

Transuterine Relocation of Pregnant Uterine Horn Segment in an Exploratory Rat Model with Implications for Ectopic Pregnancy

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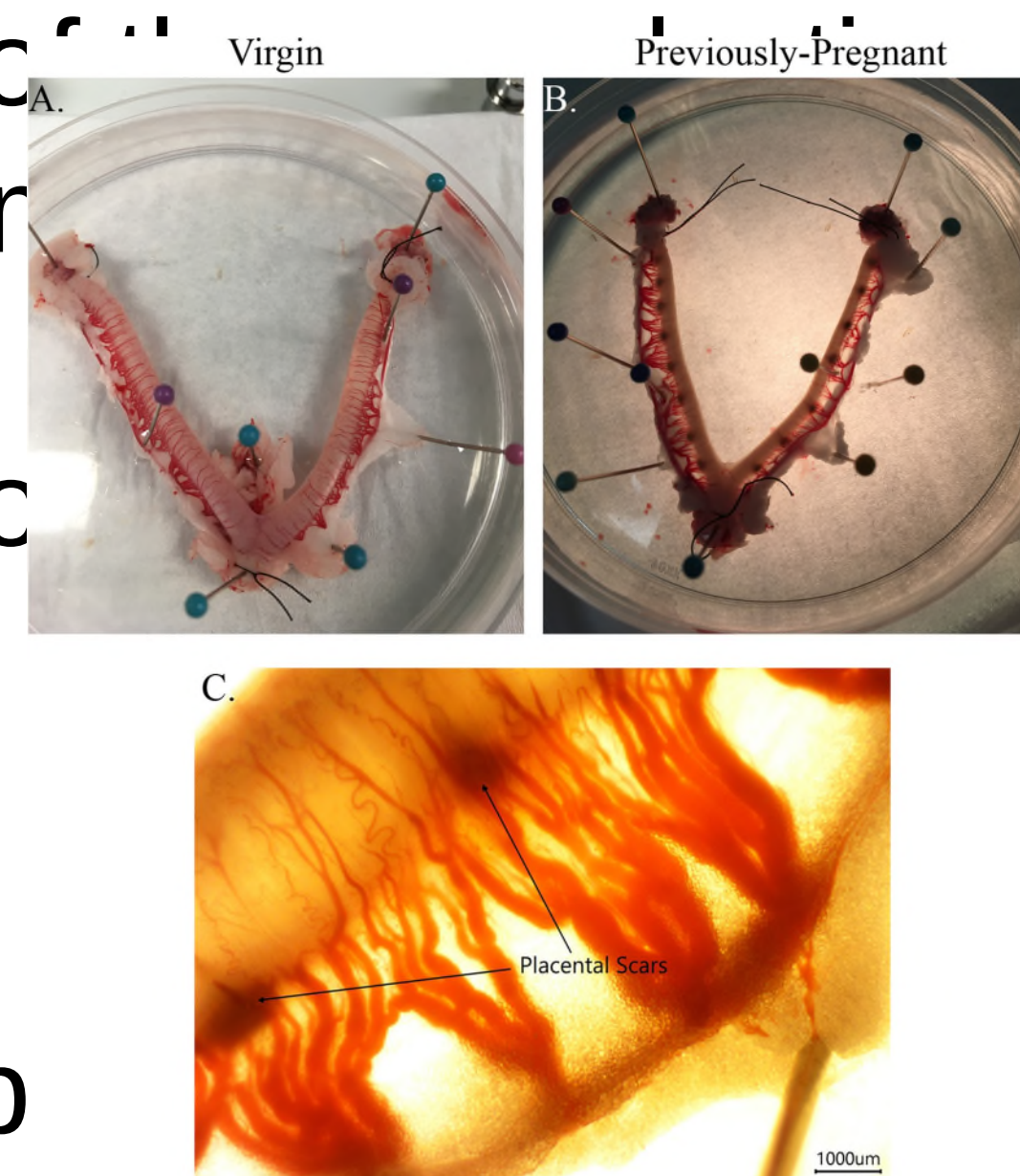
Background

About 2% of human pregnancies are ectopic (outside the endometrium), the majority of which are tubal. There are no widely-accepted methods of treating ectopic pregnancy that allow pregnancy to continue by allowing the ectopic placenta to access sufficient blood flow and myometrial containment, which the tube is unable to provide.

