

Vascular injury

Characteristics

Vascular injuries are injuries resulting from accidental trauma - criminal, traffic, industrial and iatrogenic injuries (catheterization , surgery).

Open wounds

- Disruption of the vessel - partial, tangential, lateral or complete.
- In case of gunshot wounds – severe dilation; the degree of dilation is directly proportional to the speed of the projectile.
- Iatrogenic – most often the *femoral artery* during catheterizations.
- Injuries to the aorta and pelvic arteries during neurosurgical procedures (laminectomy after disc herniation) and orthopedic operations (hip alloplasty) are serious.
- *During abdominal and thoracic operations, injuries to the portae vein , cava vein , and azygos vein* are difficult to solve .

Closed injuries

- They are caused by contusion, compression by a hematoma, compression or laceration by bone fragments.
- Arterial thrombosis during fractures and dislocations in the area of the knee and elbow joints is typical.
- Main mechanisms – thrombosis, closure of the lumen by rupture of the intima, which detaches with blood pressure and closes the lumen, vasospasm.
- Thrombosis is the most common - that's why we consider every blunt injury a thrombosis.
- Deceleration injury – mainly affects the thoracic aorta (or mesenteric or renal arteries).
- Wall ruptures or total avulsions can occur.
- In traumatic thrombosis, the time factor is very important - the collateral river is not developed.



Hematoma.

Clinical picture

- Reduction or disappearance of pulsations, major bleeding with hypotension, large or enlarging hematoma, murmur at the site of injury, neurological deficit, ischemia → these symptoms are indications for surgical exploration or angiography.
- After severing an artery, retraction of the vessel ends may occur due to vasospasm.
- When hypotension occurs, even major bleeding can stop spontaneously (usually temporarily).
- A soft, fresh thrombus can also pulsate over some distance.

Therapy

- It is often a part of polytrauma → we pay attention to the overall condition.
- We usually also give ATB, total heparinization is usually not recommended (unless it is an isolated injury).
- Exploration – in CA, skin incisions are made longitudinally (so that they can be extended).

Arterial injury

1. Direct injury
 - Sharp (penetrating – stabbing, cutting, gunshot, iatrogenic, amputating...)
 - *1st degree* – injury to the adventitia and possibly media.
 - *2nd degree* – injury to all layers of the wall, does not affect the entire circumference of the artery.
 - *3rd degree* – complete interruption of the artery.
 - Blunt (contusion, compression, constriction - strangulation)
 - *1st degree* – tear in the intima, no bleeding, usually no ischemia.
 - *2nd degree* – tear in the intima and media, no bleeding, usually thrombosis with peripheral ischemia occurs.
 - *3rd degree* – the tear affects all layers of the wall, thrombosis or occlusion by the intimal lobe causes ischemia, in large arteries hematoma in the adventitia may perforate with heavy bleeding.
2. Indirect injury
 - Dragging, deceleration, vasospasm.

Acute arterial injury

- The damage starts from the surface of the artery towards the lumen.

Consequences and clinical signs:

- Bleeding, leading to hemorrhagic shock (hypovolemia).
- Peripheral ischemia.
- In the case of a first-degree injury, a secondary rupture or the formation of a late false aneurysm may occur.
- In case of injury II. degree, the bleeding can stop spontaneously due to the pressure of the surrounding tissues and the hematoma.
- In case of injury III. degree, the bleeding can stop spontaneously by constricting both ends of the severed artery.

Therapy:

- PP – application of a compression bandage, or compression of an artery in or above the wound (pressure points, tourniquet).
- Definitive treatment – suturing the bleeding vessel (mostly straight edges).

Blunt arterial injury

- The damage starts in the intima and goes to the media and adventitia, dissection may occur.
- There is simultaneous contusion of the soft tissues near the artery, often accompanied by bone and joint injuries.
- Signs of peripheral ischemia without signs of bleeding are typical.
- In most cases, surgical reconstruction of the affected section is necessary.

Indirect arterial injury

- Deceleration injury of the thoracic aorta (dissection , rupture).
- Stretching of the artery - mostly in joint dislocations and dislocated fractures near the arteries, the basis is a rupture of the intima and media, the injured artery does not bleed, but there is ascending and descending thrombosis in it with ischemia of the periphery.
- Traumatic vasospasm – very rare, myogenic cause (spasm, disappearing within 24 hours), clinically peripheral ischemia lasting more than 3 hours and not subsiding; diagnosis of arteriography and eventual surgical revision; treatment with local application of papaverine or balloon dilatation.

