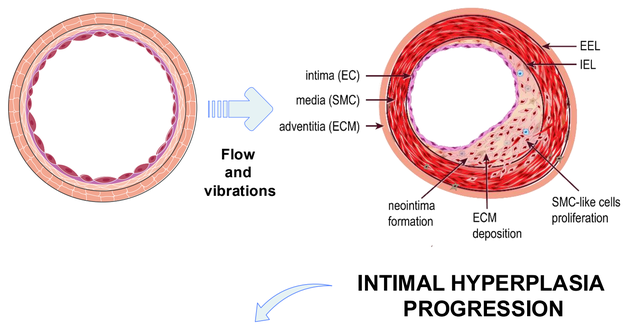
AUTOMATED 3D VASCULAR MODEL TO INVESTIGATE FLOW-INDUCED REMODELING AND NEOINTIMA FORMATION

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INTRODUCTION



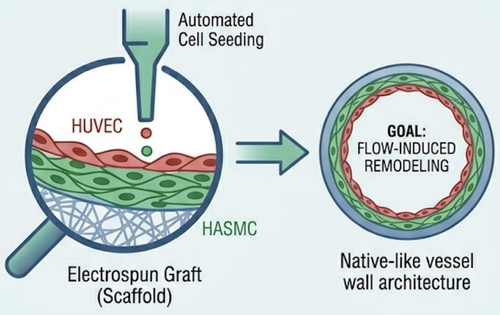
- Migration of SMC from media
- Extracellular matrix deposition
- Cell proliferation

Vascular remodeling is regulated by:
- hemodynamic stimuli
- endothelial–smooth muscle cell crosstalk

Current limitation
Conventional **2D in vitro models** do not reproduce the **3D architecture** and cellular organization of native vessels, limiting the study of pathological processes such as **neointima formation**[1].

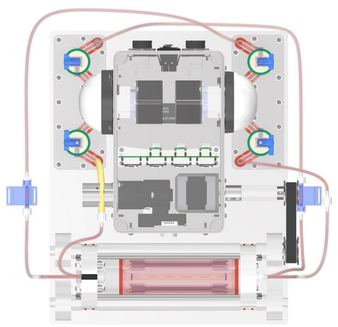
AIM

To establish a pathophysiologically relevant ***in vitro*** **3D vascular model** through the development of an integrated culture platform able to:
- Perform automated cell seeding
- Target the luminal surface of vascular scaffold
- Apply controlled flow-induced stimuli
- Reproduce key vascular microenvironmental conditions

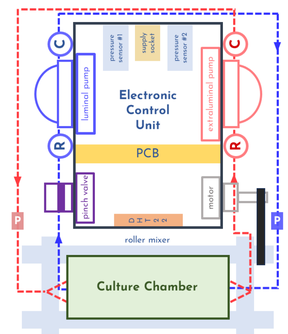


METHODS

- **Integrated culture platform**

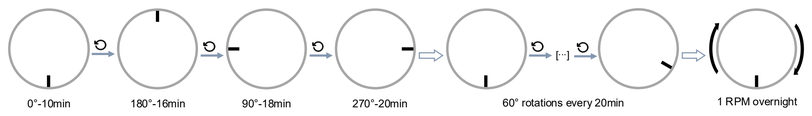


Requirements:
- High level of automation
- Reproducibility
- Minimal manual intervention
- Enhanced experimental reliability



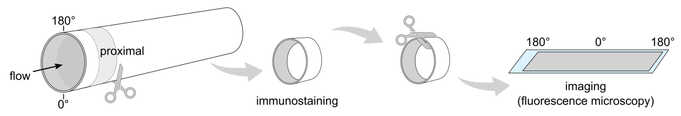
- **Seeding protocol**

Human aortic smooth muscle cells (HASMCs) + human umbilical vein endothelial cells (HUVECs) on electrospun silk fibroin tubular scaffold.



