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Session Report

Highlights from the Stem Cell Session of the 11th Yazd International Congress and Student Award in Reproductive Medicine, Shahid Sadoughi University of Medical Sciences

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Abstract

This paper summarizes the proceedings of the Stem Cell Session of the "11th Yazd International Congress and Student Award on Reproductive Medicine" held at Shahid Sadoughi University of Medical Sciences, Yazd, Iran, on May 15, 2025. The session brought together distinguished national and international experts to present and discuss advances and their studies in stem cell biology, tissue engineering, and reproductive medicine. Topics covered included in vitro gametogenesis and metabolite profiling, tissue-engineered therapeutic strategies for infertility, the role of extracellular vesicles in spermatogenesis, innovative tissue engineering approaches for azoospermia, and the therapeutic potential of exosome-based treatments for polycystic ovary syndrome. Additionally, emerging research on human pluripotent stem cell-derived cardiovascular cells for disease modeling and regenerative repair, as well as the molecular epidemiology of reproductive infectious diseases and cancers, was discussed. Collectively, the presentations highlighted the translational potential of stem cell and tissue engineering research in addressing infertility and advancing reproductive health.

Keywords: Conditioned Media, Cumulus Cells, Extracellular Vesicles, Infertility, Testicular Cells, Tissue Engineering

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Introduction

The integration of stem cell science and reproductive medicine has opened new frontiers in the diagnosis and treatment of infertility. The Stem Cell Session at the *11th Yazd International Congress and Student Award on Reproductive Medicine* provided a unique platform for researchers to present novel findings and discuss translational strategies for regenerative applications in reproductive health. The session featured a series of insightful presentations from leading Iranian and international scientists, focusing on stem cell differentiation, tissue engineering, extracellular vesicles, and regenerative therapies targeting infertility and reproductive diseases. The talks reflected the growing global interest in applying cellular and molecular advances to overcome the challenges of infertility and reproductive tissue dysfunction.

Session Highlights

Dr. Behrouz Aflatoonian opened the session with his talk entitled "Metabolites and *In Vitro* Gametogenesis". He highlighted that the metabolic co-dependence between oocytes and cumulus cells is essential for determining oocyte developmental competence. Research across various species has shown that secreted factors from reproductive nursing cells such as testicular, cumulus, and granulosa cells, can significantly support oocyte *in vitro* maturation (IVM) and *in vitro* gametogenesis (IVG) (1). Dr. Aflatoonian summarized recent findings from his group demonstrating that conditioned media from testicular and cumulus cells enhance IVM in mice (2, 3) and support human *in vitro* gametogenesis (1, 4). These results confirm earlier studies using different cell types and species. Additionally, his team examined metabolite shifts during the differentiation of human embryonic stem cells (hESCs) into germ cells, revealing dynamic metabolic changes that influence gamete development (Aflatoonian et al, unpublished). These discoveries offer new insights into the metabolic regulation of gametogenesis and may contribute to future advancements in infertility treatment (1).

Dr. Ebrahimi's presentation titled "Tissue Engineering and Stem Cell-Based Therapeutic Strategies for Infertility Diseases", bridged fundamental biology with clinical innovation by exploring tissue engineering and stem cell-based strategies for infertility treatment. Dr. Ebrahimi reviewed recent advances in the application of embryonic, induced pluripotent, and adult stem cells for the regeneration of reproductive tissues such as the ovary and endometrium. She emphasized the potential of biomaterial scaffolds to recreate the natural reproductive microenvironment, supporting cell growth and differentiation. The presentation also addressed the ethical and translational challenges of clinical implementation, underscoring the need for standardized differentiation protocols, immune compatibility assessments, and Good Manufacturing Practice (GMP) compliance. Her talk demonstrated how tissue engineering can move beyond concept to clinical utility, offering regenerative solutions for patients suffering from infertility-related diseases (5).

The emerging role of exosomes and extracellular vesicles (EVs) in male fertility and spermatogenesis was explored in Dr. Korouji's talk, "The Role of Extracellular

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Vesicles in Spermatogenesis". He outlined how these nanoscale vesicles, secreted by Sertoli, Leydig, and germ cells, serve as key mediators of cell-to-cell communication within the testicular microenvironment. Exosomes facilitate the transport of proteins, lipids, and RNAs essential for spermatid development, influencing gene expression, immune modulation, and oxidative stress protection (6, 7).

Dr. Korouji emphasized the therapeutic and diagnostic potential of exosomal cargo as biomarkers for male fertility disorders. His presentation positioned exosomes as both functional regulators and clinical tools for understanding and managing male infertility (8-10).

