Case report

Trans-catheter aortic-valve implantation by the subclavian approach complicated with vessel dissection and transient left-arm paralysis

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Abstract

We report a case of an 84-year-old female with symptomatic severe aortic stenosis, who was treated with trans-catheter aortic-valve implantation (TAVI), through the left subclavian artery. A CoreValve bioprosthesis was successfully implanted, but the procedure was complicated by a focal left subclavian dissection and transient left-arm paralysis, which was successfully managed.

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Keywords: TAVI; CoreValve; Complications; Aortic stenosis

1. Introduction

Trans-catheter aortic-valve implantation (TAVI) is an emerging technique for the treatment of symptomatic severe aortic stenosis. Currently, two bioprostheses, CoreValve (Medtronic Inc., Minneapolis, MN, USA) and SAPIEN (Edwards Inc., Irvine, CA, USA), have obtained a Conformite Europeane (CE) mark for the procedure [1]. However, technical difficulties have limited the widespread usage of the technique.

Undeniably, operators’ experience with TAVI has mainly been obtained with the procedure through the femoral artery [2,3]. However, the femoral approach may not always be an option [4,5]. This especially applies for patients with diseased peripheral arterial tree or excessive iliac tortuosity. Trans-subclavian artery access is currently considered as an alternative for such patients. Nonetheless, along with this approach, new complications may occur.

2. Case report

2.1. Patient presentation

An 84-year-old female (162 cm height; 56 kg weight), with a history of fatigue, shortness of breath on exertion (New York Heart Association (NYHA) III [6]), arterial hypertension and several episodes of syncope, was admitted in our department for further investigation. Transthoracic echocardiogram revealed: a left-ventricular ejection fraction of 60%, an aortic-valve area of 0.80 cm², while peak and mean aortic-valve gradients were 94 and 55 mm Hg, respectively. Neither mitral nor aortic regurgitation were observed; mean pulmonary artery systolic pressure was 63 mm Hg. Logistic European System for Cardiac Operative Risk Evaluation (EuroSCORE) [7] was calculated to be 31.84%.

The consensus of cardiologists and cardiac surgeons was that the aortic valve should be replaced interventionaly. The routine angiographical pre-TAVI screening revealed peripheral arteriopathy and bilateral iliac artery tortuosity, while the left subclavian artery was documented to be of adequate size and free of disease (Fig. 1(A)). All extremity arterial pulses on upper limbs were easily detectable and branchial arterial pressures were equal.

Thus, left subclavian artery access was chosen for introduction of the prosthetic valve. Alternatively, trans-apical access, for implantation of a SAPIEN prosthesis, could have been another option. Yet, this prosthesis is not available in our institution. The patient was informed, in detail, about the alternatives and provided written consent prior to the procedure.

2.2. Procedure

The procedure was conducted under general anesthesia in the catheterization laboratory. Although a true ‘hybrid suite’ is not available in our hospital, the catheterization...
laboratory is fully equipped with anesthesia facilities and strict surgical sterile techniques are applied throughout the operation.

As per routine, a 5-F pigtail catheter was inserted through the femoral artery into the ascending aorta for aortic angiograms and guided throughout the procedure. Surgical cut-down, one fingertip below the middle of the left clavicle, was carried out and 5 cm of the subclavian artery were prepared for a synthetic Dacron graft (8 mm diameter, 15 cm length) to be end-to-side anastomosed to the artery. The graft was used as an arterial conduit for the subclavian introduction of the bioprosthesis.

After balloon valvuloplasty of the aortic valve (22 mm × 40 mm balloon – Nucleus, Numed, Hopkinton, NY, USA), the conduit was used for the introduction of the 18F sheath (St. Jude Medical, Inc., St. Paul, MN, USA) through which the delivery system of the prosthesis was introduced into the mid-ascending aorta. Subsequently, a 26-mm inflow diameter CoreValve aortic bioprosthesis was advanced, without any significant difficulty, while no kinking of the sheath was observed. The prosthesis was successfully implanted and post-implantation peak aortic-valve gradient was 3 mm Hg. Withdrawal of the delivery sheath was conducted under frequent injections of contrast media to detect any subclavian dissections. In addition, absence of any significant intraluminal abnormalities, up to the point of the insertion of the graft, was documented with a subclavian angiogram (Fig. 1(B)).

After removal of the delivery sheath, the conduit was clamped and ligated 1 cm distal to its anastomosis to the subclavian artery. However, the subclavian pulse, distal to the origin of the stump of the conduit, was not detected. Immediate selective left subclavian angiogram documented an obstructing dissection of the subclavian artery 1 cm proximal to the conduit (Fig. 2(A)). The subclavian artery was clamped 4 cm proximal to the conduit and 2 cm distal to it, allowing the conduit to be resected and the anastomosis to be re-evaluated.

