New Technologies - Bionic Model and Tissue Repair

Three-dimensional bioprinted hepatorganoids

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3D bioprinting is an innovative biofabrication strategy that enables the creation of bioactive artificial multicellular tissues/organs, offering a novel approach and method for developing new human tissue models that closely resemble real physiological conditions. On one hand, 3D bioprinting presents exciting prospects in simulating human normal tissue and organ physiological functions, making the regeneration of complex living tissues and automated production possible. At the same time, bioprinted disease tissue models, such as tumors, play a significant role in the treatment of certain diseases, novel drug screening, and toxicity prediction.

We have successfully printed a stable 3D liver organoid in vitro (3DP-HO model), which exhibited systematic liver functions both in vitro and in vivo. Through transplantation assays, we demonstrated the 3DP-HO model of liver tissues possessed in vivo hepatic functions and alleviated liver failure after transplantation, suggesting that 3D bioprinting could be used to generate human liver tissues as alternative transplantation donors for the treatment of liver diseases. The model may also serve as a rescue bridge for transitioning from liver failure to liver regeneration or act as a supplement towards extensive hepatectomy resection and temporary maintenance of the liver during a waiting period for transplantation.

We have also achieved another breakthrough by extending 3D bioprinting using primary human HCC cells. We successfully established the patient-derived 3D bio-printed HCC (3DP-HCC) models, and after long-term culture, these models grew well and retained the features of parental HCCs. Furthermore, we demonstrated that 3DP-HCC models could display drug screening results intuitively and quantitatively, making them suitable for evaluating the efficacy of multiple candidate drugs for HCC patients. Therefore, 3DP-HCC models are faithful in vitro models that are reliable in long-term culture and able to predict patient-specific drugs for personalized treatment.