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The proof and reasons that starling's law for the capillary-interstitial fluid transfer is wrong: Advancing the hydrodynamics of a porous orifice (g) tube as the real mechanism

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Abstract

Introduction and Objective

In 1886, Starling proposed a hypothesis for the capillary–interstitial fluid (ISF) transfer, in which the capillary was thought a tube of a uniform diameter that is impermeable to plasma proteins. The flow of fluid across its wall was thought dependent upon a balance between the hydrostatic pressure within its lumen causing 'filtration', and the osmotic pressure of plasma proteins causing 'absorption'. The physical basis on which LP of a capillary was thought positive and responsible for filtration was Poiseuille's work on long Brass tubes of uniform diameters. Later discoveries demonstrated that the capillary is a porous orifice tube with totally different hydrodynamics that is reported here.

Material and Methods

The hydrodynamics of an inlet tube was studied in order to demonstrate the negative side pressure (SP) gradient exerted on its wall. We then studied the porous orifice (G) tube akin to capillary and later enclosed it in a chamber (C), akin to interstitial fluid space, making the G-C apparatus demonstrating the G-C circulation phenomenon. The effect of proximal (arterial) pressure (PP), distal (venous) pressure (DP) and inlet diameter on the SP and CP of the G-C model are reported.

Results

The PP induces the negative SP in the G tube which is responsible for absorption. The orifice has an inverted bell shaped effect on SP and CP. The DP augments filtration. The G tube enclosed it in a chamber (C), making the G-C apparatus demonstrating the G-C circulation phenomenon.

Conclusions

Hydrodynamic studies on G tube, based on capillary ultrastructure, demonstrate results which differ from Poiseuille's in a strait tube, challenge the role attributed to arterial pressure as a filtration force in Starling's hypothesis. A perspective literature review shows that the oncotic pressure force has been previously cancelled and the Starling's hypothesis has failed to explain the capillary–ISF transfer in most parts of the body. A concept based on a new hydrodynamic of the G-C model phenomenon is proposed for the capillary–ISF circulation. An autonomous dynamic magnetic field-like G–C circulation occurs between fluid in the G tube's lumen and a surrounding fluid compartment C. Based on results of studies on a circulatory model incorporating the G–C apparatus, factors which initiate, regulate and affect the G–C circulation, its physiological and haemodynamic relevance and its clinical importance to the pathogenesis of oedema and shock are discussed.

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