

Novel Design for a Vascularized 3D Bioprinted Co-Culture Lung Model

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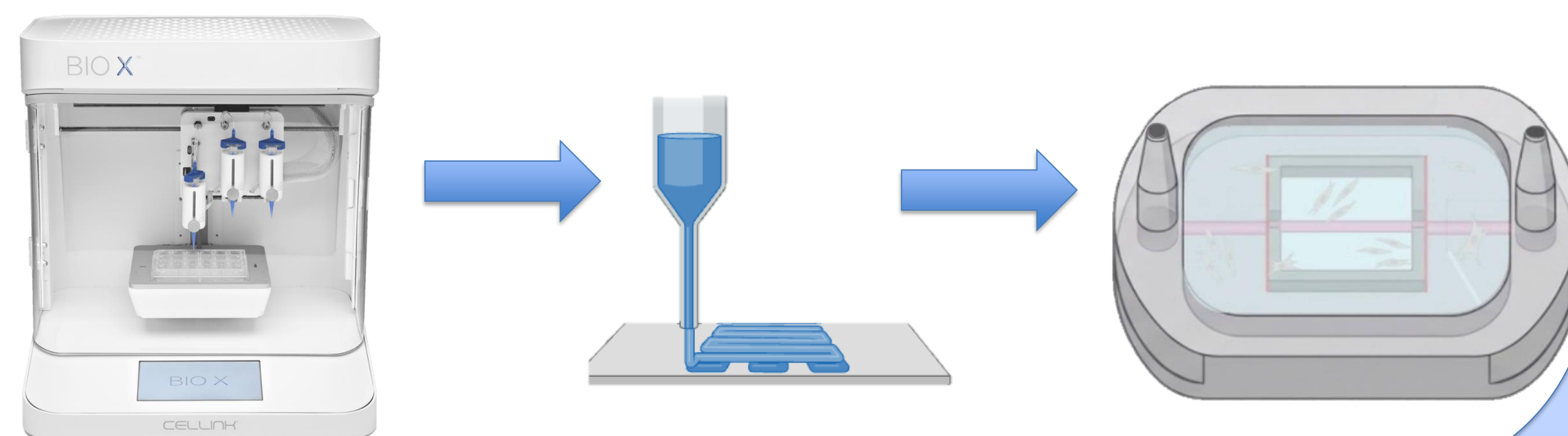


Relevance of a New Lung Model

- Chronic lung disease cases are rising, highlighting the need for physiologically relevant models.
- Current 2D Models fail to capture complex cell-cell interactions and 3D environment of human lungs.
- To address this, we developed a 3D hydrogel-based, vascularized, co-culture model that closely resembles human lungs allowing for the study of lung disease pathogenesis

Establishing the Model

- The BIO X Cellink Bioprinter was used to create our model atop a novel chip design.
- We created a co-culture with lung fibroblasts and human endothelial cells in our model to resemble human lungs.
- Alamar Blue assay assessed cell viability. Morphology of fibroblasts was checked with confocal imaging.



