



Haemorrhage Control

by Rich Bell
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Pic: Nightingale Team - US Marine Corps - Japan

Recent research has shown that in major trauma situations, severe bleeding is as important as airway. In fact, in the new PHTLS version 6, assessment for major haemorrhage comes BEFORE airway during the approach phase. This has long been a consideration in combat situations where control of major blood loss takes precedent over establishing an airway. The world is full of places where first-hand experience can be gained and research can be carried out. Coalition troops in Iraq and Afghanistan over the past 4 years have provided more information on catastrophic bleeding than has ever been produced, on a daily basis they are treating their colleagues following devastating injuries from such things as road side bombs. Unfortunately, in the current climate of terrorism on a grand scale you are now equally likely to come across combat-like injuries in your home town though blunt trauma rather than massive open haemorrhage remains the norm in the civil sector!

The conclusion from all modern operations-based research into uncontrolled bleeding is nothing revolutionary or shocking, simply

stated we need to keep the casualty's own blood inside his body and circulating normally - this is a condition known as Hemostasis. It's much better for a casualty to be circulating his/her own blood rather than salty water which does not carry oxygen or remove blood borne nasties. Your casualties are supposed to be filled with about 5 litres of their own blood, that's the way it was intended, and we need to try to keep it that way. This article looks at the options available to rescuers for rapid haemorrhage control that if not controlled would lead to death in a short space of time. Between 50% and 70% of all trauma casualties in the Combat AND civil environments die due to massive blood loss.

For years, our reaction to massive blood loss was induction of intra venous fluids into a blood stream helping reduce pressure on the body's vascular system and vital organs. This is often counterproductive! We still (as at 2007) see paramedics and immediate care doctors pouring litres of fluid into trauma patients. By all means get venous access, but we need to resist the urge to introduce litres of saline into it. Our aim in the pre-hospital setting is to maintain

palpable radial pulses, if not present then infuse no more than 200/250ml of saline and re assess.

Do not squeeze in an initial 2 litre bolus!

If the clotting process has started internally and you then squeeze a quantity of an effectively inert fluid into the blood stream, the blood pressure will rise and potentially blow all those clots away rendering the patient in a more critical status than when you found him !

INITIAL ASSESSMENT of a TRAUMA SCENE:

Once you are happy that the scene is safe using your standard procedures and methods, make your way to the patient. Take a good look at the scene as you approach, what is the casualty's position, what features look right or wrong and at this stage is there a pool of blood on the floor ?

By issuing verbal challenges to the patient you can rapidly assess airway problems and level of consciousness, as combat medics we are not interested initially in Glasgow Cma Scale as so many people seem to get it wrong , we would instead advise initial use of AVPU but assess GCS for the handover once the situation is

under control.

If there is a pool of blood on the floor, you need to establish where it is coming from and stop that bleeding. If it is a big enough pool for you to notice the chances are it is an arterial injury, this can kill the patient within a few minutes so absolutely no point in being sidetracked by complex airway rescue procedures when the casualty has exsanguinated most of his circulating blood volume because the simple truth is, with no blood there is nothing to circulate the oxygen you're busy being distracted by. And saline does nothing to improve this situation because it will NOT transport oxygen.

MEASURES to STOP BLEEDING

A US report quoted in Defence International strongly implies that of 704 casualties wounded in Iraq between March 2003 and February 2005 resulting in massive haemorrhage 34% would have been saved with adequate compression and sealing of the wound.

1) PRESSURE. Direct aggressive pressure with a large padded dressing will always be the first line of attack. My personal preference is the Israeli field dressing which has a handle to allow you to get pressure directly over

the injury site. If the patient bleeds through this DO NOT remove - simply add further dressings or you will disturb the already forming clots.

2) TOURNIQUET. Second choice on limb injuries once the blood has soaked through a couple of pads and is still bleeding will be a wide combat style tourniquet. These are used in theatres on a daily basis for routine joint replacements etc. Placed above the site of the injury and (if possible, but not essential) below the next joint. This just means that when the surgeons get hold of your patient and they cut the limb back, the patient may be able to keep his own joint with his prosthetic limb! This procedure replaces indirect pressure and all frontline troops are issued with a self applied tourniquet .

