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LETTER TO THE EDITOR
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Isolated Circulation Systems and Cellular Approaches

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ABSTRACT

Although perfusion science has historically been synonymous with cardiopulmonary bypass (CPB) applications, today it has transcended this narrow technical framework to become a multidimensional scientific field at the heart of circulation-based treatment approaches. The maintenance of physiological circulation through artificial systems, the preservation of homeostatic balance, and the application of targeted therapies constitute the contemporary application areas of perfusion science. Definitions by international professional and scientific organisations also reveal that clinical perfusion applications have expanded to encompass isolated organ and limb perfusion, cellular and genetic therapy applications, and translational approaches.

Perfusion science is emerging as a new field of research developing in line with isolated circulation systems and cellular approaches. In this context, perfusion science goes beyond being a technical field that provides macroscopic-level circulatory support; it is positioned as an advanced translational science field that enables the application of targeted treatment strategies at the cellular and molecular levels through circulatory systems.

Keywords: Isolated Organ Perfusion, Extremity Perfusion, Cellular Approaches.

Dear Editor,

Perfusion science has evolved far beyond being merely a technical field limited to cardiopulmonary bypass (CPB) applications. Today, perfusion science plays a central role in the artificial maintenance of physiological circulation, the preservation of homeostatic balance, and the implementation of circulation-based treatment approaches.

As defined by perfusion.com, the world's largest perfusion community, namely the global cardiovascular perfusion committee, the areas of application for clinical perfusion include: “Non-Differentiated Progenitor Cell Harvest”, “Isolated Limb/Organ perfusion”, 'Isolated limb/organ delivery of chemotherapeutics, progenitor cells, gene therapy vectors, etc.'(1). The same definition is also stated by the American Society of ExtraCorporeal Technology (AmSECT) (2).

Thus, these definitions show that perfusion has a broad scope of application, not limited to providing circulatory support, but also encompassing the harvesting of cellular material, isolated organ and limb perfusion, and the administration of chemotherapy, cell and gene therapy through these systems. Furthermore, it represents a multidisciplinary vision that goes beyond the traditional operating theatre-centred perfusion applications. These definitions clearly demonstrate that perfusion science is not merely the technical provision of CPB circulation but is also an active part of cellular, molecular, and biotechnological processes.

Isolated Organ and Limb Perfusion: Rediscovering a Dimension

Isolated organ or limb perfusion is based on the principle of supporting a tissue or organ separated from the systemic circulation with oxygenated blood or perfusion solution via a controlled artificial circulation system. This method has clinical value, particularly in the fields of oncological surgery and organ transplantation.

Isolated limb perfusion is a technique that enables the administration of high-dose chemotherapy by preventing systemic toxicity in malignant melanoma and soft tissue sarcomas. The success of this procedure depends on elements requiring high technical expertise, such as establishing the perfusion

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circuit, managing flow and pressure parameters, selecting the oxygenator, and controlling drug distribution kinetics. However, the effectiveness of this technical approach is not limited to mechanical and haemodynamic control; it also requires consideration of tissue permeability, cellular response, and drug-tissue interactions at the molecular level.

Isolated organ perfusion is regaining importance, particularly in the field of transplantation. Ex vivo liver, lung, kidney or heart perfusion techniques are used to increase organ viability, reduce reperfusion injury and lower the risk of organ rejection. The management of these systems requires both mechanical perfusion knowledge and the ability to maintain molecular and biochemical balance.

The scope of perfusion science in these areas extends beyond CPB applications, demonstrating that it has developed into a comprehensive discipline encompassing organ preservation approaches and translational and regenerative circulatory systems.

Consequently, isolated organ and limb perfusion with cellular therapies should be considered a strategic vision shaping the future direction of perfusion science. This approach repositioning perfusion within a circulation-based framework offers a multidisciplinary perspective in fields such as stem cell and regenerative medicine, organ preservation, oncological perfusion, and cellular applications.

Consequently, the application areas of perfusion science developing at the molecular level reveal the fundamental research direction the discipline should focus on in the future. This situation elevates perfusion beyond a limited approach confined to macroscopic circulatory support, positioning it as an advanced scientific field that examines the regulation of cellular processes and targeted biological applications through circulatory systems.

DESCRIPTIONS

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