Minimal invasive aortic arch repair with suture-mediated closure system

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ABSTRACT

Port implantation can be associated with an array of serious vascular complications, typically involving the subclavian artery. We report a case in which implantation of a port resulted in iatrogenic perforation of the aortic arch at the level of the left subclavian artery, which was sealed off using a percutaneous vascular closure device. (J Vasc Surg Cases Innov Tech 2023;9:101337.)

Keywords: Aorta; Closure device; Complication; Minimally invasive; Port; Techniques and procedures

Central venous port system placement is an essential procedure mainly used for patients with cancer or chronic illness who need prolonged administration of chemotherapeutic agents, nutritional therapy, and repeated use of antibiotics.[1,2] To avoid periprocedural complications, proper insertion and standardized procedures are vital to ensure appropriate placement of the port catheter system. Iatrogenic arterial injury at a noncompressible site can result in severe complications (ie, fatal hemorrhage), requiring treatment treated by traditional surgical techniques or endovascular treatments.[3] The patient provided written informed consent for the report of her case details and imaging studies.

CASE REPORT

A 56-year-old woman presented with nodal-positive invasive ductal right breast cancer and underwent outpatient left-sided port (8.5F) implantation on August 18, 2020, at another clinic. The woman had also developed left breast cancer some years earlier and underwent breast-conserving therapy and sentinel lymph node removal, adjuvant radiotherapy, and chemotherapy with tamoxifen.

After significant backflow occurred at the first use of the placed port the day after surgery, the planned chemotherapy was canceled. The patient was urgently referred to our polyclinic for cardiovascular surgery. Her vital signs were stable on the initial assessment, and the inpatient laboratory test findings were normal. Computed tomography angiography was urgently performed and showed the port catheter passing caudally through the left subclavian vein and between the clavicle and first rib. The catheter entered the distal aortic arch at the level of the outlet of the left subclavian artery (LSA). No pleural effusion, pneumothorax, or pericardial effusion was present. Additionally, the supra-aortic branches were normal with a separated branch of the left vertebral artery from the aortic arch (Fig 1).

THERAPEUTIC OPTIONS

Regarding the iatrogenic injury that occurred with port implantation in the aortic arch in zone 3 according to the Ishimaru classification, the decision was made in favor of an endovascular procedure after extensive interdisciplinary discussion.[4-6] However, the availability of department of cardiovascular surgery was deemed essential to be able to convert to an open surgical approach via sternotomy immediately in the case of failure. Because the entry was in the aortic arch at the level of the LSA, anterior thoracotomy was not considered feasible. Additionally, due to the location of the penetration and the neurologic risk associated with head vessel coverage, thoracic endovascular aortic repair (TEVAR) as a therapeutic option was not advisable.

First, a pigtail catheter was placed in the ascending aorta percutaneously via femoral artery access for contrast and digital subtraction angiography. The port chamber was explanted. Subsequently, the port tube was probed using an Amplatz guidewire with a tip shaped to avoid damaging the aortic valve (Fig 2). After removing the tube, a suture-mediated closure device (Perclose ProGlide) was advanced into the aorta and the suture placed. This procedure was repeated with a second Perclose ProGlide device to achieve a double stitch (Fig 3, *A*). Subsequently, both sutures were

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The data presented in this case report are available from the patient's written medical records archived at University Medical Center Mainz, Johannes Gutenberg University, Mainz, Germany.

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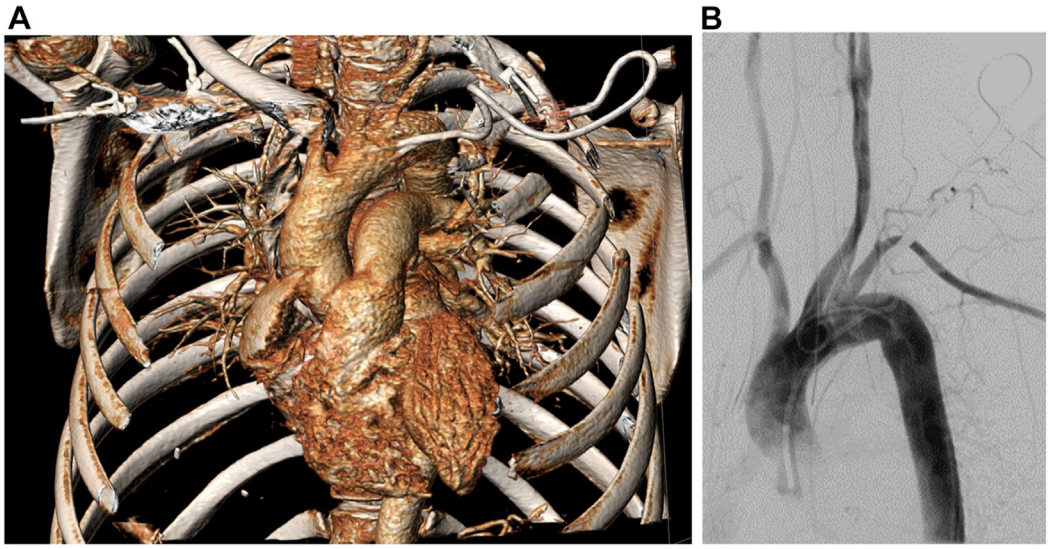

