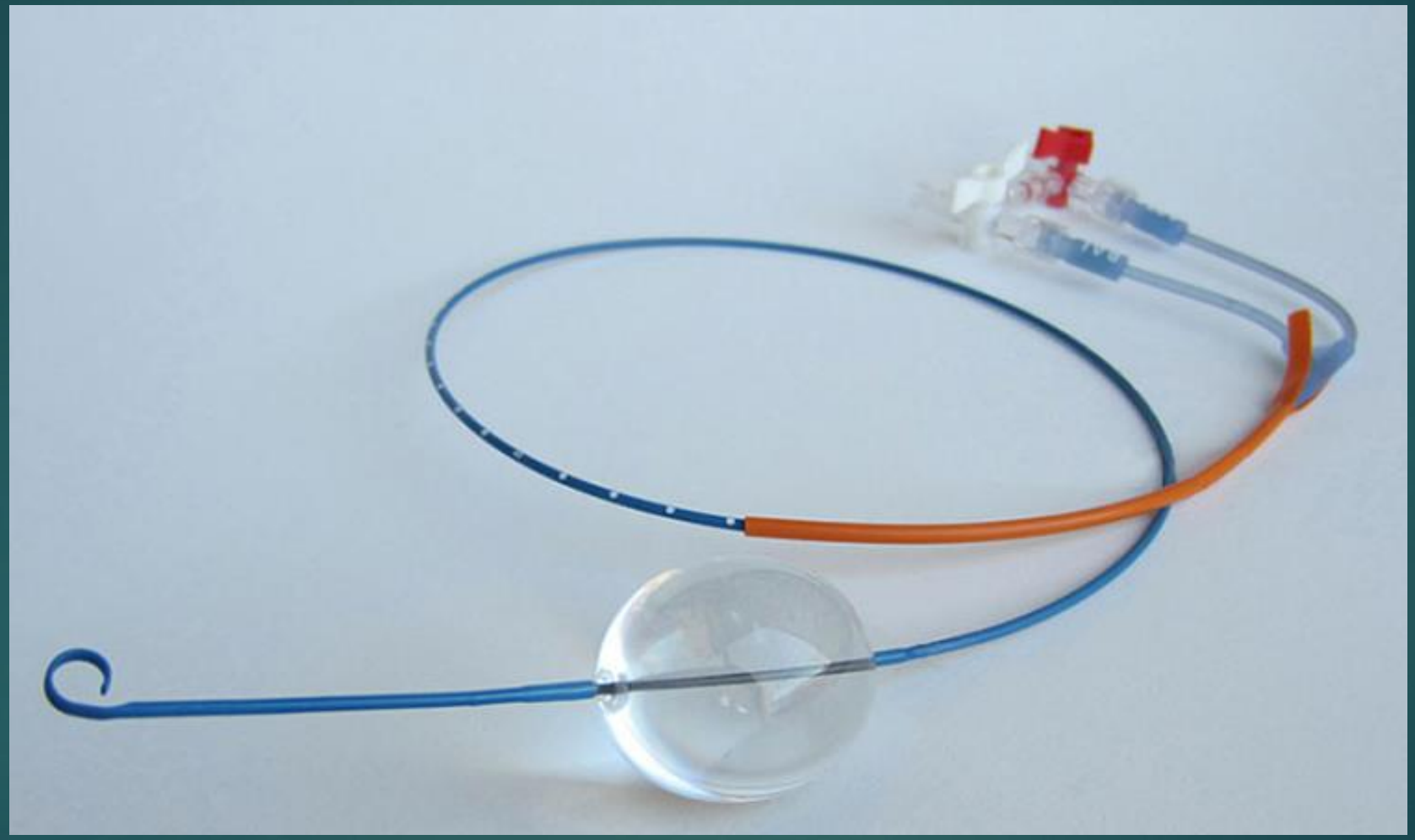
- Does embolization improve outcomes from cesarian hysterectomy?
  - Probably

Embolization for Cesarian Hysterectomy

- Is it worth doing?

Embolization for Cesarian Hysterectomy

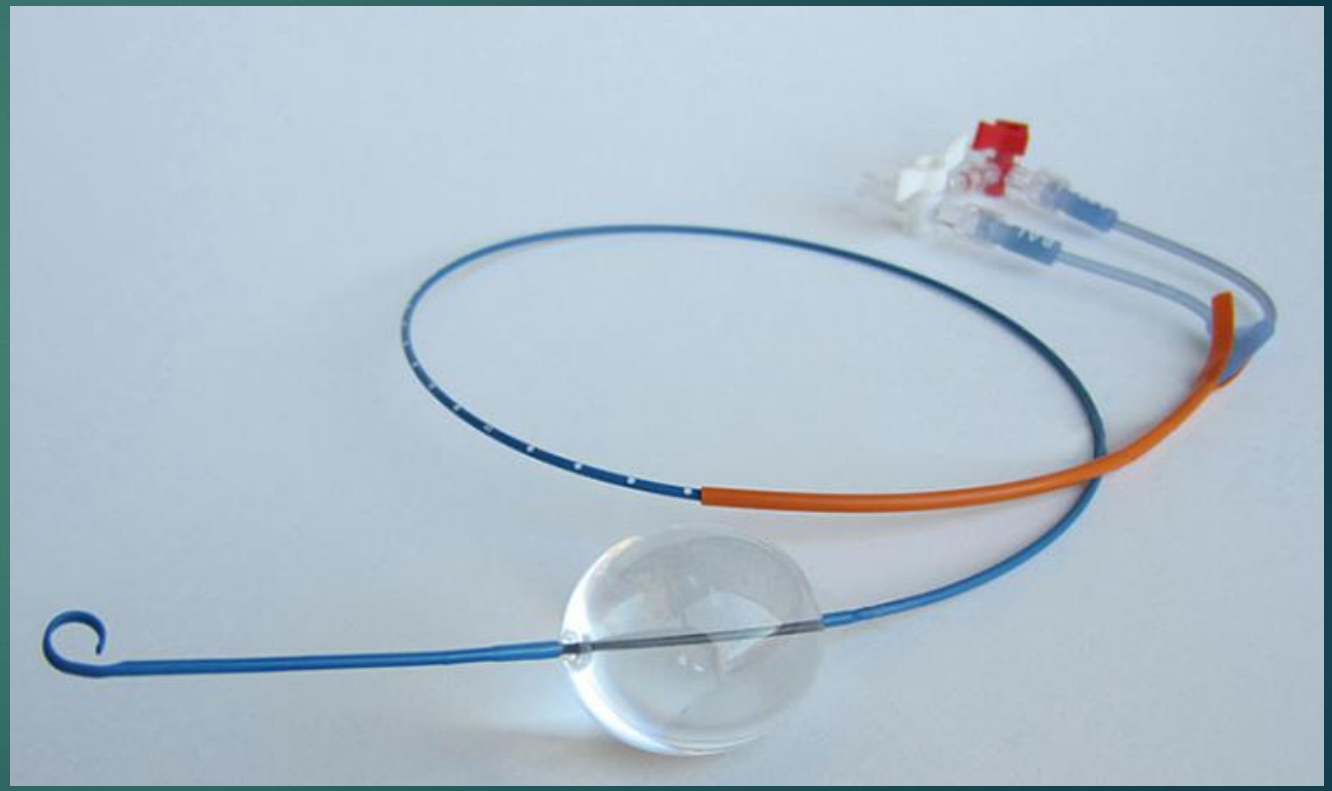
- Is it worth doing?
  - Well…



REBOA occlusion balloon

Embolization vs Occlusion Balloon

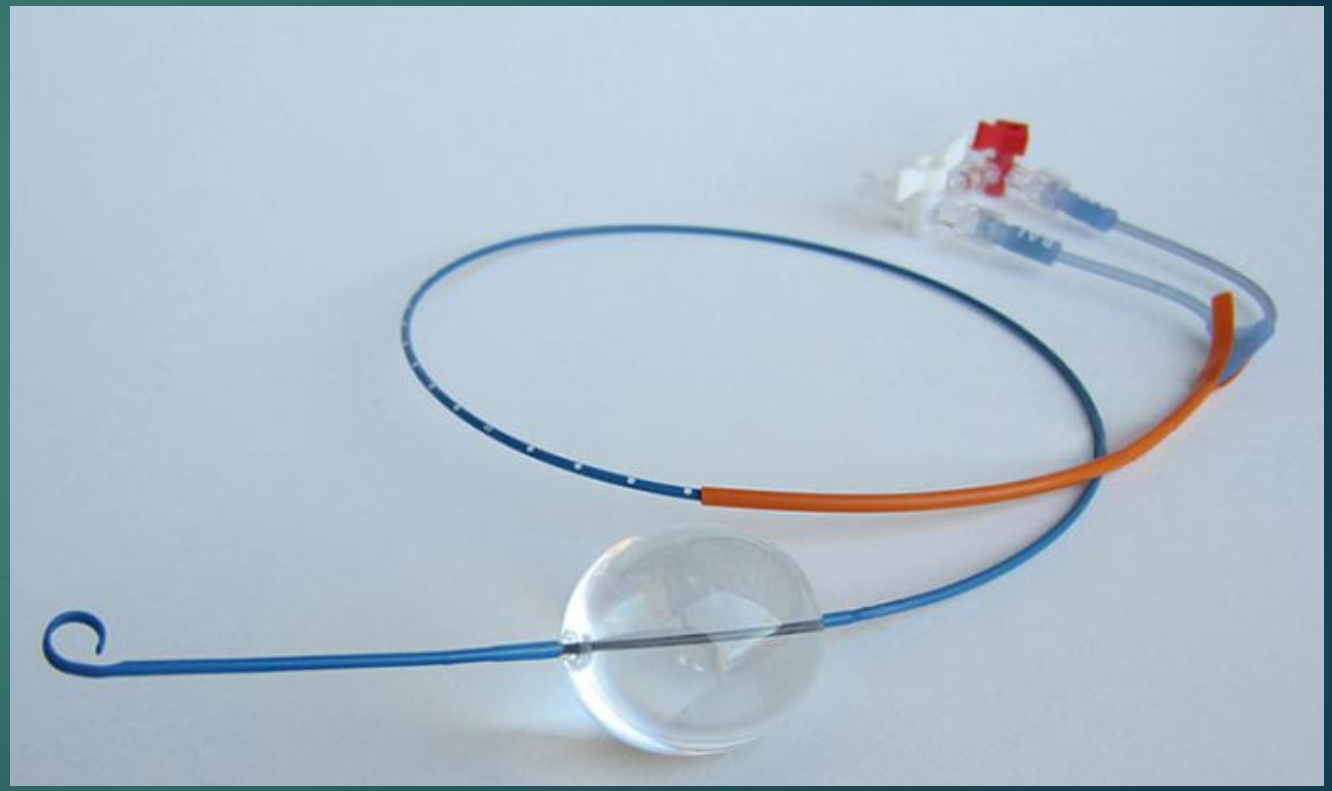
- Occlusion balloons
  - Less logistically challenging
    - →Can be placed with portable c-arm in OR



