Details of the Project sanctioned under the Human Resource Development scheme of Department of Health Research

1. Project Title: Role of paternal genome on stress response and polarity of preimplantation stage embryo

2. Category of fellowship: Category B-Women with break in career

3. PI (Name & Address):
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4. Qualifications : MSc Microbiology

5. Mentor (Name & Address):
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Professor,
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6. Duration of the project: 3 Years (01 October 2015- 01 October 2018)

7. Broad area of Research: Health Science

7.1 Sub Area Stem cell research

8. Summary of the Project:

Early embryonic development is a dynamic process which starts with the union of spermatozoa and oocyte. Even though tremendous advancement has taken place in embryology in last few years, there are still few gray areas among which, following are the most significant. Difference in the developmental potential of zygote obtained from

poor quality spermatozoa and ability of artificially activated oocyte to develop till the blastocyst stage suggests that paternal and maternal genome has definite role to play during preimplantation embryo development. Further, it is argued that failure of oocyte to get activated to become zygote following intracytoplasmic sperm injection in infertile couple might be due to the lack of key components in the sperm cytoplasm. In lower species, the blastomere containing sperm head is demonstrated to give rise to inner cell mass and subsequently embryo proper, it will be interesting to know whether the embryo polarity for lineage differentiation is driven by paternal factors in higher mammals. Since there is lack of knowledge on understanding of these aspects, in the proposed project we aim to perform comparative experiments using parthenotes (embryos without intervention of spermatozoa) and normally fertilized embryos to study a) whether they exhibit any difference in the response to stress induced by in vitro culture conditions, b) whether there is any difference in the expression pattern of genes regulating embryo polarity and c) whether supplementing sperm derived factors can enhance the developmental potential of parthenotes and alter the response of parthenotes to stress and determination of embryo polarity.

9. Objectives of the Proposal:

- To elucidate the role of paternal genome on the stress response of pre-implantation stage embryos.
- To understand the influence of paternal genome on determination of embryo polarity
- To study the developmental dynamics of parthenogenetic embryos in medium supplemented with sperm derived factors

10. Innovations in the project: (Give in about 100 words)

The present investigation is expected to give insights to the role played by parental factors in tolerating stress conditions as well as in determining embryo polarity in preimplantation embryos which are hitherto not clearly understood. The study also uses an approach where we are attempting to improve the developmental potential of parthenogenic embryos by exogenously supplementing the cytosolic factors from sperm. This novel approach will not only help in unravelling the contribution form paternal factors in governing early embryo development, their response to various culture conditions and also give a possible clue in improving the outcome of an assisted reproduction technology.

11. Significance of the outcome of the project: (Give in about 150 words)

Following fertilization, successful development of a preimplantation embryo is dependent on the equal contribution from both paternal and maternal genome. Genomic instability or abnormality in male and/or female gametes has found to result in defective fertilization or failure of the preimplantation embryos to reach its term. Even though many studies are being pursued to understand the individual role played by these gametes in early embryo development, many areas still remain unclear which could be the reasons for decreased pregnancy rate in assisted reproductive (ART) clinics. A detailed knowledge on the contribution of paternal and maternal genome, nutritional requirements and response of the embryo to various stressful conditions during preimplantation development can improve the *in vitro* development of preimplantation embryos. Results of the present investigation are expected to provide experimental evidence on paternal contribution in determining embryo polarity as well as on its role in tolerance to various *in vitro* stress responses in preimplantation embryos. The proposal is also aimed at collaborative ventures with experts in the field of assisted reproductive techniques.

12. Relevance in Public Health:

Since this study uses parthenotes as a model, it is also expected to improve the developmental potential of parthenotes which may largely benefit the developmental biology field, particularly for developing stem cell cells from parthenotes for therapeutic purposes and somatic cell nuclear transfer techniques. Embryonic stem cells derived from parthenotes are found to differentiate to myogenic, osteogenic, adipogenic, cardiogeneic and endothelial lineages which are an attractive source for tissue-engineering purposes. By this study the cultural conditions and medium for parthenogenetic embryos can also be optimized which has the potential for patenting considering the wide applications of parthenotes in stem cell research. A better culture conditions can be achieved for the in vitro manipulation and development of the embryo by a better understanding of the role played by maternal and paternal factors in embryo development.

Signature of the Fellow /Faculty