

A case report: delayed right ventricular pericardial fistula and aneurysm following penetrating traumatic injury—a controversial aetiology

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Background

Right ventricular aneurysms (RVAs) are rare. We present a case with a combined RVA and right ventricular pericardial fistula resulting in a pericardial effusion and cardiac tamponade. The RVA was detected 47 days after the patient suffered a gunshot wound. This report adds to the body of scarce literature on RVA aetiology, diagnoses, and treatment.

Case summary

A 30-year-old male patient presented with worsening respiratory distress over a 7-day period with clinical signs of cardiac tamponade following a history of a gunshot (with associated liver laceration, pulmonary embolism, right nephrectomy, and sepsis) 47 days prior. Transthoracic echocardiography showed a large circumferential pericardial effusion and an RVA. The patient was emergently taken for surgical repair of the RVA.

Discussion

Our case presents a delayed presentation of a gunshot heart and an aetiology with indications of and against a true aneurysm. It brings attention to possible complications of penetrating precordial injuries, with the need for consideration and possible evaluation at follow-up. The literature on the operative excision of RVA is reviewed and various aetiological factors and consequences are discussed.

Keywords

Case report • Right ventricular aneurysm • Gunshot wound • Ventricular aneurysm • Pericardial fistula

Learning points

- In patients with a history of a chest-associated trauma, the possibility of late ventricular aneurysm (VA) must be considered and the patient should be scheduled for follow-up echocardiography.
- Surgical repair of right ventricular aneurysm is best performed with the use of cardiopulmonary bypass and a bovine pericardial patch in case the excised VA leaves a defect too big for primary closure.

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Introduction

Ventricular aneurysms (VAs) are rare and are mainly found in the left ventricle following a transmural myocardial infarction.^{1,2} Other causes such as Chagas disease, sarcoid, congenital malformation,³ or chest trauma are distinctly uncommon.² A few cases exist describing cardiac injuries appearing months after a traumatic chest injury.⁴⁻⁷ We are therefore adding to the scarce literature on right ventricular aneurysm (RVA).

A patient with a recent history of a gunshot injury to the chest represents 40 days after the initial injury with respiratory distress and signs of cardiac tamponade due to a combined RVA and ventricular pericardial fistula.

Aneurysms of the right ventricle are difficult to detect. Four main aetiologies for RVA include congenital, inflammation, myocardial infarction, and trauma. Indications for operative intervention is usually limited to cases with debilitating symptoms such as angina pectoris, congestive heart failure, and refractory ventricular tachycardia.² Surgical recommendations on RVA treatment are rare and this report represents an addition to the scarce literature on RVA aetiology, diagnoses, and operative intervention.

Timeline

Summary of index admission 39 days prior to current admission	<ul style="list-style-type: none"> Two gunshot wounds (left lower costal margin 6–7th intercostal space at the midclavicular line + right mid-back at the level of T12). Damage control laparotomy followed by two re-look laparotomies. Right nephrectomy due to Grade V kidney injury complicated by acute kidney injury requiring haemodialysis. Liver injury Grade IV complicated by bile leak requiring intervention. Pulmonary embolism and sepsis treated in an intensive care setting. Discharged 31 days post-injury on therapeutic anticoagulation with warfarin.
Current admission (8 days post-discharge)	<ul style="list-style-type: none"> Colicky abdominal pain, non-productive cough, Grade III dyspnoea, pyrexia, International Normalized Ratio (INR) >10, bilateral pleural effusions. Blood products given, empiric broad-spectrum antibiotics started and warfarin stopped.
Day 8 post-readmission	<ul style="list-style-type: none"> Respiratory distress with signs of cardiac tamponade. X-ray showed bilateral pleural effusions and cardiomegaly. Emergency echocardiogram demonstrated a pericardial effusion with a 2 cm defect/aneurysm in the lateral right ventricular wall.
Day 9 post-readmission	<ul style="list-style-type: none"> Surgical repair of the right ventricular aneurysm.