REBOA occlusion balloon

Embolization vs Occlusion Balloon

- Occlusion Balloons
  - Less technically challenging
    - No need to select individual vessels



REBOA occlusion balloon

Kohi, et al. JVIR 2017

Embolization for Cesarian Hysterectomy

- Does embolization decrease hemorrhage from immediate hysterectomy?
  - Probably

Embolization for Cesarian Hysterectomy

- Is it worth doing?
  - Maybe for patients with most extensive disease
  - Probably not for most PAS patients

Patients Not Treated With Cesarian Hysterectomy

- Does embolization improve outcomes in patients who *do not* undergo immediate hysterectomy?
  - Patients with most severe PAS
    - May benefit from delayed hysterectomy(?)

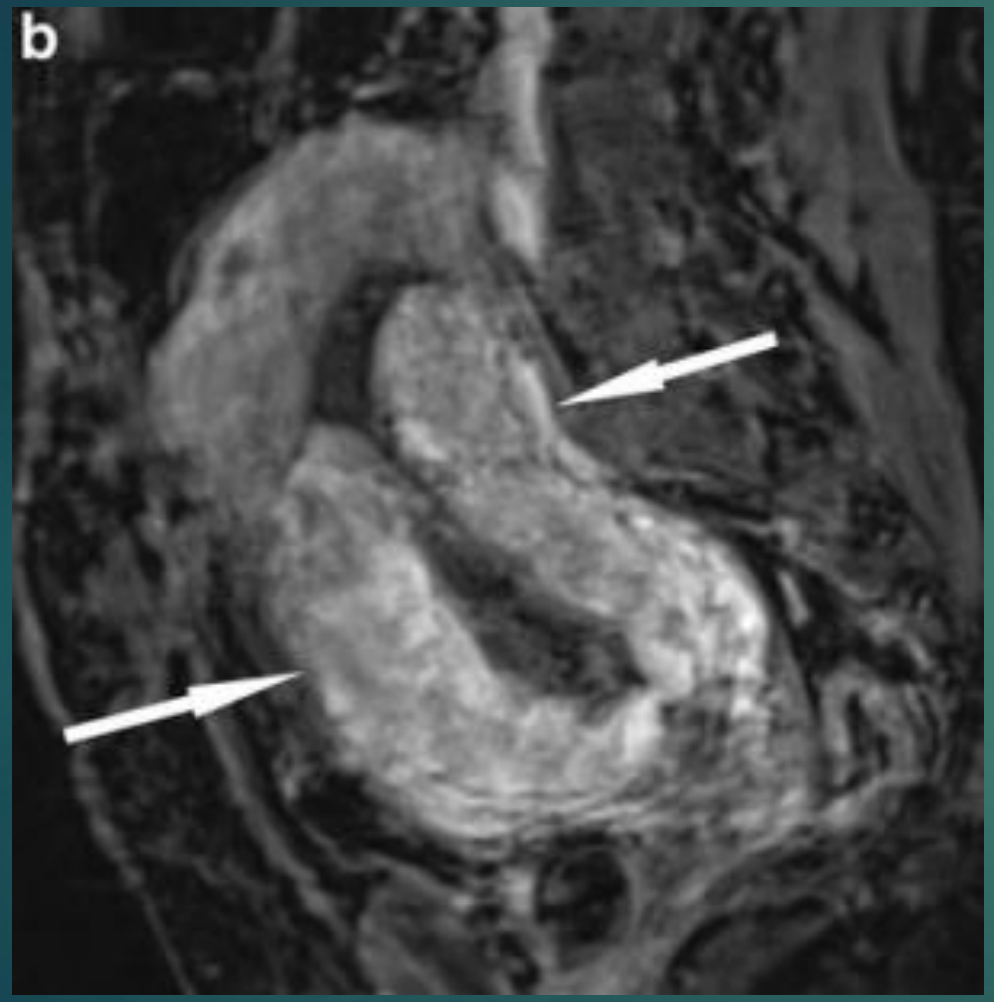
Patients Not Treated With Cesarian Hysterectomy

- Does embolization improve outcomes in patients who *do not* undergo immediate hysterectomy?
  - Patients with most severe PAS
    - May benefit from delayed hysterectomy(?)
  - Patients who wish to avoid hysterectomy
    - Potentially preserve fertility

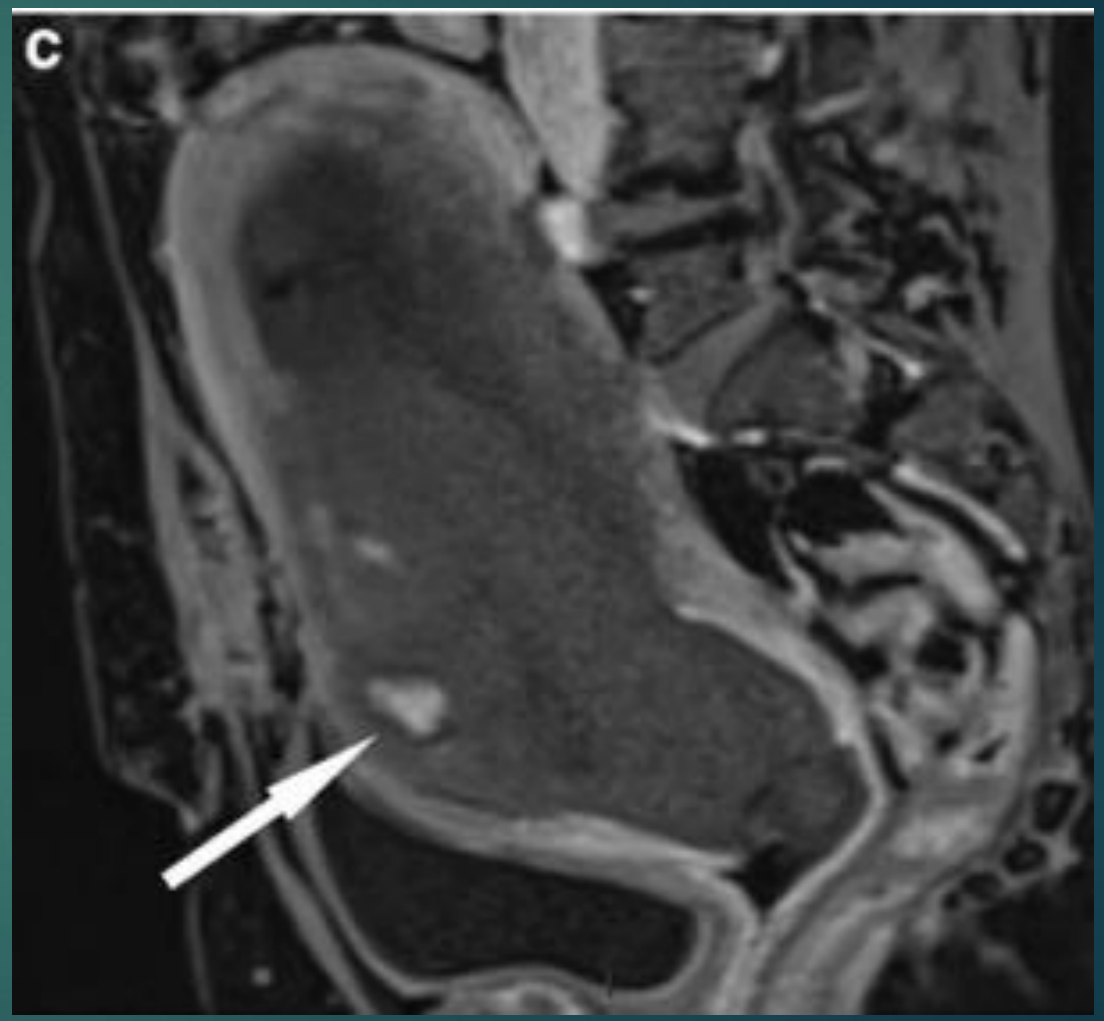
Devascularization of Placenta

- Accelerates resorption of the placenta
  - Embolization: 17 weeks
  - No embolization: 32 weeks

Soyer, et al. Eur Radiol 2013



No Embolization



Post-Embolization

Transfusion Requirements with Hybrid Management of Placenta Accreta Spectrum Incorporating Targeted Embolization and a Selective Use of Delayed Hysterectomy

Luke A. Gatta, MD[1,2] Jeremy M. Weber, MS[3] Jennifer B. Gilner, MD, PhD[1,2] Paula S. Lee, MD, MPH[1,4] Chad A. Grotegut, MD, MSc[1,2] Katherine A. Herbert, MD[5] Mustafa Bashir, MD[6] Carl F. Pieper, DrPH[2] James Ronald, MD, PhD[6] Waleska Pabon-Ramos, MD, MPH[6] Ashraf S. Habib, MBBCh[5] Kyle C. Strickland, MD, PhD[7] Angeles Alvarez Secord, MD, SC[1,4] Andra H. James, MD, MPH[1,2]

[1] Department of Obstetrics and Gynecology, Duke University Hospital, Durham, North Carolina
[2] Division of Maternal-Fetal Medicine, Duke University Hospital, Durham, North Carolina
[3] Department of Biostatistics and Bioinformatics, Duke University Hospital, Durham, North Carolina
[4] Division of Gynecologic Oncology, Duke University Hospital, Durham, North Carolina
[5] Department of Anesthesiology, Duke University Hospital, Durham, North Carolina
[6] Department of Radiology and Medicine, Duke University Hospital, Durham, North Carolina
[7] Department of Pathology, Duke University Hospital, Durham, North Carolina

Address for correspondence Luke A. Gatta, MD, Maternal-Fetal Medicine, 2608 Erwin Road, Suite 220, Durham NC 27705 (e-mail: luke.gatta@duke.edu).

