American Journal of Case Reports

e-ISSN 1941-5923
© Am J Case Rep, 2021; 22: e931844
DOI: 10.12659/AJCR.931844

Received: 2021.02.26
Accepted: 2021.05.12
Available online: 2021.05.18
Published: 2021.06.21

Coil Embolization of Post-Traumatic Pseudoaneurysm of the Ascending Aorta

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 **Mirosław A. Dziekiewicz**
BCF 2 **Karol Makowski**
ADF 3 **Rafał B. Maciąg**

1 Department of Vascular and Endovascular Surgery, Military Institute of Medicine, Warsaw, Poland
2 Department of Military Health Service, Ministry of Defense, Warsaw, Poland
3 Second Department of Clinical Radiology, Warsaw Medical University, Warsaw, Poland

Corresponding Author: Mirosław A. Dziekiewicz, e-mail: dziekiewicz@wim.mil.pl
Conflict of interest: None declared

Patient: Male, 61-year-old
Final Diagnosis: Aortic aneurysm
Symptoms: Hematoma • pain • shock
Medication: —
Clinical Procedure: —
Specialty: Surgery

Objective: Unusual clinical course

Background: Traumatic rupture of the ascending aorta is a life-threatening injury, with a survival rate of around 15% to 20%. Treatment with open surgical repair is the criterion standard. However, open surgical repair is associated with high mortality and morbidity in patients with multiple traumas. There are no systematic data on traumatic thoracic rupture and aorta rupture in a cohort of patients who had undergone partial or total replacement of the thoracic aorta. We can only speculate about the mechanisms and consequences of such an injury. Therefore, even unorthodox endovascular techniques are a welcome advancement in this field and should be considered, providing they do not compromise patient safety.

Case Report: A 61-year-old man presented with polytrauma after a fall from height. Since the patient had a history of a Bentall procedure, hypertension, coronary disease, and nicotinism, we quickly excluded open surgery as a treatment option. However, the patient's condition, additional injuries, and anatomical features prompted us to perform coil pseudoaneurysm, reducing his operative trauma and allowing for his faster recovery and early rehabilitation. The patient has remained under careful clinical supervision. The result of the patient's 1-year follow-up was satisfactory.

Conclusions: In this case, the endovascular approach was an effective, if temporary, option to open or hybrid surgery. This demonstrates that minimally invasive surgery can be helpful in some patients and can also be helpful as a bridge therapy. A good rapport between the surgeon and the patient is crucial to understanding the advantages and disadvantages of such treatment.

Keywords: Aorta • Embolization, Therapeutic • Endovascular Procedures

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/931844

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]

Background

Blunt thoracic aortic injury (BTAI) is the second leading cause of death from deceleration trauma [1,2]. The aortic tear is found most often at the aortic isthmus, and involves, in order of frequency, the descending aorta (40.8%), ascending aorta (12%), and aortic arch (14.8%) in healthy individuals. But there are no available data concerning chest blunt trauma in patients who have undergone the Bentall procedure. The anastomotic sides seem to be prone to rupture owing to loci minoris resistentiae. Thoracic aorta rupture causes immediate death on impact in up to 80% of cases. A minority of patients reach the hospital alive, often with multiple injuries, such as bone fractures, head trauma, visceral lesions, and burns, and the need for immediate treatment of aortic transection to stop bleeding. Several studies have confirmed that surgical repair of an aortic rupture aggravates the general condition of patients with multiple injuries. Thoracic endovascular aortic repair (TEVAR), therefore, has been expeditiously adopted as an alternative for BTAI treatment. Endovascular treatment is the first choice in isthmic or descending aorta rupture. Nonetheless, to implant a stent-graft, certain necessary conditions must be met. First, a stent-graft dedicated for the thoracic ascending aorta is needed. Second, without sufficient proximal and distal lending zones, this technique remains only hypothetical. Third, the hybrid interventions could be helpful in a few cases. Exceptionally, we chose a method uncommon in the proximal portion of the aorta, typically used in other regions. In our case, the anatomical conditions, specifically the lack of proximal lending zone, excluded stent-graft placement, including the hybrid procedure.