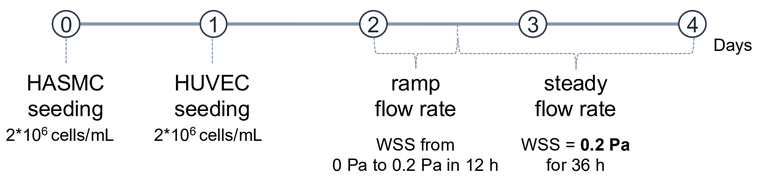
- **Biological investigation**

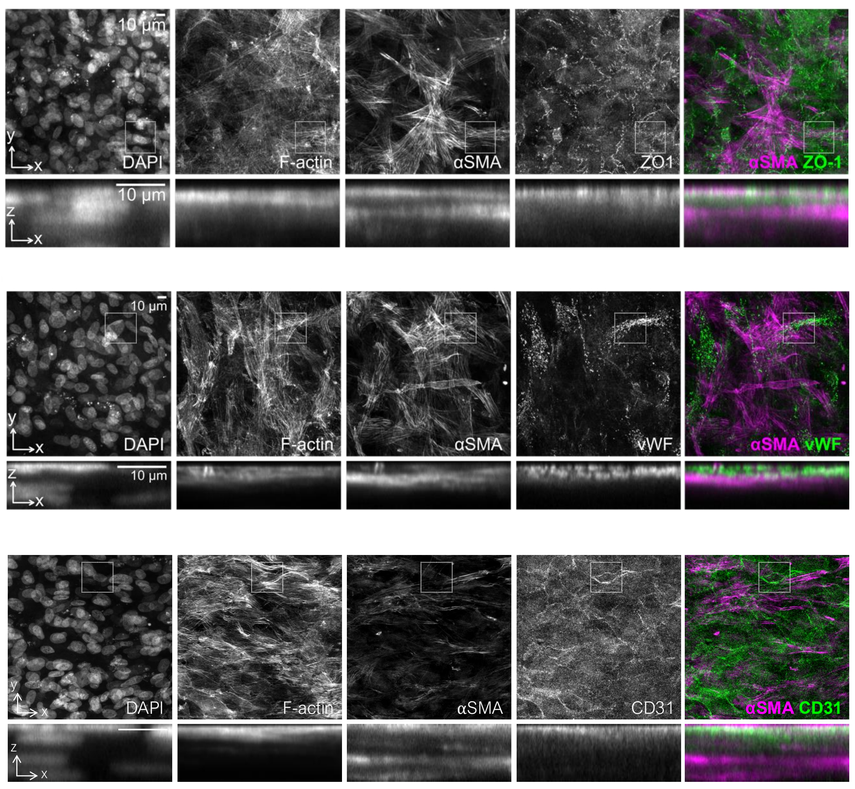
Immunofluorescence analysis: ZO-1, vWF, CD31 + cell orientation in response to the flow-induced stimulus.

