Biological Analysis of Totipotency in Early Mouse Embryos

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Abstract

Embryonic totipotency is a highly attractive and important research area in biology. Embryonic totipotency refers to the biological potential of a cell to differentiate into a complete organism under specific conditions. This totipotency is a crucial step in the developmental process of organisms, determining how embryos gradually form various cell types and tissue structures. Understanding embryonic totipotency is significant for comprehending the origin of life, the developmental process, and cell fate determination. With the continuous advancement of stem cell technologies, it has become apparent that by reprogramming embryonic stem cells in vitro, they can acquire characteristics similar to totipotent cells and, under certain conditions, differentiate into a complete embryo. Therefore, by studying embryonic totipotency, we can gain deeper insights into the mechanisms of this complex process, providing a theoretical foundation for applications in disease treatment, tissue engineering, and regenerative medicine, while addressing numerous biological and medical challenges. However, comprehensively observing changes in embryonic totipotency and understanding its mechanisms is not an easy task. Traditionally, the 2-cell stage embryos of mice and the 8-cell stage embryos of humans have been considered key periods for totipotency. However, there is still debate regarding the totipotency of embryos at later stages. Since individual development requires not only the developmental potential of cells but also a material foundation, the protocol of isolating single blastomeres and culturing them into blastocysts for implantation does not apply to studying totipotency in all stages of embryos (such as the 8-cell stage). In addition, the use of chimeric embryo protocols in primordial embryos is not only technically complex but also introduces numerous unknown variables due to the multi-step process, which may alter cell states. This study aims to adopt a half-drawing experimental approach, in which half of the blastomeres are biopsied from the embryo, while the remaining blastomeres are cultured in an incubator for continued development. By observing the blastocyst formation, implantation rates, and subsequent embryo development after implantation, the developmental potential of the embryo will be evaluated. Through this method, we can not only assess the developmental potential of the embryo, but also complement traditional methods that are complex and involve potential variables, thereby gaining a better understanding of how embryonic totipotency changes at different stages of development.

Keywords

Early Mouse Embryo, Totipotency, Biopsy, Half-Drawing