

Chapter 3.1

How to think EVTm as a trauma surgeon

Some thoughts from trauma people with “blood on their hands” regarding EVTm

Lauri Handolin, Boris Kessel, Joe Love, Pantelis Vassiliu and George Oosthuizen

“Do or do not – there is no try” Yoda, the Empire Strikes Back.

Trauma surgery; the most challenging profession there is! Why? Because you often have to step out of your comfort zone, away from conventional thinking, and make rapid, immediately life-saving decisions. You need to stay cool and trust your training; who dares wins!

Major trauma impacts the body in two ways; it causes anatomical injuries such as bowel perforation and/or complicated orthopedic fractures, but more importantly, it causes major tsunami-like disturbances in the patient’s physiology. Elective surgeons who may be very comfortable with restoring anatomy in “physiologically stable” patients may quickly be overwhelmed in major trauma with low blood pressure, poor oxygenation and ventilation, disturbed coagulation, hypoperfused tissues, increased intra-cranial pressure, and decreased body temperature. There is no place for contemplating how an intra-articular proximal tibial fracture should be plated, or how much more familiar you are with the laparoscopic approach to surgery utilized in your elective practice. While there may be instances where your familiar approaches are comforting and applicable they can and should not be the limiting factor



on whether the patient lives or dies. You need to focus on the immediate threat to life – control the damage caused by the anatomical injuries in such a way as to expedite the restoration of the physiology and do it quickly! Time is a major factor in trauma and bleeding patients.

If you don't work in a busy trauma center constantly confronted with major trauma, it may be difficult for you to change your elective mindset from developing a detailed work-up and elaborate management plan with all the time in the world to suddenly receiving a young Jon Doe with a mutilated face and chest, unstable pelvis with a distended abdomen. Oh and by the way, the patient has a systolic blood pressure of 80 mmHg and is struggling to breathe. Now you need to step away from elective surgery and become a trauma surgeon.

Your first priority must be to address what is endangering the patient the most. Don't forget the basic ABC's of initial trauma evaluation. The lack of an effective airway can kill quickly – be prepared to deal with it by doing a surgical airway if endotracheal intubation fails. Breathing may be compromised by a significant pneumo- or hemothorax and may require a tube thoracostomy urgently. For circulation, all major external bleeding should be controlled with compression or tourniquet. Sometimes it doesn't work, so this is a time and place to use your fantasy improvisation. Even in the emergency room you may use massive packing of large bleeding surfaces. If possible, quickly closing the skin over the pads may enforce the tamponade effect. In a deep relatively small hole you may insert and inflate a urinary catheter balloon. For even bigger holes just for your knowledge, you also have the option of large 32 French Foley catheters which our urology friends use for urine bladder irrigation. In a massive bleeding neck or gluteal dump it will save life! Think and teach that even your youngest resident can do it. A pelvic binder may be required, and long bone fractures may benefit from prompt splinting. If the patient fails to respond rapidly to the ABC's of initial trauma evaluation, there is an obvious need to do something quickly. Is it bleeding that is causing the circulatory compromise? Our answer will be "yes", our patient is in hemorrhagic shock, until proven otherwise. However, when you rapidly search the major source of bleeding, still keep in your mind in the course of your initial trauma evaluation, have you effectively ruled out an A and B problem as the cause? Is there a pericardial effusion? Does the negative FAST exam still suggest bleeding

into the abdomen? How portable pelvic x-ray may be helpful in your decision-making process? What if the pelvic x-ray indicates an unstable pelvic ring fracture? The findings should cause you to consider major extraperitoneal bleeding until proven otherwise! The patient remains a transient responder to your blood product resuscitation while you work rapidly through the algorithm of possible sources. Time to do something... NOW!!!

