



## Atrio-Caval Rupture and a Grade V Liver Injury after: A Rollover Motor Vehicle Collision

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### Introduction

We report a case of atrio-caval disruption from blunt injury associated with a Grade V liver laceration and diaphragm rupture. Median sternotomy with repair of the atrio-caval disruption was followed by abdominal exploration with packing of the Grade V liver injury. After a prolonged hospital course, the patient was discharged to home.

### Case Presentation

A 50-year-old male restrained driver was involved in a rollover motor vehicle collision. He was intubated in the field and transported to a Level 1 trauma center. At the time of admission his vital signs were BP 126/76 Pulse 85 with an axillary temp of 96 degrees. The GCS was 3. An endotracheal tube was in place and he was being ventilated. A CXR was performed and a right hemothorax was present and addressed with a right thoracostomy tube in the trauma bay. A FAST exam was positive for pericardial fluid and pericardiocentesis with a pericardial drain confirmed hemopericardium. Foley Catheter insertion was aborted when the catheter would not pass. The patient was taken to the operating room for further care.

A median sternotomy was performed and the pericardium was opened formally. Dark blood was evacuated and the atrio-caval rupture was noted. Multiple pledgeted sutures using 3-0 Prolene were placed and hemostasis was achieved. The pericardium was partially closed and mediastinal tubes were placed. The sternotomy was closed with sternal wires in the standard fashion. Intra-operative hypotension occurred and abdominal exploration ensued. Rupture of the right hemidiaphragm was noted along with a Grade V posterior liver injury. The posterior right lobe of the liver was packed and the diaphragm was repaired (Post-op CT Figure 1, 2). The urinary bladder was distended and a suprapubic cystostomy was placed uneventfully during the abdominal exploration. The patient received 18 PRBC, 10 FFP, 2 (10 packs) of cryoprecipitate and 2 (10 packs) of platelets. Intra-operative blood loss was 5 liters. A negative pressure dressing was applied to the abdomen (Abthera) and he was transferred to the ICU in critical condition. He returned to the operating room in 48 h for an abdominal washout with removal of packs but was repacked at that time because of recurrent bleeding. Four days later the abdomen was explored again. The packs were removed uneventfully, Microfibrillar collagen (Avitene) was applied to the raw surface of the liver and peri-hepatic drains were inserted. Component separation was utilized to restore the fascia and a biologic mesh was used as an onlay to restore the anterior rectus sheath. He also sustained open right tibial, right olecranon and right coronoid fractures. These fractures were initially splinted. Washout of these wounds and application of an external fixation device to the right tibia was performed during the initial take back. Imaging documented right superior and inferior pubic rami fractures (Figure 3, 4) and a left scapula fracture (Figure 5). Both of these injuries were managed non-operatively. After the final removal of the abdominal packs intramedullary nailing of the right tibia was performed. Open reduction and internal fixation of the remaining fractures was performed during a separate operative intervention. The patient tolerated these procedures well. A postoperative echocardiogram did not reveal any evidence of pericardial effusion with an estimated ejection fraction of 60%. There were no valve abnormalities noted. A percutaneous tracheostomy was performed at the bedside and he was weaned from the ventilator. Fever and bilious drainage from one of the hepatic drains occurred. CT imaging revealed a fluid collection in continuity with the drain. Serum bilirubin was slightly elevated at 1.3 with normal alkaline phosphatase, and liver enzymes. Broad spectrum antibiotics were administered and the drainage eventually stopped. Nutritional support was addressed with tube feedings. He was noted to have cervical spondylosis and cervical stenosis from C4-C7 on post-op CT imaging (Figure 6). Bilateral upper extremity weakness was present (consistent with a central cord syndrome). He worked with physical therapy and the weakness slowly resolved. The

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Figure 1: Post-op CT.



Figure 2: Post-op CT.



