Pre-Peritoneal Pelvic Packing with Bilateral Ligation of Internal Iliac Arteries for Exsanguinating Pelvic Trauma Hemorrhage

Dinesh Bagaria, Subodh Kumar

Introduction:

Retroperitoneal hemorrhage secondary to pelvic fractures is a significant contributor to trauma hemorrhage-related preventable deaths. The origin of hemorrhage is primarily venous origin in 85% and arterial in 15% of such patients. The treatment options are:

- Pelvic circumferential compression devices
- External fixator application
- Pre-peritoneal pelvic packing
- Angioembolization,
- Bilateral ligation of the internal iliac arteries

Most hospitals will use various combinations of the above based on availability and expertise. Pelvic circumferential compression device application is a noninvasive intervention and helps in reducing bleeding by giving a tamponade effect. External fixators are becoming less popular as they failed in various studies to provide a better impact over pelvic circumferential compression devices. The available literature recommends using angioembolization as a principal treatment option: trauma centers in high-resource settings often have "hybrid operating rooms" where surgeons and interventional radiologists can perform percutaneous and open interventions simultaneously.

In settings like ours, the combination of pelvic compression, pre-peritoneal packing, and bilateral ligation of the internal iliac is an alternative that may be used in such situations. This combination addresses both venous and arterial sources of bleeding. Our group and Choi et al. have showed applicability and acceptable outcomes using this technique.

The steps of preperitoneal packing and bilateral ligation of the internal iliac arteries are:

- Midline laparotomy and exclusion/dealing with other sources of hemorrhage.
- Entry into Zone 3 hematoma and pelvic pre-peritoneal packing.
- Retroperitoneal dissection at common iliac artery bifurcation and internal iliac artery ligation/clipping.
- Closure of Laparotomy or management as the open abdomen.

Steps:

1. A trauma victim with hemodynamic instability will undergo a primary survey and simultaneous resuscitation as per standard protocols. A pelvic circumferential compression device will be applied in suspected pelvic fracture patients. Those deemed non-responders will be wheeled into the operating theatre for surgery. A variety of strategies can be used for pelvic compression. Patients with an "open book" pelvic fracture with pubic symphysis diastasis will respond best to the treatment described here. Iliac wing fracture is an absolute contraindication to pelvic compression. Every method of pelvic compression applies pressure on the greater trochanters of the femurs (not the iliac wings) and leaves all of the abdomen exposed, allowing for laparotomy.

A bedsheet is used as a pelvic circumferential compression device when commercial devices are not available.

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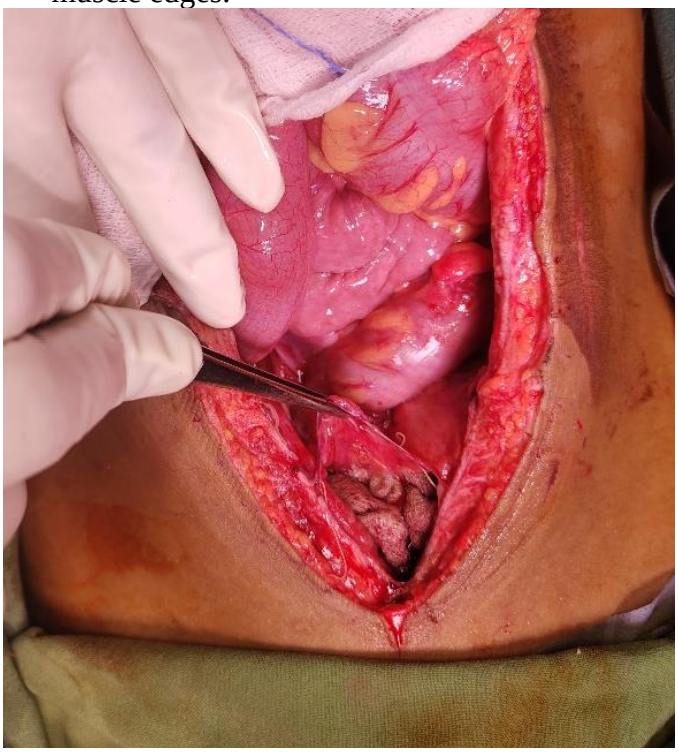
A commercially available pelvic binder in a high-resource setting: the mechanism on the front allows it to be pulled tight evenly. Source: DOI: 10.1038/s41598-021-82835-8

2. Once the patient is in the operating room and undergoing simultaneous resuscitation, midline laparotomy will be done with the intention of stopping all bleeding.
3. After entering the peritoneal cavity, a quick exploration of the abdomen viscera will be done to rule out any other simultaneous source of hemorrhage. Around 15% of patients with pelvic fracture may have a second important bleeding source besides the pelvis, requiring some intervention.
4. Once this second source is ruled out or addressed, the perivesical space is entered ("Space of Retzius"- called Zone 3 in trauma nomenclature.) Manually separate the peritoneum from the inner aspects of the pubic symphysis and pelvic ring. The hematoma is evacuated to create space for packing, and two to three surgical pads are packed on either side of the bladder from posterior to anterior.

