

Management of ascending aorta perforation during transseptal puncture for left atrial appendage closure: a case report

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Background

An 82-year-old female with a history of atrial fibrillation and repeated episodes of major bleeding on direct oral anticoagulant therapy, with a high risk for thromboembolism and was referred for left atrial appendage closure.

Case summary

During the procedure, an unrecognized puncture of the aorta by the transseptal puncture (TSP) needle and inadvertent advancement of the sheath resulted in ascending aorta perforation. This perforation was closed percutaneously using an Amplatzer™ Duct Occluder (ADO). Reversal of heparinization with protamine sulphate was given to avoid intractable bleeding. However, this resulted in thrombus formation and subsequent embolization causing an ST-elevation myocardial infarction. This was treated with balloon dilatation and thrombus aspiration with subsequent Thrombolysis in Myocardial Infarction 3 flow.

Discussion

Inadvertent ascending aorta perforation is a rare yet serious complication that can occur during TSP. Percutaneous closure using an ADO is a viable management option. The reversal of heparin carries a risk of thrombus formation and should be avoided in cases where there is no evidence of overt bleeding.

Keywords

Transseptal puncture • Ascending aorta perforation • Amplatzer™ Duct Occluder • Case report

Learning points

- To recognize intraprocedural complications of transseptal atrial puncture into the ascending aorta.
- Percutaneous closure can be considered in the management of this complication.

Introduction

Transseptal puncture (TSP) is a regularly used technique to access the left atrium for interventional and electrophysiological procedures.¹ Aortic perforation is a significant and

potentially life-threatening complication that can occur.² We report on an 82-year-old female in whom inadvertent TSP and resulting ascending aorta perforation was treated successfully by percutaneous deployment of an Amplatzer Duct Occluder device.

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Timeline

11:10	Perforation of transseptal needle and sheath into the ascending aorta during transseptal puncture
11:15	No evidence of pericardial effusion on transoesophageal echocardiographic, transseptal sheath <i>in situ</i> allowing temporary sealing of the puncture site
11:20	Protamine sulphate given to prevent major bleeding
11:45	An Amplatzer™ Duct Occluder is inserted percutaneously inserted via the transseptal sheath
12:05	Thromboembolic event causing ST-elevation myocardial infarction
12:20	Balloon dilatation and aspiration thrombectomy of thrombus in middle left anterior descending artery

Case presentation

Our case is of an 82-year-old female with permanent atrial fibrillation treated by rate control and direct oral anticoagulant agents. Past medical history included non-*ischaemic* cardiomyopathy with partially recovered left ventricular ejection fraction on maximal medical therapy and Cardiac Resynchronization Therapy Defibrillator as well as underlying chronic kidney disease. Her prior medical therapy included rivaroxaban at a lowered dose of 15 mg with a proton pump inhibitor (omeprazole).

She has been admitted repeatedly in the previous months due to symptomatic anaemia with an urgent admission to the surgical department due to major gastrointestinal bleed. She was treated with blood products and anticoagulation was stopped. She underwent a full endoscopic evaluation and computed tomographic imaging that did not reveal an obvious source of bleeding.

Due to a concern of a high thromboembolic risk (CHA₂DS₂-VASC = 5), she was referred for left atrial appendage closure (LAAC).

On the day of the procedure, her physical examination was unremarkable. Haemoglobin level was stable at 11 g/dL, coagulation profile was normal, and creatinine level was similar to baseline value at 2.2 mg/dL with no electrolyte abnormalities. The procedure was performed under transoesophageal echocardiographic (TOE) guidance. There was no left atrial appendage thrombus. Transseptal puncture was performed by the Brockenbrough technique using a 71 cm BRK-1™ XS needle and Swartz™ SL1 transseptal guiding introducer (St. Jude Medical, Inc., St Paul, MN, USA). However, during the TSP, no clear tenting of the septum was visualized under TOE guidance.

