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ORIGINAL PAPER

Embryology can unlock major challenges of human Health in modern era

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ABSTRACT

Embryology is the branch of biological sciences that played key role in understanding development of life in prenatal period. Scientists are trying to understand time-sensitive morphological changes and, secondly, appreciating the clinical implications of congenital conditions when development varies from the norm. These understandings can provide mighty weapons in man's everlasting struggle for a better existence. Experimental embryology offers immense possibilities for human welfare especially in the field of organ failure and cancer treatment. In due course, its impact on society may be no less than that of other sciences.

INTRODUCTION

Advances in science have impacted almost every aspect of survivability and growth of humans on this planet. Not only the physical sciences but the biological science too offer enormous potentialities to unlock the hidden secrets that makes a man curious. Physicists offers possibilities in the field of energy, transportation, housing etc. Similarly, the biological sciences gained much advancement in the fields of breeding, medicine, diagnosis, treatment etc.

Lower animals and chick have made the foundation for most of the information in experimental embryology, because they are comparatively easy to handle and have short developmental period during embryonic stage. The studies on these subjects have helped to arrive at certain generalizations for mammals and which have been proved, by very recent experiments and by inference, to be valid also for human beings too to varying extents. The experimental embryology can help us to solve two big worries related to human health. These are organ failures and cancer.

Transplantation of embryonic organs as a novel solution to organ shortage :

The functional failure of an organ has several origins, from malignancies to degenerative diseases. Nowadays, more and more patients are suffering from degenerative processes that end in specific irreversible organ failure. Loss of function becomes irreversible once injury exceeds the inherent regenerative potential or redundancy of the affected organ system; in many instances, therapeutic options are limited to supportive measures and prevention of further damage. In these cases, transplantation represents the ideal method of restoring full physiological organ function. However, transplantation from deceased or living human donors has been limited by donor availability, as opposed to the increasing demand, by the risks of allograft loss rejection and immunosuppressive therapy toxicity. These factors mean that many patients have to wait for long periods of time, entailing increased morbidity and mortality for tens of thousands of people each year, and a lot of patients die before receiving the desired organ. Even before obtaining an organ from doner, despite advances in renal transplant immunology, the recipients will experience an episode of acute rejection within 5 years of transplantation, and approximately 40% of recipients will die or lose graft function within 10 years after transplantation. Thus, the risk of graft rejection is still an obstacle in the field of kidney transplantation. Similarly, the use of xenotransplants has been considered for years as a possible solution to the organ shortage, but the risks of xenograft loss rejection and zoonosis have limited the clinical application of this kind of treatment. The use of individual cells or groups of cells to repair damaged tissue (cellular therapies) offers an alternative for renal tissue replacement. Embryonic stem cells or induced pluripotent stem cells that are already committed to for renal development and as its destination cell type could be worked out by experimental embryology and presents loads of scope in organ development to mitigate the problem of organ shortage for ailing humans.

A platform for prospective future in cancer research : The cancer cells could be called biomass without normal cellular regulation. They bypass most of the signaling pathways leading to programmed cell division. On the other hand, the embryos are highly regulated, giving rise to the whole organism based on the planned regulation. With a better understanding of how different cell types are made, researchers can improve the process of making cells for regenerative medicine. Moreover, researchers can apply these insights to cancer and potential therapeutic strategies. Embryos and cancers share a number of cellular and molecular features. Embryos arise from a single cell and undergo rapid growth involving cell migration and cell-cell interactions: features that are also seen in the context of cancer. Consequently, many of the experimental tools that have been used to study embryogenesis for over a century are well-suited to studying cancer. The molecular cues used to pattern an embryo are harnessed by tumor cells to enhance growth, recruit stromal cells and coordinate spread from the primary tumor. Because of the many commonalities between development and cancer at the molecular and cellular levels, it has been possible to use the tools of developmental biology to address fundamental questions about tumor biology. As tools such as lineage labeling, cellular reprogramming and live imaging are improved and further harnessed to provide new

insight into a variety of human diseases, cancer – with its close relationship to developmental biology.

The tools that can be deployed in cancer study are

Fate mapping : Fate mapping, also known as lineage labeling or lineage tracing, was originally developed to visualize the fate of individual cells and their progeny during embryogenesis, but it has also proven useful for the study of tumor-initiating populations and dynamic cellular movements in the context of cancer.

Identification of tumor initiating cells : Lineage tracing provides a powerful tool to identify stem cell populations in embryonic and adult tissues, and the same approach has now been used to identify tumor-initiating cells in cancer**.** Given the robust self-renewal capacity of cancer cells, it is often assumed that cancers arise from resident, adult stem cells within tissues, and hence the concepts of 'cell-of-origin' and 'cancer stem cells' are often conflated. it seems that some tumors, including intestinal tumors and basal cell carcinomas, arise from resident tissue stem cells, whereas, in other cases, it seems that tumors can arise from fully differentiated cells (e.g. pancreatic tumors, cholangiocarcinomas, gliomas). Further studies are needed to elucidate the specific factors involved in determining the cell-of-origin in different cancer types.

Cellular reprogramming : The ability to generate induced pluripotent stem cells (iPSCs) has revolutionized stem cell biology and opened up new avenues for regenerative medicine. Since the initial discovery that four transcription factors can reprogram terminally differentiated cells to a pluripotent state investigator have refined the methods for cellular reprogramming and repurposed the technology for other applications in biomedical science. One of the more innovative uses of iPSC methodology is in modeling human cancers, particularly the premalignant stages of tumor progression that commonly go unobserved in patients.

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