After likely sources are identified, you need to promptly control the bleeding. To do something means to control major bleeding. If the patient is still relatively stable, maybe the first stop is the angiography suite for possible embolization. However, most probably you should take the patient directly to the OR, open the abdomen, stop the hemorrhage and leave the abdomen packed and open. In case of unstable pelvic fractures think about preperitoneal packing before explorative laparotomy! **Or** do you land at zone 3 with a REBOA you put in place in ER, and stay ready to proceed to zone 1 if no hemodynamic response is seen after the balloon occlusion? With resuscitation in progress, it takes only a few minutes to insert the REBOA. The patient now needs extra pelvic packing and laparotomy for sure, but it is much more expedient for you to start operating when you have in-line proximal bleeding control in place. Deflate the balloon partially and see what happens (see the REBOA chapter); does the patient tolerate it? If prominent significant bleeding restarts again, refill the balloon and do your damage control maneuvers. If your patient tolerates partial deflation, see what happens if you deflate the balloon completely. Look for physiological responses and play the game. Let the ultimate goal, prompt stabilization of the physiology, lead your decisions, not the need to correct the anatomy.

Comment:

» Don't forget that REBOA is just one tool and it's not clear yet who has most benefit of it. Always have in mind other tools of trauma surgery. Always have plan B and plan C!

In case of a fast track whole body CT-protocol, insert the balloon and scan the patient immediately if the patient's physiology will allow. The CT scanner can be the loneliest place on the planet when this decision is made in haste and the patient actually belongs in the operating room. However, there may be no absolute indication to perform a laparotomy at this time, and it



may not be needed at all if abdominal bleeding turns out to be minor or controlled by endovascular techniques. Prevention of unnecessarily opening of a body cavity may avoid escalating hypothermia, the need for additional fluid requirements and the possibility of worsening coagulopathy. What if you find on CT that your patient also has a significant injury of the left subclavian artery and a blush in the liver? Continue resuscitation and consider where the patient needs to go. Are they better suited for some additional resuscitation in the ED or ICU before intervention? Do you have access to a hybrid suite that can facilitate combined open and endovascular procedures? If not, should they go to the interventional suite first, and then the operating room...or the other way around. Every patient will be different and a fluid thought process is mandatory. But even you have decided to go to your super fashioned hybrid room, please continue to think as a trauma surgeon. If you do any endovascular procedure after completion of thoracotomy or laparotomy, you just continue your case. Still remember, that physiology is the first priority. In fact, an endovascular procedure may be much longer than a surgical one!

Comments:

- » CT, as all imaging, must be considered carefully: What am I looking for and what would be the next stage after the examination? Put up a plans. Both plane A and plane B!

Can endovascular management (as part of the EVTm) help with management of the patient in front of you? In most instances the answer is likely “yes”, but you need to consider when / where and how to employ this skills set. You need to understand the possibilities and limitations of endo tools. When it comes down to bleeding, you generally follow the principle “proximal and distal control – then fix what is in the middle”, or you amputate distal to uncontrolled bleeding in the unstable patient if it is feasible. These decisions require a comprehensive understanding of anatomy and physiology – as well as the tools that you can bring to the fight and salvage a patient in need of help. The EVTm thought process require thinking outside of “the lesion” alone. The elective endovascular thought processes are important, but can lead you astray. Crossing the lesion with a wire may save the day – but it also might take too long in an unstable patient. Maybe embolization is a better answer in certain situations? Even if you can cross the injury effectively and deploy a

covered stent to repair an injured blood vessel – is this a “definitive” solution, or is it damage control? Is it wiser to replace a stent graft with a vein conduit for long term patency in a 20-year-old patient? Could you place a temporary vascular shunt and allow for reperfusion while additional maneuvers are undertaken? What about anti-coagulation? Should you give it in the midst of the procedure despite a liver injury? What represents a greater risk to the patient in front of you – liver hemorrhage or arterial repair thrombosis?

Comment:

- » The EVTm concept deals with these considerations and helps you decide if endo tools can help you now. It does not exclude open surgery! Moreover, keep this option always available!

These decisions are not easy. They are often made in a hurry – and they may fly counter to everything you have been used to doing in your elective practice. The best in this situation may be something different from what you are normally comfortable with. If it was easy... everyone would be doing it. Embrace the challenge!

Final tips:

- » Forget elective surgery principles if patient is dying in front of you; there is no time for waiting, slow proper sterile draping and strict anatomical dissections. React and put all efforts on the patient.
- » Consider always open surgery to solve problems, don't get locked on endo.
- » You are not finished until the patient shows signs of getting better. The ICU is not the end of surgery; it's the beginning of a very important journey. Be there!
- » You just did a REBOA and packing and the patient is stable? In some hours or days, he might develop multiple organ failure. Work actively to prevent that.