The zone 3 hematoma is evacuated, and 2-3 laparotomy pads are placed as packs on either side of the bladder. The forceps on the left side of the photo holds the peritoneum that has been dissected off of the pubic symphysis.

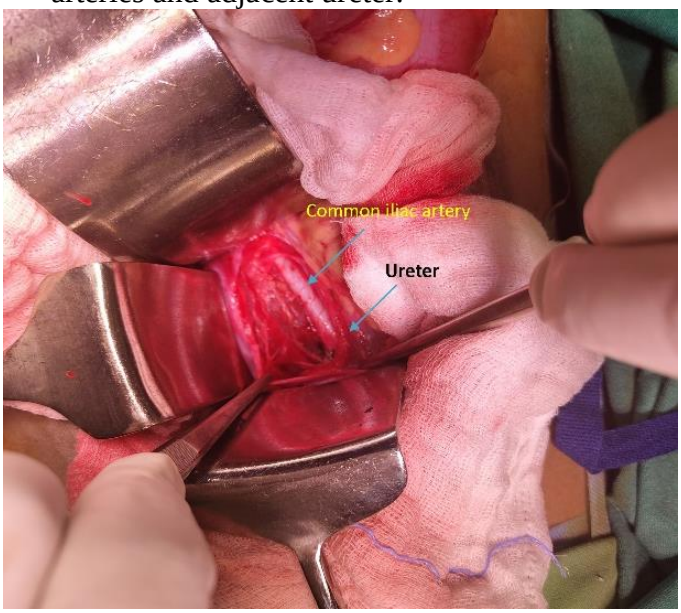
5. To augment the tamponade effect, the stripped peritoneum will be sutured back to the rectus muscle edges.



The peritoneum is sutured to the rectus muscle edges.

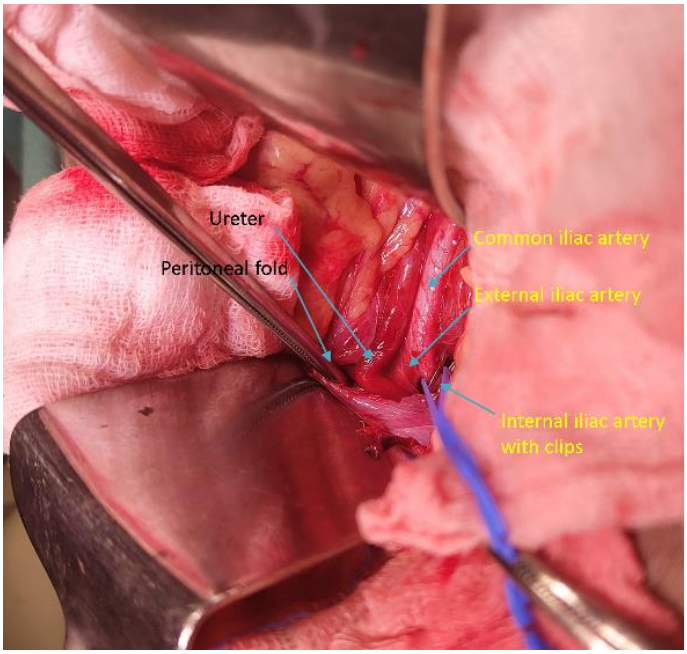
6. Starting from the bifurcation of the aorta, follow the common iliac artery until its bifurcation. The

peritoneum is dissected at the common iliac bifurcation to expose internal and external iliac arteries and adjacent ureter.



