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## Case Report

## Traumatic right atrial rupture bridge to definitive repair with extra-corporeal life support

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## ABSTRACT

Cardiac injury secondary to non-penetrating trauma is more common than thought, albeit, the injury is usually minor and goes undiagnosed without significant sequelae in most cases. Blunt cardiac rupture is much rarer accounting for <0.05% of all trauma cases but lethal in most circumstances. We present a case report of a young trauma victim who presented with both right atrial rupture and traumatic atrial septal disruption (ASD) requiring extra-corporeal life support (ECLS) and surgical repair.

Blunt cardiac trauma with chamber rupture and septal disruption is a devastating injury. Stopping the hemorrhage and using ECLS gave our patient time to stabilize before definitive management of her traumatic ASD.

## Introduction

Cardiac injury secondary to non-penetrating trauma is more common than thought, albeit usually minor, undiagnosed and without significant sequelae; however, when severe, such as in cardiac rupture (<0.05% of all patients presenting to the hospital) it is often lethal [1]. A retrospective analysis of 515 cases of blunt thoracic injury demonstrated a morbidity of 36% and mortality of 15.5% [2]. Of these cases, 14 involved cardiac lacerations and one survived. A subsequent focused study identified 32 patients with blunt cardiac chamber rupture with mortality of 81.3% (26 of 32 patients) [3]. Nowhere in ATLS is ECMO considered part of the treatment. We present a case report of a young trauma patient who presented with both right atrial rupture and traumatic atrial septal disruption (ASD) requiring extra-corporeal life support (ECLS) and surgical repair.

## Case report

A previously healthy 24-year-old female was involved in a rollover motor vehicle crash with prolonged extrication, she arrived at 02:54. She was obtunded with a Glasgow Coma Score (GCS) of three. She was tachycardic to 140, but normotensive. Within 10 min the patient was intubated. A tension pneumothorax and a hemothorax were identified, requiring emergent chest tube placement. A repeat

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chest Xray demonstrated persistent pneumothorax and hemothorax, therefore, a second right sided chest tube was placed, combined these drained over 2 l. The patient was monitored in the trauma bay and once stable, transferred to the CT scanner at 0430. CT demonstrated multiple injuries including lung contusions, right hemopneumothorax, pneumomediastinum, and a grade 4 right hepatic lobe laceration, among other injuries. The patient was taken emergently to the operating theater. The surgery began with an exploratory laparotomy at 05:55. Upon evaluation of the abdomen no active bleeding was identified, a temporary abdominal wound closure device was placed, and attention was directed to the chest. A right thoracotomy was performed. The patient had extensive injuries to her lungs requiring lobectomies and an injury to her bronchus intermedius was oversewn. The pericardium was noted to be purple and distended. A window was made, frank blood was appreciated, and a sternotomy was performed. A right atrial laceration was found and repaired. Up to this point she had received 21 packed red blood cells (PRBCs), 15 Fresh Frozen Plasma (FFP), 3 platelets. As the procedure was nearing completion, the patient was hypoxic despite maximal ventilator settings. At 0944, Venous-Venous (VV) ECMO was placed via a right femoral vein and right subclavian vein. A transesophageal echocardiography (TEE) was performed, demonstrating an ejection fraction (EF) of 45%, moderate to severe RV dysfunction and a large ASD with left to right shunt (Fig. 1). Her estimated injury severity score (ISS) was 50.

