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One hundred years on: Ypres and ATLS

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"Hemorrhage, hemorrhage, hemorrhage—blood everywhere—clothes soaked in the blood, pools of blood in the stretchers, streams of blood dropping from the stretchers to the floor" Robertson OH, unpublished WWI diaries.[1]

In the sombre predawn darkness at 03:50 hours on the morning of 31July 1917; British, French and Belgian Forces advanced along the ridges and fields of the Gheluvelt plateau. So began the Third Battle of Ypres. Their objective was a small village called Passchendaele only 13 km away. However, it would take 3 months and over half a million casualties to get there.

Two medical officers; both called Robertson, one Canadian and one American, were part of this offensive. The Canadian was Major Lawrence Bruce Robertson, a surgeon who used uncrossmatched whole blood transfused by syringe directly from donor to recipient to demonstrate the life-saving potential of blood transfusion and the need to resuscitate the badly injured with *'something more than saline'*. He felt that any danger of this novel blood transfusion method was vastly outweighed by its benefit. He published his experiences of 36 such transfusions, performed in the 2nd Canadian Casualty Clearing Station in the *BMJ* of 1916.[2] Unfortunately, three of his patients suffered fatal haemolytic reactions and died.

Sir George Makins, the Surgeon General of the British Expeditionary Force (BEF) at the time, expressed considerable concern about this use of uncrossmatched blood transfusion within the BEF. An American officer, Captain Oswald Hope Robertson (US Army Medical Officer Reserve Corps), born in Woolwich, London, and emigrated with his parents to America when he was 18 months old, was sent to assess and solve the problem. From his past experience in the transfusion laboratories of Harvard Medical School and the Rockefeller Institute, OH Robertson was able to demonstrate the safety and ease of using typed, syphilis-tested, universal donor, stored whole blood. He published his experiences of 44 transfusions given to 38 patients in the 13th BEF Hospital in the *BMJ* of 1918.[3] With an average transfusion of 500–600 mL, 25 of the 38 haemorrhage/shock casualties survived to be evacuated in *'good condition'* and *'No reactions of any consequence were observed'*.

Many years passed and for reasons that are still unclear, but in retrospect likely due to mistaken interpretations of the work of George T Shires, an American trauma surgeon and researcher into the physiology of shock, there was a planetary shift to crystalloid-based resuscitation. Shires had demonstrated that a large extracellular fluid (ECF) deficit occurred in prolonged severe haemorrhagic shock, which was greater than could be attributed to vascular refill alone.[4] He felt that only infusion of *both* shed blood and lactated Ringer's solution to replace this ECF deficit could replace those losses. A secondary part of his work went on to show that this deficit could only be corrected by the administration of isotonic crystalloids in volumes two to three times the estimated blood loss to achieve survival.

This early aggressive resuscitation was believed to produce the necessary increase in cardiac output to maintain microvascular perfusion and oxygenation as primary resuscitation goals. It was felt that any risk of accentuating ongoing haemorrhage was entirely secondary to this primary goal. Trauma victims in hypotensive shock were given large volumes of fluids as early as possible—typically 2 L of (possibly) warmed crystalloid through two large bore intravenous catheters. This became the basis of the dogmatic *'three to one rule'*, whereby every millilitre of blood lost should be replaced with 3 mL of crystalloid for the treatment of haemorrhagic shock, which was adopted by the ATLS for its treatment of trauma casualties.

We now know that this approach causes; coagulopathy andimpaired tissue oxygen delivery due to; dilutional anaemia, hypothermia, worsening metabolic acidosis, clot dislodgement and haemorrhage from blood pressure elevation, increases morbidity and mortality.[5–7] Yet current ATLS courses based on the current (2012) 9th Edition Manual[8] still state —*'Give two litres of crystalloid'* an approach that would surely generate significant discussion at any UK Hospital's Morbidity and Mortality meeting. Students are currently told by course directors to *'suspend your belief'* to pass the multiple choice exam and moulages (RSV Parker, personal communication, 2017). Yes a new manual is coming—the 10th Edition was launched in the USA in March this year. June 2017 was the Royal College of Surgeons ATLS update day in London, but UK centres will still continue to run 9th Edition courses until December 2017 and only start 10th Edition courses in February 2018.[9]

Almost all other modern trauma courses, including the successful European Trauma Course and trauma systems, such as those of the British Army with its Battlefield Advanced Trauma Life Support (BATLS), now mandate the <C>ABCDE approach where <C> is the Control of Catastrophic Haemorrhage; recognising that in the time it takes to secure the airway, check the centrality of the trachea and percuss the chest, that the patient may very well have simply bled to death. Current ATLS protocols do not advocate <C> control until at least halfway through the primary survey.