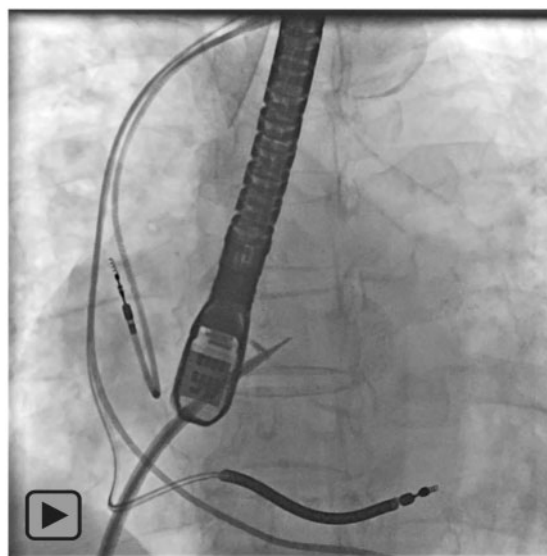
Following the TSP, intraprocedural TOE showed that perforation into the ascending aorta had occurred, with the sheath placed in the ascending aorta. This was confirmed with aortic pressure signals and contrast fluoroscopy (Video 1). The patient was haemodynamically stable and there was no evidence of a pericardial effusion on TOE. A dose of protamine sulphate was administered.

A heart team discussion was held immediately. As the patient was haemodynamically stable with the transseptal sheath *in situ*, which allowed temporary sealing of the puncture, it was decided to seal the atrial-aortic puncture percutaneously.

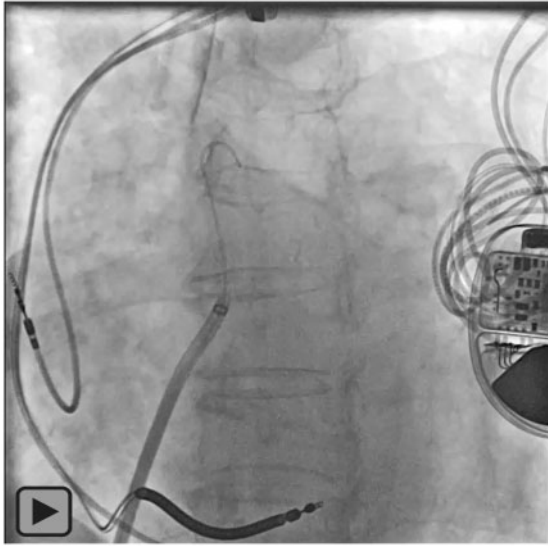
An Amplatzer™ Duct Occluder (ADO) 8/6 mm (St. Jude Medical, Inc.) was percutaneously inserted via the Swartz™ SL1 transseptal sheath and pulled back into position at the aortic puncture site (Figure 1 and Video 2). Fluoroscopy and TOE confirmed that the duct occluder was well placed between the right atrium and ascending aorta, with no residual leak (Video 3 and Figure 2). During the procedure, a thrombus was visualized by TOE at the tip of the 0.35-inch wire positioned via the transseptal sheath in the ascending aorta (Figure 3). Heparin was re-administered immediately. Soon thereafter, ST-elevation was noted in the anterior electrocardiogram leads. Coronary angiography was immediately performed and showed a thrombotic filling defect in the middle left anterior descending artery (Figure 4). This was treated with balloon dilatation and aspiration thrombectomy, with a good angiographic result and Thrombolysis in Myocardial Infarction 3 restoration of flow. Inotropic support was used during the procedure and an intra-aortic balloon pump was inserted. Due to the intraprocedural complications, LAAC was aborted.

The patient stabilized within a few hours, the intra-aortic balloon pump was removed. She was discharged within a few days.

Following the procedure, the patient was treated with 3 months of clopidogrel therapy at a dose of 75 mg daily, together with long-term low-dose Apixaban (2.5 mg twice daily). Five months later the patient was re-admitted due to generalized weakness. Her haemoglobin had remained stable and an echocardiogram showed the ADO *in situ*. She was diagnosed with a metastatic lymphoproliferative malignancy and died shortly thereafter.



Video 1 Ascending aorta perforation during attempted transseptal puncture.



Video 2 Transseptal sheath crossing from the right atrium towards the ascending aorta at the sinotubular junction. LAO 16 Caudal 0.

