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CASE SERIES

ANESTHETIC MANAGEMENT OF POST-UTERINE TRANSPLANT CESAREAN DELIVERY

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HISTORY AND OVERVIEW

- Absolute uterine factor infertility (AUFI) impacts 1:500 women
- About 1:4000 – 5000 w/ uterine agenesis - Mayer-Rokitansky-Küster-Hauser or MRKH syndrome
- Uterine transplant - emerging novel treatment
- First successful uterine transplant live birth: Sweden (2014), Sahlgrenska University Hospital, Dr. Mats Brännström [1] Mother (61 yrs)→daughter (35yrs)
- **Now > 100 uterine transplants and 40+ live births globally**
  - Countries reporting procedures: Sweden, Czech Republic, Germany, Spain, Turkey, Saudi Arabia, India, China, Lebanon, USA and Brazil
  - First successful deceased donor UTx with live birth: Brazil (2017).[2]
- US programs started ~2016; Cleveland Clinic (now closed) and Baylor University (DUETS) led early efforts
  - **Living donor only programs (78% success rates)**: [3] UAB
  - **Living (78%) and deceased donor (68% success rates) programs**: Penn and Baylor

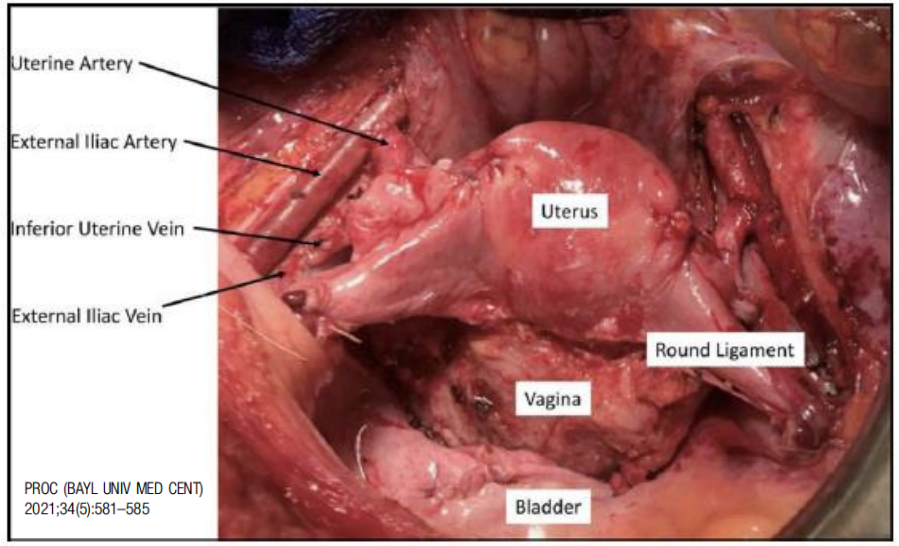

Figure 2. Uterus graft in situ after reperfusion and vaginal anastomosis. The uterine vessels are anastomosed bilaterally to the external iliac vessels. The round ligaments are suspended to the pelvic side wall.

1. Lancet. 2015 Feb 14;385(9968):607-616.
2. Lancet. 2019 Dec 22;392(10165):2697-2704.
3. Curr Opin Organ Transplant. 2021 Dec 1;26(6):616-626.

CLINICAL COURSE: SELECTION, PREPARATION AND MANAGEMENT

- **Selection:** women with AUFI; age 20–40, vaginal length > or = 5cm. Modeled on existing processes for kidney and liver transplantation
- **United Network for Organ Sharing (UNOS)** ~2021 established rules (https://unos.org)
- **Living donors:** multiparous, healthy, no uterine or surgical issues
- **Deceased donors:** brain-dead, hemodynamically stable, consented for donation
- **Pre-op:** MRI, angiography, IVF with embryo cryopreservation
- **Pre-transplant counseling** covers risks, IVF outcomes, long-term health
- **Surgery:** complex vascular anastomosis; laparotomy (recipient), robotic/open (donor-takes 6 – 11 hours)
- **Immunosuppression (based on kidney protocols):** Induction (antithymocyte globulin (ATG), methylprednisolone); maintenance (tacrolimus + antimetabolite – e.g., mycopheylate mofetil or azathioprine). Rejection treated with methylprednisolone.
  - Potential complications of immunosuppression: nephrotoxicity, diabetes, risk of malignancy
- **Post-op monitoring:** established inflow/outflow**,** Duplex US, biopsies cervix, rejection surveillance. 3 months to establish menstrual regularity.
- **Pregnancy**: frozen embryo transfer 3–12 months post-op, high-risk care, cesarean delivery at 35–37 weeks – mandatory given aberrant structural integrity of the graft and uncertainty regarding how/if labor progresses. **Maximum 2 deliveries.**
- Uterus removed 2nd post-delivery to discontinue immunosuppression.

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JAMA. 2024 Sep 10;332(10):817-824.