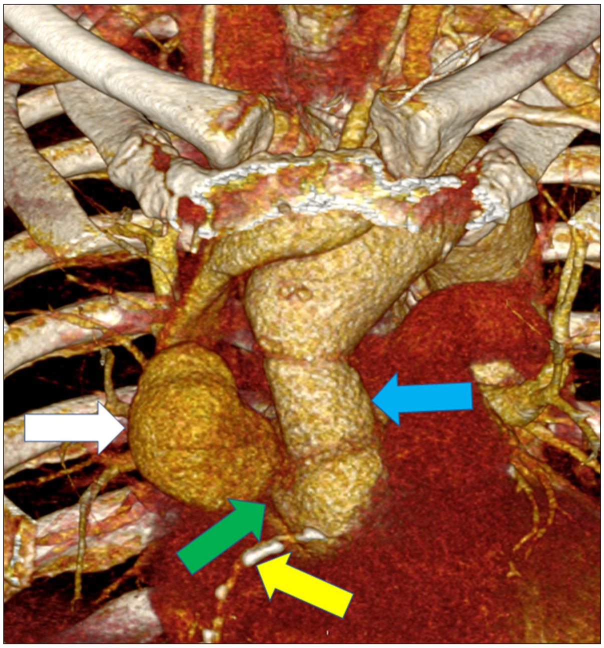

Figure 1. Three-dimensional reconstruction of aorta in computed tomography angiography. Pseudoaneurysm marked with white arrow. Antero-posterior view of the ascending aorta after the sternum and ribs were digitally removed. The highly calcified right coronary artery is located about 3 mm below the ascending aorta rupture (yellow arrow). This is where the pseudoaneurysm (white arrow) formed. The ascending aorta replaced with a graft is marked with the blue arrow. The green arrow points to the pseudoaneurysm stemming from the ascending aorta/anastomosis rupture. Pictures obtained from computed tomography (CT) scanner, General Electric Health Care Discovery CT750 HD.

Case Report

A 61-year-old man presented with polytrauma after a fall from height. He was unconscious and presented with symptoms of ischemic shock. Despite resuscitation, the patient remained hemodynamically unstable and required urgent care. The impact of his fall caused a periaortic hematoma in the region of his previous surgery's proximal anastomosis, where we found a pseudoaneurysm measuring 81×87×50 mm (grade III) [3]. The diameter of the ascending aorta (prosthesis) was 40 mm, the aortic arch was 32 mm, and the descending aorta was 30 mm. His polytrauma included an open-book pelvic fracture (left pubic bone and ischium) with extensive internal bleeding to the pelvis, right both-bone forearm fracture, and lung contusion. The patient had a history of a Bentall procedure 1 year prior to the accident, hypertension, coronary disease with ventricular ejection fraction of 65%, and nicotinism. Owing to his systemic heparinization, we excluded open surgery as a treatment option. The analysis of computed tomography angiography (CTA) scans (**Figure 1**) revealed a hematoma. The distance of the hematoma from the right coronary artery ostium was 3 mm, and 50 mm from the anonymous trunk. Furthermore, highly calcified coronary arteries would have posed an additional risk in the case of open surgery. Clearly, the lack of an adequate margin for a suture line made this procedure perilous. The rupture of the aorta with a small-diameter channel between the blood aortic stream and pseudoaneurysm sac was estimated as thin and safe for an endovascular attempt (**Figure 2**). We performed an aortography, visualizing the pseudoaneurysm using the right-femoral approach and deploying the VTK 125-cm diagnostic catheter (Cook, Bloomington, USA) into the lumen of the ascending aorta and pseudoaneurysm cavity. Next, we used detachable coils to perform embolization for the pseudoaneurysm, filling the remaining empty space with 30 coils: 20 Ruby® standard coils, 5 Ruby® soft coils, and 5 packing coils (Penumbra, Alameda, USA) deployed from a high-flow microcatheter lantern (Penumbra, Alameda, USA). The final result was evaluated first during intraoperative angiography (**Figure 3**), which showed complete occlusion. The whole sac of the aneurysm