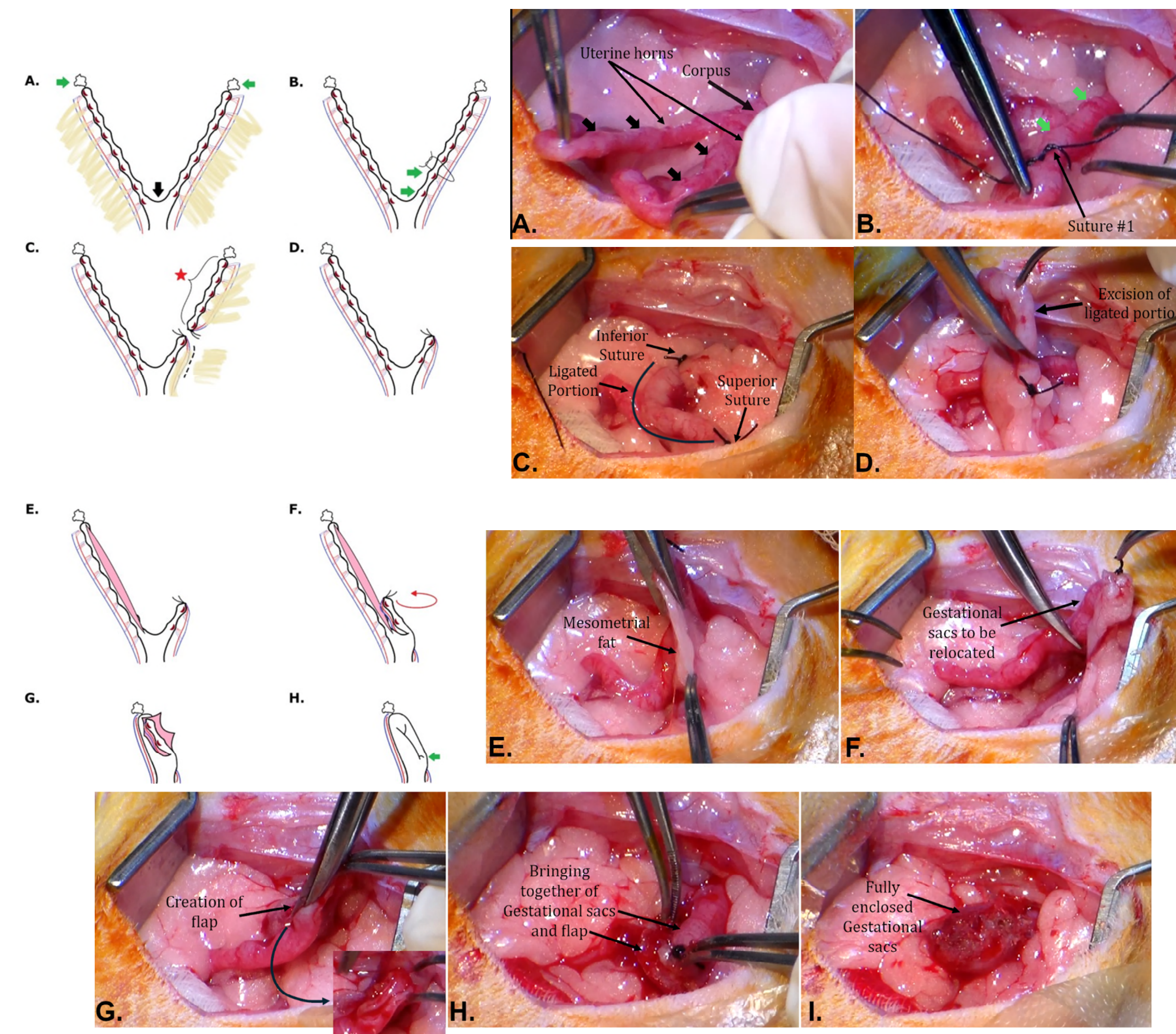
Fetal surgery permits transmural incisions in the uterus, and previous human case reports described moving ectopic embryos within the containing fallopian tube into the endometrial cavity (Wallace, 1917)

We sought to establish an animal model of hemochorial placentation establishing blood flow and being contained in an area contract separate from the original in

The rat was chosen due to hemochorial placentation and size/feasibility. Weaknesses of the model include that the pregnancies were not truly ectop and the gross anatomy of the rat uterus is different (bicornuate).