Novel Chip Model Design

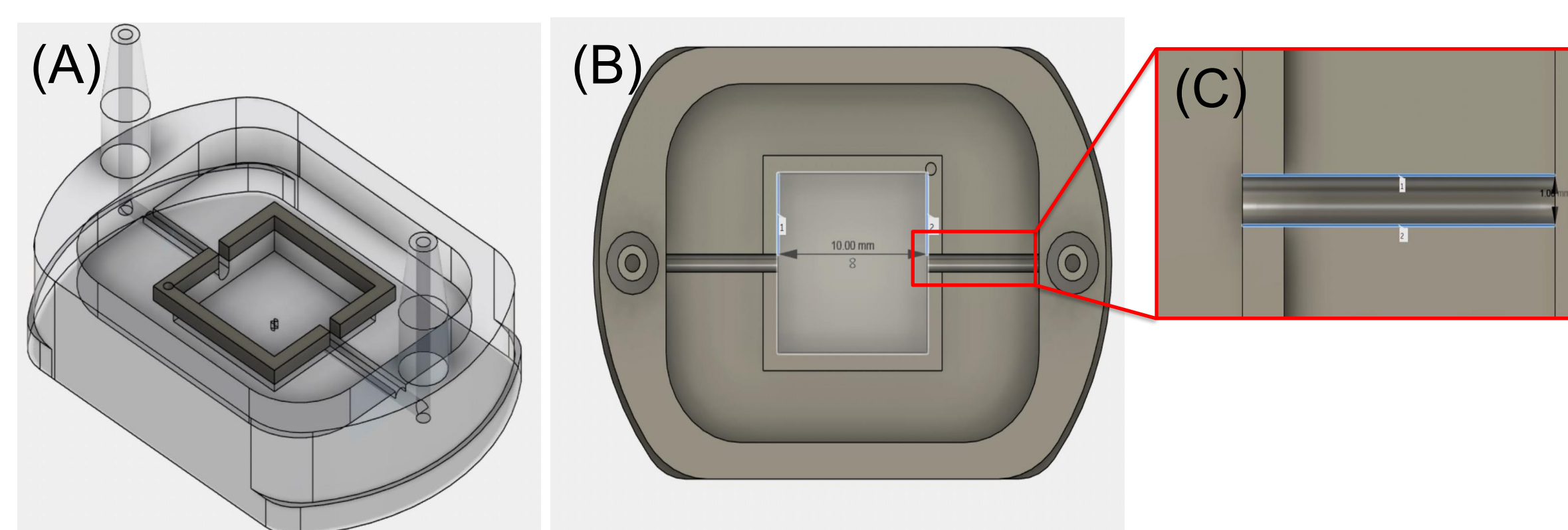


Fig. 1. Schematic for novel 3D co-culture scaffold. Images represent (A) a transparent visualisation of the model, (B) a top down-view of the model and (C) a closer view of the lumen.

Using Extrusion-Based Bioprinting to Establish Models

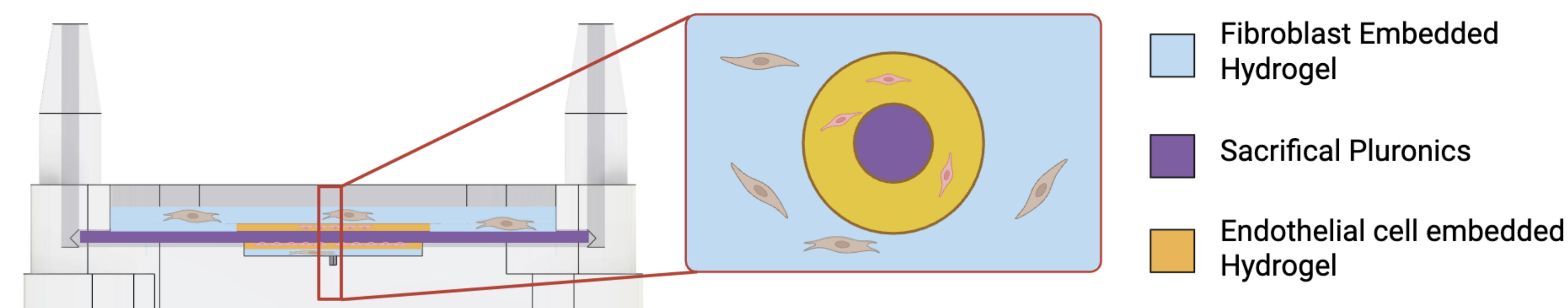


Fig. 2. Transparent chip design demonstrating the formation of co-culture layers on chip design. Fibroblast embedded hydrogel (light blue) surrounds endothelial cell embedded hydrogel (yellow). The innermost layer is sacrificial Pluronics (purple).

