Volumetric Overload Shocks (VOS) Causing the Acute Respiratory Distress Syndrome (ARDS): The Complete Evidence

Ahmed N Ghanem*

Consultant Urological Surgeon, Mansoura, Egypt

*Corresponding Author: Ahmed N Ghanem, Consultant Urological Surgeon, Mansoura, Egypt.

Received: December 13, 2019; Published: January 06, 2020

Abstract

Introduction and Objective: To report evidence that VOS causes ARDS.

Material and Methods: Literature analysis revealed overlooked facts and errors on fluid therapy. My research included:

1. A prospective clinical study on 100 TURP patients among whom 10 developed TURP syndrome.
4. A physiological study on the hind limp of sheep.

Results: The literature analysis revealed many overlooked facts and errors on fluid therapy and its correction is given:

1. The prospective study demonstrates VOS is the most important factor causing TURP syndrome and ARDS.
2. The case series study affirmed VOS is the patho-etiology of TURP syndrome and ARDS. The correct therapy is HST that saved the lives of 20 patients.
3. The physics study on the G tube showed that the proximal pressure akin to arterial pressure causes suction, not filtration, and provided the phenomenon of the G tube as the correct replacement for Starling’s law.
4. The physiological study on the hind limp of sheep demonstrated that arterial pressure induced suction not filtration and the capillary works as G tube not Poiseuille’s tube.

Conclusion: Overlooked facts and errors on fluid therapy mislead physicians into giving too much fluids inducing VOS and causing ARDS. It is clear that VOS causes ARDS. Both physics and physiological evidence prove Starling’s law is wrong. The phenomenon of the G tube provides the correct replacement.

Keywords: Shock; ARDS; Volumetric Overload Shocks; Starling’s Law; Capillary-Interstitial Fluid Transfer; Fluid Therapy

Abbreviations

VO: Volumetric Overload; VOS Volumetric Overload Shocks; VOS1 Volumetric Overload Shock, Type 1; VOS2: Volumetric Overload Shock, Type 2; TURP: The Transurethral Resection of the Prostate; ARDS: The Adult Respiratory Distress Syndrome; MVOD: The Multiple Vital Organ Dysfunction/Failure Syndrome; HN: Hyponatraemia; HST: Hypertonic Sodium Therapy of 5% NaCl or 8.4% Sodium Bicarbonate; PV: Plasma Volume; ISF: Interstitial Fluid; NaCO3 Sodium Bicarbonate; NaCl: Sodium Chloride; ICU: Intensive Care Unit; RCT: Randomized Controlled Trial; WW2: World War Two; G Tube: Porous Orifice Tube

Introduction and Objective

The acute respiratory distress syndrome (ARDS) was first reported in 1967 [1]. It was realized later that it is part of multiple vital organ dysfunction/failure (MVOD/F) syndrome that affects hundreds of thousands of cases worldwide every year and is associated with substantial morbidity, cost and mortality [2]. In the first report on ARDS [1], volumetric overload (VO) of 12 - 14L occurred in every case but later reports [2,3] never incriminated VO. As VO was not suspected, the results of both randomized controlled trials (RCT) [2,3] and systemic reviews were inconclusive. The most recent RCT investigating fluid therapy in MVOD/F aimed at the first 7 postoperative days thus missed the initiating event of bolus fluid therapy given during resuscitation or surgery that established the condition in the first place. Another RCT never mentioned VO or increase in body weight hence the most recent systemic review totally overlooked VO as possible insult inducing the ARDS or MVOD/F syndrome.

The reason for overlooking VO as cause of MVOD/F is the accumulation of clinical misconceptions based on erroneous Starling’s law on the capillary-interstitial fluid transfer. This has subtly misled physicians into infusing big bolus VO for treating hypotension of true or presumed hypovolaemia causing MOVD/F syndrome or ARDS. The nihilistic approach used here is based on reminders of basic physics and physiology facts, plausible clinical observations, physics research revealing a novel hydrodynamic phenomenon of the G tube, and clinical research on VO complicating fluid therapy done over the past 32 years, reported in thesis and articles [4,5]. This report advances the concept of VO over time inducing VOS and causes ARDS or MVOD/F, providing the complete evidence.

Historical Background

Ever since fluid therapy had proved life-saving for millions of poly-trauma victims of World War Two (WW2), the procedure was transferred into clinical practice with all its success and complications without verification. Reports from WW2 and clinical practice during the 3rd quarter of the 20th century demonstrate complications of fluid therapy that was reported as ARDS and is recognized today as the MVOD/F syndrome. The slogan of that era, that remains operative today, was: “Too much of a good thing must be a good thing”? This is untrue particularly and obviously concerning water: water is essential for life yet its excess or deficiency is equally detrimental or lethal. Excess kills by flooding/ drowning while lack is lethal by dehydration/drought.

