

The correct replacement for the wrong Starling's law is the hydrodynamic of the porous orifice (G) tube: The complete physics and physiological evidence with clinical relevance and significance

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Introduction and objective: To report the complete evidence that Starling's law is wrong, and the correct replacement is the hydrodynamic of the G tube detailed. New physiological evidence is provided with clinical relevance and significance.

Material and methods: The physics proof is based on G tube hydrodynamic. Physiological proof is based on study of the hind limb of sheep: running plasma and later saline through the artery compared to that through the vein as regards the formation of oedema. The clinical significance is based on 2 studies one prospective and a 23 cases series on volumetric overload shocks (VOS).

Results: Hydrodynamic of G tube showed that proximal, akin to arterial, pressure induces suction "absorption" not "filtration". In Poiseuille's tube side pressure is all positive causing filtration based on which Starling proposed his hypothesis, The physiological evidence proves that the capillary works as G tube not Poiseuille's tube: Oedema occurred when fluids are run through the vein but not through the artery. There was no difference using saline or albumin. The wrong Starling's law dictates the faulty rules on fluid therapy inducing VOS causing ARDS.

Conclusion: Hydrodynamic of the G tube challenges the role attributed to arterial pressure as filtration force in Starling's law. A literature review shows that oncotic pressure does not work either. The new hydrodynamic of G tube is proposed to replace Starling's law which is wrong on both forces. The physiological proof and relevance to clinical importance on the pathogenesis of clinical syndromes are discussed. The puzzles of TURP syndrome, Dilution HN and ARDS are resolved.

Abbreviations VO: Volumetric overload VOS: Volumetric overload shocks VOS1: Volumetric overload shock, Type 1 VOS2: Volumetric overload shock, Type2 TURS: The transurethral resection of the prostate syndrome ARDS: The adult respiratory distress

syndrome MVOD/F: The multiple vital organ dysfunction/ failure syndrome AKI: Acute kidney injury HN: Hyponatraemia BP: Arterial Blood pressure CVP: Central venous pressure ISF: Interstitial fluid G Tube: The Porous Orifice Tube PP: Proximal pressure to the G tube akin to arterial Blood pressure DP: Distal Pressure to the G tube akin to venous pressure LP: Lumen pressure of the G tube FP: Flow pressure is the positive pressure inside the G Tube SP: Side pressure is the negative pressure on the wall of the G Tube

Literature review on capillary physiology and ultra-structure that has been previously reported demonstrated that albumen's oncotic pressure as re-absorption force does not work in vivo; neither in clinical practice nor in physiology. This is one of the two forces of Starling's law has proved wrong. My research work proves that the other Starling's law force of hydrostatic pressure causing filtration is also wrong. The clinical relevance and significance in relation to the pathogenesis and therapy of the transurethral resection of the prostate (TURP) syndrome, acute dilution hyponatraemia (HN), the acute respiratory distress syndrome (ARDS) or the multiple vital organ dysfunction/ failure (MVOD/F) syndrome and acute kidney injury (AKI) in relation to its patho-aetiology of volumetric overload shocks (VOS) are discussed. The key points of the complete enlightening evidence are summarised here:- 1. Starling's hypothesis became a law prior to the discovery of the capillary ultra-structure and the correct physiology [1,2]. 2. The capillary has a pre-capillary sphincter as reported by Rhodin in 1967 which makes it different from Poiseuille's tube of uniform diameter as my research demonstrated [3]. 3. The capillary has porous wall of intercellular slits that allow the passage of plasma proteins as shown by Karnoveski in 1967 [4]. Hence plasma proteins cannot exert an oncotic pressure in vivo. 4. The osmotic chemical composition of various body fluids is identical to plasma proteins as demonstrated by Hendry in 1962 [5]. Plasma protein, if it works, is too weak and too slow to effect fluid

absorption. 5. Guyton and Coleman (1968) demonstrated that the interstitial fluid (ISF) space has a negative pressure of -7 cm water and Calnan et al (1972) showed that the lymph has the same negative pressure [6,7]. The pressure under the skin is negative. 6. The oncotic pressure of plasma proteins does not work as absorption force neither in physiology as proved by Hendry in 1962 nor in clinical practice demonstrated by Cochrane Injuries Group in 1998 [5,8]. 7. Inadequacy in explaining the capillary-ISF transfer in many parts of the body as reported by Keele et al in 1982, particularly vital organs, has previously called for reconsideration of Starling's hypothesis by Renkin in 1984 [9,10]. 8. My research work has demonstrated that the hydrostatic or rather the dynamic "arterial" pressure does not cause filtration across the wall of porous orifice (G) tube as proposed by Starling. It causes suction. 9. This pressure induces negative side pressure gradient along the G tube causing suction maximum near the inlet and turns positive causing filtration maximum near the exit as based on physics experiments on the G tube and physiological research on the hind limb of sheep [11-13]. 10. The physiological study on the hind limb of sheep have completed the evidence that Starling's law is wrong as the capillary works as G tube not Poiseulli's tube [13]. 11. Starling's law being wrong underlies all errors and misconceptions on fluid therapy misleading physicians into giving too much fluid during resuscitation of shock and the acutely ill patients and during prolonged surgery thus inducing VOS and causing ARDS or MVOD/F and AKI [14].