

MicroHeart: A Novel, Structurally Accurate, Physiologically Relevant, and Scalable Heart-on-a-Chip Platform

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Problem Most drug development costs go toward testing failed drug candidates, slowing innovation and ultimately costing lives. Even then, cardiotoxicity is a leading cause of drug recalls, so current cardiotoxicity screening methods (2D cell culture and animal models) are not accurate enough. Heart-on-a-chip (HoC) combines the accuracy of 3D cell culture with the scalability of microfluidics, but are prohibitively expensive, lag in structural accuracy, and do not output physiologically relevant data. A better solution is critical. **Methods** Cardiomyocytes (CMs) were derived from induced pluripotent stem cells due to their superior quality and ability for mass production. **Prototype One (P1)** had a novel light-bioprinted microtissue, maximizing similarity to in-vivo tissue. The microfluidic chip consisted of a central microtissue well, inputs, and channels. **Prototype Two's (P2)** microtissue was organoid based; bioink laden with CMs was injected into the central well. P1 and P2 were electrically matured. **Results** Chips were tested with epinephrine, isoproterenol, and verapamil for drug sensitivity. P1 and P2 displayed high responsiveness in contraction amplitude and frequency to all three drugs; however, P1 displayed a more physiological contraction pattern than P2, as well as an unprecedented accuracy high enough to compare potencies of similar drugs, suggesting that the novel light-bioprinted microtissue creates a more accurate model than existing microtissues. **Conclusion** MicroHeart is the first HoC platform that combines accurate tissue structure, physiologically relevant data, and a non-prohibitive cost, while delivering unprecedented insight into drug candidate function. Although exciting progress has been made, more investigation is required.

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