Hemorrhage control, a fundamental skill: A review of direct pressure, dressings, wound packing and bandages for life-saving

By Christopher Picard, CD, BSN, RN, ENC(C)

Traumatic hemorrhage is "the leading cause of preventable death" among trauma patients (Spahn et al., 2013), causing 40% of all mortality (Curry et al., 2011). Eighty-five percent of these patients die before leaving the emergency department (Tien et al., 2007). Improved hemorrhage control has been shown to significantly improve patient outcomes (Kragh, 2009), and as a result, controlling massive exsanguination should occur even before airway control (Forrest, Lax & van der Velde, 2014). Nurses play a major role in identifying and managing life-threatening hemorrhage; the skills required to initially control hemorrhage are nursing skills. This paper will discuss foundational knowledge for basic hemorrhage control interventions, describe how to use basic manoeuvres, and how to escalate hemorrhage control interventions.

Direct pressure

The first step in hemorrhage control is the application of direct pressure. Direct pressure is one of the least-researched components of hemorrhage control (Naimer et al., 2004), recommendations are poorly articulated, and the skill is often poorly performed. Major trauma textbooks recommend direct pressure (Assid et al., 2014; Rotondo et al., 2012), but do not specify: how hard or for how long to push, what to push with, or how to remediate ineffective interventions.

The most concise recommendation on how hard to apply direct pressure comes from The American College of Surgeons' (ACS) Hartford Consensus: "use both hands… press as hard as you can" (Pons & Jacobs, 2017). This consensus statement is the opinion of a committee of experts, is not based on empirical evidence and is challenging to standardize between clinicians. Previously an arbitrary goal for hemorrhage control pressure of 60–90 mmHg had been suggested (Naimer et al., 2004). Although no rationale was provided, this article offers the only quantifiable pressure target for trauma patients.

Neither Advanced Trauma Life Support nor Trauma Nursing Core Course curricula specify an ideal or minimum time to maintain pressure (Assid et al., 2014; Rotondo et al., 2012). Empirical recommendations for how long to hold pressure are scarce: nursing literature suggests a minimum five to 10 minutes (Day, 2016), and European consensus for physicians recommends moving to more aggressive measures if hemorrhage control is not achieved in one minute (Forrest, Lax & van der Velde, 2014), but neither offer evidence or rational for the recommendations. A meta-analysis of angiography hemostat devices may offer the best evidence for minimum pressure time, concluding that hemostatic devices have the best time to hemostasis, but range widely, with an average around 20 minutes (Dahal et al., 2017). This data is not trauma specific, but could be used as a guide for trauma patients. However, it is worthwhile to note angiography patients are less likely to have trauma-induced coagulopathies, and will have a smaller single arterial puncture at a known location.

Dressings

Direct pressure is usually applied using a dressing. Dressings can be manufactured, or improvised, but ideally, they will be: sterile, absorbent, non-stick, and lint-free. Although there are many different dressings on the market for hemorrhage control, hemostatic or non-hemostatic dressings are usually used. Hemostatic dressings contain pro-coagulants to speed clotting time, work in a variety of ways, are backed by reasonable evidence, but are not widely available. Ideally, the use of hemostatic dressings will increase, but as they're not yet in widespread use, this article will focus on the use of non-hemostatic dressings.

Unlike many other specialty dressings, literature comparing hemostasis, infection rates, or ease of use between different traditional dressings is lacking. It could be assumed then that all traditional dressings are equivalent. Dressings for hemorrhage control should allow for the application and maintenance of direct pressure to the wound, be absorbent and offer protection from contamination. Dressings should not be layered (Forrest, Lax, & van der Velde, 2014). Layering diffuses pressure and may hasten bleeding rates by increasing the capillary action of the dressing (Holley & Filips, 2014). The goal is hemorrhage control not spill containment. Dressings are an important part of direct pressure application, provided they are applied with sufficient force. Dressing saturation should trigger hemorrhage control evaluation, not layering. If the first dressing becomes saturated, hemorrhage control measures should be assessed to ensure pressure is being directly applied to the wound, and to assess if measures need to be escalated with wound packing or by using a tourniquet.