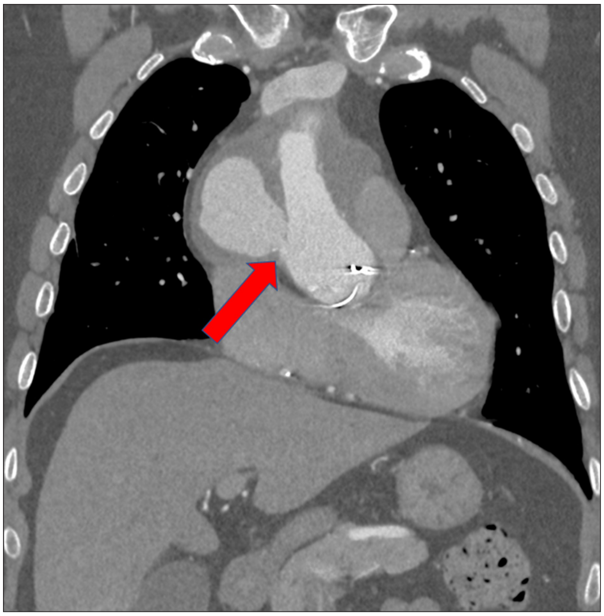

Figure 2. Narrow inflow channel into the pseudoaneurysm is marked with a red arrow. An antero-posterior computed tomography (CT) scan focused on a thin tunnel joining the ascending aorta and pseudoaneurysm lumens (red arrow). Pictures obtained from the CT scanner, General Electric Health Care Discovery CT750 HD.

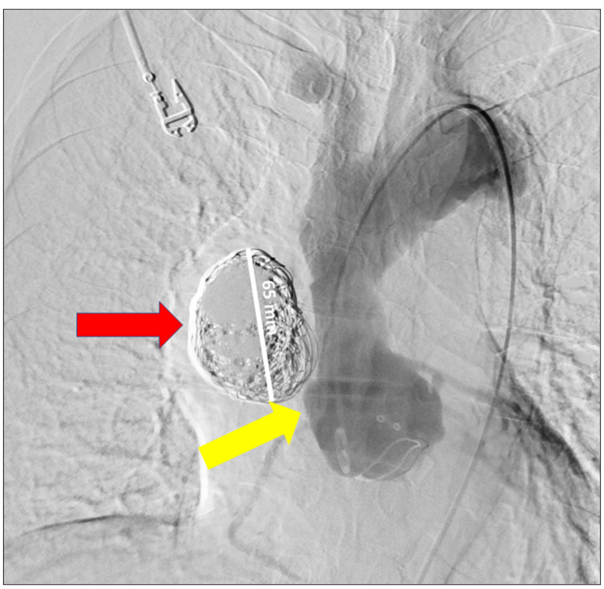

Figure 3. Postoperative angiography. Coils fill the pseudoaneurysm cavity (red arrow) completely. We see the diameter of the pseudoaneurysm excluded from the flow (major axis equals 65 mm). The yellow arrow shows an earlier detected outflow from the ascending aorta, which is no longer patent. Angiograph apparatus, Artis Zee Simens. Contrast agent, Optiray 320. Flow 20 mL/s, volume 40 mL.

was filled with coils, stimulating clotting and excluding it from the arterial blood flow. The patient spent 25 days in the hospital and was discharged for conservative treatment and rehabilitation of his remaining injuries. A 1-year follow-up CTA scan confirmed successful treatment, with pseudoaneurysm sac shrinkage. The patient is in long-term follow-up, and our cardiac and vascular surgeons are ready to perform an open operation if necessary. From the beginning, open surgery was our second option had the intervention of embolization not been successful. We routinely do not perform postoperative CT scans when we have satisfying intraoperative angiography results and no clinical symptoms requiring additional exams. We usually scan patients 30 days, 6 months, and 1 year after a procedure and then repeat yearly. Because of his lung contusion, the patient required 1 week of respiratory therapy. The pelvic and a right both-bone forearm fractures were closed and stable. Thus, the patient required stabilization, pain management, and anticoagulant intake and then physical therapy.