Am J Perinatol 2022;39:1503–1513.

Delayed Hysterectomy

- Outcomes from immediate and delayed hysterectomy
  - Embolization
  - No embolization

Transfusion Requirements with Hybrid Management of Placenta Accreta Spectrum Incorporating Targeted Embolization and a Selective Use of Delayed Hysterectomy

Society for Maternal-Fetal Medicine
High-risk pregnancy experts

Gatta, et al. Am J Perinatol 2022

Findings

	Scheduled	
	Embolization	No Embolization
Total EBL	1.275	3
% requiring blood	30%	83%
% requiring FFP	10%	50%
% requiring ICU	0%	50%

Gatta, et al. Am J Perinatol 2022

Findings

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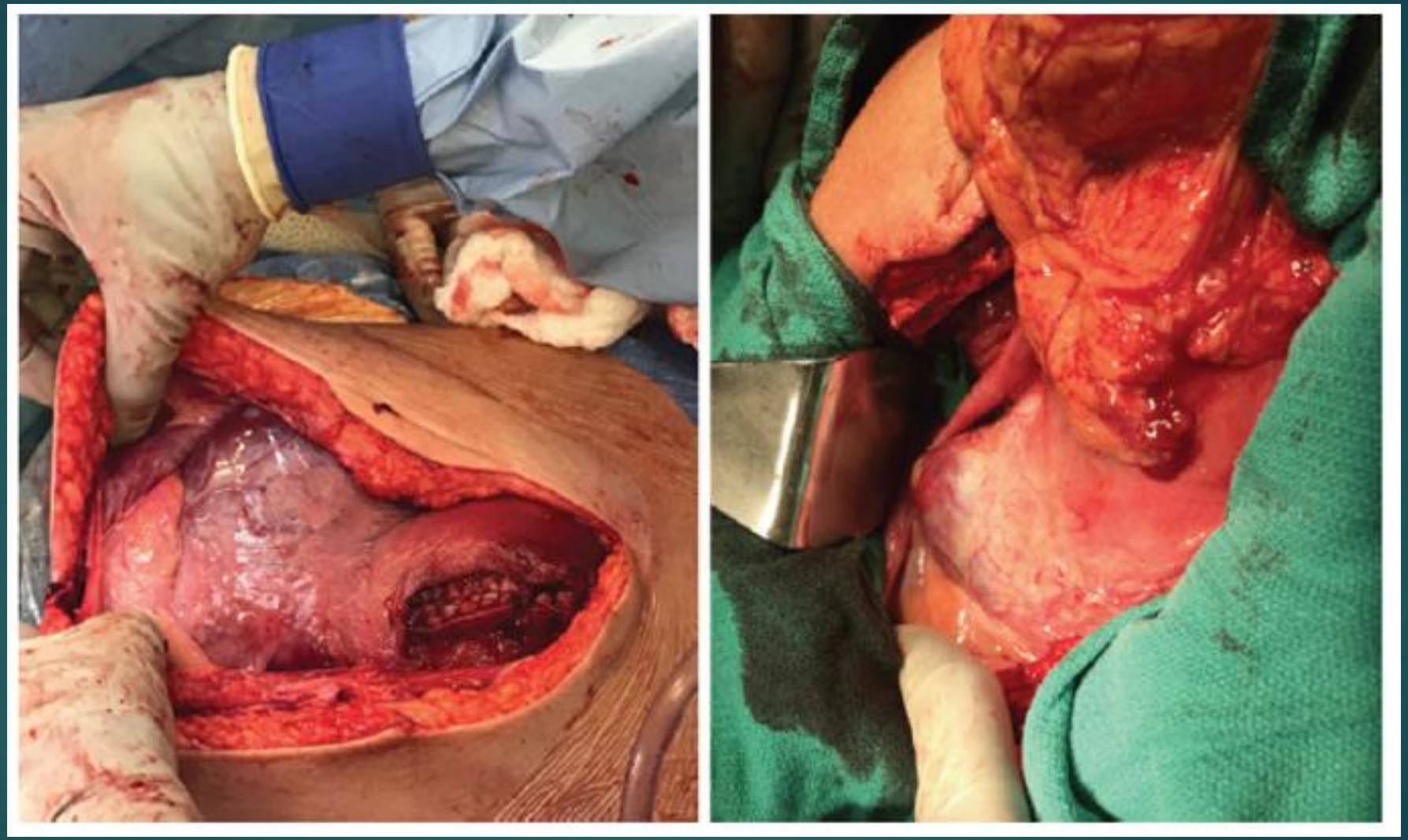
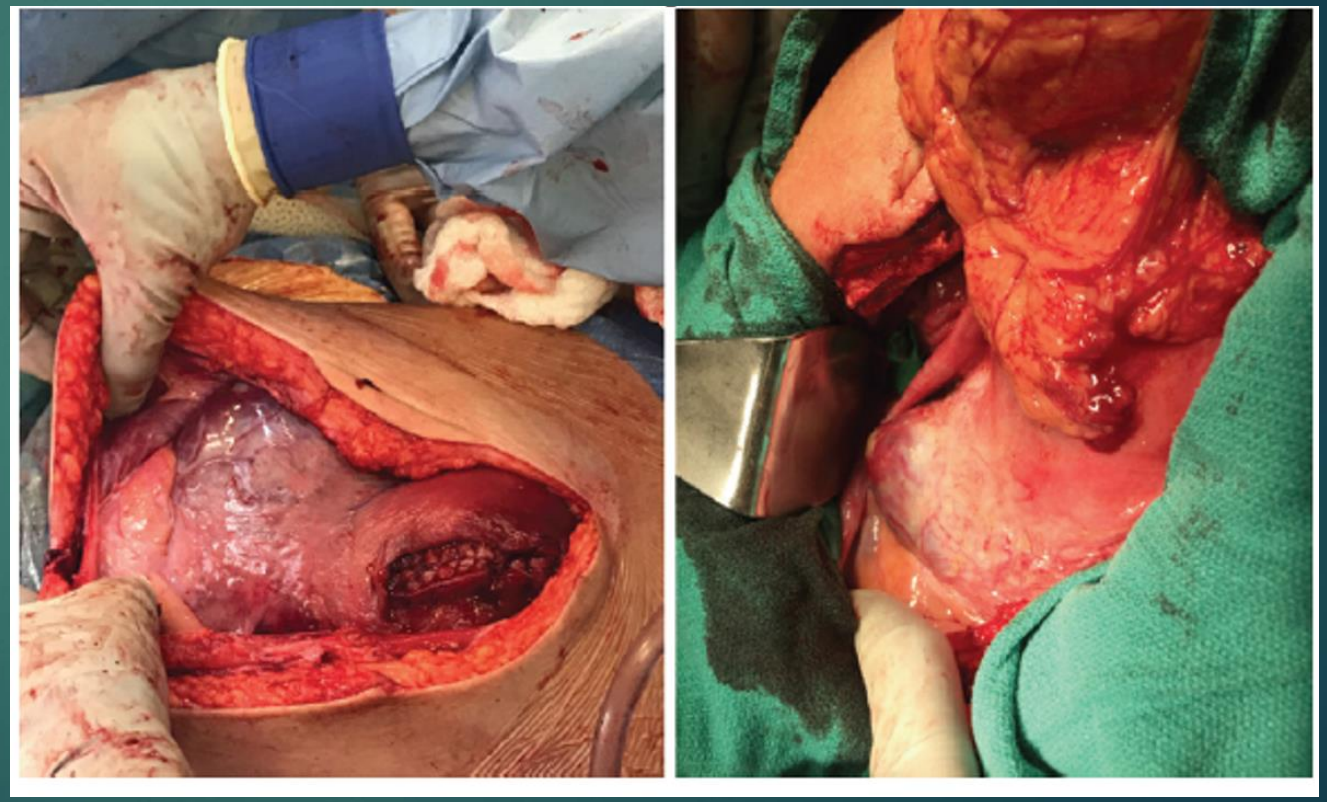
Gatta, et al. Am J Perinatol 2022



Day 0

Day 42

- Does embolization improve outcomes from delayed hysterectomy?