Subsequently, the arteriotomy was opened proximally and a posterior-intimal flap at the subclavian artery was seen. Tacking sutures (Prolene 6/0) were used to secure the dissection. Patency of the distal subclavian artery was then secured by good back bleeding and the arteriotomy was closed using a synthetic Dacron patch (6 cm × 5 mm). Subsequently, a subclavian artery angiogram was conducted through a pigtail catheter positioned in the aortic arch. This revealed that the left subclavian artery was patent from its origin to the arm (Fig. 2(B)) while good radial and ulnar pulses were detectable at the wrist.

The patient was transferred to the intensive care unit (ICU) for monitoring. On day 1 after the intervention, the patient complained about weakness of the left arm, while a moderate hematoma was noted around the incision site. Physical examination showed elevation inability of the left shoulder (2/5); efference and afference inability of the left arm (2/5) and flexion and extension inability of the left antebrachium (0/5). Movements controlled by radial, middle and ulnar nerves remained unaffected (4/5).

Laboratory tests revealed elevated levels of creatinine phosphokinase (CPK) (Total: 3418 IU l⁻¹, MB fraction: 67 IU l⁻¹), troponin-I (7.9 ng ml⁻¹) and lactic acid (6.6 mmol l⁻¹). Moreover, metabolic acidosis (pH 7.197) and worsening of renal function (maximum serum creatinine levels of 1.9 mg dl⁻¹) were observed. The patient was managed with maintenance of adequate urine output, good systolic blood pressure and urine alkalinization. In addition, dual anti-platelet therapy was continued. Renal function returned to normal after 6 days without the need for renal dialysis.

The patient’s upper extremity function improved over the next 7 days and she was discharged home on day 8, with minor limitation. Full recovery of arm neurological function and good radial and ulnar pulses were detected after 1 month.

3. Discussion

In this case, we present a successful implantation of a CoreValve self-expandable bioprosthesis through the left subclavian artery, which was performed under general anesthesia (GA) and was complicated by vessel dissection and left-arm paralysis.

In our case, we chose to use GA for the procedure. Although GA has been the conventional approach, opioid-based sedation, along with superficial cervical plexus block in addition to local infiltration, has been reported to give excellent results for infraclavicular subclavian artery access [8]. However, since TAVI is currently an option for the high-risk patients [9], a more controlled environment during the procedure is usually sought. Yet, the final decision is left to
the anesthesiologist, while the patient’s preference is also taken into consideration.

As far as valve implantation is concerned, the prosthesis was inserted, appositioned and deployed successfully. Nevertheless, immediately after removal of the delivery sheath, an obstructive dissection of the subclavian artery was observed at the site of incision. Undeniably, transition difficulties between graft and artery may occur and predispose to vessel dissection when using the conduit technique for vascular access. In our case, every effort was made so that the graft-vessel angle is constructed in a way that would allow the delivery sheath to be inserted in an almost straightforward direction. Vessel dissection, in such a procedure, could have been created during insertion of the prosthesis’ delivery system or from manipulations performed while closing the surgical cut-down.

Despite the fact that complication was resolved, a transient left-arm paralysis was observed as a secondary complication. In this particular setting, we believe that the cause of the paralysis was nerve ischemia until the re-establishment of normal blood flow, augmented by the post-traumatic local tissue edema.

The associated ischemia—reperfusion syndrome, evident by rhabdomyolysis and increased lactic acid levels, could also be responsible for this transient paralysis. Although the potential of direct brachial plexus trauma seems rather unlikely because surgical manipulations had no interference with the track of the nerve, some neuronal apraxia due to direct trauma cannot be excluded. Moreover, total resolution of neurologic symptoms is compatible with either ischemia—reperfusion syndrome or a traumatic cause. In addition, such a focal paralysis would be unreasonable to be attributed to any systemic metabolic disorders.

Fortunately, in our patient, subclavian-artery dissection was successfully managed in the catheterization laboratory. Nonetheless, more severe complications such as vessel perforation or rupture may occur during a TAVI. If such a complication occurs, inflation of a balloon at the site of perforation could stabilize the patient and temporarily seal the leakage. We note that this technique has produced successful results in managing vascular complications of TAVI through the femoral approach [10]. However, for a more permanent result, the use of a stent graft or conversion to conventional surgery solution would be needed.

Undeniably, TAVI, especially with the subclavian approach, requires a multidisciplinary team consisting of interventional cardiologists, surgeons, anesthesiologists and experienced nursing staff to be safely performed [9]. Particularly, in our case, a cardiac surgeon obtained vascular access, two interventional cardiologists performed implantation of the prosthesis, a vascular surgeon tackled vascular complications, while an anesthesiologist monitored the patient’s state through the whole procedure.

References