Executive Summary

Transuterine relocation of pregnant uterine horn segment in an exploratory rat model with implications for tubal ectopic pregnancy

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Highlights

- Ectopic pregnancy affects ~2% of pregnancies in the US.
- Current treatment does not allow for the continuation of the pregnancy.
- Investigating potential surgical procedures raises ethical and scientific challenges.
- This preclinical study (in the rat) sought to investigate the design of a potential surgical technique that could be developed further and used in humans in the case of an ectopic pregnancy.
- Our findings reflect
  - a successful transuterine relocation of living (non-ectopic) embryos within the same rat,
  - resulting in viable relocated fetuses,
  - with uncomplicated vaginal delivery and living offspring to adulthood.
- In the human, it is expected that, a comparable procedure will involve the translocation of the fallopian tube into the uterus.

Background:

Ectopic pregnancy affects ~ 2% of pregnancies annually in the United States, with no current treatments allowing for the continuation of the pregnancy.

- Current treatments aim to protect the pregnant woman from the potentially lethal consequences associated with the continued development of the pregnancy in the fallopian tube;
- Treatment options do not allow for the continuation of the pregnancy;
- Investigating potential surgical procedures can raise ethical and scientific challenges.

Goal of the Study:

The goal of this study was to initiate an investigation into the potential design of a surgical technique (in an animal model) that could serve as a foundation for future research into the potential of relocating an ectopic embryo into the uterus at the human level.

Note: While there are similarities in relation to pregnancy between the rat and the human, there are differences that must be taken into consideration. For example, the rat's uterus, unlike the human uterus, is bicornuate (meaning “having two horns” and as a result is V-shaped). The fallopian tube is also miniscule. Additionally, ectopic pregnancy in rats (and other animals) tends to be abdominal, rather than tubal (in the fallopian tube).

Keeping this information/limitations in mind, while this rat model did not use an actual ectopic pregnancy, we exploited the bicornuate nature of the rat uterus in order to explore the potential for an embryo in one uterine horn to develop normally after being physically relocated within the other uterine horn.

Results:

The findings of our study:

- 100% of the relocated embryos were alive, as indicated by heart rate detected on ultrasound, at the end of gestation.
- All relocated embryos, except one, were delivered vaginally, indicating that the cervix remained patent and the ability to deliver vaginally was not compromised by the surgical procedure.
- Average day of delivery was not affected by the embryo relocation procedure relative to those with a normal pregnancy.
- 80% of the relocated embryos (86% of the embryos delivered) survived until adulthood.
- The rats in which the relocation surgery took place ***only*** lost weight and showed a significant decrease in food consumption **on the day** immediately following surgery, indicating that the surgical procedure did not result in undue stress on the mothers. The rats then proceeded to gain weight throughout the rest of gestation and return to normal food consumption.
- Fertility was minimally impacted.
- Histological investigation of the placentas indicated thicker placentas in the embryo-relocation group relative to the normal-pregnancy group reflecting thicker layers on the fetal side, possibly reflecting compensatory mechanisms adjusting for the relocation process.

Human Application:

- It is anticipated
    - that a comparable procedure in humans will involve the translocation of the fallopian tube into the uterus.
    - The procedure would involve
        - Moving folding the part of the fallopian tube containing the gestational sac and inserting it into the uterus through an incision
        - Ultimately, it is hoped that the original blood flow from the fallopian tube would decrease as the placenta grows through the fallopian tube tissue and continues to develop within the uterus with its own blood supply.
        - Birth would likely be through a cesarean section.

Conclusion:

- This is the first preclinical study that initiates an investigation to address a surgical technique with potential implications in the relocation of an embryo in the case of an ectopic pregnancy.
- Our findings reflect a successful transuterine relocation of living (non-ectopic) embryos within the same rat, resulting in viable fetuses, uncomplicated vaginal delivery and living offspring to adulthood.
- These findings lay the foundation for future preclinical research in higher animals, with potential implications on a procedure relevant to human ectopic embryo relocation.