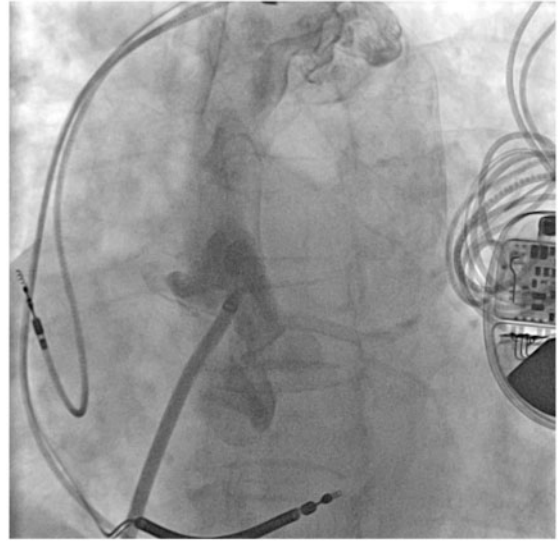
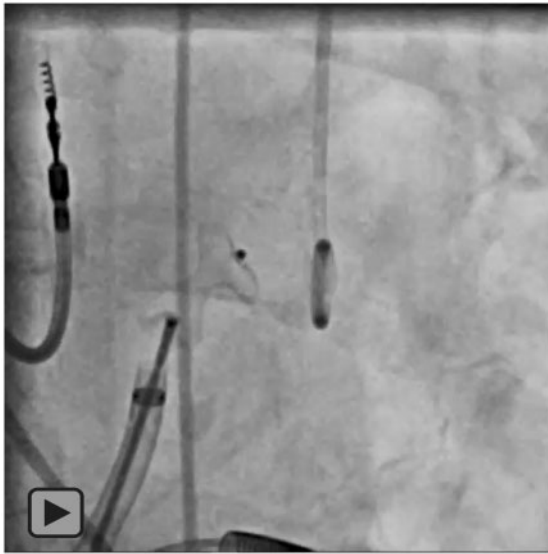


Figure 1 Transseptal sheath crossing from the right atrium towards the ascending aorta at the sinotubular junction. LAO 16 Caudal 0.



Video 3 An Amplatzer™ Duct Occluder was percutaneously inserted between the right atrium and the ascending aorta. LAO 26 Caudal 2.

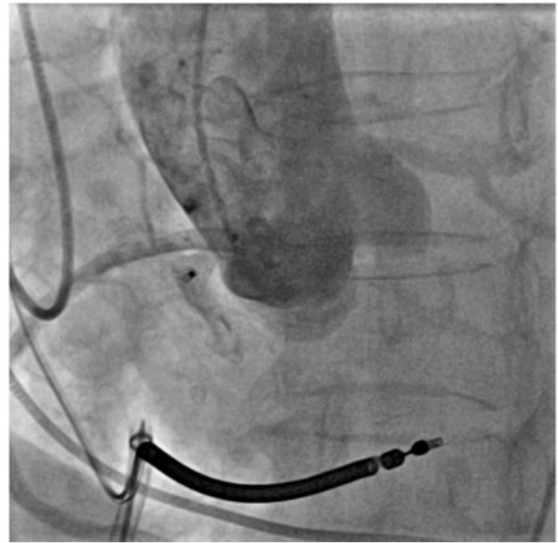


Figure 2 An Amplatzer™ Duct Occluder was percutaneously inserted between the right atrium and the ascending aorta. LAO 26 Caudal 2.

Discussion

Transseptal puncture has enabled many interventional procedures on the left side of the heart to be done percutaneously.¹ There are serious, albeit infrequent, intraprocedural complications that can occur.

Our case documents an unrecognized puncture of the aorta by the TSP needle and inadvertent advancement of

the sheath resulted in ascending aorta perforation, and the management of this complication percutaneously using an ADO.

Combined TOE and fluoroscopic guidance has facilitated TSP, and made it easier and safer than fluoroscopic guidance alone.³ However, sometimes the team is misled to believe that they see the transseptal needle on the atrial septum when in fact, they have punctured elsewhere as distorted anatomy and pacemaker electrodes may obscure