Day 0

Day 42

- Does embolization improve outcomes from delayed hysterectomy?
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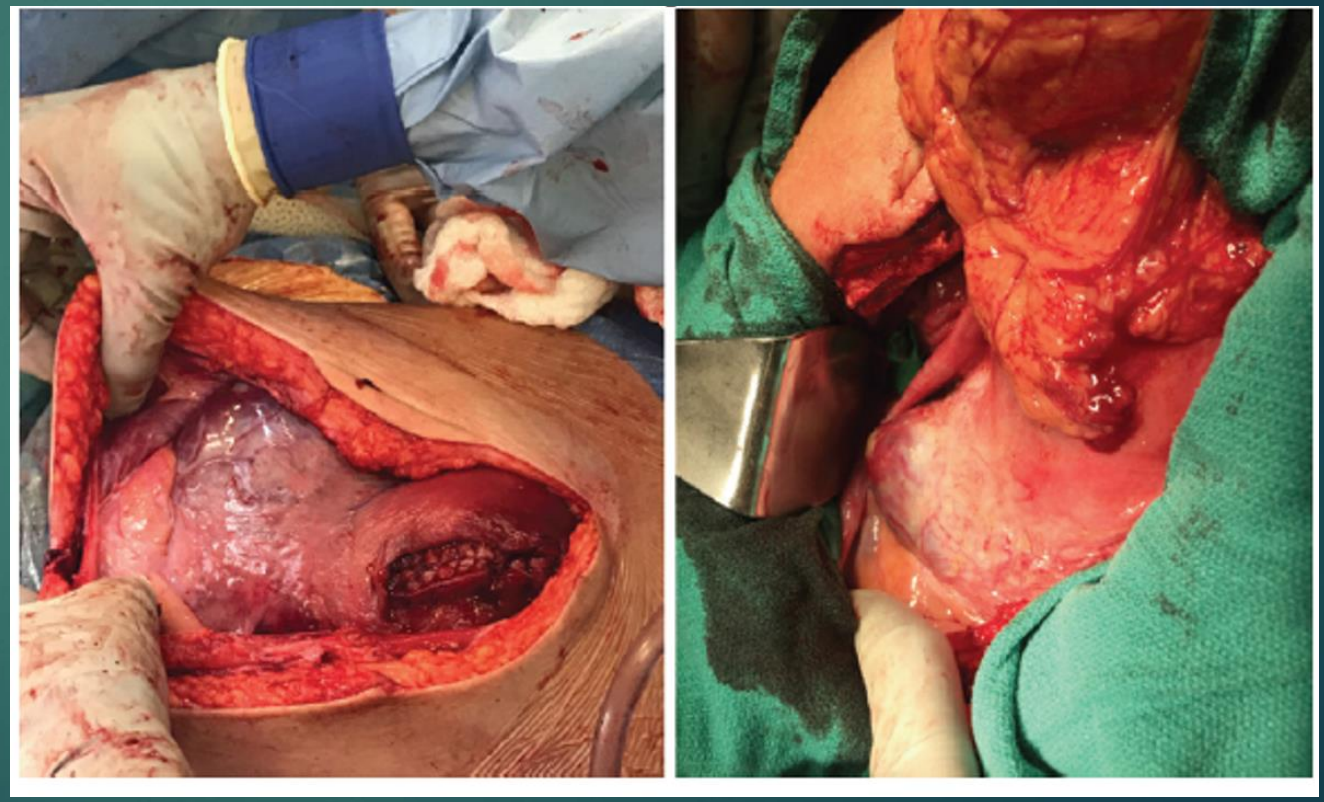


Day 0 Day 42

Uterine Preservation

- Does embolization decrease need for hysterectomy?

Kohi, et al. JVIR 2017

Uterine Preservation

- Does embolization decrease need for hysterectomy?
  - Conflicting evidence

Kohi, et al. JVIR 2017

Embolization Unhelpful(?)

- 45 patients with uterus preserving surgery
  - 26 UAE at time of delivery
  - 19 no endovascular intervention

Pan, et al. Int J Gyn Ob 2017

Embolization Unhelpful(?)

- Embolization
  - Did not decrease need for hysterectomy

Pan, et al. Int J Gyn Ob 2017

Embolization Unhelpful(?)

- Embolization
  - Did not decrease need for hysterectomy
  - Did not decrease need for massive blood transfusion

Pan, et al. Int J Gyn Ob 2017

Embolization Unhelpful(?)

- Embolization
  - Did not decrease need for hysterectomy
  - Did not decrease need for massive blood transfusion
  - 1 patient required urgent hysterectomy for uterine necrosis

Pan, et al. Int J Gyn Ob 2017

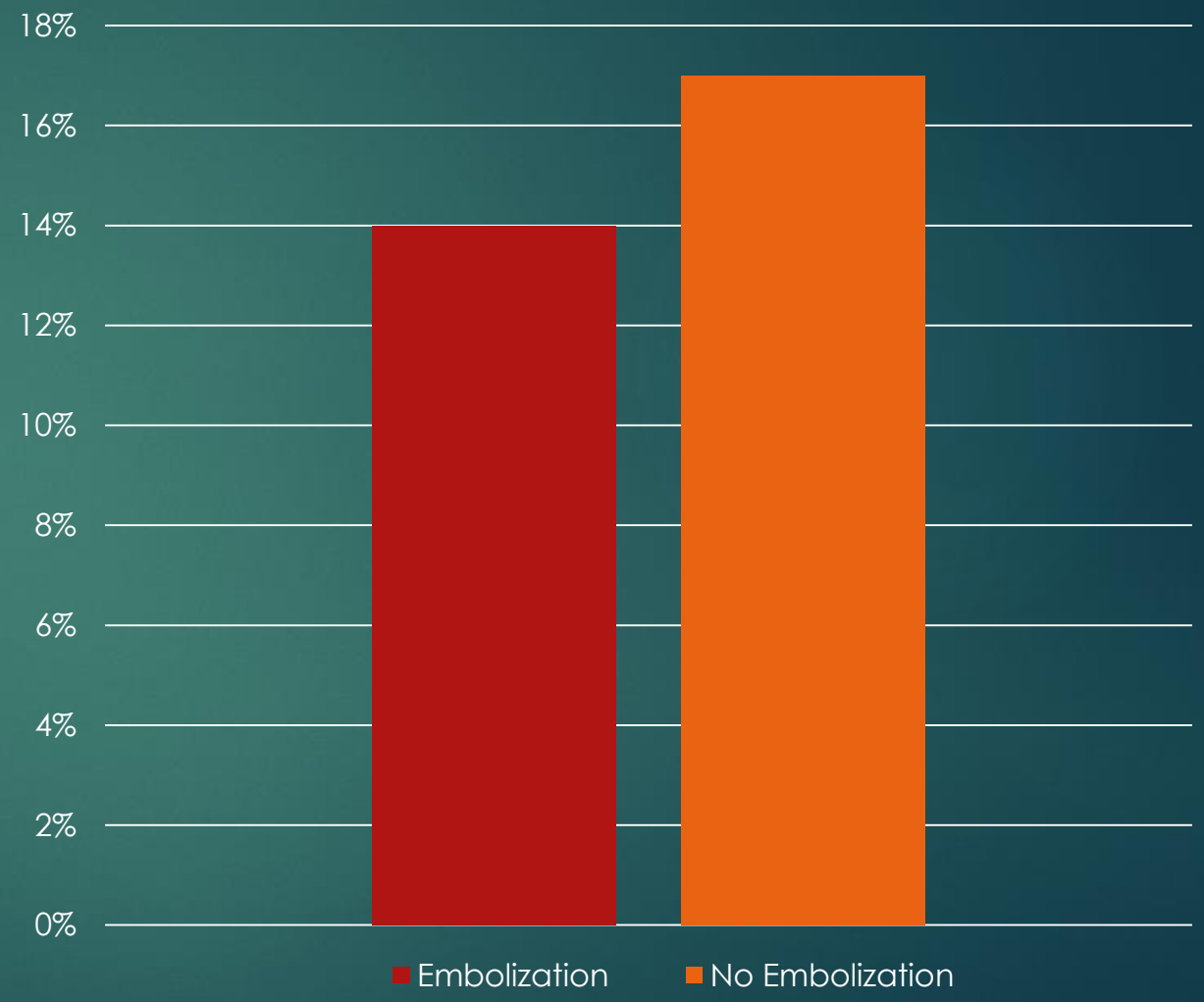
Uterine Preservation

- 272 women with uterus preserving treatment
  - 64 underwent embolization
  - 208 no embolization

Mohr-Sasson, et al. Acta Obstet Gynecol Scand 2020

Uterine Preservation

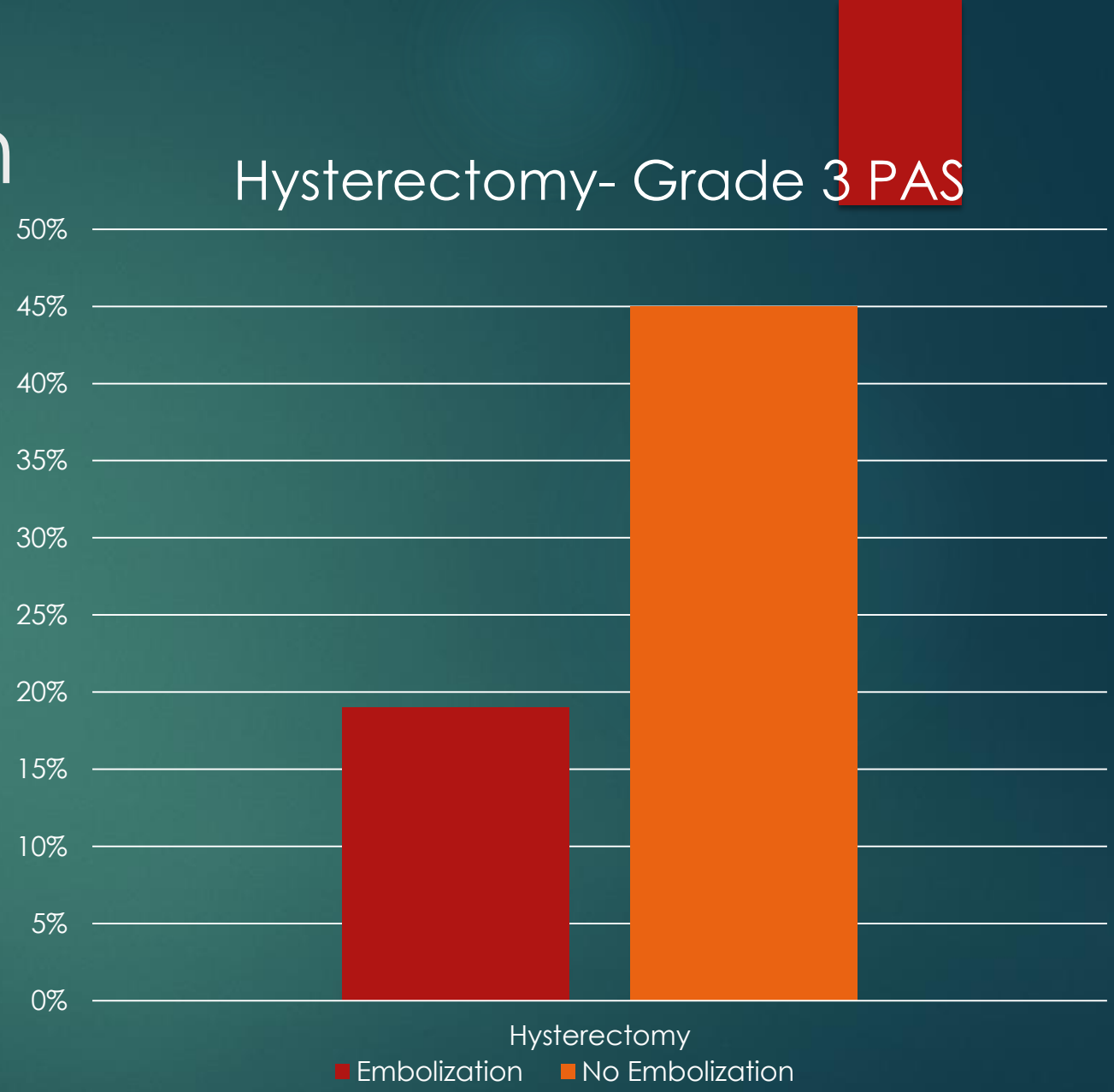
- Hysterectomy, all patients
  - Embolization 9/64 (14%)
  - No embolization 35/208 (17%)