Wound packing

If direct pressure fails, management should be escalated. Wound packing is the next intervention to consider. Packing increases direct pressure on injured vessels in the wound. The ACS recommends packing as the second step for any smaller bleed not controlled with direct pressure and as the first step for large open

wounds, or injuries at the junction of trunk and limb (Pons & Jacobs, 2017). Direct evidence for external wound packing is scarce, but there is excellent evidence for packing in damage control surgery (Spahn et al., 2013). The process of packing a traumatic wound is similar to placing surgical, chronic wound or abscess packing, except that the wound is packed tightly. To pack a wound, clean cloth, gauze or hemostatic dressing is pressed as deeply and firmly into the wound as possible. Packing should be added while maintaining direct pressure until the wound is completely filled (Pons & Jacobs, 2017). Once packed, the wound should be covered with a dressing and the highest possible level of direct pressure maintained bimanually or through tight bandaging.

Bandages

Dedicating personnel to maintain sufficient pressure for sufficient time is difficult. Often, bandaging is used instead to maintain pressure. Experimental data suggests that bandaging with an elastic bandage maintains a higher average direct pressure on the wound bed (88 mmHg) than inelastic dressings (33 mmHg) (Naimer et al, 2004). Specialty dressings with integrated elasticized bandage and "pressure bar" to focus pressure exist. Experimental data show integrated bars can result in a further three-fold increase in direct pressure (Shipman & Lessard, 2009). Case reports suggest that improvised "pressure bars" may be beneficial (Rudge, Rudge & Rudge, 2010), and these dressings have been widely used by Western militaries with good effect, but experimental data to demonstrate their superiority to other dressings are lacking. Research shows elasticized bandages can be safely used without producing a tourniquet effect on limbs. When compared against direct pressure and cloth bandage, elasticized bandages maintained a higher and more consistent pressure and stayed in place better, without having a tourniquet effect on limbs (Naimer et al, 2004; Shipman & Lessard, 2009). Replicating these bandages can easily be done with normal ward stock by firmly pressing gauze to the wound, and wrapping a tensor bandage as tightly as possible over the smallest area possible with increasing tension. Bandages should be checked periodically to ensure the patient is not bleeding through the dressings, that the bandage remains secure, and to assess for distal circulation.

Tourniquets

Although tourniquets have been successfully used for hundreds of years, until very recently they have been considered a measure of last resort due to their perceived risk for limb damage (Kragh 2009). There is excellent evidence for the effectiveness of tourniquet in hemorrhage control. If a wound is not responding to direct pressure or packing, tourniquets should be considered. Extremity hemorrhage is the primary source of preventable death in the armed forces. Their experience managing these injuries has shown tourniquets to be safe and effective, with very low complication rates (Kragh et al., 2009). For non-military extremity hemorrhage, tourniquet use has also been shown to be safe and effective (Scerbo et al., 2016).

Tourniquets are circumferential bands that are placed on long bones (never over a joint), just proximal to extremity wounds, and tightened until arterial blood flow (and therefore bleeding) is stopped. Tourniquets can be improvised or commercially manufactured, but commercial tourniquets have been shown to be superior to improvised devices (Bulger et al., 2014). Improvised, or incorrectly used tourniquets have been shown to worsen bleeding if the pressure used is insufficient to occlude arterial flow (Day, 2016). Venous-only tourniquets, like a tourniquet to start an IV or blood draw, will result in increased venous pressure and dilation and will hasten bleeding. For this reason, use a commercial tourniquet, if available, tighten the tourniquet until active bleeding stops and pulses are no longer palpable, mark the time of application, and leave the tourniquet in place until definitive management of the bleeding can be achieved (Day, 2016). If hemorrhage control is not achieved with one tourniquet, an additional tourniquet should be placed in the same manner, proximally.

Conclusion

Massive external hemorrhage can be deadly within minutes, and needs to be addressed immediately. Nurses are often the first point of contact for patients, as they enter hospital, and will often be required to make the initial decisions on how to control deadly bleeding until definitive management. This article reviewed the evidence for direct pressure, wound packing, bandaging and tourniquet use, discussed foundational knowledge for escalating hemorrhage control interventions, and made specific recommendations for how best to manage traumatic hemorrhage.

