IVC Injuries

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Case presentation

The patient is a xx year old male, brought in by EMS after a single stab wound to the left paraumbilical region, with eviceration. On the field the EMS reported a moderate amount of blood, the patient was alert, tachycardic and normotensive.

PMHx denied
PSHx denied
Meds: denied
NKDA
SHx: denied ETOH, smoking or illicit drug use
Case presentation

T=96.5 BP=90/60 HR=130  RR=24 SO2=100%
Somnolent but arousable, tachypneic, pale
HEENT: no JVD, midline trachea
Lungs: CTA B
Heart: sinus tachycardia, no M/G/R
Abdomen: distended, right paraumbilical single SW with colon eviceration with perforation, no active bleeding.
Rectal : normal tone no gross blood
Neuro: grossly intact
Extremities: acrocyanosis, moving all four extremities
Laboratories

- CBC: WBC=2.84, Hb=4.8, Ht=15, Plt=102
- Chem: Na=135, K=3.9, Cl=98, HCO3=9, BUN=14, Cr=1.3, Glc=248.
- Coags: PT=15.7, PTT=30.7
- ABG: 7.21/24/346/14.5/99%/-17.2
- Lactate: 16
- UA neg
- Utox neg
- ETOH neg
Operative procedure

- The patient became more hypotensive to 70/35 and tachycardic to 140, tachypneic, with worsening mental status.
- The patient was intubated in the ER, received 4 L of crystalloid and 2 u of blood, with good response in the BP to 100/40, HR to 130.
- The patient was taken emergently to the OR for exploratory laparotomy.
Operative procedure

Findings:

- 3 L of hemoperitoneum
- Proximal transverse colon through and through perforation.
- Right colon mesentery laceration with transection of the ileocolic artery.
- Retroperitoneal hematoma with 5 cm laceration of the distal IVC and common iliac vein with active bleeding.
- Ischemic right colon and terminal ileum.
Operative procedure

- **Procedure:**
  - Cattell maneuver performed.
  - Hemorrhage control with sponge sticks and Allis clamps.
  - Primary IVC repair with 3-0 prolene.
  - Right hemicolecctomy with primary stapled anastomosis.
  - Abdominal closure with vicryl mesh.

- **Fluid received:**
  - 20 u PRBC, 6u FFP, 1u Cryo, 10 L crystalloids, 1 dose of aFVII.
Hospital course

- Transferred to SICU immediately post op.
  - Received 6u of PRBC, 4u FFP, 3u cryo, 2 doses of aFVII.
- POD#4 tolerated extubation.
- POD#6 starting bowel function
- POD#8 persistent elevated WBC, with vomiting diarrhea and abdominal distention.
- POD#9 CT scan showed a large fluid collection in the mesentery, no signs of anastomotic leak, ileus.
Hospital course

- POD#10 percutaneous drainage of intra-abdominal fluid collection. Serosanguinous. Negative cultures.
Management of IVC Injuries
Incidence

- 10 to 15% of cases of abdominal penetration.
- 1 in 50 gunshot wounds.
- Retro-hepatic and intra-pericardial likely to be injured by blunt trauma.
- 50% of patient die before reaching the hospital.
- 20 to 57% mortality in patients who arrive to the hospital with signs of life.
Factors associated with survival:
- Hemodynamic condition of the patient on arrival
- Occurrence of spontaneous tamponade of the caval injury
- Location of the caval laceration
Surgical Anatomy

- Five sections of intra-abdominal IVC:
  - Bifurcation
  - Infrarenal
  - Perirenal
  - Suprarenal/Subhepatic
  - Retrohepatic
Surgical anatomy
Mechanism of injury

- Blunt trauma affect more often the retro-hepatic and intra-pericardial IVC.
- Most of the injuries are caused by penetrating trauma.
- Almost every patient has injuries to other viscera (liver, duodenum, pancreas, bowel), major vessel (10% of IVC injuries, aorta and portal vein) or both.
- Aorto-caval fistulas, renal-caval fistulas, duodenal-caval fistulas.
Mechanism of injury

- Blunt injuries caused by shearing forces in violent deceleration.
- Avulsion of atrio-caval junction, tearing of hepatic veins from retro-hepatic IVC, Intra-parenchymal laceration of the hepatic veins or anterior surface of the IVC.
- Low pressure hemorrhage. Confining by surrounding tissues causes tamponade in half of the cases. Free bleeding associated with surrounding tissue damage.
Mechanism of injury

- Tamponade more likely to occur with oblique, crossing, low velocity GSW and stab wounds. Also with injuries posterior to the pancreas, duodenum or liver if these organs are not extensively disrupted.

