Endothelial cell

see Vascular endothelial cells.

Endothelial cells are a type of specialized cells that line the interior surface of blood vessels, lymphatic vessels, and the heart. They form a crucial barrier between the bloodstream and the surrounding tissues. These cells play various essential roles in maintaining vascular homeostasis, regulating vascular tone, controlling blood clotting, and mediating inflammatory responses. Here are some key aspects of endothelial cells:

Location: Endothelial cells form a continuous monolayer lining the entire circulatory system, from the smallest capillaries to the largest arteries and veins.

Structural Integrity: Endothelial cells provide structural integrity to blood vessels, forming a barrier that regulates the passage of substances between the bloodstream and surrounding tissues. This barrier function is vital for controlling the movement of nutrients, oxygen, hormones, and immune cells in and out of the bloodstream.

Vascular Tone Regulation: Endothelial cells produce and release various signaling molecules such as nitric oxide (NO), endothelin-1, and prostacyclin, which regulate vascular tone by influencing the contraction and relaxation of smooth muscle cells in blood vessel walls.

Blood Coagulation and Anticoagulation: Endothelial cells play a critical role in blood clotting and anticoagulation processes. They produce factors that promote blood clot formation when the vessel wall is damaged, while also secreting anticoagulant substances to prevent excessive clotting within healthy blood vessels.

Inflammation and Immune Response: Endothelial cells participate in the body's immune response by expressing adhesion molecules and chemokines that facilitate the recruitment of immune cells to sites of infection or injury. They also contribute to the regulation of inflammatory processes within blood vessels.

Angiogenesis: Endothelial cells are involved in angiogenesis, the process of new blood vessel formation. During angiogenesis, endothelial cells proliferate, migrate, and organize into new vascular structures in response to various growth factors and signals.

Endothelial dysfunction, characterized by impaired endothelial cell function, is associated with various cardiovascular diseases such as atherosclerosis, hypertension, and diabetes. Understanding the molecular mechanisms underlying endothelial cell physiology and pathology is critical for developing therapeutic strategies to treat cardiovascular disorders and maintain vascular health.

Endothelial cells (ECs) continuously line the cerebrovasculature. Molecular aberrations in the ECs are hallmarks and contributory factors to the development of cerebrovascular diseases, including intracranial aneurysms and arteriovenous malformations (AVMs). Endovascular biopsy has been introduced as a method to harvest ECs and obtain relevant biologic information. We aimed to

summarize the literature on endovascular biopsy in neurointerventional surgery.

Methods: We conducted a comprehensive literature search in multiple databases, identifying eligible studies focusing on neurosurgical applications of endovascular biopsy. The systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The relevant information was collected, including study characteristics, biopsy techniques, and key findings.

Results: Nine studies met the inclusion criteria and were included. The studies involved the collection of ECs using various endovascular devices including coils, guide wires, different stents, and forceps. Endothelial-enrichment techniques, such fluorescence-activated cell sorting (FACS), collected ECs and facilitated downstream applications of bulk or single-cell RNA sequencing (scRNAseq). The studies provided insights into gene expression profiles and identified potential biomarkers associated with intracranial aneurysms. However, challenges were observed in obtaining an adequate number of ECs and identifying consistent biomarkers.

Conclusion: Endovascular biopsy of endothelial cells (ECs) in cerebrovascular pathologies shows promise for gene expression profiling. However, many studies have been limited in sample size and underpowered to identify “signature genes” for aneurysm growth or rupture. Advancements in minimally invasive biopsy methods have potential to facilitate applications of precision medicine in the treatment of cerebrovascular disorders [1].

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Shekhtman O, Sioutas GS, Piavchenko G, Bhalla S, Cooke DL, Winkler E, Burkhardt JK, Srinivasan VM. Endovascular biopsy in neurointerventional surgery: A systematic review. Interv Neuroradiol. 2024 Mar 22:15910199241240508. doi: 10.1177/15910199241240508. Epub ahead of print. PMID: 38515364.