About the author

Christopher Picard, CD, BSN, RN, ENC(C), has worked in tertiary, rural, and remote areas as an emergency nurse and in pre-hospital, clinical and austere roles domestically and abroad as a medic with the Canadian Forces. He currently works as an emergency nurse at the Royal Alexandra Hospital in Edmonton, AB. His research interests are trauma care, evidence-based practice and knowledge translation.

REFERENCES

Assid, P., Blank-Reid, C., Bokholdt, M., Brathcer, C., Cornell, A., … Wolff, A. (2014). *Trauma Nursing Core Course (TNCC) Provider Manual (7th Ed)*. Des Plains, IL. Emergency Nurses Association.

Bulger, E.M., Snyder, D., Schoelles, K., Gotschall, C., Dawson, D., Lang, E., ... White, L. (2014). An evidence-based prehospital guideline for external hemorrhage control: American College of Surgeons Committee on Trauma. *Prehospital Emergency Care*, *18*(2), 163–173.

Curry, N., Hopewell, S., Dorée, C., Hyde, C., Brohi, K., & Stanworth, S. (2011). The acute management of trauma hemorrhage: A systematic review of randomized controlled trials. *Critical care*, *15*(2), R92.

Dahal, K., Rijal, J., Shahukhal, R., Sharma, S., Watti, H., Azrin, M., ... Lee, J. (2017). Comparison of manual compression and vascular hemostasis devices after coronary angiography or percutaneous coronary intervention through femoral artery access: A

meta-analysis of randomized controlled trials. *Cardiovascular Revascularization Medicine, 19* August 2017. In press.
Day, M.W. (2016). Control of traumatic extremity hemorrhage. *Critical care nurse, 36*(1), 40–51.
Forrest, M., Lax, P., & van der Velde, J. (2014). *Anesthesia, Trauma, and Critical Care Course Manual 2014*. Retrieved from https://www.ataccgroup.com/wp-content/uploads/2017/04/ATACC-Manual-version-8-low-resolution-v2.pdf
Holley, J., & Filips, D. (2014). 10 hemorrhage control myths. *Journal of Emergency Medical Services, 39*, 12.
Kragh Jr, J.F., Walters, T.J., Baer, D.G., Fox, C J., Wade, C.E., Salinas, J., & Holcomb, J.B. (2009). Survival with emergency tourniquet use to stop bleeding in major limb trauma. *Annals of surgery, 249*(1), 1–7.
Naimer, S.A., Anat, N., Katif, G., & Team, R. (2004). Evaluation of techniques for treating the bleeding wound. *Injury, 35*(10), 974–979.
Pons, P., & Jacobs, L. (2017). SAVE A LIFE: What everyone should know to stop bleeding after an injury. *American College of Surgeons.*
Rotondo, M., Fildes, J., Brasel, K., Kortbeek, J., Al Turki, S., … McIntyre, C. (2012). *Advanced Trauma Life Support (ATLS) Student Course Manual (9th Ed)*. Chicago, IL. American College of Surgeons.
Rudge, W.B., Rudge, B.C., & Rudge, C.J. (2010). A useful technique for the control of bleeding following peripheral vascular injury. *Annals of the Royal College of Surgeons of England, 92*(1), 77.
Scerbo, M.H., Mumm, J.P., Gates, K., Love, J.D., Wade, C.E., Holcomb, J.B., & Cotton, B.A. (2016). Safety and appropriateness of tourniquets in 105 civilians. *Prehospital emergency care, 20*(6), 712–722.
Shipman, N. & Lessard, C.S. (2009). Pressure applied by the emergency/Israeli bandage. *Military Medicine, 174*(1), 86–92.
Spahn, D.R., Bouillon, B., Cerny, V., Coats, T.J., Duranteau, J., Fernández-Mondéjar, E., ... Neugebauer, E. (2013). Management of bleeding and coagulopathy following major trauma: an updated European guideline. *Critical care, 17*(2), R76.
Tien, H.C., Spencer, F., Tremblay, L.N., Rizoli, S.B., & Brenneman, F.D. (2007). Preventable deaths from hemorrhage at a level I Canadian trauma center. *Journal of Trauma and Acute Care Surgery, 62*(1), 142–146.