Case presentation

A 30-year-old man without any documented previous medical history presented with two gunshot wounds to the anterior left thoracoabdominal region and the right back. He was primarily stabilized with intravenous fluids. Physical examination findings included blood pressure (109/66 mmHg), pulse (95/min), abdomen tender but non-peritonitic, and a normal chest X-ray. Due to the criminal nature of the incident, the calibre of the rifle is unknown. The direction of the lesion is showing an oblique, upwards pointing kinetic motion, which could feature a stab or a shot, if the attacker was kneeling. After transferral to our trauma unit, his haemodynamic parameters were still stable, chest examination and heart sounds were negative, but the E-FAST scan showed free fluid in the abdomen (arterial blood gas pH 7.18, lactate 3.5 mmol/L, base excess 5.3 mmol/L, haemoglobin 11 g/dL, HCO₃ 17 mmol/L). Therefore, he underwent a damage control laparotomy which included a right nephrectomy and liver packing. This was followed by two re-look laparotomies before his abdomen was closed. At the first relook laparotomy a subxiphoid pericardial window was done due to concern of missile trajectory but was noted to be negative with no blood or pericardial effusion to be seen. In hindsight a pericardial window with or without partial lower sternotomy or a transoesophageal echocardiography (TOE), if available, could have been better options to assess cardiac injuries. The patient underwent a complex post-operative course which included: an acute kidney injury requiring haemodialysis, a persistent bile leak requiring endoscopic retrograde cholangiogram with placement of a common bile duct stent, sepsis requiring prolonged antibiotics and a pulmonary embolism requiring anticoagulation. During this time, no cardiac injury was suspected due to a normal cardiac examination and imaging including an E-FAST ultrasound and a computed tomography (Figure 1). The patient was discharged home on therapeutic anticoagulation with warfarin with a plan for close follow-up as an outpatient.

Eight days after discharge (39 days after gunshot), the patient represented to the emergency department with colicky abdominal

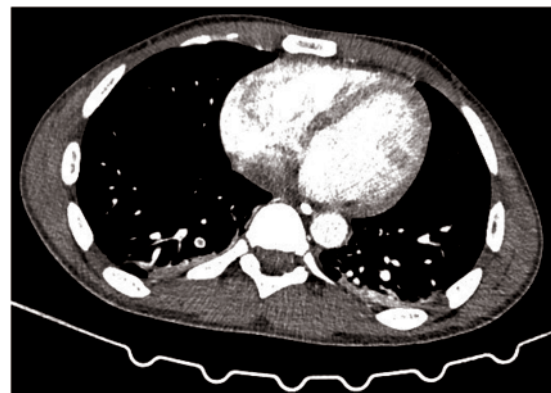


Figure 1 First computed tomography 7 days after the gun shot during the patient's first hospitalization. The computed tomography is clearly unremarkable with no signs of any cardiac lesion detectable.

pain, non-productive cough, Grade III dyspnoea associated with fever, and an International Normalized Ratio (INR) >10.00 (white cell count 24.5/ μ L, haemoglobin 6.6 g/dL). An intrahepatic collection suggestive of a liver abscess and small bilateral pleural effusions were observed. Blood products were transfused, the patient was started empirically on antibiotics and warfarin was omitted.

Eight days into his re-admission, the patient developed respiratory distress and clinical signs of a cardiac tamponade prompting a chest

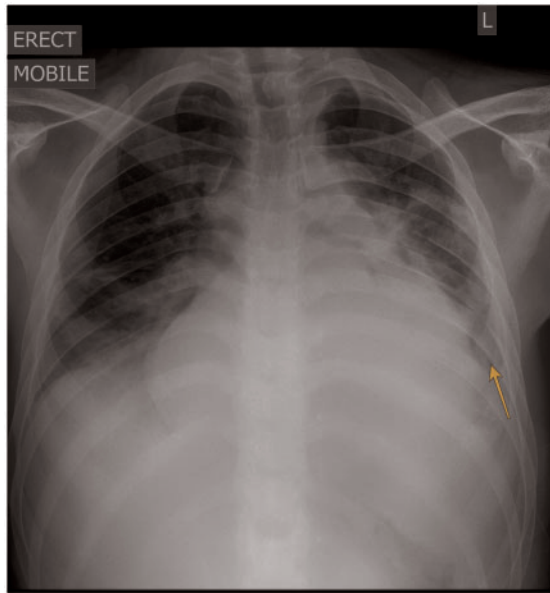


Figure 2 Respiratory distress prompted an X-ray 8 days into the patient's second hospitalization. The arrow depicts a pleural effusion on the left, later diagnosed as a haemothorax. An effusion on the right side and substantial cardiomegaly, suspicious for a pericardial effusion, can be observed.