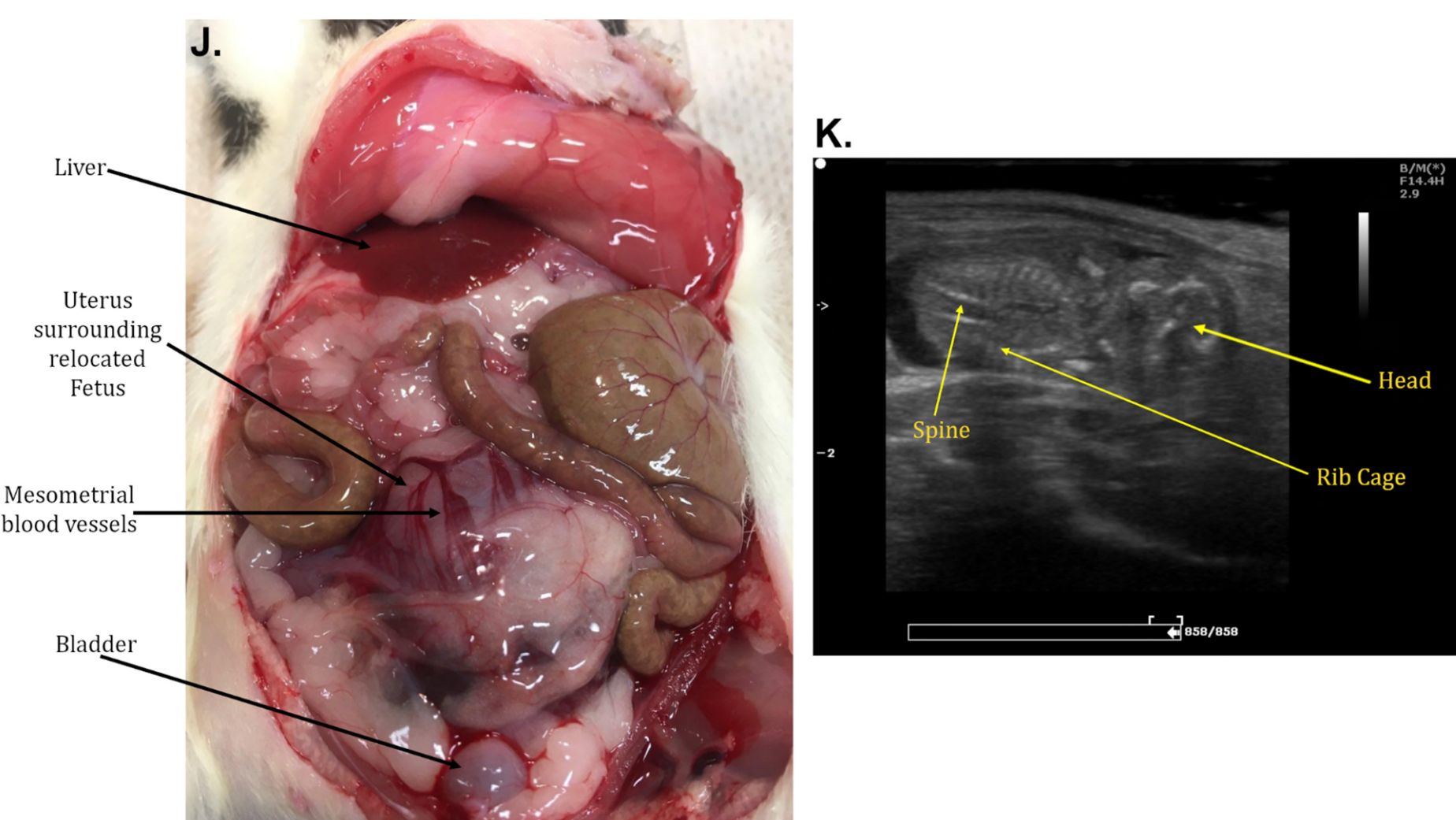


Methods



Representative images from embryo relocation surgical procedure and follow-up. Images (A-I) are shown with superior (towards the head) aspect at the bottom left corner and inferior (towards the tail) aspect towards the top right corner. (A) Visualization of uterine horns containing gestational sacs (thick black arrows). (B) Insertion of first suture, superior to the gestational sacs (thick green arrows) to be relocated. (C) Ligated portion of the uterine horn to be excised. (D) Excision of the ligated portion of the uterine horn. (E) Removal of mesometrial fat on remaining portion of the uterine horn containing gestational sacs to be relocated. (F) Portion of the uterine horn containing gestational sacs to be relocated prior to relocation to other horn. (G) Creation of the flap in the receiving uterine horn. Inset indicates the flap once created. (H) Gestational sacs being relocated onto flap. (I) Relocated gestational sacs fully enclosed by flap.