Fig 1. Preoperative volume-rendered three-dimensional computed tomography reconstruction (**A**) and intraoperative digital subtraction angiography (**B**) of aorta. The port catheter entered the distal aortic arch at the level of the outlet of the left subclavian artery (LSA) and left vertebral artery.

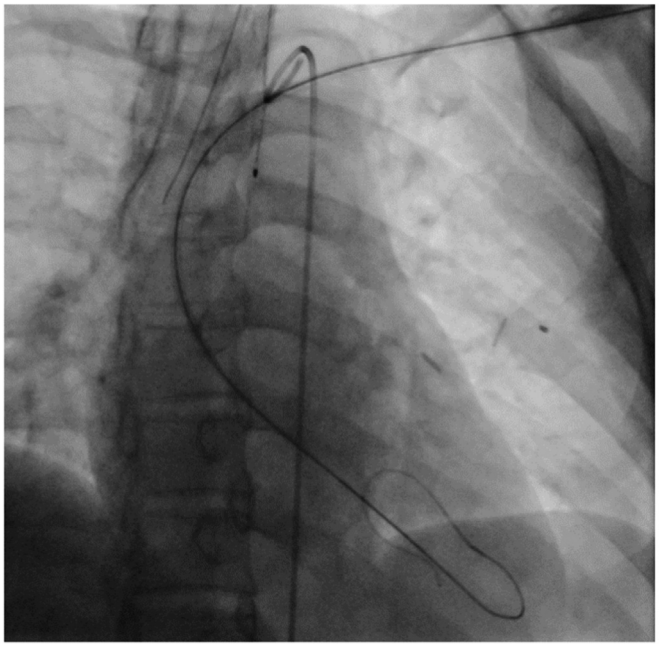

Fig 2. Intraoperative view showing Perclose ProGlide advanced into the aorta, with the tip placed through the aortic valve in the left ventricle.

tightened with the pusher (Fig 3, *B*). Intraoperative digital subtraction angiography showed good results, with sealing of the iatrogenic aortic arch entry. The patient was transferred to intensive care for postoperative monitoring. On the first day after surgery, the patient was transferred to the general ward in stable condition.

Radiologic assessment with computed tomography angiography on the fourth day postoperatively showed a regular appearance of the entire aorta, in particular, the aortic arch after minimally invasive aortic repair (Fig 4). We discharged the patient on the fifth day after surgery in cardiopulmonary condition stable enough for further medical treatment. We placed a new central venous port system via the right cephalic vein under local anesthesia a short time later.

DISCUSSION

Arterial injury is an uncommon complication of central venous catheter and port insertion. The incidence of inadvertent arterial puncture with a small needle during central venous catheterization ranges from 4.2% to 9.3%. Severe iatrogenic arterial injury is an even rarer complication.[7] Traditionally, to avoid arterial puncture, the color and pulsatility of blood coming from the needle hub are carefully observed before placement of the guidewire and catheter. However, according to the American Society of Anesthesiologist's guidelines, color and pulsatility are not reliable for differentiating a vein from an artery. In such cases, ultrasound guidance and blood pressure monitoring are recommended as practical and more reliable alternatives.[7-10]

Iatrogenic aortic injury as a fatal complication can be treated by traditional surgical approaches or endovascular treatment. In one case report, a temporary balloon-tipped pacemaker electrode inserted via the right jugular vein inadvertently punctured in the aortic arch and was closed with a ProGlide suture device.[8] In a case of acute embolic cerebral infarction after implantation of a port catheter in the LSA with its tip overlying the ascending aorta, the catheter was explanted during open surgery.[10]