Mohr-Sasson, et al. Acta Obstet Gynecol Scand 2020

Uterine Preservation

- Hysterectomy, patients with grade 3 PAS
  - Embolization 19%
  - No embolization 45%



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Journal of Obstetrics and Gynaecology, November 2015; 35: 777–782

ISSN 0144-3615 print/ISSN 1364-6893 online
DOI: 10.3109/01443615.2015.1011106

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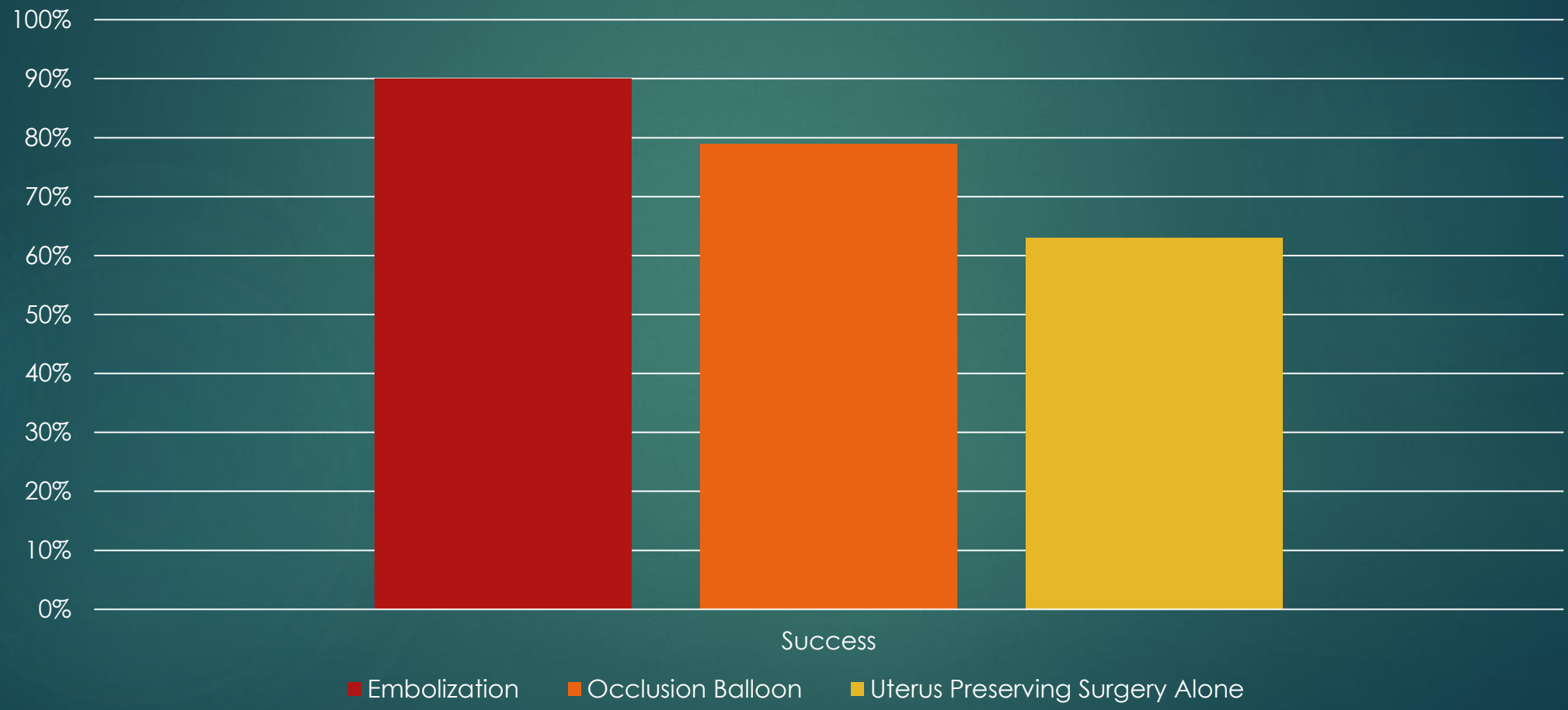
REVIEW

Systematic review of uterus-preserving treatment modalities for abnormally invasive placenta

J. Mei, Y. Wang, B. Zou, Y. Hou, T. Ma, M. Chen & L. Xie

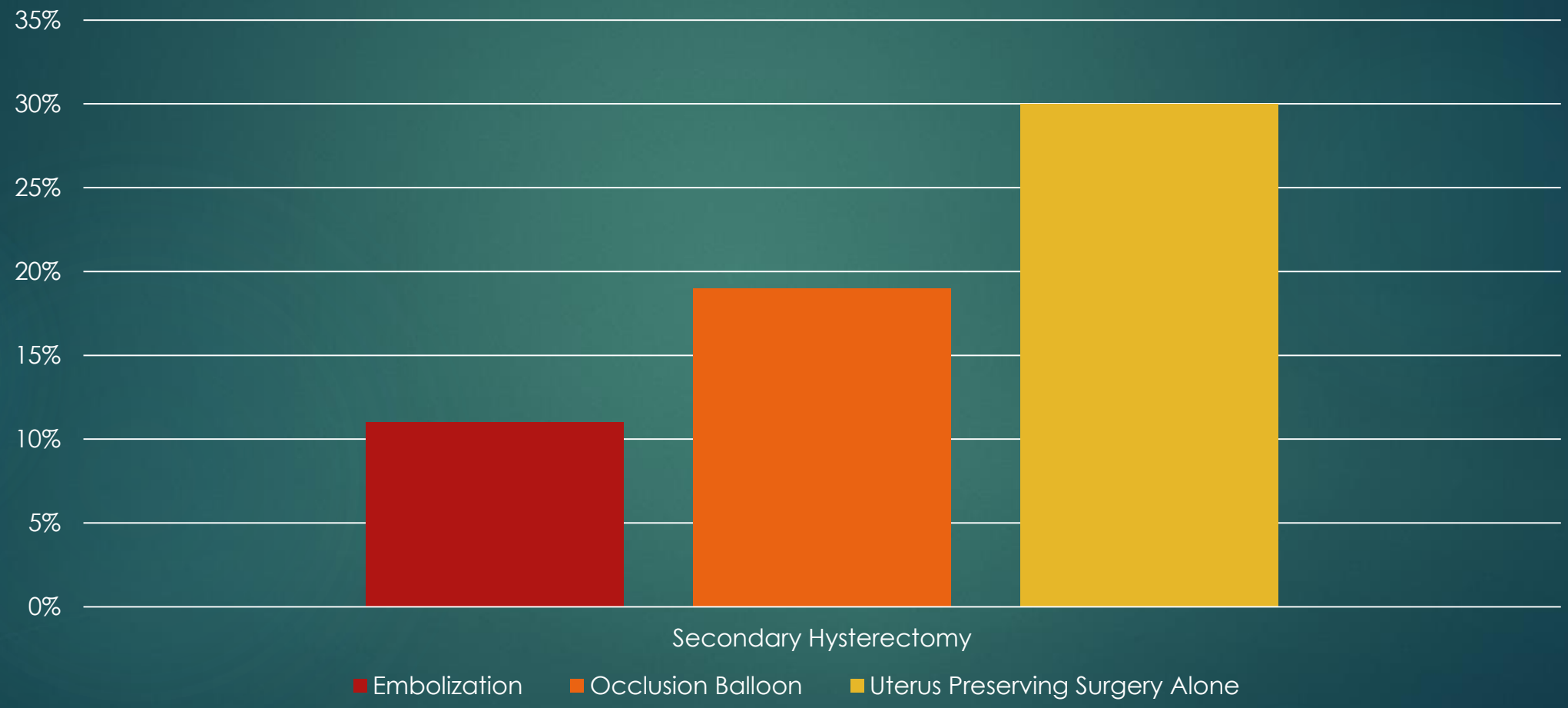
Department of Obstetrics and Gynecology, Sichuan Academy of Medical Sciences, Sichuan Provincial People's Hospital, Chengdu, P. R. China