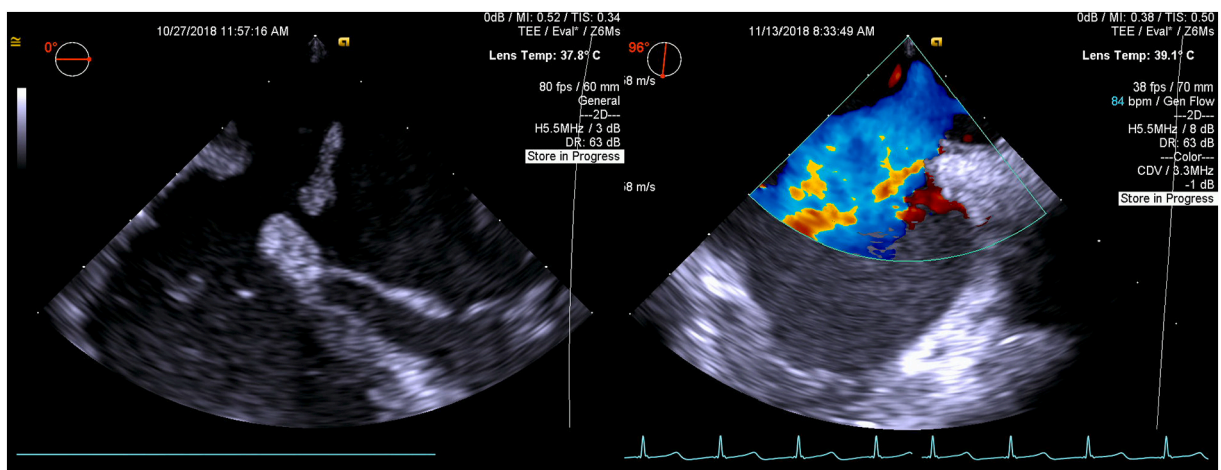
We chose to defer treatment of the traumatic ASD until the patient's condition stabilized as the required heparinization for cardiac surgery posed a risk for bleeding. Throughout her first several days, she was initially coagulopathic and transiently hypotensive, requiring blood products and inotropes. She was febrile and she had an increasing leukocytosis, antibiotics were started for potential aspiration pneumonia. On POD #4 the abdomen was closed. On POD #5, follow-up echocardiography revealed an improved left ventricular systolic function, moderate tricuspid regurgitation, and re-demonstrated the large ASD (2.6 cm × 1.8 cm) with bidirectional shunting. Additional findings included a linear echogenic structure with independent movement suggestive of a torn atrial septum with inferior dissection toward the mitral-aortic intervalvular fibrosa, which was supportive of a traumatic injury over a congenital finding. The extent of the traumatic ASD meant percutaneous repair was not feasible.

On POD #17, the patient was taken back to the operating theater for definitive management of her traumatic ASD. The ECLS lines were 'Y-ed' together for venous drainage and access of the mid-ascending aorta for arterial cannulation. Under inspection, the septal injury was consistent with a traumatic ASD. The edges of the defect were ragged with a large membranous flap as described by echocardiography. The edges were trimmed, and a bovine pericardial patch was used. Post-repair, intra-operative TEE found no evidence of a residual defect (Fig. 2). She was placed back on ECLS and tolerated decannulation the following day. The remainder of her hospital course was complicated by chest abscess formation, *C. difficile*, and IVC filter placement.

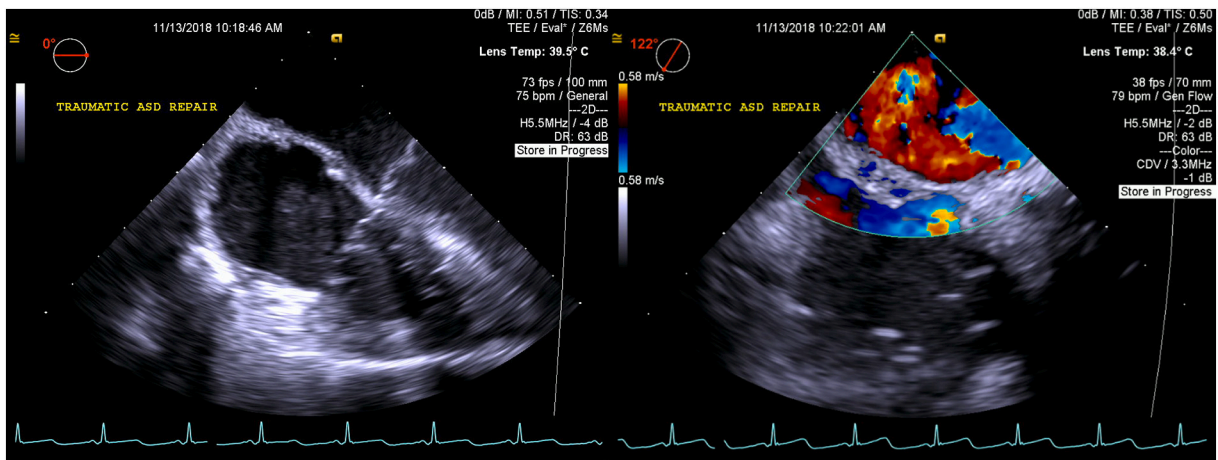
By POD #21, the patient's condition worsened. She was found to have agonal breathing, increasing ventilator requirements, and difficulty with oxygenation. As per the family's wishes, she was transitioned to comfort measures only.

