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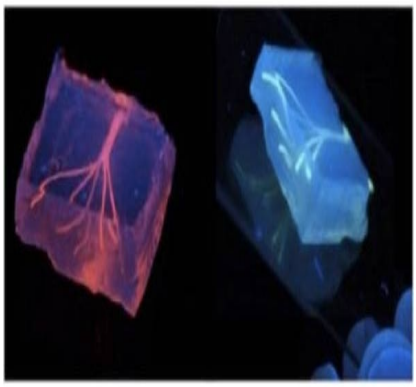
Need Blood Vessels? Just Print Them!



Delivering essential nutrients to our organs and clearing them of hazardous waste are the tasks of our blood vessels, which run inside our bodies in an entangled highway. Up to now, scientists have tried in vain to artificially replicate these tiny transporters.

In a study published online in 'Lab on a Chip', a team from Brigham and Women's Hospital (BWH) describes how it has been successful in fabricating blood vessels using a three-dimensional (3D) bioprinting technique.

Ali Khademhosseini, PhD, biomedical engineer, and director of the BWH Biomaterials Innovation Research Center, recalled how engineers have made impressive progress towards reconstructing artificial tissues such as those of the liver, heart and lungs. The challenge to create artificial blood vessels has, however, remained. He went on to explain how the team addressed this issue by devising a remarkable strategy for vascularisation of hydrogel constructs combining advances in 3D bioprinting technology and biomaterials.

As a first step the scientists produced an agarose (naturally derived sugar-based molecule) fiber template to serve as the mold for the blood vessels through the use of a 3D bioprinter.

Next, the mold was covered with a gelatin-like substance called hydrogel, which formed a cast. Photocrosslinks were used to provide reinforcement, and these agarose fibers became the blood vessel channels.

As Khademhosseini stated, the uniqueness of the team approach lies within the strength of the fiber templates printed, which enables physical removal to make the channels. When the strength is lacking, template layers need to be dissolved, and this in turn may harm the cells entrapped in the surrounding gel.

Successfully constructing microchannel networks, which exhibit a variety of architectural features, has enabled Khademhosseini and his team members to embed these functional and perfusable microchannels inside a wide range of hydrogels. These are commonly used methacrylated gelatin or poly(ethylene glycol)-based hydrogels at different concentrations.

Methacrylated gelatin laden with cells was particularly useful in demonstrating how the artificially constructed vascular networks functioned to improve mass transport, cellular differentiation and cellular viability. A further achievement was the successful formation of endothelial monolayers within the fabricated channels.

Khademhosseini concluded that the future potential of 3D printing technology also included the development of patient-tailored transplantable tissues, and added that it could be used outside the body to develop drugs that are efficient and safe.

Source: Science Daily
Image Credit: Courtesy of Khademhosseini Lab

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