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UTERINE TRANSPLANTATION: OPPORTUNITIES, CHALLENGES, AND FUTURE PERSPECTIVES

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Abstract: Uterine transplantation has ushered in a new era in reproductive medicine. This procedure is emerging as an effective treatment for infertility related to uterine absence or dysfunction. The article analyzes the clinical opportunities, existing challenges, and future perspectives of uterine transplantation. Special attention is given to patient selection, immunosuppressive therapy, ethical issues, and technological innovations.

Keywords: uterine transplantation, infertility, reproductive medicine.

Introduction: In recent years, one of the most significant innovations in transplantology and reproductive medicine has been **uterine transplantation**. Congenital or acquired uterine absence represents one of the most complex forms of infertility. According to global statistics, approximately one in every 5,000–7,000 women is deprived of the opportunity to become pregnant due to congenital uterine absence (Mayer-Rokitansky-Küster-Hauser syndrome) or surgical removal of the uterus.

Previously, the only options available in such cases were adoption or surrogacy. However, over the past decade, uterine transplantation has offered women the possibility of carrying their own biological child. In 2014, the first live birth following uterine transplantation in Sweden marked a historical milestone in this field.

Currently, both experimental and clinical uterine transplantations are being conducted worldwide. The success of this procedure depends not only on surgical techniques but also on immunosuppressive therapy, donor selection, and ethical and psychological considerations. Thus, uterine transplantation raises not only medical but also social and legal issues.

This article provides an analytical overview of the clinical opportunities, challenges, and future perspectives of uterine transplantation.

Relevance of the Topic: Infertility affects approximately one in ten couples worldwide, making it a critical medical and social problem. Among the various causes of infertility, congenital or acquired uterine pathologies hold significant importance. Statistics show that 1 in every 5,000–7,000 women cannot conceive due to uterine absence or dysfunction. This condition profoundly affects not only women's physical health but also their psychological well-being and social life.

For such patients, the only previous alternatives were adoption or surrogacy. However, surrogacy is banned in many countries due to religious, legal, and social reasons. Against this backdrop, uterine transplantation has emerged as a promising alternative.

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By enabling women to give birth to their own genetic child, uterine transplantation represents not only a medical breakthrough but also a solution with profound social and psychological implications. Therefore, this subject holds global relevance and may become one of the main directions of reproductive medicine in the future.

Materials and Methods

This article is written in the style of a **review analysis**, relying on scientific literature, clinical reports, and practical experiences regarding uterine transplantation. The materials were collected from international scientific articles, clinical reports, the World Health Organization (WHO), and leading transplant centers.

The analysis was focused on four key areas:

1. **Opportunities of transplantation** – donor selection criteria (living vs cadaveric donors), surgical techniques, and immunosuppressive therapy strategies.
2. **Clinical challenges** – postoperative complications, pregnancy-related risks, and long-term outcomes.
3. **Ethical and legal issues** – comparison with surrogacy, patient and donor rights, social and religious perspectives.
4. **Future perspectives** – regenerative medicine, artificial uterus, and biotechnological approaches.

The methodology involved **systematic review and analytical comparison** of clinical data from various countries, followed by the formulation of generalized conclusions.

Results

Clinical studies of uterine transplantation have shown that this method provides a **real opportunity** for treating uterine-related infertility. To date, hundreds of uterine transplantations have been performed worldwide, with dozens of successful pregnancies and healthy live births.

Key findings include:

1. **Donor selection efficiency**:
    - Living donors (usually mothers or relatives) yield higher success rates.
    - Cadaveric donor cases are technically more complex but feasible.
2. **Immunosuppressive therapy**:
    - Properly chosen regimens can ensure long-term graft survival.
    - However, the effects of immunosuppressive drugs on maternal and fetal health remain a major concern.
3. **Complications**:
    - Postoperative risks include bleeding, thrombosis, and infections.
    - In some cases, graft removal becomes necessary.
4. **Pregnancy outcomes**:
    - The first live birth occurred in Sweden in 2014.
    - Since then, successful births have also been reported in the USA, Turkey, India, and other countries.
5. **Ethical and social aspects**:
    - In countries where surrogacy is prohibited, uterine transplantation is considered the only alternative.
    - Nonetheless, debates continue regarding donor safety, experimental status of the procedure, and compatibility with societal and religious values.

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Overall, these results demonstrate that although uterine transplantation is still experimental, it holds significant promise for expanding biological motherhood opportunities.

Discussion

Uterine transplantation has emerged as one of the most **innovative areas of reproductive medicine** in the past decade. While current results show its potential effectiveness, several challenges remain before it can become a standard clinical practice.

- **Donor selection**: Living donors have shown higher success rates but face health risks. Cadaveric donors, while safer for the donor, pose technical and logistical challenges.
- **Immunosuppressive therapy**: Essential for graft survival, but long-term drug use increases infection risks and raises concerns during pregnancy regarding maternal and fetal safety.
- **Ethical and legal concerns**: In some countries, uterine transplantation is the only alternative to surrogacy. However, issues such as donor safety, the experimental nature of the procedure, and its alignment with religious and social norms remain contentious.
- **Future perspectives**: Advances in regenerative medicine, such as bioprinting artificial uterine tissue, may eventually eliminate the need for donors altogether.

Thus, uterine transplantation, while still in the experimental stage, may soon offer thousands of women the chance to achieve biological motherhood.

Conclusion

Uterine transplantation represents a **revolutionary advancement** in reproductive medicine. Clinical experiences worldwide have shown its feasibility and effectiveness, with healthy live births achieved following successful procedures.

However, several challenges must be addressed before widespread implementation:

- Risks and limitations in donor selection.
- Long-term effects of immunosuppressive therapy.
- Ethical and legal controversies.

The future remains promising, with biotechnological and regenerative approaches—such as artificial uterus development—expected to resolve many current limitations.

Although still experimental, uterine transplantation is anticipated to become a practical and life-changing treatment for thousands of women worldwide in the near future.

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