Anesthesia for transcatheter aortic valve implantation in a patient with restenosed bioprosthetic aortic valve with hypersensitivity pneumonitis

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Transcatheter aortic valve implantation is coming up as an alternative to surgical aortic valve replacement. This is especially helpful in patients with aortic stenosis who who are high risk for open heart surgery owing to advanced age or presence of multiple comorbidities. Local anesthesia and general anesthesia are both valid alternatives; however, depending on the patient type and cardiac function, local anesthesia with conscious sedation (LACS) appears to be a safe alternative with some added advantages. Owing to the frail constituency of typical transcatheter aortic valve implantation recipients, this transition from general anesthesia to LACS is certainly an improvement; however, even mild to moderate sedation added to local anesthesia can have deleterious effects like postoperative cognitive dysfunction, respiratory depression, delirium, and agitation on the surgical table, making the procedure even more difficult. We report one such patient who was of advanced age along with multiple comorbidities like diabetes, hypertension, hypothyroidism, and severe chronic hypersensitivity pneumonitis and was done successfully under LACS.

Keywords:
aortic stenosis, conscious sedation, hypersensitivity pneumonitis, transcatheter aortic valve implantation

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Introduction

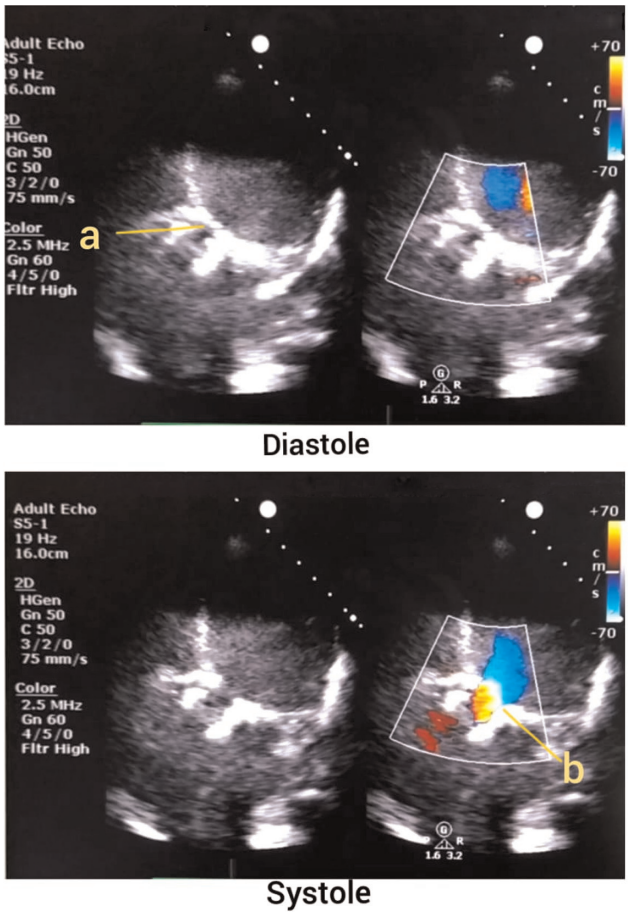
Surgical replacement of aortic valve is currently the standard of care to treat patients with severe symptomatic aortic stenosis. However, transcatheter aortic valve implantation (TAVI) has evolved over the past decade as the new standard of care for patients with symptomatic aortic stenosis who are considered 'inoperable.' In recent years, it is also an alternative to surgical aortic valve replacement (SAVR) in selected patients who are at high risk if operable [1].

Hypersensitivity pneumonitis (HP), also called extrinsic allergic alveolitis, is a respiratory syndrome involving the lung parenchyma and specifically the alveoli, terminal bronchioles, and alveolar interstitium, owing to a delayed allergic reaction [2]. Pulmonary function tests can be normal in acute HP, whereas in chronic forms, they typically demonstrate a restrictive pattern with small lung volumes and decreased diffusion capacity. Corticosteroids may be useful either in relieving acute symptoms, or in subacute and chronic forms of HP [3]. Presence of other comorbidities like severe aortic restenosis after aortic valve replacement along with diabetes, hypertension, and hypothyroidism makes this picture grim for the management of such patients under anesthesia. Thus, TAVI appeared to be a better option compared with redo SAVR for this patient, but plan of anesthesia still remains controversial in such case. General anesthesia (GA) not only allays the anxiety in the patients' and operators' mind but allows the use of intraprocedural transesophageal echo imaging with a secured airway. However, securing airway comes at the cost of hemodynamic manipulation, which is critical in such cardiac patients. Here, we describe the management of one such case where GA is avoided and managed successfully with conscious sedation.