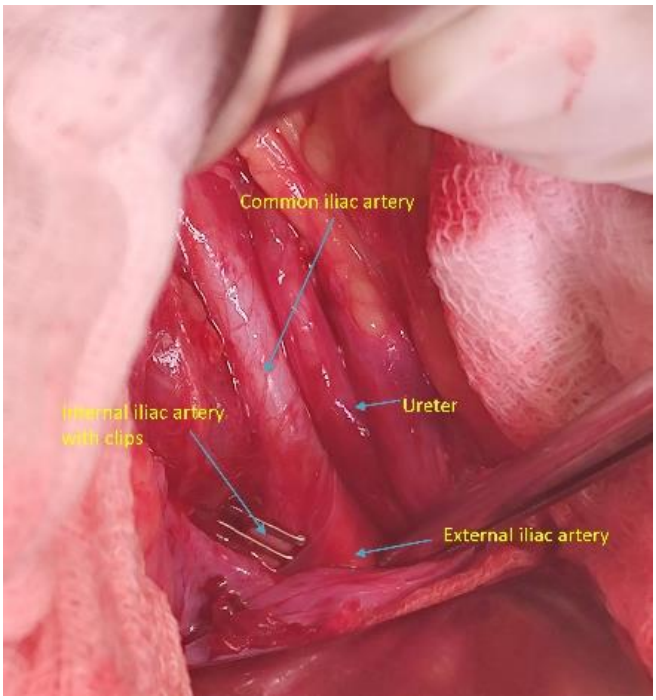
Shown here on the patient's left side, the posterior peritoneum is dissected at the bifurcation of the common iliac artery to expose its division into internal and external iliac arteries, with the adjacent ureter carefully preserved.

7. The internal iliac artery will be separated carefully from the underlying vein and ureter. Now, it can be suture ligated, or clipped if clips are available. Clipping is preferable, because the clips can be removed at a later time, such as during abdominal re-exploration.



Shown here on the patient's right side, the internal iliac artery is dissected from surrounding structures (shown here, encircled with a blue vessel loop) and clipped or ligated.

8. The same dissection and clipping will be done to the other side.



Shown here on the patient's left side, the internal iliac artery is dissected from surrounding structures and clipped or suture-ligated.

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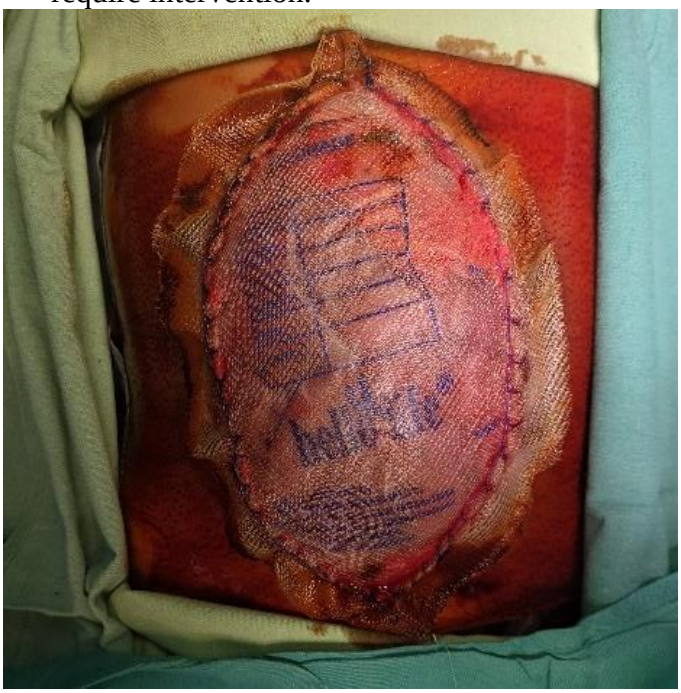
9. If the fascia can be sutured closed, this will increase the pressure effect of the pelvic packing. If the patient is hemodynamically unstable or the fascia cannot be closed due to edema, perform Temporary Abdominal Closure. Now, the patient will be shifted to the ICU for further resuscitation. The patient will be taken back to the operating theatre within 24-48 hours but not later than 72 hours to remove the packs. Our practice is to obtain a contrast-enhanced CT scan before re-exploration to find any missed injuries that may require intervention.



Open abdomen treated with "Bogota bag," one of the options for when the fascia cannot be closed. In the situation of pelvic fracture, this closure maintains tension on fascia and may maintain better pressure on the packing within the pre-pelvic space. See the chapter on Temporary Abdominal Closure in this Manual for further details.

Pitfalls

- Due care needs to be taken to avoid injuries to the underlying veins. Dissect very carefully. Such venous injuries in already compromised patients might be fatal.
- Inadvertent ligation/clipping of external iliac arteries. Always make sure the anatomy is clear through careful dissection. If it isn't clear, occlude the vessel that you plan to ligate with finger pressure and feel for the femoral pulse. Have an assistant check pulses in the bilateral lower limbs manually, or use Doppler in hypotensive patients.
- Iatrogenic ureter injuries are to be avoided by careful dissection and awareness of their usual course. Be aware that a pelvic hematoma may displace them.
- Perineal ischemic necrosis is a theoretical possibility after bilateral internal iliac artery ligation. The incidence is lower than was originally thought. If the patient has perineal injuries these may have difficulty healing. However this concern should not prevent you from applying this life-saving intervention.

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