Successful Uterus Preservation



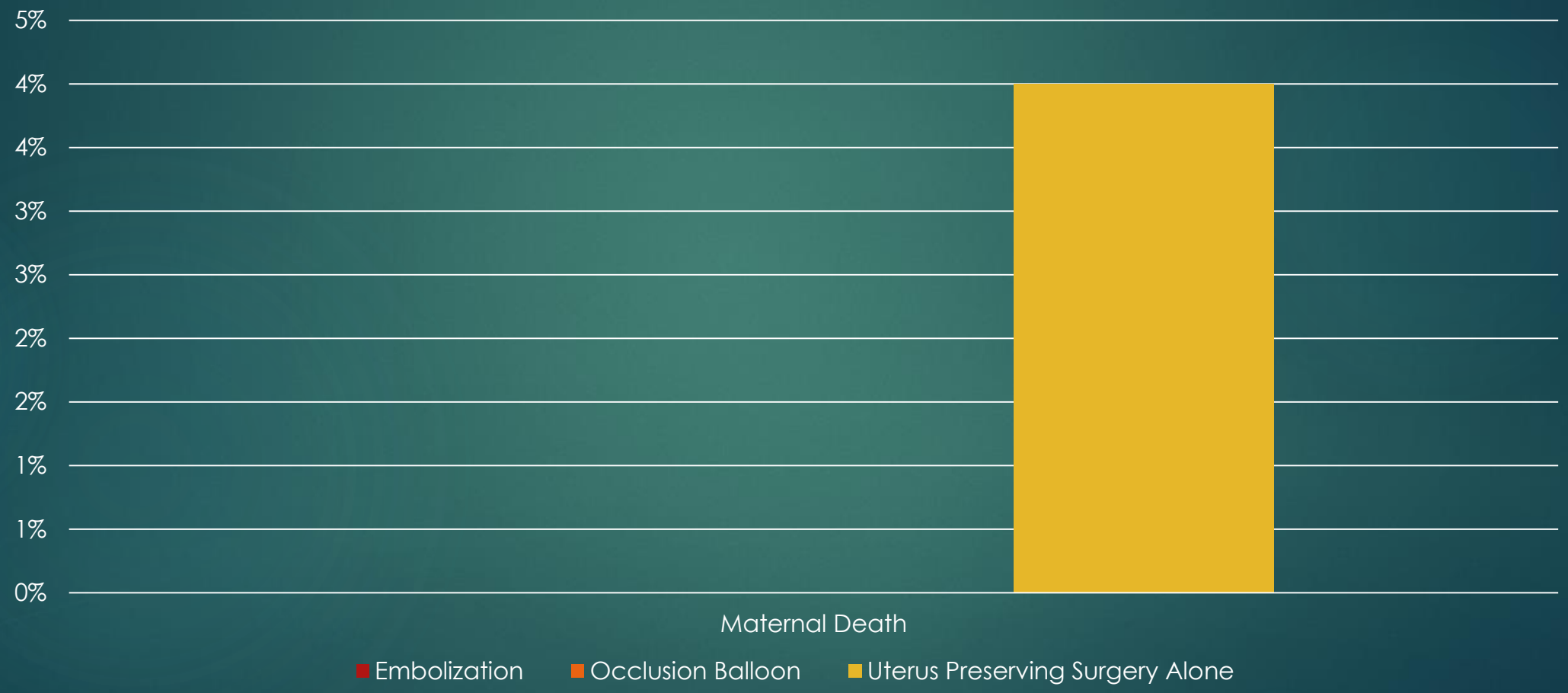
Mei, et al. J Ob Gyn 2015

Secondary Hysterectomy



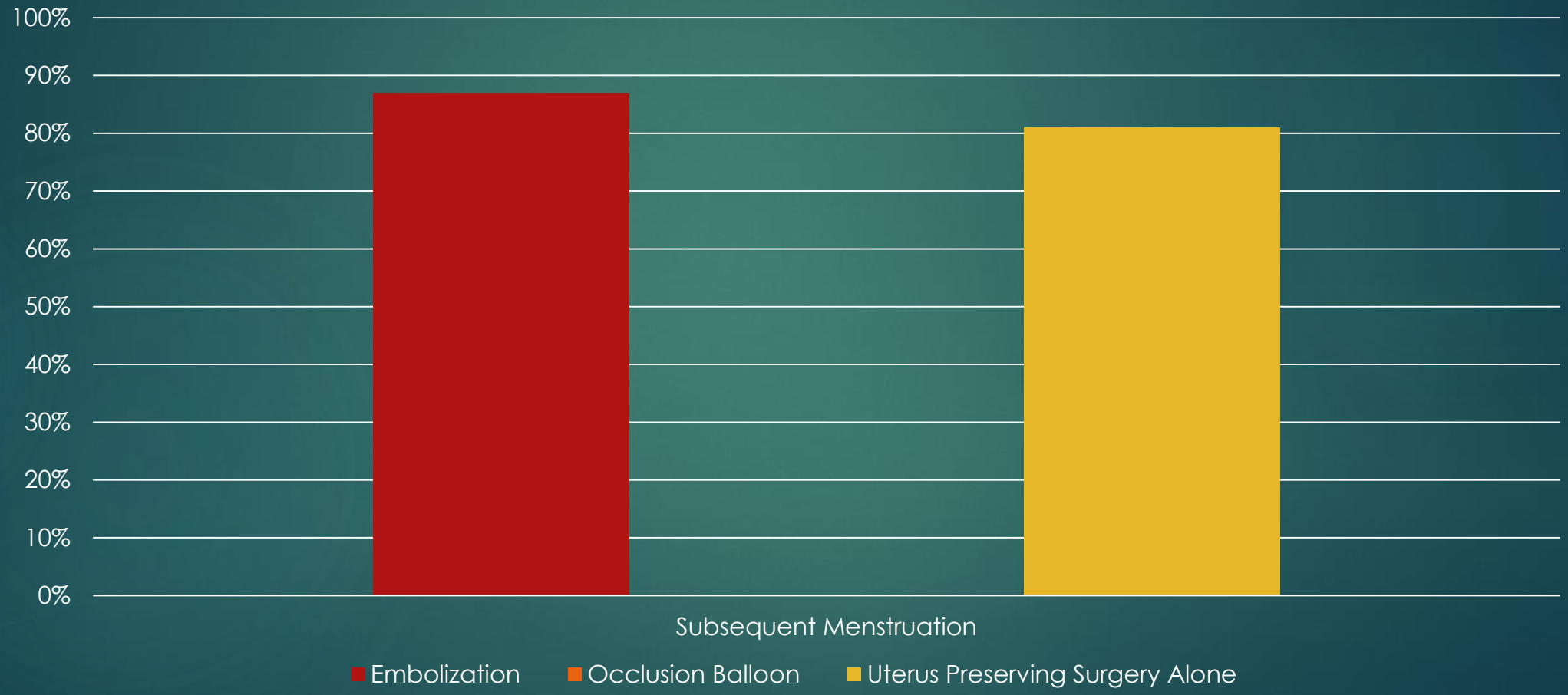
Mei, et al. J Ob Gyn 2015

Maternal Death



Mei, et al. J Ob Gyn 2015

Resumption of Menstruation



Mei, et al. J Ob Gyn 2015

Uterine Preservation

- Does embolization decrease need for hysterectomy?
  - Conflicting evidence

Kohi, et al. JVIR 2017

Uterine Preservation

- Does embolization negatively to impact fertility?

Kohi, et al. JVIR 2017

Does Embolization Decrease Fertility?

- Conflicting data from the fibroid literature
  - Decreased ovarian reserve?
  - Spontaneous abortion?

Shamy, et al. Acta Obstet Gynecol Scand 2020
Tulandi, et al. Fertil Steril 2002
McLucas, et al. Min Inv Ther 2016

Impact on Future Pregnancy(?)

- Meta-analysis of outcomes
  - 483 subsequent pregnancies in women who required embolization for post-partum hemorrhage during a prior pregnancy

A systematic review and meta-analysis of obstetric and maternal outcomes after prior uterine artery embolization

Shinya Matsuzaki[1,2,3,7], Misooja Lee[1,7], Yoshikazu Nagase[1], Mariko Jitsumori[1], Satoko Matsuzaki[3,4], Michihide Maeda[2], Tsuyoshi Takiuchi[1], Aiko Kakigano[5], Kazuya Mimura[1], Yutaka Ueda[1], Takuji Tomimatsu[1], Masayuki Endo[1,6] & Tadashi Kimura[1]

Matsuzaki, et al. Nature Scientific Reports 2021

Long Term Outcomes of Embolization

- Compared with pregnancies in the general population
- No difference in risk of
  - Placenta previa

Matsuzaki, et al. Nature Scientific Reports 2021

Long Term Outcomes of Embolization

- Compared with pregnancies without history of embolization
- No difference in risk of
  - Placenta previa
  - Fetal growth restriction

Matsuzaki, et al. Nature Scientific Reports 2021

Long Term Outcomes of Embolization

- Compared with pregnancies without history of embolization
- No difference in risk of
  - Placenta previa
  - Fetal growth restriction
  - Preterm birth

Matsuzaki, et al. Nature Scientific Reports 2021

Long Term Outcomes of Embolization

- Compared with pregnancies without history of embolization
- Increased risk for
  - PAS
  - Post-partum hemorrhage

Matsuzaki, et al. Nature Scientific Reports 2021

TABLE 4 Long-term outcomes

	CD with UAE (n = 49), n (%)	CD without UAE (n = 139), n (%)	*P* value
Complete follow up	29 (59.18)	72 (51.79)	.36
Desire to conceive	15 (51.72)	38 (52.77)	.87
Trial to conceive	7 (24.14)	24 (33.33)	.39
Abortion	1 (3.4)	4 (5.55)	.85
Pregnancy	5 (17.24)	17 (23.61)	.11
Delivery	5 (17.24)	11 (15.27)	.74

Mohr-Sasson, et al. Acta Obstet Gynecol Scand 2020

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Mohr-Sasson, et al. Acta Obstet Gynecol Scand 2020

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Mohr-Sasson, et al. Acta Obstet Gynecol Scand 2020