## Discussion

Blunt cardiac injury is more common than we think. Cardiac chamber rupture is plagued by an extremely high mortality, particularly if the patient presents without vital signs or with rapidly declining hemodynamics [1]. Interestingly, this is not quite the case with cardiac septal ruptures. Case series have found no particular area of the inter-atrial septum was more susceptible to rupture [2,3]. Patients are typically able to survive for several days following this type of injury. The size of the defect will determine the physiological and hemodynamic consequences [2,3]. The natural history of a congenital ASD is an initial left-to-right shunt with increased pulmonary blood flow. Over time, this results in increased pulmonary vascular resistance and pulmonary hypertension. The eventual outcome is a reversal of the left-to-right shunt to a right-to-left shunt, also known as Eisenmenger syndrome. The acuity of the ASD in our patient along with her previously healthy state meant that shunt reversal was unlikely. However, due to severe pulmonary



**Fig. 1.** ECHO images of traumatic ASD. ECHO imaging demonstrating ASD rupture. Left image is from initial presentation, image on right is intraoperatively before repair.



**Fig. 2.** ECHO Images of repaired ASD.  
ECHO imaging demonstrating the repaired ASD.

contusion, fluid shifting, and massive transfusion, her lungs suffered, and she developed acute respiratory distress syndrome.

The use of ECLS, formerly extracorporeal membrane oxygenation (ECMO), has increased since the H1N1 pandemic in the 2009 and has given patients, who would otherwise die, a fighting chance at recovery [4]. There have been several case reports of patients with a post-infarction ventricular septal defect and cardiogenic shock, who were stabilized on veno-arterial (VA) ECLS as a bridge to definitive therapy [5–7]. Our patient developed respiratory failure without cardiogenic shock. We elected to initiate VV ECLS to provide just respiratory support. Serial echocardiography was performed to assess her cardiac function, which did not demonstrate evolution into heart failure. She was able to survive for 17 days on ECLS and time for stabilization for definitive ASD repair. Ling and Massey published a case report of a 57-year-old man who suffered a motorcycle crash resulting in blunt thoracic injury [8]. The result was a ruptured ventricular septum and flailed tricuspid valve with progression into cardiogenic shock. The patient was placed on VA ECLS until occlusion of the septal defect and replacement of the tricuspid valve could be performed. We consulted interventional radiology to review the case for percutaneous repair. However, due to the extent of the ASD and dissection flap toward the aorto-mitral septum, this was not possible. Unfortunately, pneumonia, sepsis, severe pulmonary contusions, respiratory failure, and multisystem organ failure complicated the patient's hospital course. She was able to survive her right atrial laceration and ASD repair. However, she would succumb to her injuries.

## Conclusion

Blunt cardiac trauma with chamber rupture and septal disruption is a rare but devastating injury. ECLS can be successfully applied to traumatic patients to provide stabilization for definitive management and diagnostics. Consideration of ECLS for trauma patients is warranted and should be considered as part of ATLS resuscitation.

## Disclosures

JB – none, AT – none, MA – none, JP – none, JG – none, SWH – none, DF – none.

## Declaration of competing interest

No author has any financial disclosures and no authors have any conflicts of interest.

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