Endovascular management of arterial injury in War

Nasser Algharem, MD, FRCR, EBIR.

KING KHALED HOSPITAL NAJRAN
Endovascular Management of arterial injury can be divided in

A. Embolization.
B. Stentgraft.
C. Others.
Blast injuries are not as unique to battle as we would hope, however, as they are unfortunately becoming more common worldwide outside the battlefield environment.

Disasters, explosions, and shootings can happen in all types of settings and can occur anywhere.
There are several types of explosive ordinance seen in modern combat:

- **IED:** Improvised Explosive Device that is home-made from everyday materials.

- The harmful projectiles include anything from paperclips, screws, pins/nails and spent bullet shells to automobile parts (especially when the car is part of the bomb).
There are several types of explosive ordinance seen in modern combat:

- RPG: Rocket Powered Grenade: a grenade that is shot from a rocket to explode on impact of a human, group, or structure to inflict damage.
There are several types of explosive ordinance seen in modern combat worthy of discussing:

- **Landmines**: an explosive device concealed under or on the ground and designed to destroy or disable enemy targets, ranging from combatants to vehicles and tanks, as they pass over or near it.
- Such a device is typically detonated automatically by way of pressure when a target steps on it or drives over it, although other detonation mechanisms are also sometimes used.
- A land mine may cause damage by direct blast effect, by fragments that are thrown by the blast, or by both.
There are several types of explosive ordinance seen in modern combat worthy of discussing:

- Mortar is a device that fires projectiles at low velocities and short ranges.
- The mortar has traditionally been used as a weapon to propel explosive mortar bombs in high-arcing ballistic trajectories.
There are several types of explosive ordinance seen in modern combat worthy of discussing:

- Rockets and warheads missiles.
There are four types of blast injury depending on proximity, severity, type of explosive, and surrounding environment:

- **Primary:** Blast wave: hollow organs essentially burst due to overpressure
- **Secondary:** debris and projectiles that have ballistic properties (most common, IED, other blasts)
- **Tertiary:** happens when the patient’s body becomes the flying object and collides with other objects (walls, objects, vehicles..)
- **Quaternary (or miscellaneous):** injury comes from burns from the blast heat or inhalation of gases and smoke released in the explosion.

Many casualties have a combination of these injury types.
Case # 1
CASE #1

27 year old male involved in combat injury by flying debris and projectiles in battlefield after a landmine explosion.
• Large area of penetrating FB and laceration more in the left leg with comminuted fractures and skin loss.

• Blood loss was continuous and CT shows a pseudoaneurysm at the Lt SFA mid-third.
✓ Angiography was done and therapeutic intervention was done by a PTFE heparinized Viabahn stent graft was done successfully.
Case #2
CASE #2

27 year old male involved in combat injury by flying debris and projectiles in battlefield after a landmine explosion
• Large area of penetrating FB and laceration more in the left leg with comminuted fractures and skin loss.

• Same patient in Case 8, after one month he presented with pulsatile lump above and medially to the left knee.

• US show an aneurysm.
• Blood loss was continuous and CT shows a pseudoaneurysm at the Lt SFA distal third/P1 with AVF.
• Angiography and therapeutic intervention was done by a PTFE heparinized Viabahn stentgraft was done successfully.
One month later,, Pulsatile mass!!!
1500 IU Thrombin injection.
Case # 3
CASE 3

24 year old male involved in combat injury by snipper attack his right thight with a bullet causing active arterial bleeding.
• Angiography was done and therapeutic intervention was done by a PTFE heparinized Viabahn stentgraft was done successfully.
Case # 4
CASE 4

18 year old female involved in mortar grenade injury falling on her house, flying debris and objects cutting and crossing her right proximal thigh and perineum.
• She bleeds a lot and arrived to the local health facility with irrecordable pulse and BP, resuscitated with fluids and given 8 units of blood and plasma and referred to our hospital.
• Her Hb on arrival was 4..
• 6 units given and 8 FFP and emergency CTA was done vascular surgeon was planning to interfere with high risk of amputation as patient was unstable and wound was difficult to control and family was seeking better chance foe the young girl..
• Patient then was referred to me for opinion by ICU team in the midnight..
• I decide to shift her for angio..
Case # 5
CASE 5

25 year old male involved in combat injury by gunshot at the Right shoulder
Undergo uneventful hospital stay, except for heaviness and hotness of the forearm and hand more on using it, and ongoing swelling.

He was diagnosed as a traumatic AV fistula and surgery was done but failed to locate it.

He was referred to my hospital and after US check I prepare him to angio and stenting.
Case # 6
CASE 6

21 year old male involved in combat injury by gunshot at the left thigh.
Case # 7
CASE # 7

22 year old male involved in combat injury by flying debris and projectiles in the abdomen
• Primary laparotomy was done in a near field hospital and bowel repair, patient still dropping his Hb and abdomen becomes tenser.

• Second laparotomy was done in a second hospital and surgeon was frustrated by bleeding and he tried to control and close.

• Patient continued bleeding and yet consumed around 40 units of blood in the last 2 days.

• He was referred to me for CT and opinion.

• CT was done and showed the continuous jet of splenic artery bleeding.
Case # 8
CASE 8

21 year old male involved in combat injury by a snippers’ gunshot at the Rt side of neck..
Case # 9
CASE 9

23 year old male involved in combat injury by a snippers’ explosive gunshot at the Rt side of neck.
Computed Tomography Scans.

- Hemodynamically stable patients.
- Identification and classification of injuries.
- Sensitivity: 92 to 98 %.
- Specificity: 99%.
- CT has a high negative predictive value to allow immediate discharge from the emergency department.
Vascular Injury-Lessons

- Control of haemorrhage.
- Vascular repair – maintain blood supply.
- Prevention of infection.
- Speed.
- 85% of early deaths are due to blood loss.
- Early blood loss has a significant effect on late deaths.
THANK YOU
The angiographic manifestations of vessel injury

Angiographic manifestations of vessel injury:

- Arterial cut-off
- Mural irregularities or flap
- Laceration
- Thrombosis
- Dissection
- Free-flow contrast extravasation
- Stagnant intraparenchymal accumulation of contrast
- Parenchymal blush
- Stagnant arterial or venous flow
- Diffuse vasoconstriction
- Pseudoaneurysm
- Arteriovenous fistula
- Vessel displacement
Angiographic Manifestations of Bleeding

• Free-flow contrast extravasation.
• Stagnant intraparenchymal accumulation of contrast.
• Disruption of visceral contour.
• Displaced organ.
• Intraparenchymal avascular zones.