Optimizing the Formation of a Vascularized Lumen

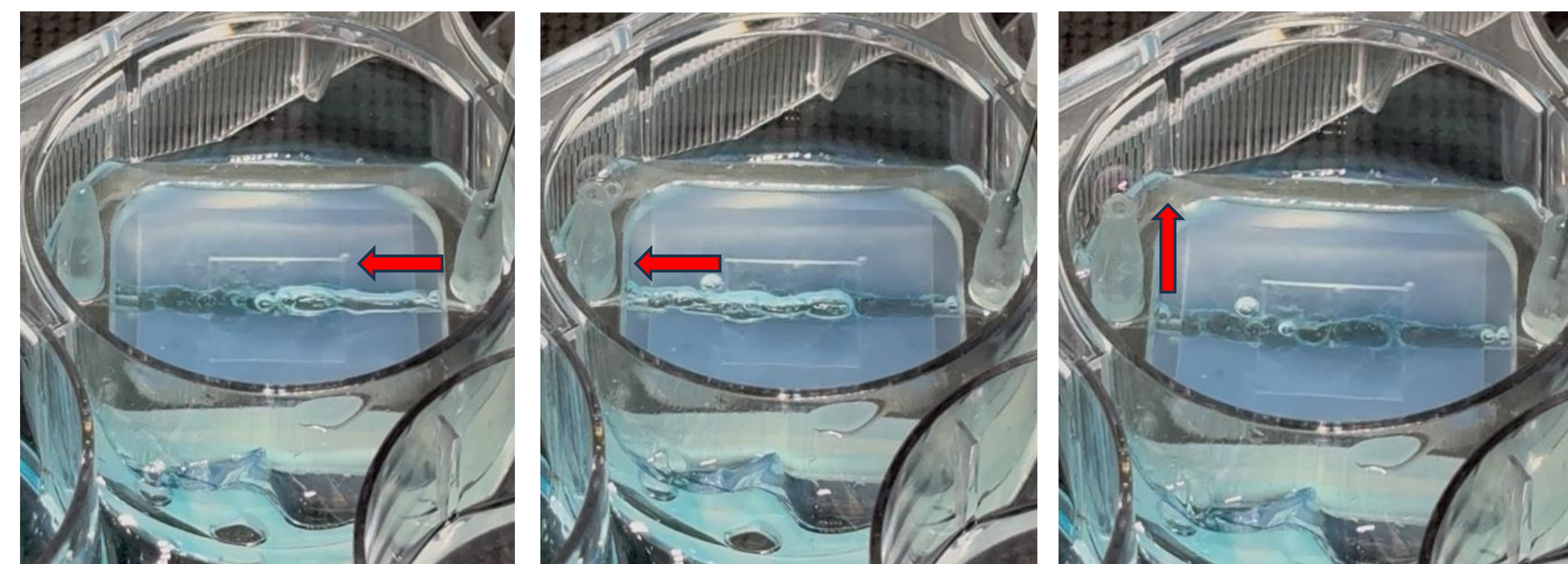


Fig 3. Flow of an air bubble through a vascularized acellular model. Red arrows indicate the direction of flow demonstrating end-to-end perfusion.

