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Cardiac tissue engineering for the treatment of cardiovascular diseases

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Cardiovascular diseases (CVDs) have become the leading cause of death worldwide. They involve disorders related to the heart and blood vessels that may occur due to the hardening of arteries or heart muscles which lead to blockage or reduced heart function. The human heart cannot regenerate itself because unlike the skin and most other cells, the cardiac cells (cardiomyocytes) do not have the ability to replicate themselves after injury. But in view of this problem, advanced technology has been introduced, i.e. cardiac tissue engineering (CTE). CTE holds potential in the treatment of various aspects of heart diseases through the engineering of a bioartificial heart for heart transplantation or regeneration of damaged cardiomyocytes using stem cells. CTE requires the use of biomaterials called scaffolds which can be made from synthetic polymers, such as polyglycolic acid (PGA) or natural hydrogels, such as fibrin and collagen. In this strategy, specific cells such as mesenchymal stem cells from bone marrow are extracted from the patient and grown on a scaffold under controlled culture conditions. Scaffolds provide a 3D environment and behave as a template by providing structure and organisation to the growing cells. The desired cell type can be used in combination with biomaterials, depending on the requirements for the specific type of CVD. Myocardial infarction (MI), commonly known as heart attack, occurs due to a lack of oxygen flow to the heart muscles resulting in scarring of the heart tissue. The scar tissue is not functional and eventually leads to heart failure. Studies have shown that even after the removal of the scar tissue through surgical procedures, the cardiac functions could not be restored to pre-MI levels. However, cardiac tissue engineering has provided a novel approach to restore myocardial functions after myocardial infarction. Therefore, the application of CTE is an effective method for optimising the treatment of CVDs and improving the quality of life.

Keywords: Cardiovascular disease, Cardiac tissue engineering, Scaffolds, Biomaterials, Myocardial infarction

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