- Survival is more likely in spontaneous cessation of bleeding. 40% of patients die from exsanguination after tamponade is surgically decompressed.
Management

- Half of the patients present with hypotension often with profound hemodynamic instability.
- Most improve with fluid resuscitation. Failure to respond correlates with the presence of active bleeding (failure of spontaneous tamponade).
- Caval-duodenal fistula present with emesis of dark blood.
- Aorto-caval fistulas present with wide pulse pressure, abdominal bruit and hematuria.
Surgical management

- Stable hematoma of the central retroperitoneum.
- Active bleeding should be controlled with manual tamponade using a rolled gauze. Aortic compression in severely compromised patients.
- Retroperitoneal structures evaluation after tamponade.
- Since most of the patients die from intra-operative exsanguination, stable hematomas should not be explored, especially retro-hepatic. Unless it is associated with injuries to pancreas, duodenum, colon, kidney or ureter. (Buckman et al, J Trauma, 48:978-983:2000), (Burch et al, Am J Surg, 156:548-552,1998)
Bleeding control techniques
Surgical management

- 10 to 40% re-bleeding after spontaneous or manual tamponade. (Burch et al, Am J Surg, 156:548-552, 1998)

- Most of the immediate sub-hepatic hematomas need exploration because of the high risk of associated injuries.

- Wide exposure of the sub-hepatic IVC to the bifurcation is achieved by a Cattell maneuver, mobilization of duodenum, head of pancreas, right colon and base of the mesentery. (Cattel et al, Surg Gynecol Obstet 113:379-380,1960)
Cattell maneuver
Surgical management

- Peri-renal IVC exposure may require medial rotation or division of the renal vein.

- Bifurcation exposure is best achieved by division of the right common iliac with subsequent re-anastomosis. (Salam et al, Surgery, 98:105-108, 1985)

- Retro-hepatic IVC exposure requires extensive mobilization of the right triangular ligament. In left sided wounds the left triangular ligament also needs to be mobilized.
Surgical management

- Exposure of the anterior surface of the retro-hepatic IVC is achieved by dividing the liver along the interlobar plane.

- Schrock et al. recommended left lateral segmentectomy for exposure of the left anterior surface of the IVC.

- None of these maneuvers are recommended unless they constitute completions of massive traumatic fractures or bleeding cannot be controlled with peri-hepatic packing. Associated with very high mortality. (Buckman et al, J Trauma, 48:978-983, 200.)
Surgical management

- The best control of the hemorrhage is a rapid repair.

- In retro-hepatic caval injuries it is better to reinforce the structures capable of tamponading. (Sharp et al, Ann Surg 215:467-474, 1992).

- Trans-parenchymal hepatic caval hemorrhage are controlled with omental packing, deep liver sutures or peri-hepatic gauze packing. (Beal SL, J Trauma, 30:163-169, 1990.)
Surgical management

- Intra-caval shunt or atrio-caval shunts don’t constitute a method of initial hemorrhage control. Bleeding control should be achieved by tamponade before shunt insertion.

- If bleeding can be stopped by tamponade, atrio-caval shunt is required to attempt direct suture repair.

- Vascular isolation by clamping the supra- and infra-hepatic IVC with a Pringle maneuver is advocated by some for retro-hepatic injuries but can trigger cardiac arrest in severely hypovolemic patients.
Atrio-caval shunt
Surgical management

- Veno-venous bypass and hypothermic circulatory arrest has been also reported. (Baumgartner et al, J trauma, 39:671-673, 1995), (Hartman et al, J trauma 31:1310-1311, 1991).

- If an IVC injury exists, with no evidence of trauma to the retro-hepatic or immediate sub-hepatic IVC, primary repair should be performed to prevent recurrent hemorrhage or thromboembolic complications. (Buckman et al, J Trauma 48:978-983, 2000.)
Surgical management

- Three important facts to consider during repair of IVC injuries:
  - Patient that didn’t die from intra-op hemorrhage or shock tend to be long term survivors regardless of the method of managing the caval injury.
  - Complication of caval repairs or of the expectant management of spontaneous tamponaded caval injuries are very uncommon.
  - The long term outcome for ligation of the infra-renal IVC is approximately the same as for repair.
Surgical management

- Caval ligation above the renal veins is considered incompatible with survival.

- Reduction of 75% of the luminal cross-section would be tolerated. Unless the patient is exsanguinating, it is advisable to preserve a lumen of at least 25% during repair of the suprarenal or peri-renal IVC.

- If the repair is narrow and the patient condition permits, a patch angioplasty should be performed with vein or PTFE.
Caval repair
Surgical management

  - Juxtahepatic IVC injuries with stable retroperitoneal hematomas.
  - Requires proper facilities, an experienced interventional team, and an assortment of devices must be available.
Post operative management

- Leg elevation, Wrapping, SCD’s
- Dextran infusion for 24 to 72h is used by some surgeons.
- Edema of the legs is common initially but is never long-lasting or severe problem.
- Sudden death from PE has been reported after IVC repair in patients older than 50 years of age. The use of IVC filters above the repair may be consider in this subgroup.
**Conclusions**

- IVC injuries carry a very high mortality rate
- Survival is associated with spontaneous tamponade or surgically achieved tamponade
- Stable retroperitoneal or retro-hepatic hematomas should be observed.
- Most of patients with IVC injuries die from exsanguination after exploration of hematoma or free intra-peritoneal rupture.
- IVC injuries are associated with other organ injuries that need to be ruled out at the time of surgery.