Cell Morphology was Impacted by Dimension & Stiffness of ECM

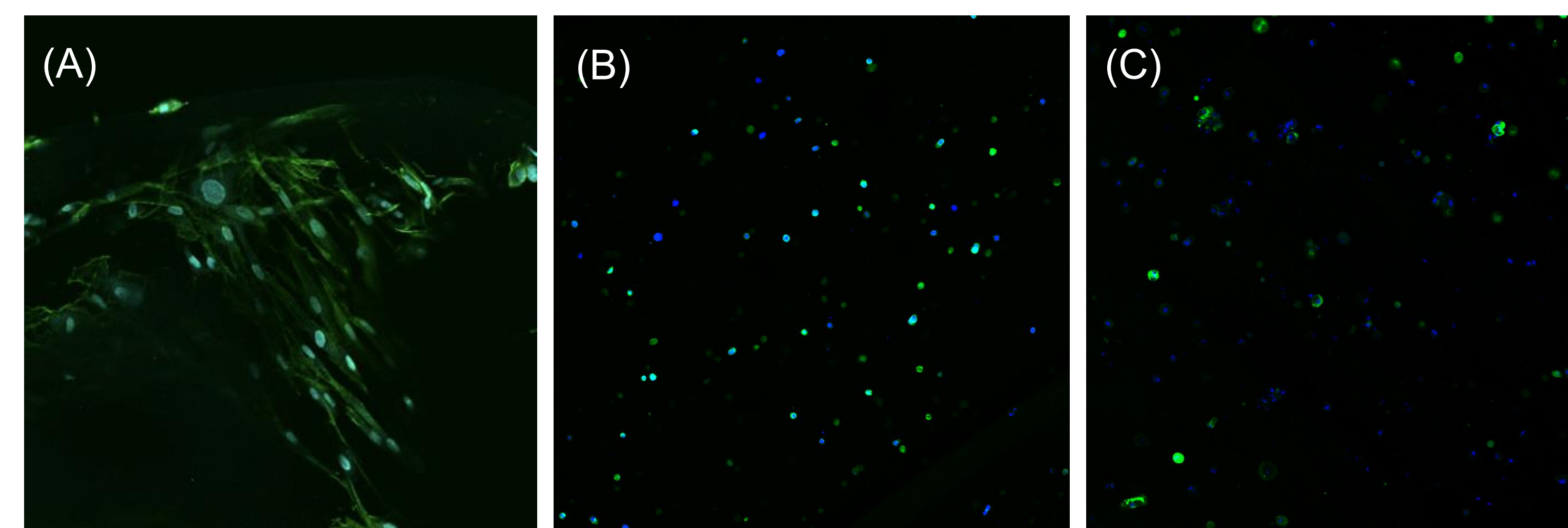


Fig 4. ICC imaging of lung fibroblasts at 10x magnification (A) on top of Tissugel Medium, (B) embedded in GelMA 5%, (C) and embedded in GelMA 7.5%. All nuclei were stained with DAPI (blue) and F-actin (green) was stained with phalloidin in the cytoskeleton of cells.

Established Vascularized Model

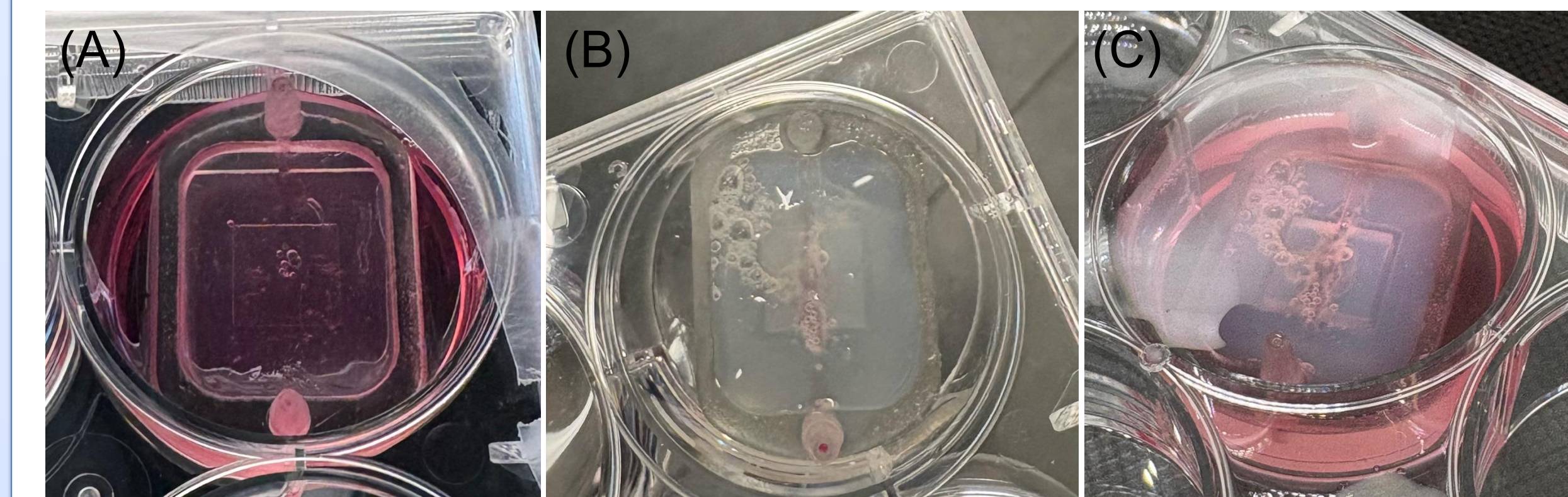


Fig 5. Cell embedded co-culture models formed with (A) GelMA 5% and (B-C) GelMA 7.5%.