3) CLOTTING AGENT. Next on the list for central injuries or persistent bleeders will be a clotting encouragement agent which is the main focus of this article. These are dressings or particulates that increase the clotting action around a wound site thereby reducing haemorrhaging. Testing has normally involved live pigs subjected to varying degrees of massive trauma and particularly difficult to staunch, pumping arterial bleeds but this has led to confidence in use of such products in the combat arena. There have been one or two hiccups and ineffectiveness due to certain very specific factors but on the whole such dressings are now a vital part of every soldier's personal kit. In the civil sector there may not be the same concerns associated with a requirement for rapid extraction from a very hostile environment and the cost of some of the options here would be prohibitive but there is definitely a case to be made for a haemorrhage dressing/packet to be a part of every medical kit. Most medics or trauma docs won't have occasion to use such dressings for massive haemorrhage but don't forget their effectiveness in ALL forms of haemorrhage - massive and uncontrolled or much smaller bleeds easily controlled with direct pressure. Active dressings /particulates can be of huge benefit in controlling smaller haemorrhages where direct pressure is difficult to establish or maintain due to a congested or confined environment and throughout a protracted extrication. Any rescue teams operating in remote or wilderness areas, cave/mines and aero-med, may consider such dressings/particulates a welcome aid to patient care. Unfortunately, outside of the combat



HemCon

Cost: \$20-\$100
£18-£75

environment any casualty with a wound large enough to warrant the more expensive dressings may well have exsanguinated before you arrive! Nevertheless the US, UK and Australian military and UK ambulance and aeromedical services feel these measures to be so effective as to warrant personal issue now or their presence on every frontline ambulance by the end of 2008.

The treatments discussed here have a number of things in common:

- 1) introduction of or promotion of natural clotting agents such as thrombin to promote the body's own fight to control bleeding, in half the cases here this is promoted through the reduction of the blood's water content leaving behind coagulating components.
- 2) a 'gluing' action to seal the wound and exert a controlling pressure
- 3) inert and bio-stable construction of the bandage or particulate so that there is no risk of introduction of infection or foreign bodies that could promote an adverse reaction from the bodies immune system, indeed brands like HemCon promote their action as providing a barrier to further infection.

We are looking at the best known brands here but all have seen 'action' sufficient to recommend them for consideration. In all cases they have been cleared for use by the US FDA and many have been funded by the US military in an ongoing program to improve battlefield trauma care.

a) HemCon Medical Technologies Inc achieved media attention when the news channels picked up on it's revolutionary use of a crustacean bi-product to promote clotting. The 'Shrimp' bandage is manufactured from Chitosan a deacylated form of chitin (one of the toughest materials in the natural world) and when in contact with blood (the bandages are not adhesive until they contact moisture) the dressing becomes sticky and an integral part of the wound's clot. This adhesive action is an outstanding bi-product of the Chitosan reaction because it actively seals the

wound forming a 'plug' that holds well over time which is vital in a protracted extraction. The adhesive properties of HemCon may be the sole reason for it's success or there may be an associated reaction of the positively charged Chitosan attracting negatively charged blood cells in a 'clumping' of red blood cells and platelets around the wound site. As far as we know this has yet to be proven categorically but there is enough field experience to suggest that this is another advantage of using HemCon.

HemCon is a simple dressing requiring minimal training and without the handling problems associated with granules. The bandage is available in 3 sizes (2"x2", 2"x4" and 4"x4") and can easily be cut into smaller squares and applied across multiple wound sites. There is also a longer version of HemCon called ChitoFlex™, this is a long dressing treated on BOTH sides and intended to be folded or rolled and 'stuffed' into the wound. Both types of dressing should have direct pressure applied to control the bleed then wrapped in place for transport. If costs can be maintained and even reduced then this product will become a standard part of medical kit in the Medical-Rescue sector.

b) QuikClot has been around for a while now and is in general circulation within frontline military circles. QuikClot or QC is a manmade chemical (bio-inert) available in 3 distinct forms - the original 3.5oz loose-fill sachets costing \$30/£15 each, a new 1st Responder pack with

the granules contained in a mesh bag and ACS/ACS+ which is a larger 'sponge' version . The basic granules work by attracting and holding water with an accompanying exothermic reaction, in this case blood is a fluid containing water and QuikClot 'soaks' up the water content while leaving the other components like platelets free to do their work. An issue with excessive heat production has cropped with excessive application of the original granules but this has been addressed with the new 1st Responder and ACS/+ versions. Quikclot has a shelf life of 3 years, it makes a noise when applied as the granules react with the blood but does work well. A word of warning though, Quikclot works when it contacts ANY fluid, this includes your eyes and your saliva. Be careful when using it, don't be tempted to rip the sachet open with your teeth and during application be sure to keep an eye open for helicopters landing because the downdraft could blow the clotting agent into all of your open orifices!