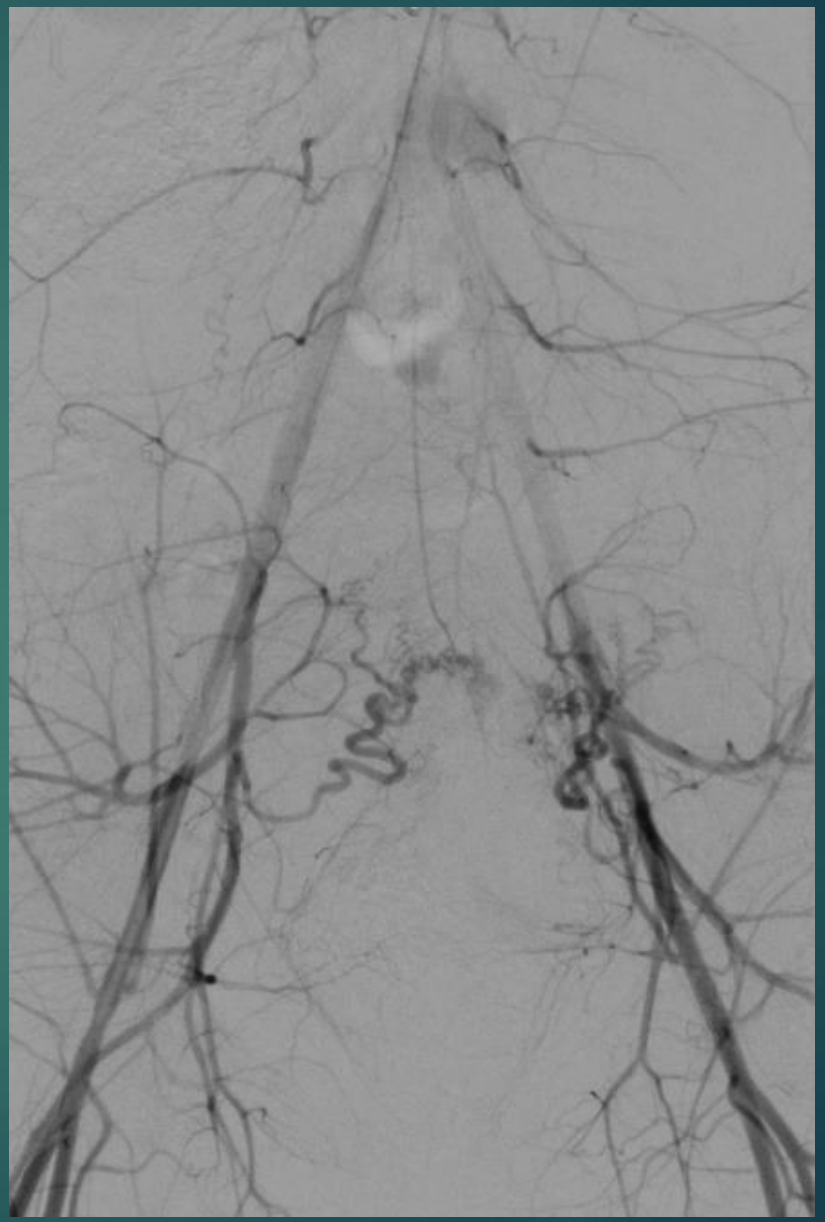
Uterine Preservation

- Does embolization negatively impact fertility?
  - Probably not significantly

Kohi, et al. JVIR 2017

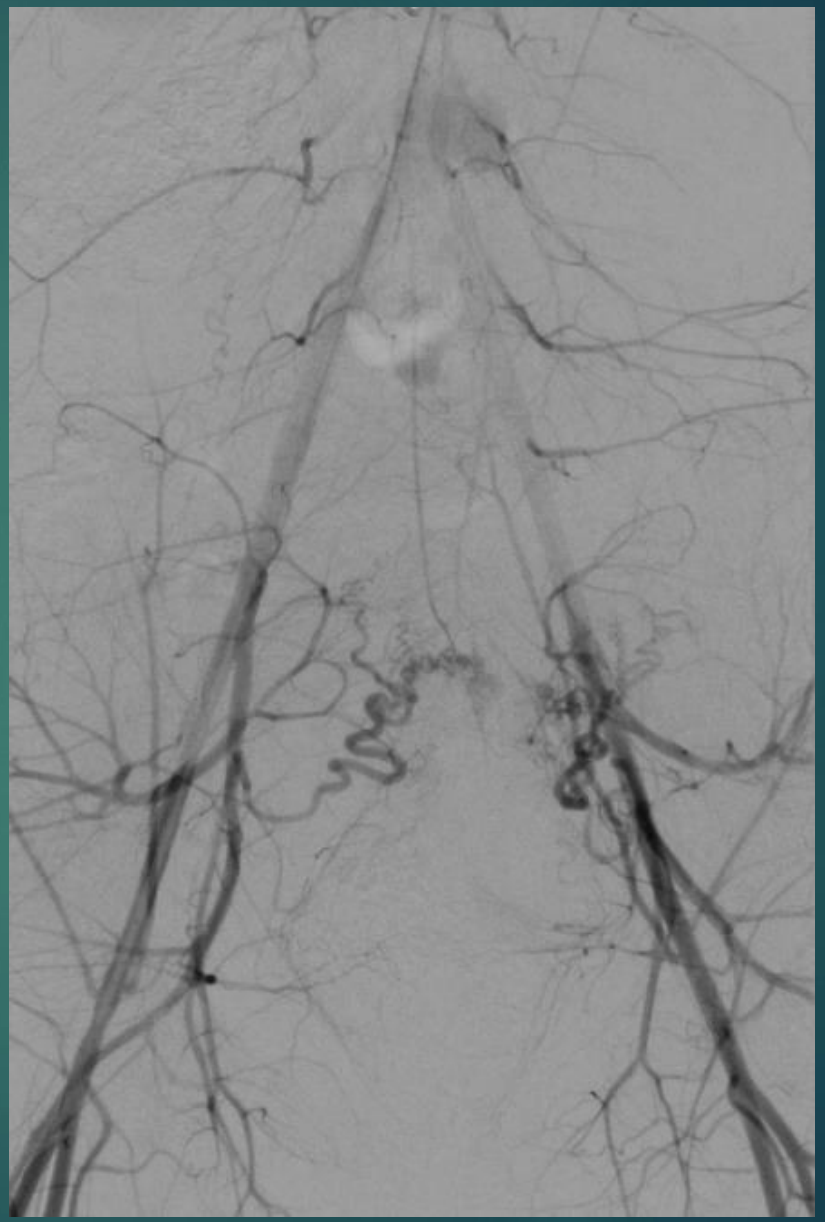
Conclusion

- Prophylactic embolization in the setting of PAS
  - Safe



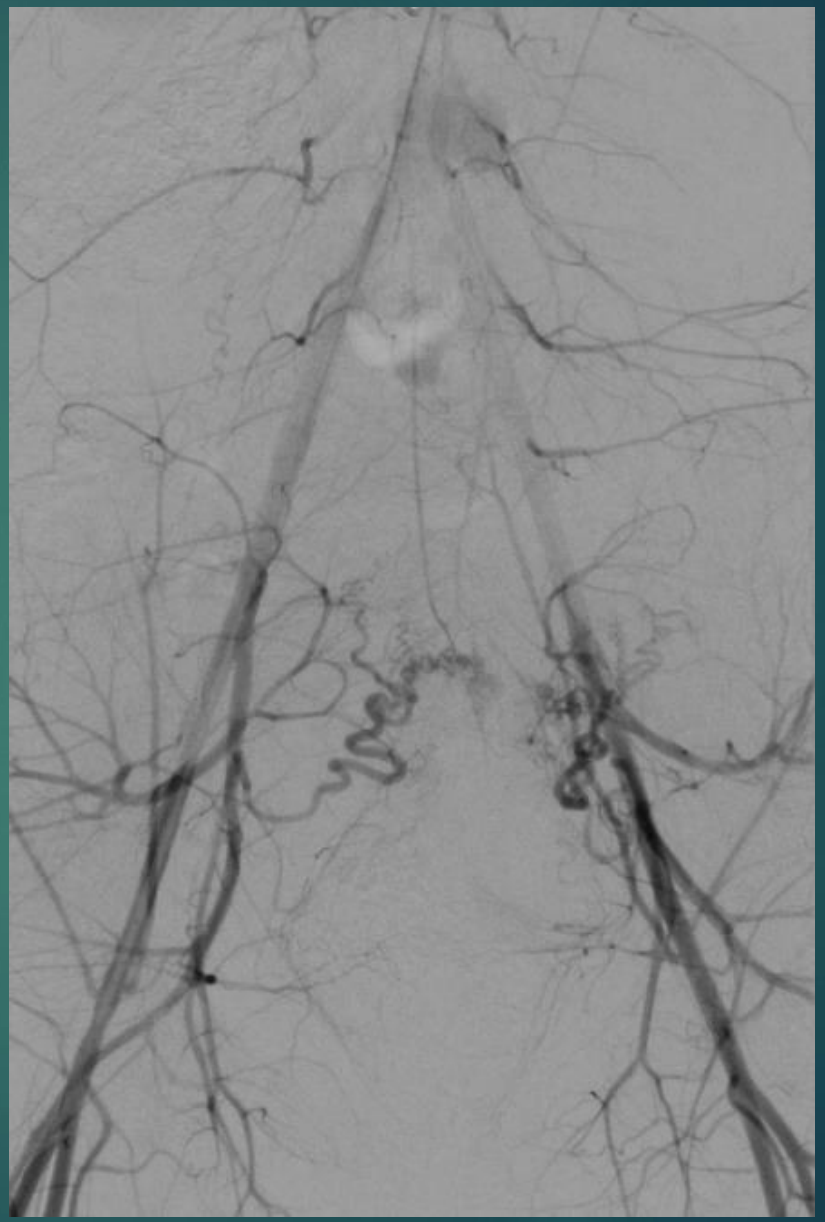
Conclusion

- Likely decreases hemorrhage during cesarian hysterectomy
  - Patients with most extensive disease
  - Most patients seem to do well with aortic occlusion balloon