Discussion

Traumatic injury of the thoracic aorta is the leading cause of death in patients with multiple traumas and requires urgent management. The injuries occur in a specific set of circumstances: road traffic accidents, crushing accidents, falls from height, and other deceleration accidents, such as skiing. Three main mechanisms of traumatic rupture of the aorta are mentioned in the literature: torsion, bending, and shearing forces [1]. The isthmus of the aorta is most prone to damage in falls from height, and the ascending aorta is most affected in traffic accidents. During the last decade, there has been a compelling shift from open surgery to TEVAR and nonoperative medical management of BTAI [3] as the first line of treatment, but only as long as it is feasible in the particular patient. Repair of injuries to the ascending thoracic aorta are less common because they usually result in immediate death. The Society for Vascular Surgery recommends TEVAR for aortic injury grades II to IV, although recent retrospective reviews have proved that medical treatment can be acceptable in selected cases [4]. Trauma injuries affecting the external wall of the aorta create an indication for an endovascular technique, sometimes extended by a hybrid procedure. The management of patients with thoracic aorta injury varies depending on their condition at hospital admission, as well as any associated injuries detected. Many studies have shown that not all traumatic injuries of the thoracic aorta need urgent intervention and that some of them can be treated conservatively or with a delay. We initially had no knowledge of the presence of the pseudoaneurysm in the anastomotic region. It is usually asymptomatic in patients, but in the case of our patient, we are inclined to attribute it to the trauma. The diminished elasticity and increased fragility may have contributed to the aortic

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]

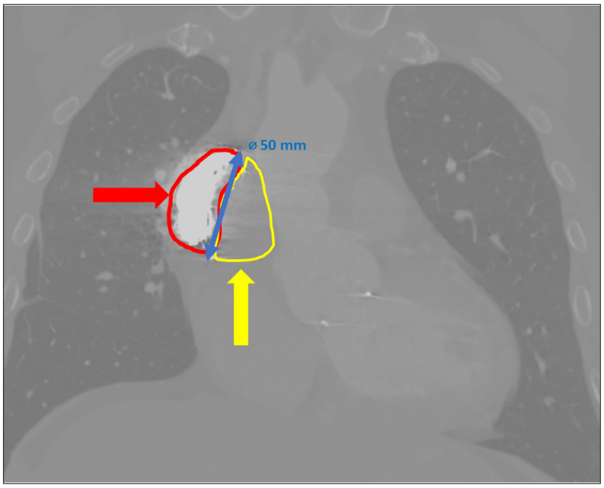

Figure 4. Postoperative computed tomography (CT) scan after 1 year. The red arrow shows the coils migrated and are more packed, filling half of the pseudoaneurysm. The yellow arrow shows the rest of the pseudoaneurysm cavity filled with clots. No inflow to the lumen of the pseudoaneurysm was detected. The diameter of the pseudoaneurysm is diminished from a maximum diameter of 65 mm to 50 mm. Picture obtained from CT scanner, General Electric Health Care Discovery CT750 HD.