Fluid therapy is used in hospitals mainly for treating hypotension of hemorrhage or hypovolemic and septic shocks as well as in the resuscitation of poly-trauma, preloading and per-operative maintenance of prolonged major surgery [3,6]. This is when, where and how ARDS or MOVD/F is induced as iatrogenic complication of bolus VO used for treating hypotension of presumed or true volume deficit. It occurs only in hospitals, commonly in theatre or on intensive care units (ICU), never in community and thus is iatrogenic.

Materials and Methods

Critical analysis of literature revealed overlooked facts and errors on fluid therapy. My research results are summarized here including.

A prospective clinical study on 100 TURP surgery patients among whom 10 developed the TURP syndrome. The symptomatic cases were randomized into two groups of 5 patients each: Group 1 was treated conservatively with “guarded” volume expansion, and Group 2 was treated with hypertonic sodium therapy (HST) of 5% NaCl or 8.4 NaCO₃.

A case series of 23 patients who suffered TURP syndrome presenting with VOS. The first 3 patients were mistaken for hemorrhagic or septic shock and treated with volume expansion inducing VOS and causing death. The remaining 20 patients were correctly diagnosed as VOS and treated with HST; all survived.

A physics study on the hydrodynamics of the G tube investigating the role of proximal hydrostatic pressure, akin to arterial pressure, to demonstrate whether it causes filtration or suction. The porous orifice (G) tube, based on capillary ultrastructure, was used and its hydrodynamic was compared to Poiseuille’s tube- based on which Starling proposed the arterial pressure causing filtration. The G tube dynamics are totally different from Poiseuille’s tube.
A physiological study on the hind limb of sheep comparing infusion of fluid through the artery to that through the vein using normal saline or plasma proteins. The objective was to verify whether the capillaries work as Poiseuille's tube or the G tube through verifying the causation of oedema formation.

**Results**

The literature analysis revealed many overlooked facts as well as errors and misconceptions on fluid therapy that mislead physicians into giving too much fluid during fluid resuscitation of shock, acutely ill patients and prolonged surgery, and its correction is given. Starling's law underlies all the errors and misconceptions that induces VOS and cause ARDS as my research demonstrated.

The prospective study demonstrates VO is the most important factor causing TURP syndrome as example of VOS1 and ARDS later (Figure 1 and Table 1). The symptomatic cases randomized into two groups of 5 patients each: Group 1 was treated conservatively with "guarded" volume expansion showed morbidity including one patient who had coma and paralysis suggesting cerebrovascular accident diagnosed by a neurologist but was completely cured with belated hypertonic sodium therapy (HST). Group 2 treated with HST of 5% NaCl or 8.4 NaCO₃ were cured. The difference was significant on comparing the results.

The case series study affirmed VOS is the real patho-etiology of TURP syndrome and ARDS. The volumetric overload of these patients is shown in figure 2. The first 3 patients were mistaken for haemorrhagic or septic shock and treated with volume expansion inducing VOS and caused death. The remaining 20 patients were correctly diagnosed as VOS and treated with HST all survived and completely cured. The correct therapy is HST of 5% NaCl or NaCO₃ saved the lives of 20 patients.

*Figure 1:* Shows the means and standard deviations of volumetric overload in 10 symptomatic patients presenting with shock and hyponatraemia among 100 consecutive patients during a prospective study on transurethral resection of the prostate. The fluids were of Glycine absorbed (Gly abs), intravenously infused 5% Dextrose (IVI Dext) Total IVI fluids, Total Sodium-free fluid gained (Na Free Gain) and total fluid gain in litres.
Volumetric Overload Shocks (VOS) Causing the Acute Respiratory Distress Syndrome (ARDS): The Complete Evidence