Metabolic Activity Decreased at Higher GelMA Concentration

Alamar Blue Viability of Cell Embedded Co-Culture Models At Different GelMA Concentrations

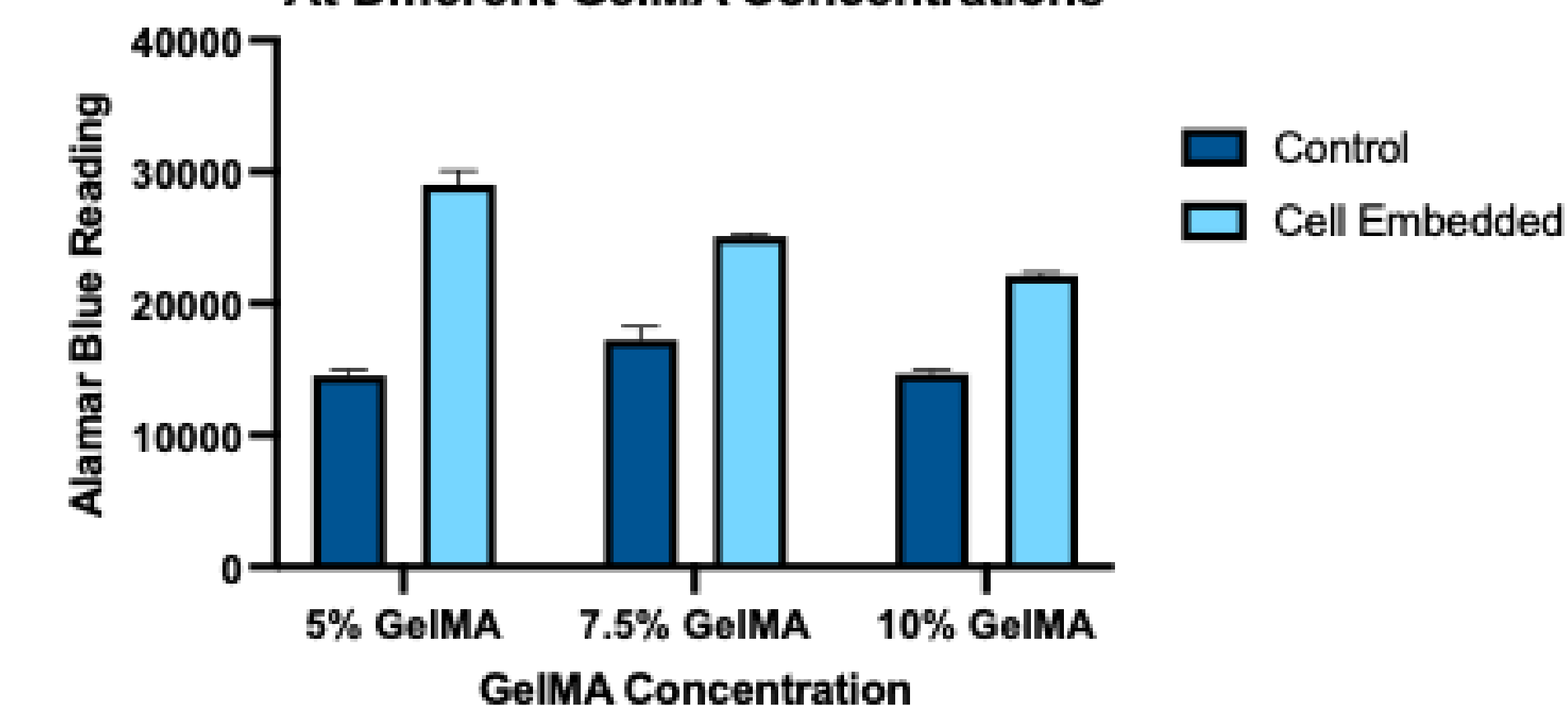


Fig 6. Alamar Blue readings of models at varying GelMA concentrations ranging from 5%, 7.5% and 10%. Models were embedded with MRC-5 and EA.hy926 cells.

Conclusion and Further Direction

- This project has established a novel bioprinted, vascularized, co-culture lung model.
- Future work should increase physiological relevance by flowing media through the model.

