



# Volumetric Overload Shocks (VOS) in Surgical Patients



**Ahmed N Ghanem\***

Consultant Urologist Surgeon, Egypt

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\*Corresponding author: Ahmed N Ghanem, Consultant Urologist Surgeon, No1 President Mubarak Street, Mansoura 35511, Egypt

**Keywords:** Shock; Hyponatraemia; Fluid therapy; The TURP syndrome; ARDS; Starling's law; G tube; Porous orifice tube

**Abbreviations:** HN: Hyponatraemia; VOS: Volumetric Overload Shock; VOS1: Volumetric Overload Shock Type 1; VOS2: Volumetric Overload Shock Type 2; TURP: The Transurethral Resection of the Prostate; ARDS: Acute Respiratory Distress Syndrome; MVD/F: Multiple Vital Organ Dysfunction/Failure; HST: Hypertonic Sodium Therapy; ARF: Acute Renal Failure; NaCl: Sodium Chloride; NaCO<sub>3</sub>: Sodium Bicarbonate

## Key Points

**Question:** What are the new discoveries in medicine and physiology and why should it concern the surgeon?

**Findings:** Two shocks and its treatments are recognized. Both volumetric overload shocks are iatrogenic complication of fluid therapy. Starling's law proved wrong and the correct replacement is the hydrodynamics of the porous orifice (G) Tube. These have resolved the puzzles of TURP syndrome, HN and ARDS.

**Meaning:** Two new types of shocks are discovered. Starling's law is wrong, and the correct replacement is the hydrodynamics of the G tube. These resolve the puzzles of syndromes discovering patho-aetiology and successful treatments.

## Editorial

Volumetric overload shocks (VOS) are common iatrogenic complication of fluid therapy in hospitals that is overlooked and underestimated. It may present in theatre as cardiopulmonary arrest or later with coma and ARDS. VOS is 2 types; VOS1 and VOS2. VOS1 is induced by 3.5-5 litres of sodium-free fluid and is characterized with dilution HN that has 2 nadirs and 2 paradoxes, is most dynamic and illusive and currently has a lifesaving therapy of HST. VOS2 may complicate VOS1 or occur de novo complicating sodium-based fluid therapy during resuscitation of shock, acutely ill patients and prolonged surgery. It has no obvious serological markers or none. Many errors and misconceptions mislead physicians into giving too much fluid for resuscitation due to faulty rules on fluid therapy dictated by the wrong Starling's law. The correct replacement for this law is the hydrodynamic of the porous orifice (G) tube.

Volumetric overload shocks (VOS) are iatrogenic complications of fluid therapy in hospitals [1-3]. It is overlooked and underestimated. When it is realized that acute dilution hyponatraemia (HN) and the acute respiratory distress syndrome (ARDS) is representative of each type of VOS it would be appreciated that it has staggering morbidity, cost and mortality. It affects hundreds of thousands of patients worldwide each year including surgical, urological and obstetric patients of men, women and children undergoing surgery. It concerns new discoveries in medicine and physiology [4]. The objective of this article is to bring these new discoveries into the attention of readers, particularly surgeons as these condition concerns them most.

The scientific discoveries include 2 VOS [1-3], proving the physiological law of Starling wrong and finding a new correct replacement which is the hydrodynamic of the porous orifice (G) tube [5-7]. Starling's law being wrong has resulted in many errors and misconceptions on fluid therapy [8] during prolonged surgery and the resuscitation of shock and the acutely ill patients. This misleads physicians into giving too much fluid which induces VOS, causing cardiac or respiratory arrest or both "cardiopulmonary arrest" immediately in theatre [9] or the acute respiratory distress syndrome (ARDS) later [10].

VOS are two types depending on the type of fluid: VOS1 is induced by sodium-free fluid such as 5% Glucose and/or 1.5% Glycine used as irrigating fluid during the transurethral resection of the prostate (TURP) surgery. It is known in urology as the TURP syndrome [11] or hyponatraemic shock [12]. This VOS1 is induced

by 1.5% Glycine absorption and 5% glucose infusion of about 3.5-5 liters or >5% of body weight and is characterized with dilution hyponatraemia (HN) [13,14]. It has 2 nadirs and 2 paradoxes [15] making it dynamic and illusive [16]. The 2 nadirs are: The immediate drop of serum sodium level as result of dilution of the extra-cellular fluid that occurs during or immediately after surgery. The second nadir is that occurring later within 24 hours after water shift into the intracellular compartment causing spontaneous elevation of serum sodium level towards normal, yet the clinical picture gets worse due to generalized cellular edema. This cellular edema manifests as the multiple vital organ dysfunction/(MVOD/F) syndrome. The 2 paradoxes are: A pathological volumetric overload induces hypotensive shock of VOS and acute renal failure (ARF) which is paradoxical to the response of physiological volume replacement that treats hypotensive shock and induces diuresis [14].

VOS1 currently has a lifesaving therapy of hypertonic sodium therapy (HST) of 5% NaCl or 8.4% CO<sub>3</sub> [17]. It may present with cardiopulmonary arrest [9] or one or more of the other manifestations of MVOD/F syndrome- being the new name for ARDS [10]. The clinical manifestations include in addition to cardiorespiratory features: coma, ARF and hepatic dysfunction. It also causes coagulopathies and excessive bleeding at the surgical site. VOS1 affects women too during the trans-cervical resection of endometrium due to Glycine absorption, or during Cesarean section due to excessive 5% Glucose infusion [14]. VOS is always mistaken for one of the recognized shocks such as haemorrhagic and septic shocks hence wrongly treated with further volume expansion using sodium-based isotonic fluids. This induces VOS2 and cardiopulmonary arrest that has no serum markers of HN [2] and causes ARDS in patients who survive a little longer [8,9]. Multiple regression analysis has proved that volumetric overload is the most significant factor in causing the clinical picture of VOS.

Volumetric overload shock type 2 (VOS2) [1-3,10] is induced by massive infusion of sodium-based fluids such as normal saline, Hartmann, plasma, plasma substitutes and blood. VOS2 may complicate VOS1 or is induced by sodium-based fluid during fluid therapy for resuscitation of shock and the critically ill and prolonged surgery and presents with ARDS later. Volumetric gain of 12-14 litres of sodium-based fluids reported in the first article on ARDS [18] which is the only article in the whole literature, other than the articles of mine some of which are referenced here, that documents the volume of retained fluid in ARDS.

In summary, VOS are common iatrogenic complication of fluid therapy in hospitals that is overlooked and underestimated. It may present in theatre as cardiopulmonary arrest or later with coma and ARDS. VOS is 2 types; VOS1 and VOS2. VOS1 is induced by 3.5-5 litres of sodium-free fluid and is characterized with dilution HN that has 2 nadirs and 2 paradoxes, is most dynamic and illusive and currently has a lifesaving therapy of HST. VOS2 may complicate

VOS1 or occur de novo complicating sodium-based fluid therapy during resuscitation of shock, acutely ill patients and prolonged surgery. It has no obvious serological markers or none. Many errors and misconceptions mislead physicians into giving too much fluid for resuscitation due to faulty rules on fluid therapy dictated by the wrong Starling's law. The correct replacement for this law is the hydrodynamic of the porous orifice (G) tube. These scientific discoveries should make the Medical World wake up, pay attention and listen to what I have to say [19].

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