Pressure Arteriography or Wire Myography? How to choose for your model.

Introduction

The study of vascular function is central to understanding almost every aspect of physiology, pathophysiology and pharmacology since it is the vasculature that perfuses and maintains the entire body. Diseases such as hypertension, diabetes and arteriosclerosis, and even normal processes such as aging, directly impact vascular structure and function, so it is of vital importance to investigate vascular function.

Since it is often very difficult, if not impossible, to investigate all these aspects of vascular structure and function using non-invasive or minimally invasive techniques in humans, important and powerful in-vitro methodologies have been developed to help research scientists better understand the complex, yet vital, nature of blood vessel biology.

The in-vitro study of blood vessels can be divided into three main areas: ultrastructural, vasoreactivity and mechanics. For this brief review we will focus in the latter two.

To better understand vasoreactivity and mechanics, there are two sets of tools and methodologies. For vasoreactivity, pressure arteriography serves as the gold-standard for quantifying vascular reactivity in isolated perfused blood vessels. For mechanics, the ideal is research tool is wire myography.

Here, we will review both techniques and highlight which method best fits your research needs and objectives.

Wire Myography

Wire myography enables the investigation of isolated blood vessels with respect to mechanical properties and response to external (pharmacological, etc.) stimuli. Vessel sections are isolated and prepared as ring segments which are then mounted onto wires (for smaller vessels) or L-bars (for larger vessels) supported by mounts (aka "jaws"). One of the mounts is paired with a precision micro positioner to set vessel diameter, while the other mount is paired to a force transducer to measure the tension generated by the vessel; measured force is normalized to the size of the vessel. The entire vessel segment is then submerged in a perfusion chamber filled with a physiological buffer solution.

During typical experiments, vessel diameter is held constant and the vessel is stimulated by adding active pharmacological agents causing the vessels to contract or relax (from an induced pre-contracted state) resulting in change in isometric tension which is measured and recorded. Electrical field stimulation can also be implemented. With wire myography, you

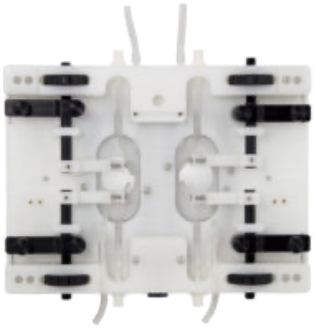
can not only quantify the cellular contribution of vascular tone (smooth muscle & endothelium reactivity), but also the extracellular matrix contribution (material stiffness of elastin and collagen layers) by performing tensile testing and stress/strain curves analysis.

Advantages of wire myography

There are a few advantages of wire myography.

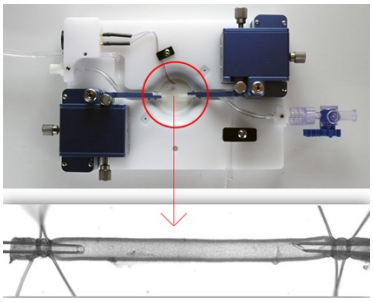
- It is relatively easy to setup and maintain technically. Vessels of almost any size can be studied with wire myography.
- Also, you have the ability of setting up and running multiple vessel rings simultaneously allowing for higher experimental throughput.
- Finally, it is the more cost-effect solution to assessing vascular function.

Pressure Arteriography



Pressure arteriography enables the detailed investigation of the vasoactive physiologic function of small vessels. Vessels are carefully isolated and dissected into lengths (typically several millimeters) and then cannulated at either one (aka 'blind sac' setup) or both ends ('constant pressure-flow' setup). In the case of the former, the distal vessel end is closed off. In either case, the cannulas are connected to a user-controlled perfusion circuit which pressurizes the vessels to physiological levels. With the 'constant pressure-flow' setup, both pressures and flows are precisely controlled by the perfusion circuit. The cannulated vessel is submerged in a specialized vessel chamber where it is maintained in a physiologic saline perfusate in either a static self-heating or continuously perfused setups.

A digital camera connected to a microscope is positioned above the vessel chamber where the inner/outer diameters and wall thicknesses of the vessels are digitized and quantified. It is the changes in these dimension that are the direct measure of vessel reactivity.



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Advantages of pressure arteriography

There are many advantages to pressure arteriography.

- First, because vessels are cannulated and pressurized, it is very close to the vessel's physiological *in-vivo* state. Uniform pressure is applied to the inner vessel wall as opposed to radially stretching the vessel in one direction. Thus, normalization is not required when the measuring diameter and wall thickness changes from applying fluid pressure.
- Also, with pressure arteriography, there are specialized vessel chambers available for certain microscopy applications, long-term perfusion/remodeling, and electrical field stimulation for electromechanical/neuronal studies.
- Pressure arteriography also allows the study of known and important vaso-physiological phenomenon such as flow-mediated dilation and the myogenic response.
- Finally, vessel cannulation enables the application of pharmacological agents to be applied externally or intraluminally. This is especially important when studying endothelial function.

How Do You Choose?

Many investigators take a graduated approach to studying vascular function where they start with the more technically easier wire myography and then move up to pressure arteriography

There are several selection criteria when deciding between wire myography and pressure arteriography. If you are interested more in vessel wall mechanics, then wire myography is the more suitable technique.

For those that want to delve deeper into the physiology of vasoreactivity, especially in resistance vessels, then pressure arteriography is the method of choice. Note that larger vessels such as the thoracic aorta often cannot be used with pressure arteriography since those vessels are too thick to allow visualization of the inner vessel in the microscope. Finally, cost favours wire myography.

Many investigators take a graduated approach to studying vascular function where they start with the more technically easier wire myography and then move up to pressure arteriography, with first the 'blind sac' setup and then if their research takes them in that direction, the 'constant pressure-flow' setup.

Conclusion

Many disease models are directly caused or impacted by altered or impaired vascular function. Furthermore, characterizing vascular function is central to elucidating the physiological processes involved at the organ, tissue and even cellular and molecular level. Thus, the detailed study of blood vessel reactivity and mechanics is of vital importance to enhancing our understanding of vascular biology.

The availability of wire myography and pressure arteriography equip the investigation researcher with powerful and effective in-vitro tools to elucidate the many complex aspects of vascular function.

If you have any questions on which method best meets your research needs, feel free to contact us to discuss your model. We have many resources available, from scientist webinars to journal citations, to help point you in the right direction.

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To see the systems that Living Systems offers, please visit our website (www.scintica.com) or feel free to reach out to us via email at info@scintica.com or by phone at 832-548-0895 and we would be glad to assist you.