Diagnosis of arterial injuries

- Clinical – external or internal bleeding with a shock state, growing hematoma, ischemia under the injury site.
- Display methods:
 - *limbs*: duplex US, Doppler measurement of pressure on peripheral arteries, angiography, MRI;
 - *chest*: chest X-ray and CT, MRI, aortography, pericardial puncture, hemothorax puncture;
 - *abdomen*: ultrasound of the abdomen, aortography, diagnostic peritoneal lavage, laparoscopy.
- Operative revision in diagnostic uncertainties (especially blunt injuries with ischemia without bleeding).

Treatment of arterial injuries

1. First aid - temporary stoppage of bleeding (pressure bandage, manual compression of the artery in the wound or above the wound - pressure points), volume therapy.
2. Definitive treatment – the limb endures ischemia for 4-6 hours, then irreversible changes occur, during reconstruction it is possible to maintain perfusion by introducing a plastic shunt, which is pulled out just before the suture is completed.
 - Suture simple or with plastic vein graft.
 - Resection of the damaged part of the artery with end-to-end anastomosis.
 - Reconstructive surgery with a vein graft (preferably *in the great saphenous vein*) – interpositum, bypass.
 - Exceptionally, arterial ligation (small arteries below the elbow or below the knee - but at least one artery must be reconstructed to maintain sufficient circulation, in the case of large soft tissue defects making even a temporary arterial reconstruction cover impossible, in mass accidents due to time constraints and polytrauma - the treatment of organ trauma takes precedence).
 - *In case of combined injury of bones, veins and nerves*:
 - stabilize fractures, treat dislocations;
 - trunk vein reconstruction;
 - arterial reconstruction (if there is significant and prolonged ischemia, the artery should be reconstructed first);
 - nerve reconstruction;
 - provide cover with vital surrounding tissues (muscle, skin).

Consequences of arterial injuries and their treatment

- Post-traumatic closure (ligature, thrombosis).
- Arterial aneurysm and pseudoaneurysm.
- Traumatic AV fistula.
- Arterial embolism.
- Compartment syndrome.
- Reperfusion syndrome.

Vein injury

Injury to the veins of the extremities - clinically large nonpulsatile bleeding of dark blood from the site of penetrating injury, large nonpulsatile hematomas.

Treatment of vein injuries

In first aid, compression with elevation of the limb is indicated, foreign bodies are removed from the wound only during definitive treatment (vein reconstruction with vein grafts, ligatures in very rare cases), in the case of impending compartment syndrome, fasciotomy, postoperative heparinization and warfarinization (if the nature of any associated injury), full prevention of TEN.

1. Provisional construction of venous bleeding
 - Tamponade with masks with warm physiological solution (up to several days – thrombosis of the injured vein).
2. Definitive staging of venous bleeding
 - *Venous reconstruction:*
 - suture plain or with plastic (vein patch);
 - resection of the injured vein and direct end-to-end anastomosis;
 - resection of the injured vein with vein graft interposition.
 - *Garter:*
 - *limb veins* - below the knee and elbow can be ligated, above the joints - at least one deep vein should be ligated;
 - *superior vena cava* – can be ligated (SVC syndrome, but collateral circulation will gradually develop);
 - *inferior vena cava* - can be ligated subrenal, possibly between the renal and hepatic veins (collateral circulation), cannot be ligated above the hepatic veins;
 - *inferior mesenteric vein and lienalis vein* – can be ligated;
 - *v. mesenterica superior, v. portae* - there is a risk of intestinal infarction, with v. portae in addition hepatic encephalopathy.

Consequences of vein injuries and their treatment

- Postoperative venous bleeding.
- Postoperative thrombosis of reconstruction – collateral circulation is formed, not indicated for reoperation, TEN prophylaxis.
- Reconstruction infection.
- AV fistula with simultaneous injury of artery and vein.

Links

Source

- BENEŠ, Jiří. *Studijní materiály* [online]. [cit. 28.6.2010]. <<http://jirben.wz.cz>>.