The manufacturer of Quikclot, Z-Medica Inc has resolved this problem by creating a small teabag-like surround in the 1st Responder and a packaged 'sponge' with the ACS+ to control the flight of the granules. It has also reduced the temperature of the exothermic reaction which caused enough problems in the early days of its use to cause it to be withdrawn from frontline issue. This is an excellent aid to haemorrhage control and in it's newest form could well be considered again for individual issue within the military if it weren't for our next contender HemCon having already filled the void and taking over as the US Military's preferred choice for personal issue to combat troops. I have no personal experience of the next 3 options but include them here as products aimed at active haemorrhage control:

c) TraumaDex seems to be less capable in dealing with massive bleeds but is a very cheap and easy to



QuikClot



Cost: \$60-80.
£30-40.

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TraumaDex

Cost: \$10.-\$20.
 £5-£10.

apply product. The potato starch-based powder is poured directly into an open wound using a small syringe-like bellows applicator and as the blood's water content is drawn out so the clotting agents are left and again concentrated at the wound site. It costs less around \$10./£5. a packet making it the least expensive of the options listed here. It is most suitable for minor bleeding and where access is more of an issue, for example confined spaces /helicopter where pressure is difficult to apply.

c) DFSD (Dry Fibrin Sealant Dressing) Costing between \$500. and \$1000 each (£250 -£500)! this is at the top end of the pricing scale and will probably never see a market in the civil rescue sector. It is a 10cm x10cm 'sandwich' dressing utilising donated human coagulating products - fibrinogen, thrombin and calcium chloride. As a biological product there are complications with it's FDA categorisation but it has been specially treated so as to be sterile. The dressing introduces coagulants directly into the wound and according to the manufacturer causes an immediate strong binding. What sets this dressing apart is that it forms an integral part of the body and doesn't need to be removed. Instead it is simply absorbed as part of the body's natural healing process. It is suitable for very serious arterial bleeds and has seen some operational use with Special Forces in Afghanistan but remains a limited availability product and unlikely to be preferred to HemCon or QuikClot.!

d) RDH (Rapid Deployment Haemostat Dressing)
 The Rapid Deployment Hemostat (RDH) dressing is marginally less expensive than DFSD at \$300/£150 and is an algae-derived dressing composed (so I am reliably informed!) of poly-Nacetyl-glucosamine (p-GlcNAc).

It is another US military research project come to fruition but is not yet commercially available. It's promotion of rapid coagulation at the wound site is similar to the other brands here but it also has active vasoconstriction directly at and around the wound site. Again too expensive for most civil rescue and EMS agencies to consider but with more work to be done it could become commercially viable.

CONCLUSION: Best practice is to keep the patients own blood circulating and we have discussed what products are available to achieve this goal. Some of the tactics and products available to the military are quite clearly useful in the pre hospital rescue setting, others require further thought. My favoured sequence of treatment for massive haemorrhage is: **Pressure, Tourniquet, Coagulant Dressing (Hemcon/QuikClot), Transport**

While we have much to thank the military researcher for in terms of treatment of major trauma the cost implication cannot be ignored in the civil sector. Can you justify the cost of something that may sit in your responder bag for 3 years until it requires replacing? What are the implications of using real blood products without consent? The same issues discussed throughout emergency rooms I'm sure, but do we need the added pressure of that decision? Some of these products are absolutely perfect for pre-hospital use where there are no consent issues but others are best suited to in-hospital use where consent can often be sought more easily. We will always do what is right for our patient, but we all work with severe financial constraints that may preclude the use of the best treatment available. Haemorrhage control products are affordable now and even the high-end brands may become so in the not too distant future as Homeland Security issues dictate better availability.

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