

Endovascular control of ongoing pelvic hemorrhage after intraoperative arterial shunting and venous ligation in peripheral vascular trauma

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Received 13 August 2024
Accepted 25 October 2024**CASE PRESENTATION**

An adult patient presented with multiple gunshot wounds to the pelvis and thighs. The patient arrived awake and alert but in advanced hemorrhagic shock. A left femoral Cordis was placed, and massive transfusion protocol was initiated. There was a robust response to resuscitation. Physical examination revealed gunshot wounds as outlined in [figure 1](#). The right buttock wound had significant non-pulsatile, venous bleeding. The patient had palpable femoral pulses bilaterally and multiphasic left pedal signals by Doppler examination but absent right dorsalis pedis and posterior tibialis signals. Focused Assessment with Sonography in Trauma (FAST) examination showed free fluid in the hepatorenal space, though the abdomen was soft and non-tender. Abdominal and pelvic plain radiographs did not show pneumoperitoneum, pelvis disruption, or retained missiles. The patient was taken directly to the operating room, and an exploratory laparotomy was performed. There was no blood, succus, or urine in the peritoneal cavity and no retroperitoneal hematomas. There was a significant amount of dark blood staining the muscular tissue in the pelvis but no overt bleeding into the peritoneal cavity. After transabdominally packing the pelvis, we performed a right femoral cutdown. There was a destructive injury to the common femoral vein and a laceration to the posterior wall of the superficial femoral artery. Hemorrhage was slowed with direct pressure, but the patient remained tachycardic, hypotensive, and coagulopathic despite active blood product transfusion.

WHAT WOULD YOU DO?

- Primarily repair both the vein and artery?
- Ligate the vein and primarily repair the artery?
- Ligate the vein and reconstruct the artery?
- Ligate the vein and temporarily shunt the artery?

WHAT WE DID AND WHY

We chose to ligate the common femoral vein as the injury was severe, involving the anterior and posterior walls, and the patient was unstable. Tissue loss from the arterial injury was too extensive for primary repair, and we deferred resection and anastomosis at that time due to the patient's instability. We therefore placed an Argyle shunt to restore distal perfusion. The patient then appeared to stabilize, and we gained multiphasic pedal pulses on the right. Shortly thereafter, the patient's hemodynamics

worsened, deteriorating into ventricular fibrillation requiring several rounds of cardiopulmonary resuscitation with return of spontaneous circulation. We noted a significant amount of blood had soaked through our previously placed pelvic packs. We repacked the pelvis but had continued bleeding from deep within the left pelvis. The source of this bleeding remained unclear.

WHAT WOULD YOU DO?

- Diagnostic angiography by interventional radiology, possible embolization?
- Ligate the internal iliac vein?
- Ligate the common iliac vein?
- Ligate the internal iliac artery?
- On table injection of gelfoam slurry down the internal iliac artery?

WHAT WE DID AND WHY

Given the patient's improved hemodynamics, immediate availability of interventional radiology (IR), and the ability to fully evaluate both sides of the pelvic vascular system, we proceeded with angiography and endovascular intervention. A temporary abdominal closure system was placed, and the patient was transported to the IR suite. Multiple areas of active extravasation and arteriovenous fistula from branches of the left internal iliac artery (prostatic and superior gluteal arteries) were identified and embolized, halting any further bleeding in the pelvis ([figure 2](#)). The patient went on to have a prolonged, complicated course but was ultimately discharged on hospital day 54 with the function of both legs.

DISCUSSION

Despite the unrelenting prevalence of gun violence, peripheral vascular trauma from firearm injuries is present in only 1%–5% of admissions in urban trauma centers.¹ Concurrent with the infrequency of these injuries, diminishing exposure of surgical trainees to vascular trauma further adds to the challenge of treating these injuries.^{2,3} Nonetheless, critical principles of decision-making hold true and should guide management. For example, hard signs of vascular injury should prompt immediate operative exploration, which was done in this patient via laparotomy and groin exploration.

In hemodynamically stable patients, definitive repair of major veins should be attempted. However, in the damage control setting, although temporary intravascular shunting is an option,

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To cite: Schaid TR, Marshall WA, Burlew CC, et al. *Trauma Surg Acute Care Open* 2024;**9**:e001595.

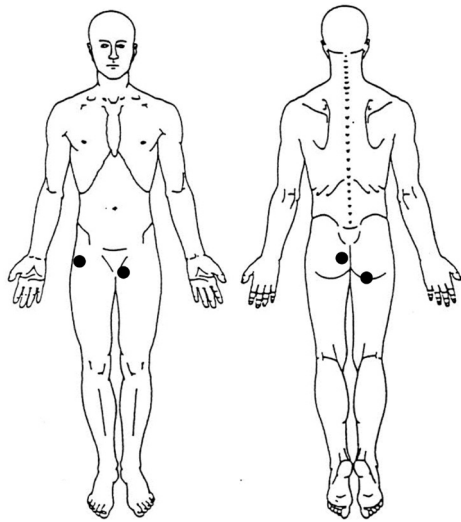


Figure 1 Injury diagram. Black dots indicate gunshot wounds.

ligation is quick and effective in controlling hemorrhage and is generally well tolerated.^{4,5} Intra-arterial shunt placement is an essential element of vascular damage control. Our profoundly unstable patient needed quick restoration of distal blood flow

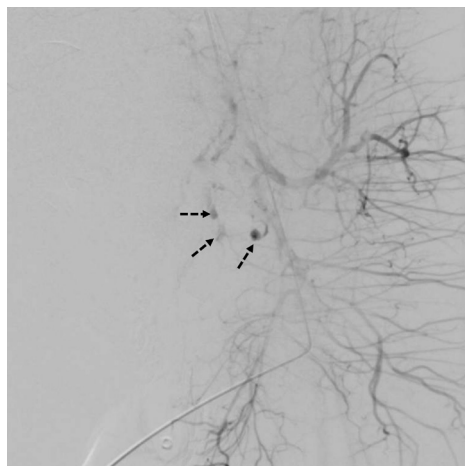


Figure 2 Left pelvic angiography demonstrating multifocal areas of extravasation and/or pseudoaneurysm/arteriovenous fistula (dotted arrows) from the left prostatic and superior gluteal arteries.

and also resuscitation. Prophylactic four-compartment calf fasciotomies should always be considered in this clinical scenario. In our patient, the patient's limb was ischemic for only 1–2 hours, and he was too unstable to perform fasciotomies during the index operation.

The unique aspect of this patient was the delayed bleeding from branches of the internal iliac after peripheral venous ligation and arterial shunting. With arterial inflow restored but venous outflow via the common femoral impeded, we think venous drainage was redirected through collaterals and back-bleeding in the pelvis. Access to this area would have been difficult operatively and was effectively managed endovascularly.

In conclusion, in peripheral vascular damage control, do not hesitate to ligate the vein and shunt the artery. After venous ligation and arterial shunting, be aware of possible ongoing bleeding from collateral back flow, which may be addressed in the majority of patients endovascularly.

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Contributors Guarantor: KLH. Idea and literature review: KLH and TRS. Writing: TRS. Images: TRS. Critical editing of the article: KLH, WAM, and CCB.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; internally peer reviewed.

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