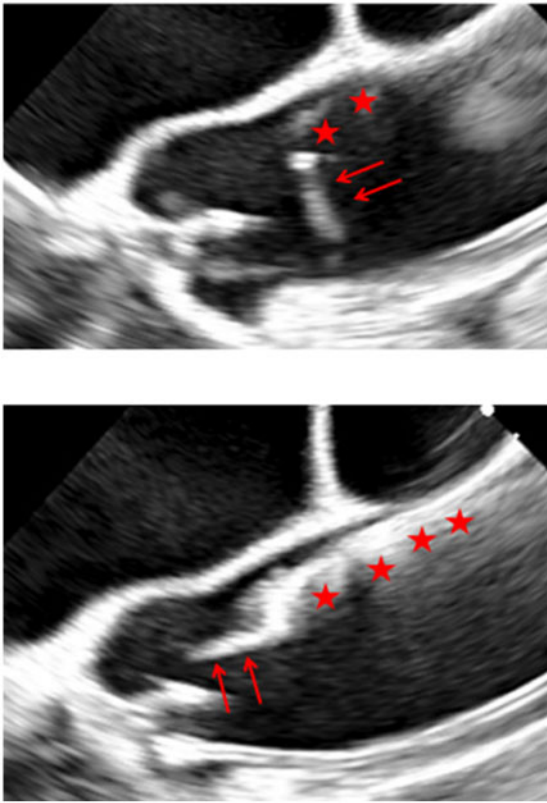


Figure 3 Thrombus visualized by transoesophageal echocardiography at the tip of the wire positioned via the transseptal sheath in the ascending aorta (top image in systole, bottom image in diastole; star = wire, arrow = thrombus).

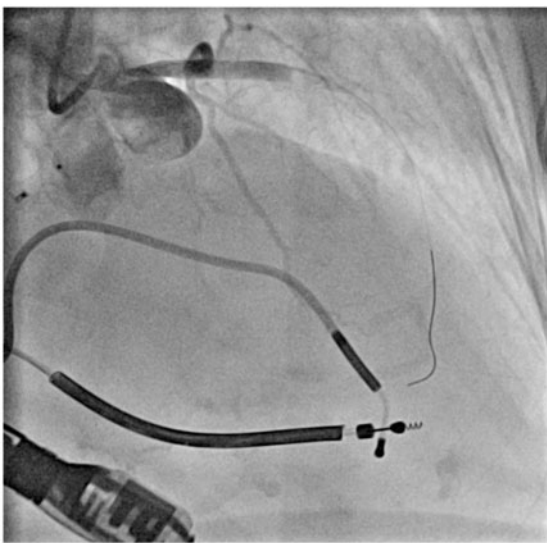


Figure 4 Coronary angiography shows a thrombotic filling defect in the middle left anterior descending artery. RAO 10 Cranial 20.

the exact location of the needle. When crossing the septum with the needle, it is prudent to perform a pressure tracing and to ensure it is in the left atrium, before advancing the sheath. In our case, this precautionary measure could have assisted in detecting the aortic puncture immediately, allowing safe removal of the thin needle, most often without the need for further intervention.

However, if the sheath is advanced into the aorta, as was in our case, it is imperative not to withdraw the sheath. The sheath allows temporary sealing of the puncture until definitive management can be performed. This approach has also been advocated in other studies.²

While this complication has been primarily treated with surgical repair, there have been previous case reports describing the use of an ADO to treat iatrogenic aortic perforations complicating TSP.^{4,5} This self-expandable device, designed for the closure of patent arterial duct, creates a mechanical plug ensuring sealing of the defect. In our case, considering that our patient was haemodynamically stable, and had a high surgical risk, we opted for device closure of the puncture site with an ADO. This procedure effectively sealed the aortic puncture.

Another measure that should be avoided if there is no evidence of active bleeding is reversal of heparinization with protamine sulphate. In our case, this resulted in thrombus formation and subsequent embolization causing an ST-elevation myocardial infarction. While there is a concern about limiting potential haemorrhage, thrombus formation on the transseptal sheath and subsequent systemic embolism is a known concern.⁶ It has been suggested that, if there is no evidence of active bleeding, continued heparinization with low activated clotting time levels can be the optimal strategy to minimize the risk of thromboembolism from the foreign body devices in the aorta.²

Conclusion

Serious complications can occur during TSP. Clinicians performing these procedures should be aware of these complications and their emergent management. Our case suggests that percutaneous closure of an inadvertent TSP of the ascending aorta is a viable management option in centres with interventional expertise.

Lead author biography



Dr Nili Schamroth Pravda is currently a cardiology fellow-in-training at Rabin Medical Center, Petach Tikva, Israel. She completed her medical training at the University of the Witwatersrand, South Africa and worked at Chris Hani Baragwanath Academic Hospital and Knysna Provincial Hospital. She completed her internal medicine residency at

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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 authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

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