Figure 3: Right superior and inferior pubic rami fractures.

suprapubic catheter worked well during his hospitalization. It was clamped and he was able to void without difficulty. This catheter was removed prior to discharge. His Injury Severity Score (ISS) was 59 and he spent 54 days in the hospital.

## Discussion

In the current era because of advanced rapid emergency transport, we continue to see more complex injuries that are



Figure 4: Right superior and inferior pubic rami fractures.



Figure 5: A left scapula fracture.

potentially survivable. Initial vital signs may not tell the entire story. This patient had a normal blood pressure and pulse rate on admission but had two life-threatening injuries. The ATLS protocol guides the resuscitation and initial care of the multiply injured patient [1]. The airway was secured in the field. In this instance a right hemothorax was noted on the chest film. A thoracostomy tube was inserted and the hemothorax evacuated. The Focused Abdominal Ultrasound for Trauma (FAST) was performed and a positive finding was noted with blood in the pericardium. This was confirmed with pericardiocentesis. A pericardial drain was placed and the patient was taken to the operating room. A subxiphoid window is another approach to evaluate patients with presumed pericardial blood [2,3]. It is accurate in detecting hemopericardium. Both procedures have been used in the management of cardiac tamponade [4]. A median sternotomy is the standard for patients with cardiac tamponade secondary to blunt injury [5]. Access to the heart and great vessels is facilitated with this approach. In our patient dark blood was evacuated from the pericardium and rupture of the atrial-superior vena caval junction was evident. Pledgeted suture repair was performed because the tear extended into the superior vena cava. Once the chest was closed intraoperative hypotension prompted abdominal exploration and a Grade V liver injury was evident along with rupture of the right hemidiaphragm. On-going liver bleeding was decompressing into



**Figure 6:** Cervical spondylosis and cervical stenosis from C4-C7 on post-op CT.

the right pleural space. Packing provided control and diaphragmatic repair was performed uneventfully. This patient also had right superior and inferior pubic rami fractures likely associated with a urethral injury. A suprapubic cystostomy was indicated because a urinary catheter would not pass.

Atrio-caval rupture is unusual. A National Trauma Data Bank 5-year review of blunt cardiac rupture revealed that it occurs most commonly after a motor vehicle collision. Patients are often men with high injury severity scores and mortality is high (89% in that study). Survivors were more likely to have higher GCS and systolic pressures of 90 or above [6]. It is thought to occur because of a hydraulic vacuum phenomenon or shear forces in the setting of acute deceleration [7]. Low pressure bleeding can be contained by the pericardial sac. If the pericardium has ruptured after the injury decompression into the right pleural space can occur. A right anterolateral thoracotomy is another approach if uncontrolled hemorrhage from the right thorax is present.

Isolated right atrial rupture has a better prognosis than other causes of blunt cardiac rupture overall. When the rent involves the right atrial appendage superior vena caval junction mortality has been estimated at 13% [7].

Repair with pledgeted suture has been described for this specific injury [8].

Most often these injuries can be repaired without the need for cardiopulmonary bypass [9,10]. A PubMed and Google literature search revealed one case report of blunt cardiac rupture combined with a Grade IV liver injury that was not bleeding at the time of abdominal exploration [11].

Intraoperative hypotension mandated abdominal exploration once the source of the hemopericardium was definitively treated. The degree of liver trauma was consistent with massive transmission of blunt force to the torso during the motor vehicle collision. Packing has been a useful approach to manage liver injuries of this grade [12,13].

Balanced resuscitation with the use of component therapy to approximate whole blood administration has been essential in the care of these patients [14-16]. Implementing a massive transfusion

protocol early is critical.

The development of the biloma postoperatively was not unexpected. The moderate quantity of the drainage and the fact that the total bilirubin was almost normal predicted a satisfactory clinical course.

In summary we present a patient with a potentially lethal combination of injuries (atrio-caval rupture and Grade V liver injury) who presented with normal vital signs after a severe motor vehicle collision. Rapid assessment and operative intervention led to a full recovery.

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