X-ray and an ECHO. The X-ray showed bilateral pleural effusions and cardiomegaly (Figure 2). The ECHO showed a large circumferential pericardial effusion measuring approximately 19 mm (diastole) at the apex. A 2 cm defect/ruptured aneurysm was seen in the lateral free wall of the right ventricle (Figure 3A and B). The electrocardiogram (ECG) was normal with no ischaemic signs or deep Q waves.

With a diagnosis of cardiac tamponade, the patient was scheduled for emergency surgery within 24 h. His ventricular function was moderate (ejection fraction 45%). The patient was put on a femoro-femoral bypass and a full sternotomy incision was performed. Access was complicated by Grade 2 pericardial adhesions. He was cooled to 28°C and bypass perfusion time was 132 min. The aortic cross-clamp was applied and the heart arrested with antegrade cold blood cardioplegia. Cross-clamp time was 41 min. When opening the pericardium a significant bloody pericardial effusion was noted. The RVA could be detected on the lateral wall (Figure 4A). A significant bile collection in the sub-diaphragmatic area was encountered. The abdomen was not re-opened but a closed suction drain was placed in the subdiaphragmatic position with the diaphragmatic defect closed over by the trauma surgeons. The RVA was identified and its margins were excised until viable tissue was noted. The defect was thought to be too large for primary closure and thus a bovine pericardial patch was used to close the defect using a 4/0 Prolene suture (Figure 4B). Strips of bovine pericardium were used for reinforcement by placating the suture lines. Routine sternal closure was performed after pericardial and mediastinal drain placement and the patient was transferred to the intensive care unit in a stable condition.

Post-operative stay in the intensive care unit and in the general ward was uneventful and the patient's recovery was satisfactory. He was discharged home on therapeutic anticoagulation and a follow-up ECHO was scheduled. Unfortunately, the patient did not show up for this appointment.

The excised tissue of the RVA measured 25 × 10 × 3 mm and was sent for histology which revealed a true aneurysm consisting of all three cardiac wall layers, supporting the hypothesis of a non-

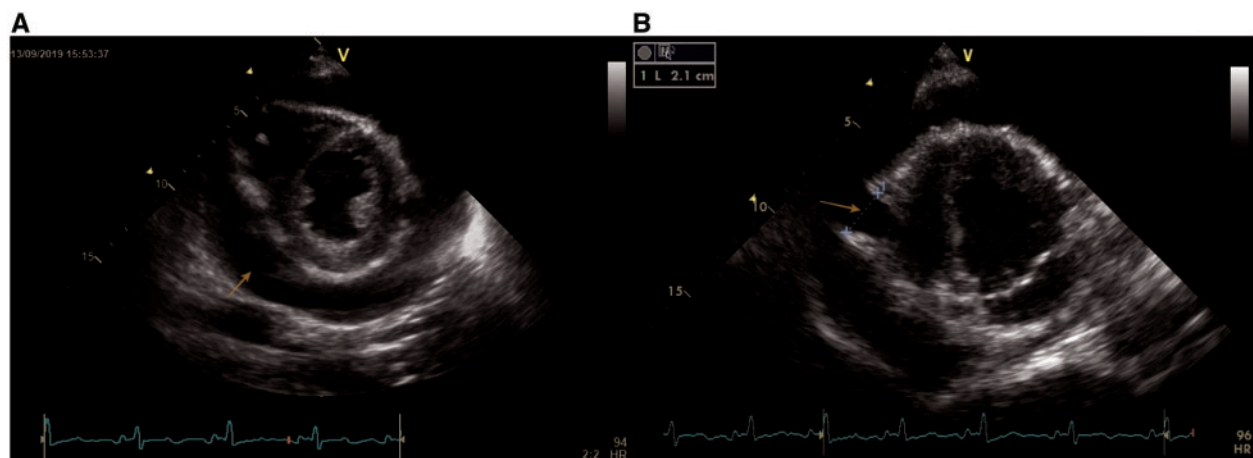


Figure 3 Echocardiography. (A) A large circumferential pericardial effusion measuring approximately 19 mm (diastole) at the apex (arrow in 'A'); and (B) a 2 cm ruptured aneurysm in the lateral free wall of the right ventricle (arrow in 'B').