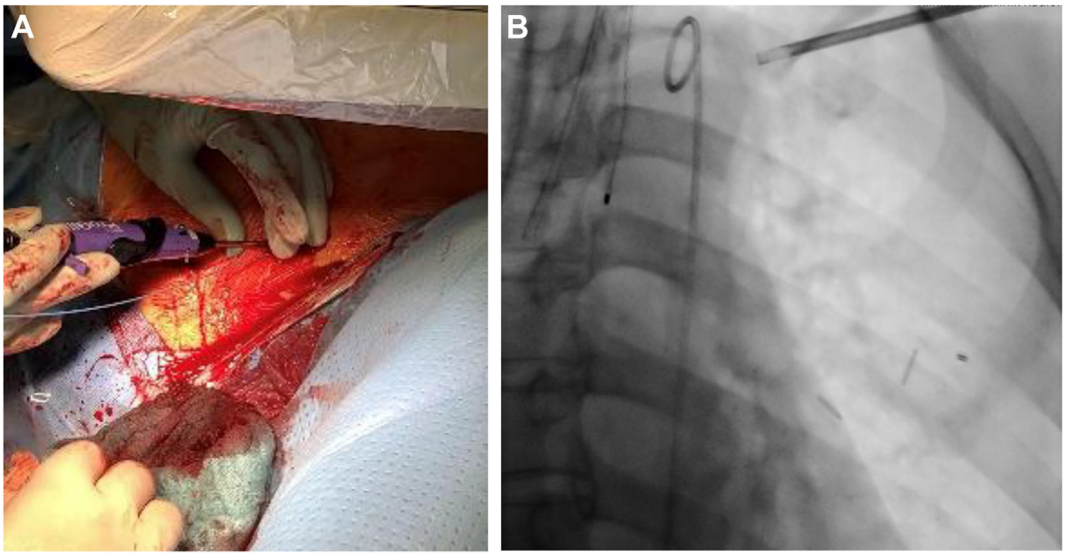

Fig 3. Intraoperative photograph (**A**) and imaging scan (**B**) showing tightening of sutures with the pusher at the level of the aortic arch.

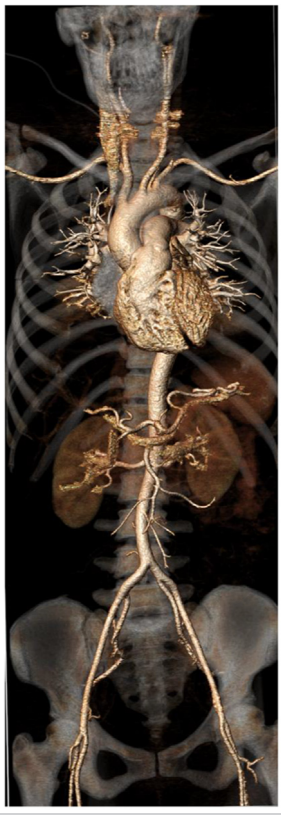

Fig 4. Postoperative volume-rendered three-dimensional computed tomography reconstruction of the aorta showing regular visualization of the entire aorta, in particular, the aortic arch.

Although open cardiac surgery via a sternotomy is a therapeutic option, most of the patients requiring port implantation, such as our patient, have critical comorbidities, including malignancies treated with chemotherapy. However, in recent years, significant progress has occurred in endovascular surgery and the associated devices such as suture-mediated closure systems. Therefore, for patients with suspected iatrogenic arterial penetration after port implantation and central venous catheterization who are transferred to cardiovascular and endovascular surgery centers with highly experienced surgical teams, minimally invasive aortic repair will be feasible using a suture-mediated closure system. Finally, after our successful experience in the treatment of the present case, we highly recommend endovascular repair for iatrogenic aortic penetration.

It is noteworthy that for our patient, an intense interdisciplinary discussion took place among all treating physicians, including interventional radiology, cardiac surgery, and vascular and endovascular surgery, regarding whether to perform open aortic surgery through a sternotomy or a less invasive method. For our patient, due to the unfortunate location of the aortic wall defect and uncertain collateral vessels from the right vertebral artery, TEVAR was not possible without LSA coverage and increasing the neurologic risk. Thus, we decided in favor of a minimally invasive approach with a suture-mediated closure device (Perclose ProGlide) but with cardiovascular surgery on standby for conversion to open surgical treatment in the case of complications.

CONCLUSIONS

Minimally invasive closure of an aortic arch penetration is feasible, even if that includes advancing the closure system into the ascending aorta and the left ventricle.

Interdisciplinary management is key, and the ability to convert to either TEVAR, minimally invasive repair, or open surgical repair is mandatory.

DISCLOSURES

None.

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