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err</th>
<th>Std. Value</th>
<th>T Value</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td></td>
<td></td>
<td>0.773</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid Gain (l)</td>
<td>0.847</td>
<td>0.228</td>
<td>1.044</td>
<td>3.721</td>
<td>0.0001</td>
</tr>
<tr>
<td>Osmolality</td>
<td>0.033</td>
<td>0.014</td>
<td>-0.375</td>
<td>2.42</td>
<td>0.0212</td>
</tr>
<tr>
<td>Na⁺ (C_B)</td>
<td>0.095</td>
<td>0.049</td>
<td>0.616</td>
<td>1.95</td>
<td>0.0597</td>
</tr>
<tr>
<td>Alb (C_B)</td>
<td>0.062</td>
<td>0.087</td>
<td>0.239</td>
<td>0.713</td>
<td>0.4809</td>
</tr>
<tr>
<td>Hb (C_B)</td>
<td>-0.282</td>
<td>0.246</td>
<td>-0.368</td>
<td>1.149</td>
<td>0.2587</td>
</tr>
<tr>
<td>Glycine (C_B)</td>
<td>-4.973E-5</td>
<td>5.975E-5</td>
<td>-0.242</td>
<td>0.832</td>
<td>0.4112</td>
</tr>
</tbody>
</table>

Table 1: Shows the multiple regression analysis of total per-operative fluid gain, drop in measured serum osmolality (OsmM), sodium, albumin, Hb and increase in serum glycine occurring immediately post-operatively in relation to signs of the TURP syndrome. Volumetric gain and hypoosmolality are the only significant factors.

Figure 2: Shows volumetric overload (VO) quantity (in litres and as percent of body weight) and types of fluids. Group 1 was the 3 patients who died in the case series as they were misdiagnosed as one of the previously known shocks and treated with further volume expansion. Group 2 were 10 patients from the series who were correctly diagnosed as volumetric overload shock and treated with hypertonic sodium therapy (HST). Group 3 were 10 patients who were seen in the prospective study and subdivided into 2 groups; Group 3.1 of 5 patients treated with HST and Group 3.2 of 5 patients who were treated with guarded volume expansion using isotonic saline.

The physics study on the G tube showed that the proximal pressure akin to arterial pressure causes suction, not filtration, through a negative side pressures gradient on its wall causing irrigation of the surrounding space without oedema formation. This proved the hydrodynamic phenomenon of the G tube (Figure 3) is the correct replacement for erroneous Starling’s law.

Volumetric Overload Shocks (VOS) Causing the Acute Respiratory Distress Syndrome (ARDS): The Complete Evidence

The physiological study on the hind limb of sheep demonstrated that arterial pressure induced suction not filtration. Oedema occurred when fluid flows through the vein but not when it flows through the artery. Hence the capillary works as a tube not Poiseuille’s tube. There was no difference between using normal saline and plasma protein solutions.

Discussion

The presented evidence represents the complete proof that VOS causes ARDS. It all new discoveries in medicine and physiology originated in urology [7], but cover a wide range of specialties including physics, physiology, medicine, cardiovascular, nephrology and respiratory medicine. The scientific discoveries include 2 volumetric overload shocks (VOS) [8-10], proving the physiological law of Starling wrong [11-13] and finding a new correct replacement which is the hydrodynamic of the porous orifice (G) tube (Figure 3).

Figure 3: Shows a diagram of the porous orifice (G) tube enclosed in chamber (C) demonstrating the magnetic field-like G-C circulation phenomenon. The inflow pressure (1) pushes fluid through the orifice (2) creating fluid jet in the lumen of the G tube. The fluid jet creates negative side pressure gradient causing suction maximal over the proximal half of the G tube near the inlet (3) that sucks fluid into lumen. The side pressure gradient turns positive pushing fluid out of lumen over the distal half maximally near the outlet (4). Thus the fluid around G tube inside C moves in magnetic field-like circulation (5) taking an opposite direction to lumen flow of G tube. The inflow pressure 1 and orifice 2 induce the negative side pressure energy creating the dynamic G-C circulation phenomenon that is rapid, autonomous and efficient in moving fluid out from the G tube lumen at 4, irrigating C at 5, then sucking it back again at 3, maintaining net negative energy pressure (7) inside C. The distal out flow pressure (6) enhances out flow at (4) and its elevation may turn the negative energy pressure 7 inside C into positive, increasing volume and slowing down the G-C circulation.

Starling’s law being wrong has resulted in many errors and misconceptions on fluid therapy [14] during prolonged surgery and the resuscitation of shock and the acutely ill patients. This misleads physicians into giving too much fluid which induces VOS. It may present with cardiac or respiratory arrest or both “cardiopulmonary arrest” [15] immediately in theatre or the acute respiratory distress syndrome (ARDS) later [16]. VOS are two types depending on the type of fluid inducing volumetric overload: VOS1 is induced by sodium-free

Volumetric Overload Shocks (VOS) Causing the Acute Respiratory Distress Syndrome (ARDS): The Complete Evidence

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 [4] or hyponatraemic shock [17].