rupture at the suture line. From the point of view of his injuries, our patient was not a good candidate for stent-graft deployment. However, his coexisting injuries, a quite recently performed thoracotomy, and the need for anticoagulation therapy during cardiac surgery prompted us to consider an endovascular approach. Owing to this solution, it was possible to stabilize the patient's condition, gain more time for management of other injuries, and prepare for the possibility of final cardiac surgery. We perceive embolization as a modality, not the best and final treatment. The anatomical conditions did not meet the criteria for other endovascular interventions, such as stent-graft deployment. Even the ischemic shock was a result of the pelvic fracture, with the trauma scan showing the pseudoaneurysm of the ascending aorta, propelling us to cope with this potentially deadly condition. Again, the coronary bypass surgery, as a part of an open or hybrid procedure, could have been highly risky in this case owing to the severe calcification of the coronary arteries. These satisfactory results remained stable at 1 year after surgery (**Figure 4**). In our center we routinely monitor such patients with CT. An alternative could be ultrasound, but CT needs to be performed eventually to plan the next steps, as per indications. Intravascular ultrasound seems to be an interesting option. However, in our opinion, manipulations in such fragile regions of the aorta could enhance the risk of pseudoaneurysm rupture.

At our patient's 1-year follow-up, the CT scan showed the aneurysm sac shrinking, with reduced diameters of the pseudoaneurysm of 65×65×50 mm, and no flow in the clotted aneurysm filled with the embolic material. However, our team considers it to be only a bridge surgery and far from the definitive treatment. For the time being, we are only focusing on endovascular interventions, according to the patient's request.

Although coil embolization has become an accepted, first-line treatment for aneurysms in specific locations [5], its use in the thoracic aorta, in particular in its ascending portion, raises doubts. It is primarily owing to the fact that while other locations have been well vetted in the literature, there are no reports solely concerning treatment of post-traumatic ascending aorta pseudoaneurysm with embolic materials. Discourse is still open about the best treatment for this kind of injury, especially in the context of the development of minimally invasive techniques. Our publication is based on a single case. From the surgical point of view, every traumatic aortic rupture should be handled in a proven way. The 1-year follow-up may not be sufficient to draw far-reaching conclusions. We believe that the classical treatment, although more burdensome for the patient, would be his best therapeutic option.

Conclusions

Traumatic aftermaths of thoracic aorta injury are serious and linked to significant mortality. The endovascular approach, including the ascending aorta or aortic arch, continues to evolve, playing an increasing role in the management of patients with trauma and high comorbidity linked to aging. The line of surgical approach requires an experienced team able to provide all treatment modalities and cope with all possible complications. Our case demonstrates a possible scenario in a patient with trauma with a high risk of hemorrhage, where heparinization was impossible. The endovascular solution proved safe for him not only as a bridge procedure, but also as a long-term solution. This method shows that an unconventional approach to a problem can sometimes be fruitful. As shown in our patient, this approach allowed in some way for a specific traumatic thoracic aorta injury to be downgraded from grade III to grade II. The latter can be treated medically under close monitoring. Of course, this classification can be helpful only to some extent because the previous Bentall procedure changed the status of the patient and local conditions.

Department and Institution Where Work Was Done

Department of Vascular and Endovascular Surgery of the Military Institute of Medicine in Warsaw, Warsaw, Poland.

Conflicts of Interest

None.

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]

References:

1. Piffaretti G, Czerny M, Riambau V, et al. Endovascular repair of ascending aortic disease with custom-made endografts. Eur J Cardiothorac Surg. 2021;29:741-49
2. Eforakopoulos F, Akrida I, Zampakis P, et al. First Use of GORE TAG thoracic endograft with active control system in traumatic aortic rupture. Case Rep Surg. 2020;5:9-16
3. Nan J, Rezaei M, Mazhar R, et al. Finite element analysis of the mechanism of traumatic aortic rupture (TAR). Comput Math Methods Med. 2020;29:6396-404
4. Jacob-Brassard J, Al-Omran M, Nathens AB, et al. Management and in-hospital mortality of 2235 patients with a traumatic intimal tear of the thoracic aorta. Ann Surg 2020 [Online ahead of print]
5. Obara H, Kentaro M, Inoue M, Kitagawa Y. Current management strategies for visceral artery aneurysms: An overview. Surg Today. 2020;50:38-49

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]