Hopes that ATLS would have responded appropriately to this challenge appear to be misplaced.

First views of the 10th Edition Manual are highly troubling.[9] The hospital preparation section requests that *'warmed intravenous crystalloid solutions are immediately available for infusion'*. The primary survey, although emphasising a trauma team approach is still stuck at ABCDE. *'First assess the airway to ascertain patency, inspect for foreign bodies, facial, mandibular fractures, tracheal, laryngeal fractures…establish an airway whilst restricting cervical spine mobility… establish an airway surgically if intubation is contraindicated or cannot be accomplished'*. Five paragraphs on breathing, including *'percuss the thorax… chest decompression should follow immediately when (Tension Pneumothorax) is suspected by clinical evaluation'*, then follow before any mention of circulation.

Bleeding begins with the ambivalent phrase *'Tourniquets are effective in massive exsanguination from an extremity injury but carry a risk of ischemic injury to that extremity. Use a tourniquet only when direct pressure is not effective and the patients life is threatened*'. What then follows is, quite simply, difficult to comprehend in a 2017 publication likely to be used (by some) for another 4 years.*'Initiate IV fluid therapy with crystalloids. A bolus of 1L may be required to achieve an appropriate response in an adult patient…if a patient is unresponsive to initial crystalloid therapy, he or she should receive a blood transfusion'*. Yet within the very next paragraph on the risk of coagulopathy; the manual bizarrely states that, *'crystalloid resuscitation of more than 1.5L independently increases the odds ratio of death'*.

We live in troubled times on what many term the 'asymmetric battlefield' where the war is among the people. If the question is haemorrhage, then immediately stopping the bleeding and replacing losses, like-for-like, is surely the answer. We know that survival after trauma is inversely proportional to the amount of saline administered. Currently, we use component products (cells, plasma and platelets) to recreate whole blood transfusion. Salt water therapy was debunked 100 years ago. It was Aldous Huxley who said that the only consistent lesson of history was that *'Men do not learn the lessons of history'*.[10] Unfortunately, it would seem that the 10th Edition of the ATLS Manual has made the same error. It is still back in the trenches with its saline in 1916.

Contributors RP attended the ATLS course, PP is a trauma surgeon with an interest in trauma physiology, resuscitation and prehospital care. PP and RP both cowrote the paper. PP acts as guarantor. PP affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained. PJP conceived the paper, RSVP attended the ATLS course described in 2017. Both PP and RP contributed equally to the planning, writing and editing of the paper.

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REFERENCES

1 Stansbury LG, Hess JR. Blood transfusion in World War I: the roles of Lawrence Bruce Robertson and Oswald Hope Robertson in the "Most Important Medical Advance of the War". *Transfus Med Rev* 2009;23:232–6.
2 Robertson LB. The transfusion of whole blood. A suggestion for its more frequent employment in war surgery. *BMJ* 1916;2:38–40.
3 Robertson OH. A method of citrated blood transfusion. *Br Med J* 1918;1:477–9.
4 Bacter CR, Canizaro PC, Carrico CJ, *et al*. Fluid resuscitation of hemorrhagic shock. *Postgrad Med* 1970;48:95–9.
5 Shaz BH, Winkler AM, James AB, *et al*. Pathophysiology of Early trauma-induced coagulopathy: emerging evidence for hemodilution and coagulation factor depletion. *J Trauma* 2011;70:1401–7.
6 Harada MY, Ko A, Barmparas G, *et al*. 10-Year trend in crystalloid resuscitation: reduced volume and lower mortality. *Int J Surg* 2017;38:78–82.
7 Krausz MM. Initial resuscitation of hemorrhagic shock. *World J Emerg Surg* 2006;1:14.
8 ATLS Subcommittee, American College of Surgeons' Committee on Trauma, International ATLS working group. Advanced trauma life support (ATLS®): the ninth edition. *J Trauma Acute Care Surg* 2013;74:1363–6.
9 www.rcseng.ac.uk/education-and-exams/regional-and-international-centres/practical-resources/atls-10/ (accessed 12 Aug 2017).
10 Huxley A. *Collected Essays*. Harper Colophon, 1958.

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