Organ Printing

Salman alhuwayshil, *Civil Engineering, University of the District of Columbia*
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Abstract
As it is obvious that there is an acute need for various body organs like heart, liver lungs, and kidneys transplantation, several approaches have been proposed to solve the problem. The approaches include the use of regenerative medicine, tissue engineering, artificial mechanical organs, and xenotransplantation. The use of tissue engineering as well as regenerative medicine is a promising approach to solving issues related to failed organs. In regenerative engineering, the following method can be used to complete the approach; Organ Printing. The method incorporates inkjet printing, scaffold design, and the ability to design and also fabricate these complex 3D biomedical devices.

I. Introduction

There have been significant improvements in the field of biotechnology, with organ printing being one of them. This kind of biotechnology is faced with various challenges that relate to the assembly of the vascularized soft organs that are in 3D form. Organ printing has also progressed to the application of inkjet printing to its tissue engineering processes.

II. Methods

Tissues engineering is a complex exercise, and it requires a cell printer that can print single cells, cell gels as well as cell aggregates (Lanza, et al. eds 2000). This organ printing can also be termed as a rapid prototyping technology that is "according to nature."

The incorporation of inkjet printing technology to tissue engineering in organ printing aims at taking this biotechnology to higher levels. As organ printing involves placing the various cell types on a flexible scaffold that is fabricated using computer aided design, it has proved to be a viable option within tissue engineering scaffolds. Inkjet printing, as reprographic technique, takes data from a digital computer to reproduce an image onto a substrate (An, Y.H. et al. 2001). The technology allows the construction of tissue and organs as a 3-D object with living biological material.

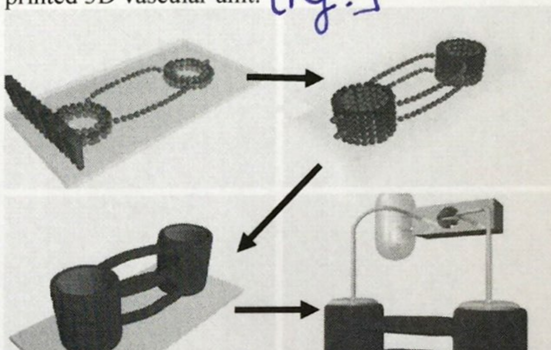
As it mentioned above that organ printing involves placing the various cell types on a soft scaffold that is fabricated using computer aided design, these scaffolds need to designed in a way they will facilitate a proper attachment of the cells. A scaffold needs to be in 3D and be highly porous to enable cell growth, biodegradable and have a suitable surface conducive for cell chemistry.

There have been recent advances in a 3D printing of these biomaterials. The material, as well as technology advancement, have been witnessed as some materials like 3DP gelatin has been replaced with PCL and chitosan. Prototyping has also been made rapid by the use of stereolithography.

III. Results

When cells are printed, and the organs are made, the question of whether organ printing is feasible emerges. From the methods above, it is evident that the goal of this technology is to reduce the complex tasks of tissue engineering into a series of non-complex, testable prototypes as well as in pilot projects. The printed organs can immediately be perfused after printing, and the 3D printing tube indicates the overall feasibility of this proposed organ printing technology.

Figure 1. Printing, assembly and perfusion of an elementary printed 3D vascular unit.



IV. Discussion

In a nutshell, the computer-aided layer-by-layer assembly of organs and other biological tissues is a possible technology that proves to be fast evolving technology in tissue engineering. This technology will help in mass-production of working organs for those who are in need. This technology is also set to face challenges like the need to vascularize the artificial structure responsible for cell sustainability. The technology will also face various challenges that remain unanswered.

References

[1] An, Y.H. et al. (2001) Regaining chondrocyte phenotype in thermosensitive gel culture. Anat. Rec. 263, 336–341
[2] Lanza, R.P., et al. eds (2000) Principles of Tissue Engineering. Academic Press
[3] Landers, R. et al. (2002) Rapid prototyping of scaffolds derived from thermoreversible hydrogels and tailored for applications in tissue engineering. Biomaterials 23, 4437–4447
[4] Thompson, R.P. et al. (2003) The oldest, toughest cells in the heart. In Novartis Foundation Symposium on the Development of the Cardiac Pacemaking and Conduction System (in press).

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