

Chapter 11

EVTM when you have limited resources

Viktor Reva and Tal Hörer

You have to be lucky to work at a level-one trauma centre. The trauma system is well organized, everybody knows what to do and how to do it, all the equipment is readily available. The system is stable.

A patient with severe chest trauma is admitted to your hospital. He has multiple rib fractures and a clavicle fracture. The left hand has a weak pulse, and there is a supraclavicular pulsatile mass. The patient is stable. CTA reveals partial injury of the first/second portion of the left subclavian artery with contrast extravasation. You go through with a 0.035 inch guidewire and put a covered stent inside the lesion. The problem is solved and a sternotomy or “book” thoracotomy is avoided.

But what do you do in your OR if you do not have a shelf full of numerous devices, stent grafts, catheters, etc.? You do not have an angio suite, and no interventional radiologist is on call. It is clear that extensive open proximal arterial control presents as an additional insult to the injured patient. You know it and want to change the usual practice of open trauma surgery. What do you need for it?

1. The will to provide the best possible care for your patient.
2. Appropriate training in both open and endovascular methods.
3. Fluoroscopy (any mobile C-arm).
4. Minimal equipment.



The first is indisputable. Until you follow entirely your hospital's old standard recommendations, you can easily say that no EVT is indicated. Some patients tolerate big incisions well, some do not. But it is in your power to change the practice of your local hospital. You have to be appropriately trained in basic endovascular skills (see other places in this manual).

If you do not have a fluoroscopy machine, then your EVT practice might be limited to REBOA only. Take any standard X-Ray machine, put a cassette under the patient's body and go in (see the REBOA Chapter). For any other procedure you have to use fluoroscopy. Although both wires and catheters can be seen well under ultrasound guidance, it is difficult to navigate them into the targeted vessel. But it can be done.

The EVT techniques that you might adopt can be divided into two groups: "occlusive" or "closing" procedures, and "opening" procedures. You have a broad spectrum of possibilities in terms of the first procedures, but equipment limits the second set of procedures. That is reasonable because it is harder to build than to destroy. "Occlusive" procedures mean any kind of embolization. There are many different embolic materials available on the market, such as coils, Onyx, embosh-peres, NBCA, etc., but they cost quite a lot of money. The only aim of this type of procedure is to occlude the vessel somehow. For any bleeders from minor arteries or bleeding arterial branches, you can prepare the coils *ex*



Figure 1



Figure 2: Remove the core from the wire and use the external winding to make coils. Then the core for straightening the coils before introducing them into the catheter.

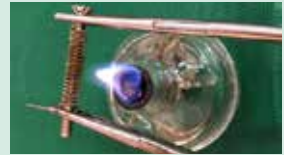


Figure 3: Wind the soft part of the wire around the screw and heat for some minutes. When the wire cools down, cut it to pieces. Use the guidewire core to straighten the coils.



Figure 4



Figure 5

Figure 1-5: Home-made coils using a wire.

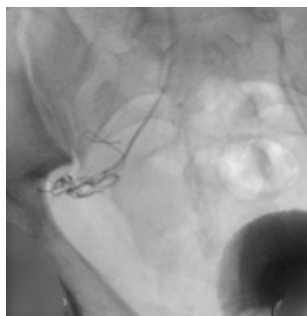


Figure 6: Selective embolisation of a gluteal artery after gunshot injury. Home-made coils used here.



Figure 7



Figure 8

Figure 7-8: Collagen sponge embolization.

tempore from a standard starting guidewire. It is not recommended but we will show it anyway. Maybe you will run out of wire in your fancy hybrid suite one day!

Another common approach is to use gelatin sponge or powder or even collagen sponge, which is much cheaper. Sponge injected selectively through a diagnostic catheter temporarily occludes a targeted vessel and provides excellent hemostasis in case of severe pelvic bleeding, splenic injuries, arterial branches, etc. See other places in this manual for further details.

The powder just needs to be diluted with a mixture of saline and contrast medium. While doing an angiography, you certainly get some blood out from the catheter, so when it is clotted you can use these sterile clots for embolization of the bleeder. It provides immediate but temporary hemorrhage control, and that is what you need in most cases, at least until transportation to another hospital. Another cheap embolic material is suture material. Just put a short piece of a surgical suture into a catheter's shaft and push it with a syringe. Repeat if necessary.

Now you know how to embolize a bleeder for free. All you need is just to cannulate the targeted artery with an angiographic catheter. Which type of catheter depends on the vessel and individual anatomy. There are a huge amount of different types of catheters, but in most cases just a few are enough: a Judkins Right catheter, a Simmons catheter, and a Cobra catheter. The difference between them is



in the tips. So, you need a few catheters to make embolization possible. But if you have only one of them on the shelf, you can use a boiling kettle to soften a catheter's tip above the steam and reshape it as you wish. You can do the same with the tip of a guidewire, and no steam is needed. Just use a common needle and your fingers to modify the tip for better manipulation.

Of course, all these instruments are single-use items, but if your hospital does not buy equipment for them, theoretically, you can reserialize them in a plasma sterilizer. Note, that resterilization is not recommended, and it is completely your own responsibility. Obviously, we cannot recommend it in this manual!

Certainly, you cannot embolize an arterial injury in the way described above. So, you must use one of the “opening” procedures instead of a “closing” one. You have no stent-graft available for definitive hemorrhage control. But you can take any cheap non-compliant PTA balloon for proximal arterial control if no runoff is seen on angiography, or for topical control inside a zone of injury if the wire has passed through the lesion. Usually, we use an inflation device with a manometer for PTA balloon inflation, but here you just need gently to occlude the vessel and can use a standard Luer-Lock syringe with a three-way stopcock. When proximal control is achieved, go straightforwardly to the hematoma for open repair. Or you can even leave the inflated balloon in place as the endovascu-

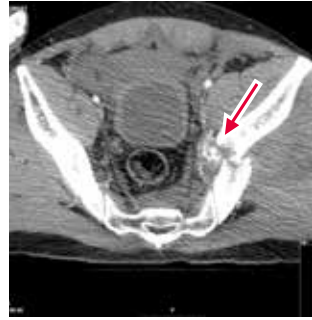


Figure 9.1



Figure 9.2



Figure 9.3

Figure 9 1-3: Extravasation on CTA in a patient with pelvic fracture. Angiography with extravasation and coils in place. Can be done with a simple C arm and any material described above for embolization. It's your technical skills that matter, not the fancy equipment!

lar damage control option if the patient is critically unstable or if the patient is referred to another hospital. You can use this technique for most penetrating arterial trauma. An antegrade femoral puncture will allow control of any arterial lesion of an extremity. At the end of arterial reconstruction, you can do a completion angiography through the sheath placed in the femoral artery.

So, what do you need on your shelf to have the possibility adopting an EVT approach?

- » Puncture needle 18G
- » Sheath 5-6Fr
- » Long wire (straight tip)
- » Diagnostic catheter
- » Non-compliant balloon of large size (8-9 mm)
- » REBOA balloon
- » Gelatin or collagen sponge (or powder)

For appropriate use of these devices, be prepared mentally and practically. Train yourself and your team. And spend a bit of money to buy some very basic armamentarium, which might save your patient's life someday.