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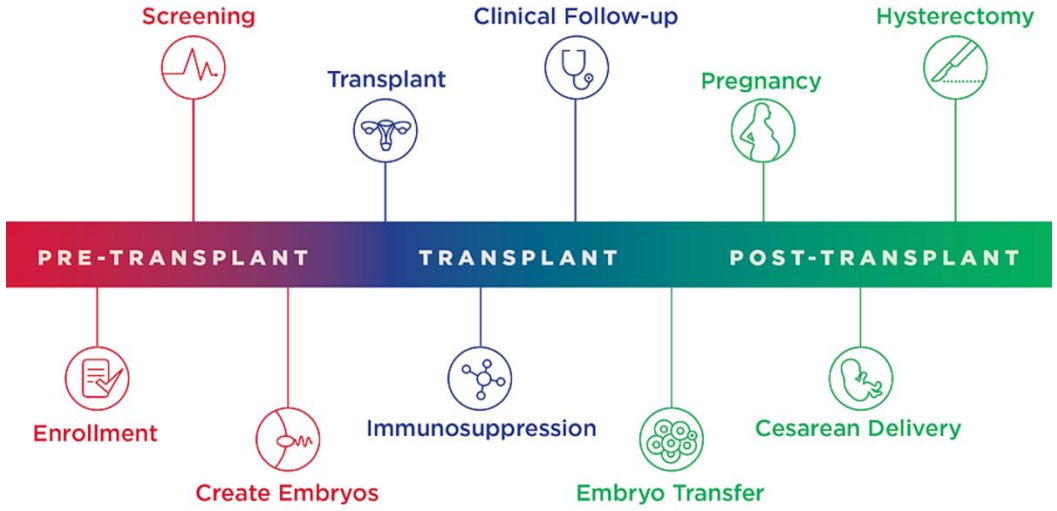
Methods and Results

- Given rarity of cases and limited data to inform best practices, we share our experience with anesthetic management of 7 deliveries post- uterine transplant at Penn
- Retrospective chart review – single center, urban academic center
- 7 cases involving 5 patients (2 with repeat delivery)
- Neuraxial (CSE or epidural) performed for all, conversion to GETA for hysterectomy



https://www.pennmedicine.org/for-patients-and-visitors/find-a-program-or-service/penn-fertility-care/uterus-transplant

Age (years)	Race	Ethnicity	Transplant Indication	Donor Type	Maintenance Immunosuppression	Gravidity/Parity	Gestational Age	Anesthesia Type	Special Monitors	Procedure	Comorbidities	Post-op pain management	EBL (mL)	Incision - skin/uterus	Apgar Scores	Birth Weight (gms)
33	White	Non-Hispanic	Mayer-Rokitansky-Küster-Hauser Syndrome	Deceased	Tacrolimus, imuran, prednisone	G1P0	30	Epidural/General	Arterial line	Cesarean Hysterectomy	Preeclampsia (severe features, acute renal insuffiency, gestational diabetes, anemia (HB 7.6)	PCEA	700	Vertical/classical	3/6/9	1310
27	White	Non-Hispanic	Mayer-Rokitansky-Küster-Hauser Syndrome	Deceased	Tacrolimus, azathioprine, prednisone	G1P0	37	Epidural	None	Cesarean Delivery	None. Fetal heart rate deceleration after induction of epidural anesthesia	PCEA	1200	Vertical/low transverse	4/6/8	2915
29	"	"	"	"	"	G2P1	36	Epidural/General	Arterial line	Cesarean Hysterectomy	Preeclampsia (severe features), acute renal insufficiency	PCEA	1000	Vertical/low transverse	1/9	3170
33	White	Non-Hispanic	Mayer-Rokitansky-Küster-Hauser Syndrome	Deceased	Tacrolimus, azathioprine, prednisone	G1P0	34	Epidural	None	Cesarean Delivery	Preeclampsia, hypothyroidism, decreased fetal movement, non-reactive NST	Epidural morphine	1000	Vertical/low transverse	8/9	1880
34	"	"	"	"	"	G2P1	37	Epidural/General	None	Cesarean Hysterectomy	Preeclampsia, hypothyroidism	PCEA (severe post-op pain)	2000	Vertical/low transverse	8/9	3310
33	Black	Hispanic	Mayer-Rokitansky-Küster-Hauser Syndrome	Deceased	Tacrolimus, azathioprine, prednisone	G1P0	38	Spinal	None	Cesarean Delivery	Anemia (Hb 10), hearing loss	Intrathecal morphine	1000	Pfannensteil/low transverse	8/6	3810
41	White	Non-Hispanic	Prior cesarean hysterectomy for PAS Grade 3	Deceased	Tacrolimus, azathioprine, prednisone	G4P0	32	Combined spinal epidural	None	Cesarean Delivery	Preclampsia (severe features), acute renal insufficiency, gestational diabetes	Intrathecal morphine	800	Pfannensteil/low transverse	7/9	1620
			Note: " = same patient, second delivery													

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Conclusions and Key Takeaways

- Uterine transplantation in U.S. < 10 years old, management rapidly evolving
- Difficulty making meaningful comparisons due to still small numbers

- Higher than expected rates of **preeclampsia and hypertensive disorders of pregnancy**
- Other complications- **placenta previa, gestational diabetes**
- 40% of patients have major obstetric complications; 60% have preterm delivery (38% neonatal RDS)

- Regional anesthesia safe and effective for cesarean delivery of transplanted uterus
- Careful interdisciplinary planning helps anticipated and manage potential complications

- Preparation for major hemorrhage is crucial, along with the availability of leukocyte-poor irradiated blood products, **however our experience has been that deliveries relatively routine – similar to accreta preparation**

- Hysterectomy of the transplanted uterus may be complex due to adhesions.
- **Need registry data** due to still relatively rare occurrences, including recording long term medical and psychological outcomes

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