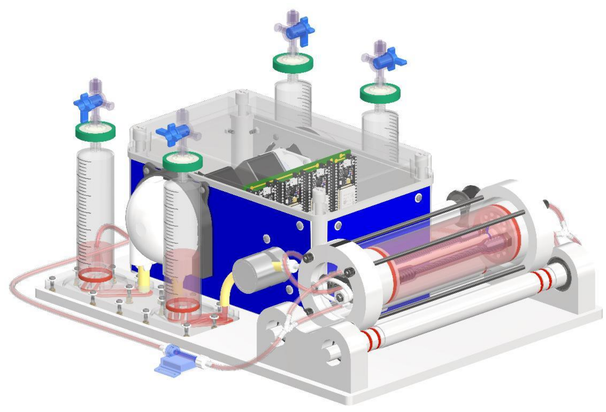


RESULTS

Venous-like conditioning







Luminal and extraluminal independent hydraulic circuit

Automated cell seeding

Different sample diameter and lengths

User friendly

Long term sterility maintenance

Wireless remote control

Dynamic stimuli

Versatile and customizable system

Experiment variables monitoring

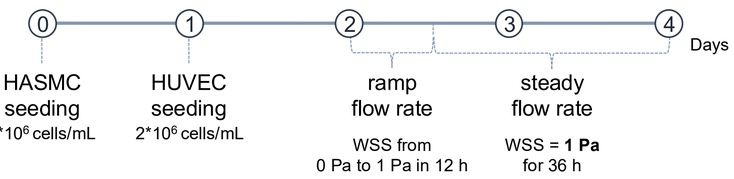
Homogeneous cell seeding

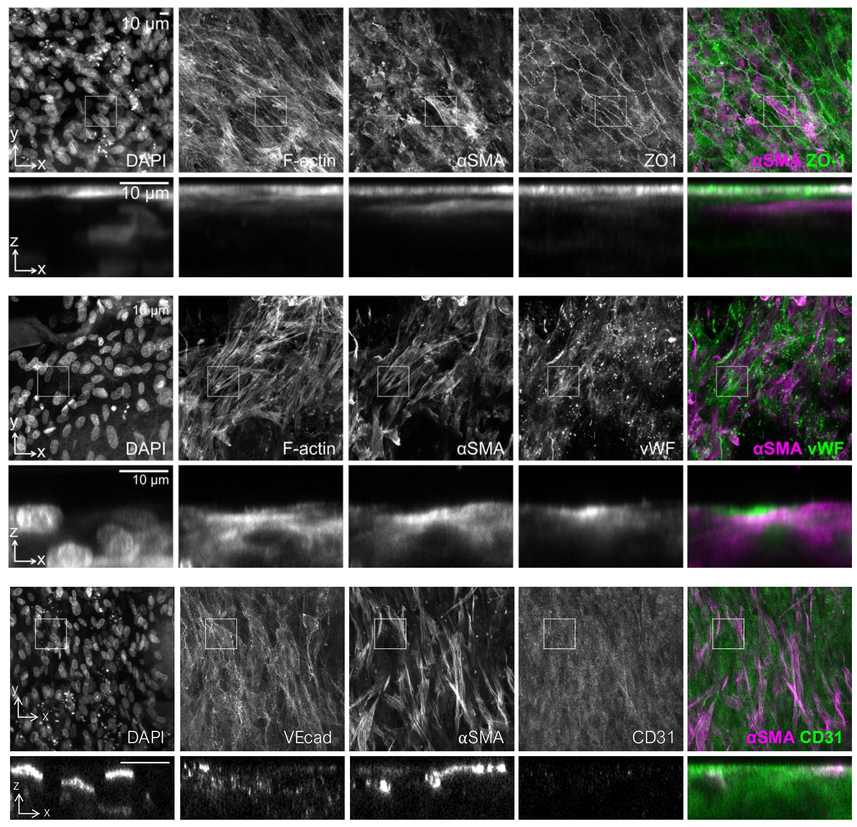
Two cell layers clearly visible with ZO-1 and vWF staining

No endothelium activation

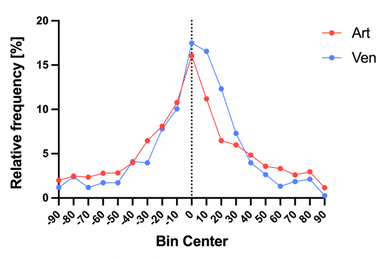
Cytoskeletal orientation in response to stimuli

Arterial-like conditioning



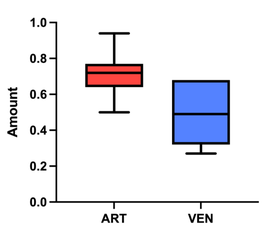


Cell nuclei orientation

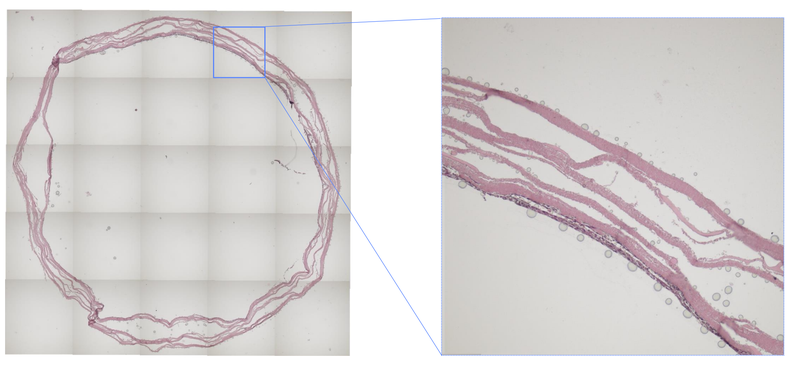


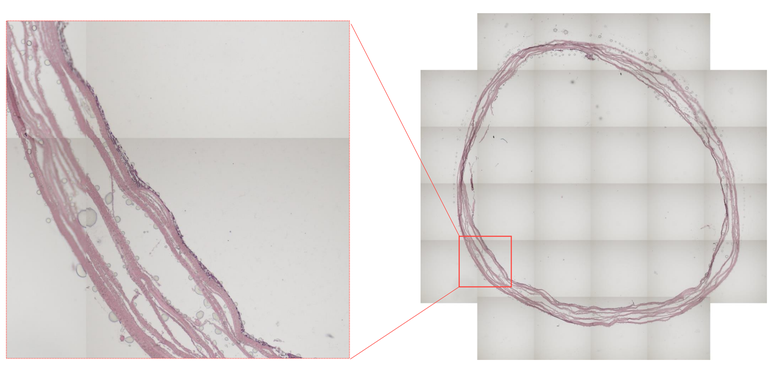
No significant differences in nuclear orientation were observed between venous and arterial stimulation.

F-actin orientation
(FTT analysis)



Measure of signal concentration around the preferred direction:
→High values = greater alignment





CONCLUSIONS

The *in vitro* platform provides a powerful tool to investigate **vascular cell crosstalk** and **remodeling processes** in response to diverse hemodynamic environments, ultimately contributing to the advancement of translational vascular research.

References
[1] Yuan et al., PLoS One, 2015
[2] Smart Servier Medical Art

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