Rat weight, food consumption and vaginal impedance of the mothers were measured throughout the experiment. Ultrasounds were performed and fetal heart rates measured on day 20–21 of gestation. Additionally, rat weight of all offspring was measured at adulthood.



(J) Rat in the Embryo Relocation group at full-term (D20/D21), prior to tissue collection. Visualization of uterus surrounding the relocated fetus and mesometrial blood vessels. (K) Representative ultrasound image of fetus from full-term rat in Embryo Relocation group, with the head, spine and rib cage labelled.

We developed a surgical procedure which moved 1-2 embryos within one horn into the other horn, keeping their implantation site intact.

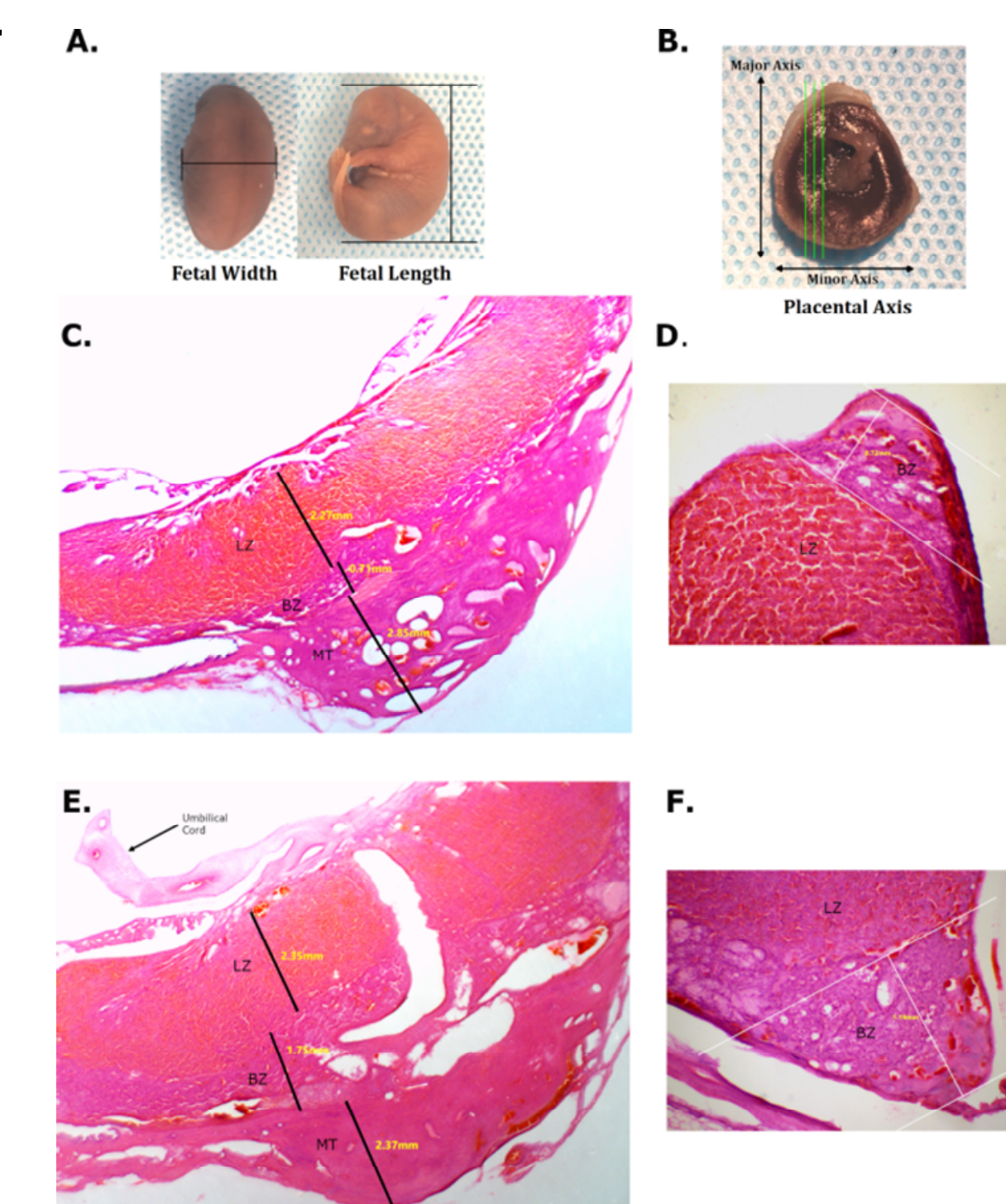
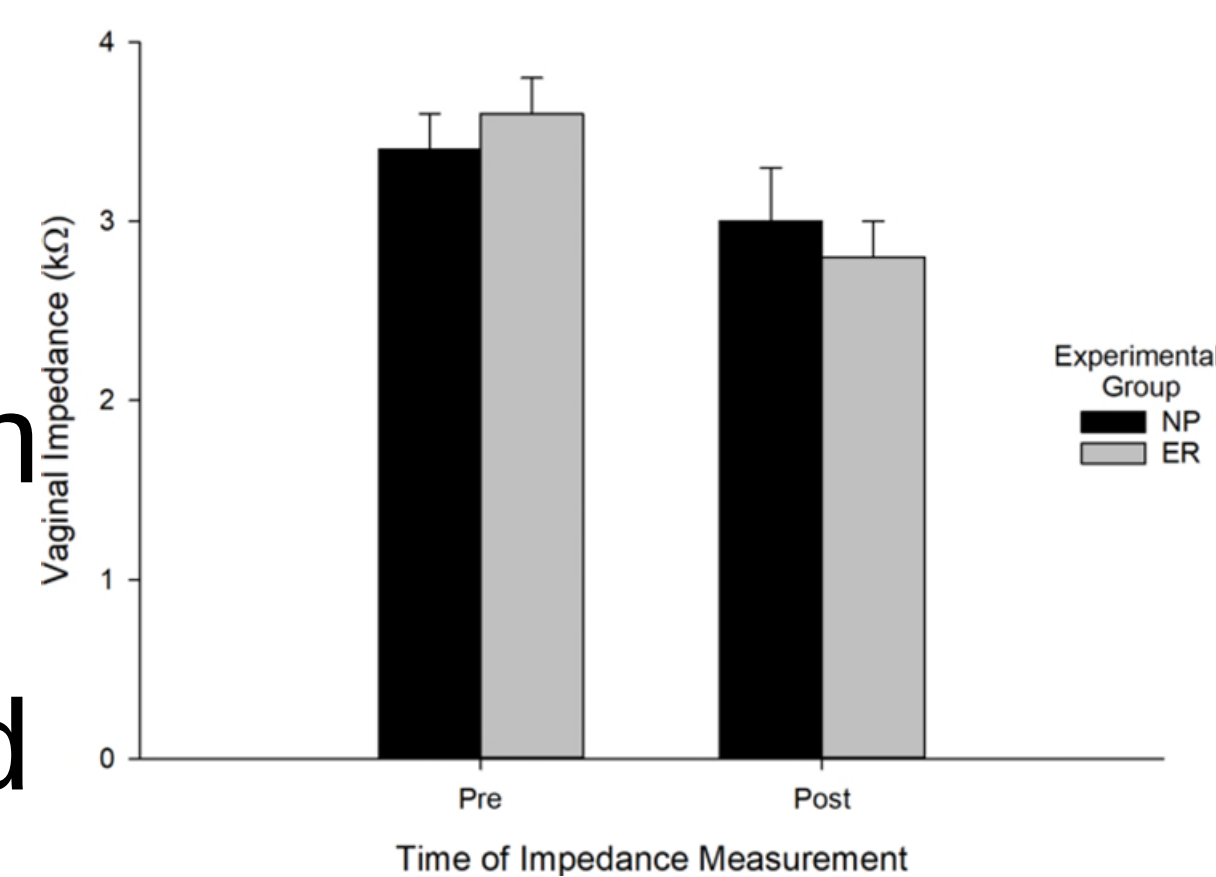
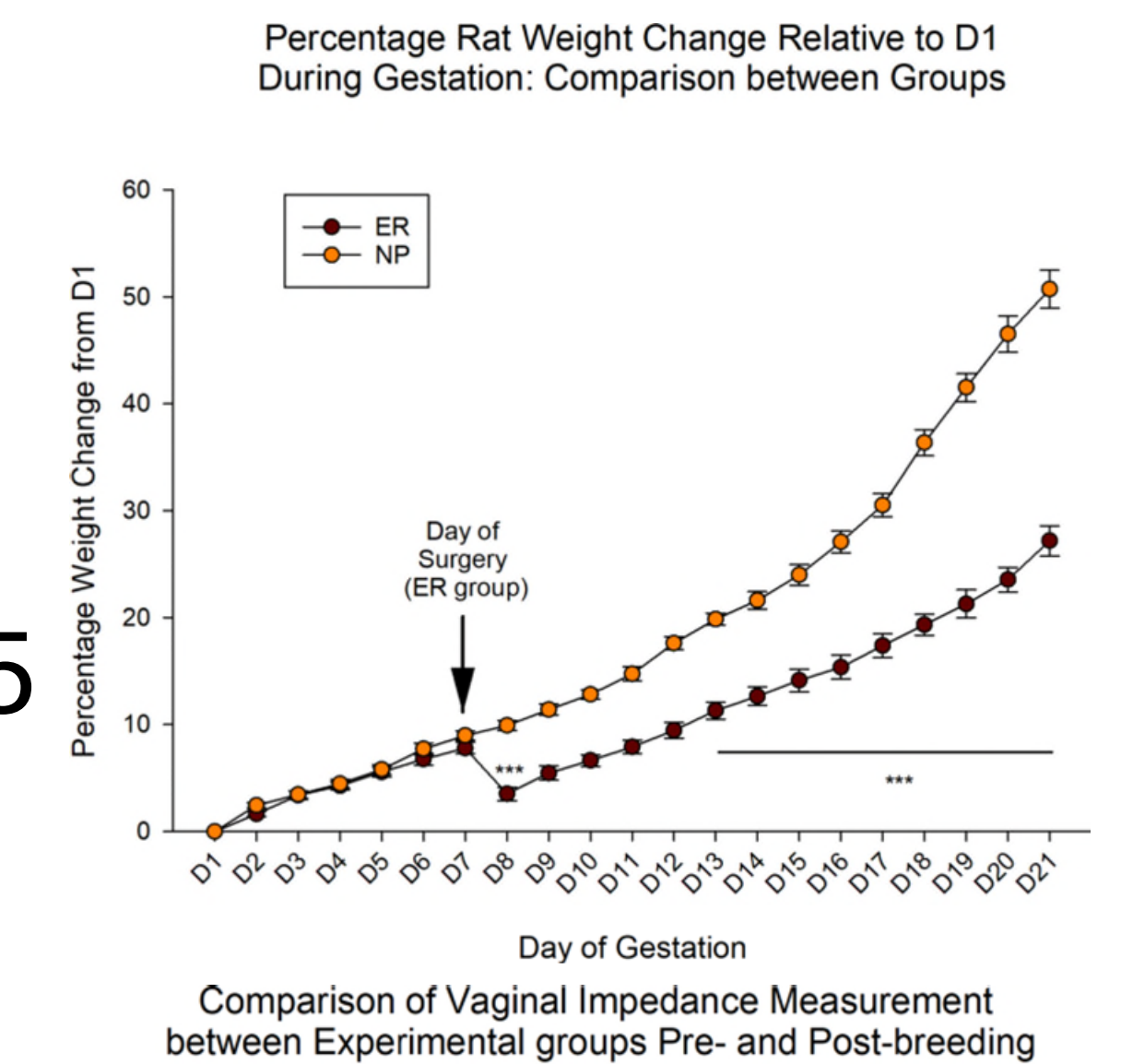
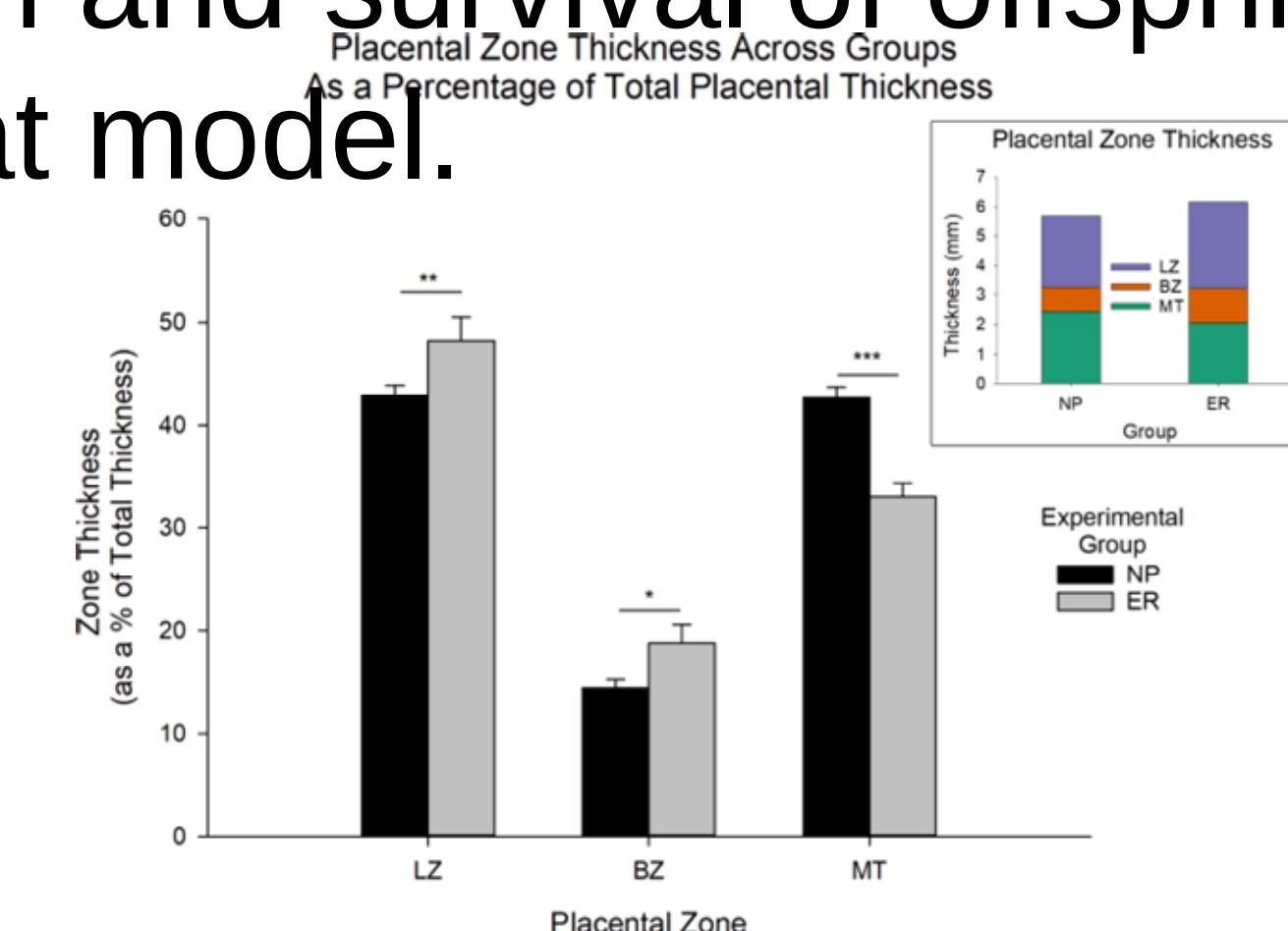
N = 12 female Long-Evans rats underwent the procedure and were compared to N = 12 normal pregnancies.

8 rats/group carried to term and delivered, while 4 had uteri harvested at term.

Results & Conclusion

In the surgery group, 15/15 (100%) of the relocated embryos had detectable heart rates at the end of gestation (within the normal range), 14/15 (93%) were delivered vaginally, and 12/14 (86%) survived until adulthood.

Rat weight and food consumption decreased only on the day following surgery. Fertility was minimally impacted by surgery. Histology showed a thicker placenta in the surgery group. Our findings reflect a successful transuterine embryo relocation followed by vaginal birth and survival of offspring in a rat model.



Gross anatomical measurements (A & B) and representative images of histological analysis from both Normal Pregnancy (C & D) and Embryo Relocation (E & F) groups. (A) Measurement of fetal width (left) and fetal length (right). (B) Measurement of placental major and minor axes. Green lines represent placental slices for histological investigation. (C & E) Measurement of the specific placental layers at 10x. (D & F) Measurement of basal shoulder, measured from the apex of the labyrinth zone to the furthest point of the basal zone (including giant cells) at 40x. LZ = labyrinth zone, BZ = basal zone, MT = maternal tissue.