Compelling data on oocyte progenitor stem cells and their potential role in female fertility restoration were presented by Dr. Fathi from the Royan Institute. In his presentation entitled "Redesigning life: Ovarian Germ Cells are the Intelligent Sleepers", he described pioneering research that demonstrated the existence and proliferative capacity of these cells in ovarian tissue. Using an artificial ovary model, his team successfully induced the differentiation of progenitor stem cells into oocytes and primordial follicles after transplantation. This breakthrough suggests that modifying the extracellular niche can awaken dormant progenitor cells, potentially restoring fertility in women with premature ovarian failure or post-cancer treatment infertility. The findings represent a remarkable advancement in reproductive tissue engineering and underscore the regenerative potential of ovarian stem cells (11).

Dr. Movahedin from Tarbiat Modarres University, delivered an overview on recent advances in tissue-engineered with the title "How Tissue Engineering Can Help Azospermia Patients; In Vitro and In Vivo Studies". The talk highlighted progress in in vitro spermatogenesis, including the use of biomimetic scaffolds, organoid cultures, bioreactors, and decellularized testicular matrices that replicate the native testicular environment (11-13).

Exosome-enhanced dynamic culture systems and 3D-printed ECM scaffolds enriched with bioactive molecules were noted for their success in promoting SSC proliferation and achieving haploid spermatid formation in animal models (8). The review also covered in vivo approaches, such as testicular tissue grafting and SSC transplantation, which have enabled functional sperm generation in murine hosts. The role of mesenchymal stem cell–derived exosomes in restoring spermatogenesis in azoospermic models was emphasized as a promising regenerative therapy (12).

The following presentation by Mahdieh Karimi highlighted the therapeutic promise of exosome-based interventions for polycystic ovary syndrome (PCOS). Using an animal model, her study examined the effects of exosomes derived from human embryonic stem cell–derived mesenchymal stromal cells (Yazd2/MSCs) on PCOS-induced rats. The results showed that intra-ovarian injection of exosomes significantly reduced ovarian size, normalized testosterone levels, and improved ovarian morphology in a dose-dependent manner. The findings emphasized the regenerative and endocrine-modulatory novel, cell-free therapeutic strategy for effects of exosome therapy, introducing a managing

PCOS a major cause of female infertility (9, 14).

A comprehensive overview of the applications of human pluripotent stem cells (hPSCs) in disease modeling and regenerative therapy was presented by Dr. Jie Na from Tsinghua University, China. His group has successfully developed protocols to derive cardiomyocytes, endothelial cells, and macrophages from hPSCs under defined conditions, enabling the construction of 3D mini-cardiac organoids. These organoids, when transplanted into rat models of myocardial infarction, significantly improved cardiac function and reduced fibrosis. Additionally, hPSC-derived endothelial cells were shown to restore choroidal vasculature and visual function in ocular disease models. Dr. Na also introduced hPSC-derived macrophages as valuable models for studying host–pathogen interactions in infections such as hepatitis C and SARS-CoV-2. His presentation showcased the remarkable versatility of hPSC technologies across regenerative and immunological domains (15).

Dr. Farashahi concluded the session with a presentation entitled “Infectious Diseases and Reproductive Cancers on human papillomavirus (HPV) genotyping and its implications in reproductive cancers”. A major focus of the talk was on Human Papillomavirus (HPV) and Chlamydia trachomatis, two of the most significant infectious contributors to reproductive malignancies worldwide. High-risk HPV serotypes, particularly HPV-16 and HPV-18, were emphasized for their causal role in cervical cancer, jointly responsible for roughly 70% of global cases. The presenter also underscored the importance of persistent HPV infection, noting that host genetic factors such as polymorphisms in immune-related genes (e.g., HLA-DQ, TLR9) may impair viral clearance and increase susceptibility to malignant transformation.(16-18).

Conclusion

The Stem Cell Session at the 11th Yazd International Congress and Student Award on Reproductive Medicine demonstrated the dynamic interplay between basic stem cell research, tissue engineering, and translational reproductive medicine. From in vitro gametogenesis and artificial ovary engineering to exosome-based fertility treatments and hPSC-derived regenerative models, the session highlighted both scientific innovation and clinical relevance. The integration of molecular insights, bioengineering tools, and regenerative strategies showcased the future of infertility treatment and reproductive health restoration. Collectively, the discussions reflected a shared vision: translating stem cell research from the laboratory to clinical application to improve reproductive outcomes and human well-being.

Conflict of Interest

The authors declare that they have no competing interests.

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