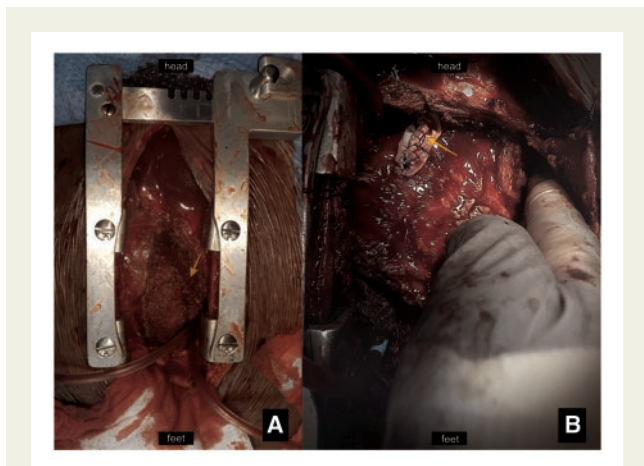


Figure 4 The arrow in 'A' indicates the right ventricular aneurysm on the lateral wall. Thrombotic tissue prevents a clear picture of the aneurysm. The arrow in 'B' shows the bovine pericardial patch used to close the defect caused by excision of the right ventricular aneurysm.

traumatic aetiology. The specimen showed fibrosis, haemorrhage with organization, haemosiderin deposition, fibrin, and dystrophic calcification—all signs of granulation tissue, supporting the hypothesis of a traumatic aetiology. Histology further revealed focal endarteritis obliterans, which might have added to weakening of the myocardium and ultimate formation of the fistula.

Discussion

The main 'take-home' lessons from this case is that there should be a high index of suspicion of a possible late onset cardiac lesion after a penetrating (or blunt, as reported by Liedtke *et al.*⁸) injury to the chest. This should also be considered at the follow-up if not evaluated adequately as an inpatient. During damage control procedure more attention needs to be put on possible cardiac injuries by making use of sternotomy or TOE when justifiable. Also, cardiomegaly, as seen in *Figure 2*, in combination with a high INR should suspect a pericardial effusion immediately.

Patients with VA, especially due to ischaemia, may present with a diffuse pansystolic apical thrust with a double impulse, a third heart sound and deep Q waves on ECG. The X-ray can be unremarkable if the aneurysm is small, or distorting the cardiac silhouette. ECHO is the 'gold standard' for VA diagnosis. The VA appears as a bulge in the ventricular contour, in both systole and diastole.⁵ A study examining VA diagnoses post-myocardial infarction with ECHO indicates a sensitivity of 93% and specificity of 94% for this method.⁵ This data have not been verified for traumatic settings though.

The history of our case suggests a traumatically acquired aetiology. The initial injury from the missile might have caused weakness of the myocardium. Pulmonary embolism and recurrent pleural effusions further strained the right ventricle and could have thinned out a pre-existing RVA. Usually, the mechanism of mechanical injury creates a channel within the myocardium. If the lesion is fortunately sealed off

by a forming clot-plug, the channel closes. In some rare cases, the clot is step-by-step distended by the right ventricular pressure and a false aneurysm forms, which may rupture occasionally. Even though this represents the likeliest sequence of events in this case there are a few aspects arguing against a sole mechanical nature of the incident. Histology and history of our case conflict with each other. Surprisingly, histology confirmed a true aneurysm and also an endarteritis obliterans, which supports the theory of a non-mechanical partial cause. A combination of course is plausible with a true aneurysm presenting a susceptible myocardium. Anyhow, ultimately the events resulted in a pericardial effusion and pericardial tamponade.

Whether true or false aneurysm, the events presented in this report underline the need for thorough consideration of cardiac injuries in trauma patients. Taking into account a 10% operative mortality,⁵ elective surgery for incidentally detected VA is questionable. Indisputable, when RVA results in pericardial effusion, as presented in our case, surgical intervention is inevitable.

Lead author biography



Martina Steinmaurer, cand. med., is studying at the Ludwig-Maximilians-University in Munich, Germany. She is currently in her final year of studies. Mrs Steinmaurer spent 9 months with a BMEP research scholarship at the University of Cape Town, South Africa. She is interested in surgery, regenerative medicine, as well as global health and aims to pursue her future career in cardiac surgery. Previous research and publications in neuropathology and nanomedicine.

Supplementary material

[Supplementary material](#) is available at *European Heart Journal - Case Reports* online.

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Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: The authors declare that they have no competing interests.

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