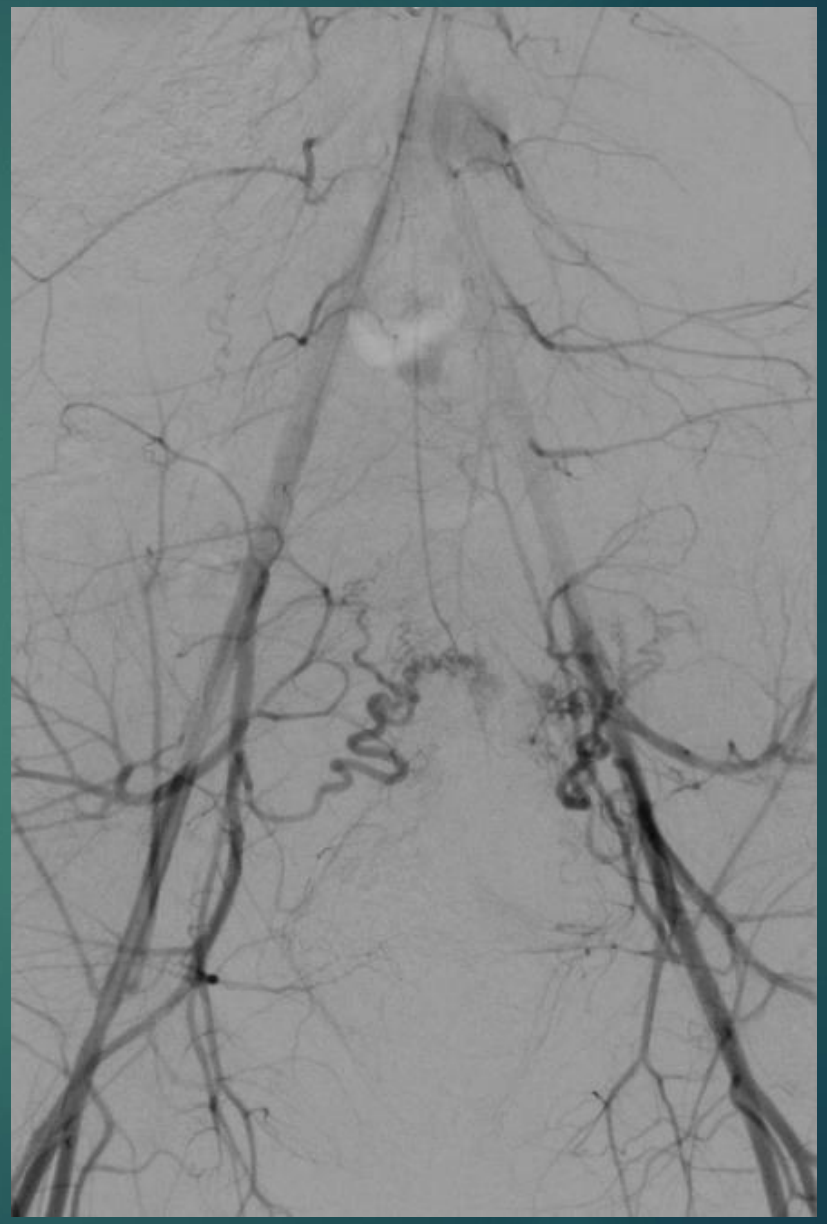
Conclusion

- Delayed hysterectomy
  - Appears to improve outcomes for patients with most extensive disease



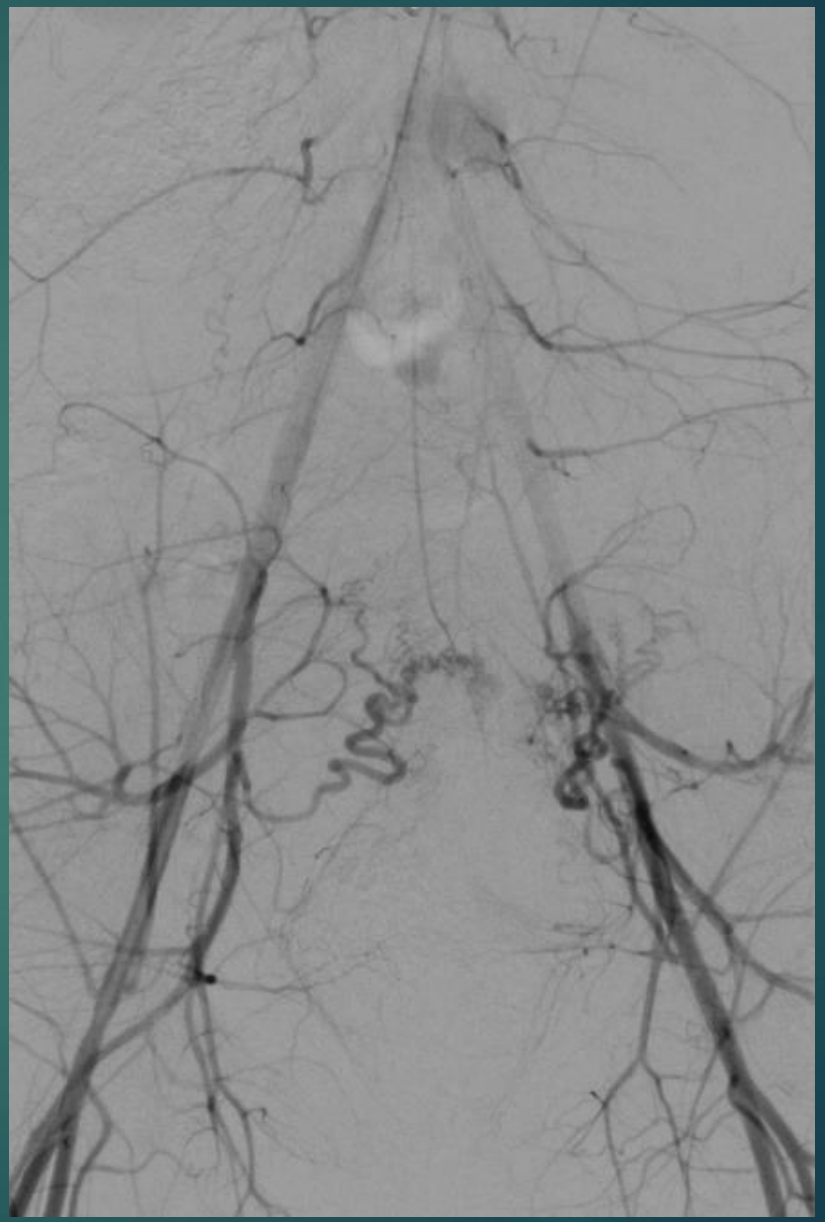
Conclusion

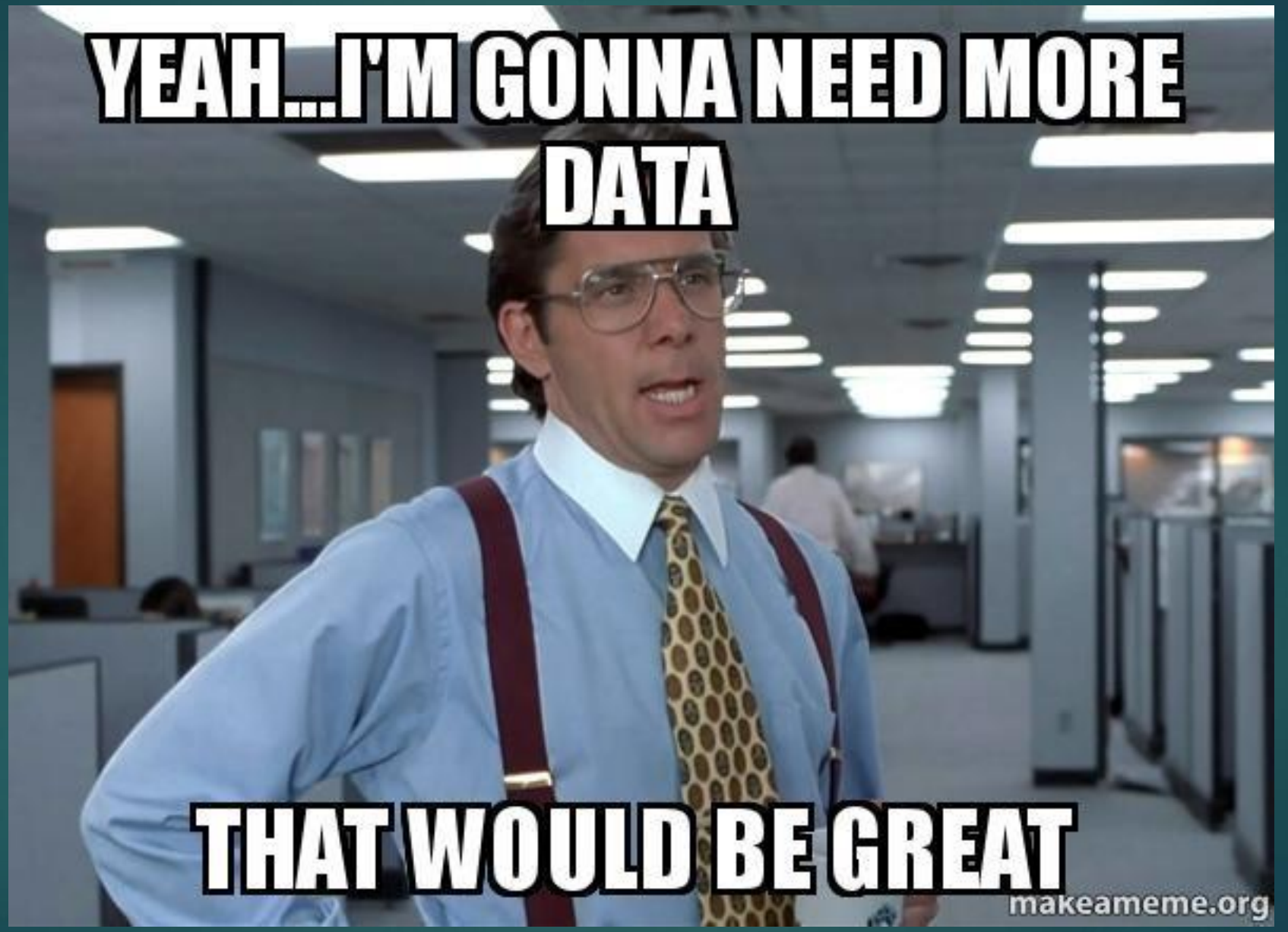
- Preservation of uterus
  - May decrease need for hysterectomy



Conclusion

- Fertility
  - Does not appear to adversely impact fertility




YEAH...I'M GONNA NEED MORE DATA
THAT WOULD BE GREAT
makeameme.org

Thank You

Texas Children's Hospital®