This VOS1 is induced by 1.5% Glycine absorption and/or 5% glucose infusion of about 3.5 - 5 liters or > 5% of body weight causing severe condition characterized with dilution hyponatraemia (HN) [18-21]. Hyponatraemia has 2 nadirs and 2 paradoxes [20,21] making it dynamic and illusive [21]. 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 the generalized cellular oedema manifesting with the multiple vital organ dysfunction/failure (MVOD/F) syndrome. Also using sodium-based saline solutions for treating VOS1 may apparently correct serum sodium level but worsen volumetric overload inducing VOS2 and ARDS. The 2 paradoxes are: A pathological volumetric overload induces hypotensive shock of VOS and acute renal failure (ARF) which is paradoxical to the physiological response of volume replacement that treats the known hypotensive shock and induces diuresis [16].

VOS1 currently has a lifesaving therapy of hypertonic sodium therapy (HST) of 5% NaCl or 8.4% NaCO₃ [22]. It may present with cardiopulmonary arrest [15] or one or more of the other manifestations of MVOD/F syndrome- being the new name for ARDS. The clinical manifestations include in addition to cardiac and respiratory 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 [18-22]. VOS is always mistaken for one of the recognized shocks such as hemorrhagic and septic shocks thus it is wrongly treated with further volume expansion using sodium-based isotonic fluids. This induces VOS2 and cardiopulmonary arrest that has no serum markers of HN [18-22] and causes ARDS in patients who survive a little longer [14-16]. Multiple regression analysis has proved that volumetric overload is the most significant factor in causing the clinical picture of VOS (Table 1) [4].

Volumetric overload shock type 2 (VOS2) [8-10] 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 patients and prolonged surgery and presents with ARDS later. Volumetric gain of 12 - 14 liters of sodium-based fluids reported in the first article on ARDS [1] which is the only article in the whole literature, other than the articles of mine referenced here, that documents the volume of retained fluid in ARDS. Discovery of VOS has resolved the puzzles of three conditions namely; the TURP syndrome, HN and ARDS. The exact patho-etiologies were identified and curative therapy was found. These are real serial killers of thousands of surgical and medical patients each year. Not only these most serious conditions preventable but also possibly curable when occur inadvertently and treated promptly.

Conclusion

In summary, VOS causes ARDS. It may present with cardiopulmonary arrest in theatre and ARDS later. It is an iatrogenic complication of fluid therapy in hospitals. VOS is 2 types; VOS1 and VOS2. VOS1 is induced by 3.5 - 5 liters 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 may be 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 G tube. Discovery of VOS has resolved the puzzles of TURP Syndrome, HN and ARDS These scientific discoveries should make the Medical World wake up, pay attention and listen to what I say [24].

Key Points

Question: Does volumetric overload shocks (VOS) cause the acute respiratory distress syndrome (ARDS) and how should it be treated?

Volumetric Overload Shocks (VOS) Causing the Acute Respiratory Distress Syndrome (ARDS): The Complete Evidence

**Findings:** Yes. The evidence is based on the following investigations:

1. A critical analytical review of literature.
2. A prospective clinical study.
3. A case series of 23 patients who suffered TURP syndrome.
4. A physics study on the hydrodynamics of the porous orifice (G) tube.
5. A physiological study on the hind limp of sheep.

**Meaning:** Results of the above studies show:

1. Many errors and misconceptions on fluid therapy.
2. Volumetric overload (VO) induces shock (VOS) which is the real patho-etiology of the TURP syndrome and ARDS.
3. When VOS is mistakenly diagnosed as recognized shocks and treated with further volume expansion transferring the TURP into ARDS and causing death of 3 patients. The remaining 20 patients were correctly diagnosed as VOS1 treated successfully with hypertonic sodium therapy (HST).
4. The proximal pressure akin to arterial pressure causes suction, not filtration.
5. Arterial pressure induces suction not filtration as proposed by Starling in which the capillary works as G tube not Poiseuille’s tube. This means Starling’s law is wrong on both forces.

**Conflict of Interest**
None declared by the author.

**Funding**
None.

**Bibliography**


15. Ghanem AN. "Cardiac arrest and volumetric overload shocks (VOS) complicating fluid therapy". EC Clinical and Medical Case Reports (2019).


23. Ghanem AN. "Medical World wake up, pay attention and listen: Ghanem’s new scientific discoveries in Medicine, Physiology, Urology, Nephrology, Cardiovascular and Surgery". EC Clinical and Medical Case Reports (2019): 01-06.