Case history

A 59-year-old, 70-kg female patients having severe aortic restenosis [thickened calcified bioprosthetic

Figure 1



Preoperative transthoracic echocardiographic image showing the stenosed aortic valve with hyper echoic calcified annulus(a) and turbulence across the valve (b) on colour doppler imaging.

valve with mean gradient of 80 mmHg, peak velocity of 6.1 m/s and calculated valve area of 0.33 cm^2 (Figure 1)] after aortic valve replacement done in 2006 was admitted for transfemoral TAVI. Her left ventricular function was preserved (with ejection fraction of 60% and grade I diastolic dysfunction). She is a known case of hypertension (20 years), hypothyroidism (20 years), and diabetes (2 years), all of which are controlled with regular medications like telmisartan 40 mg OD, eltroxin 100 µg OD, and metformin 500 mg BD, respectively. She was diagnosed with chronic HP after a history of repeated admissions owing to dyspnea of noncardiac origin for which she is receiving methylprednisolone during acute exacerbations. Last episode of pneumonitis was 2 months back, after which the steroids were tapered gradually from 30 mg OD to 10 mg OD till date.

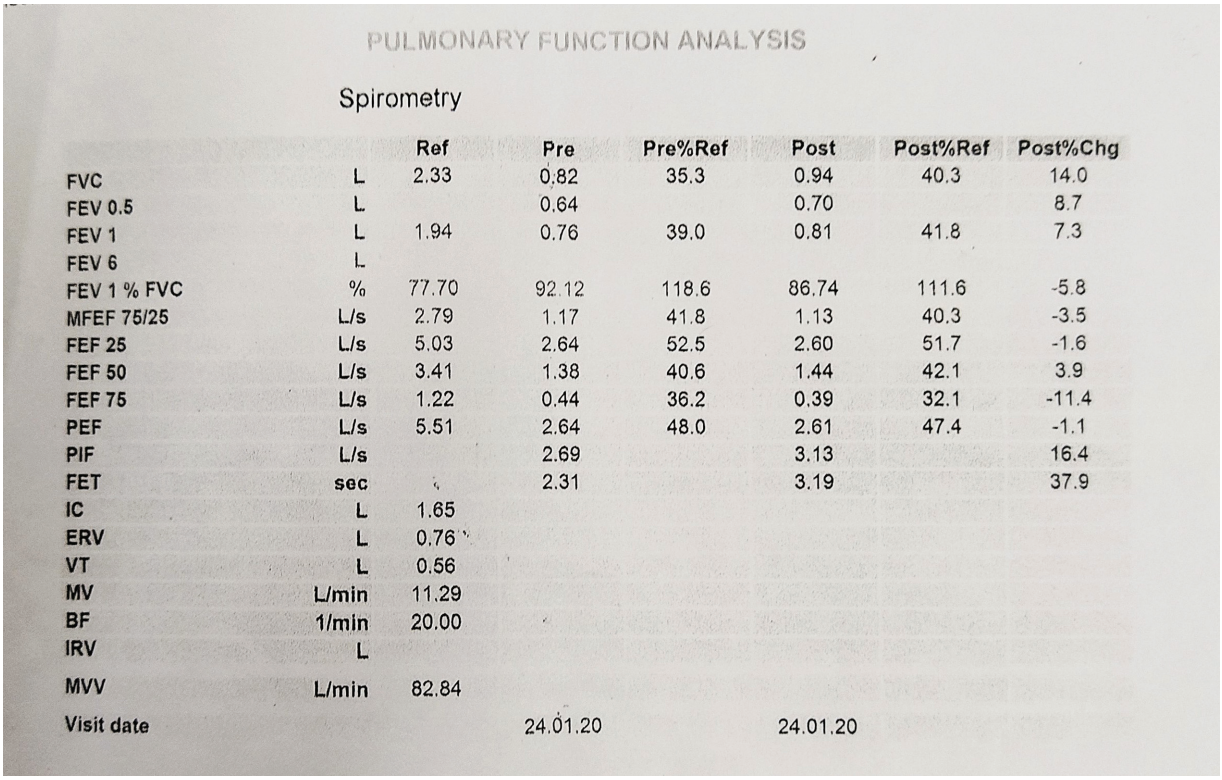
A detailed examination of the patient showed air entry was reduced in basal lung zones on auscultation and reduced breath holding time (<10 s). The routine blood investigations were within normal limits; however, her recent pulmonary function test was suggestive of severe restriction with small airway obstruction, poorly reversible to bronchodilator (Figure 2), and arterial blood gas showed PaO_2 of 75 mmHg on room air with oxygen saturation of 96%. Her high-resolution computed tomography chest had multiple patchy areas of ground-glass opacities with mild interlobular septal thickening in bilateral lung field suggestive of subacute HP Figures 3 and 4.

After explaining the procedure and taking high-risk consent, under standard ASA monitoring and supplemental oxygen via nasal cannula (at 4 l/min), intravenous access was achieved. Anxiolytics were subsequently administered (injection midazolam 0.5 mg and dexmedetomidine loading 0.5 1 µg/kg over 30 min), and 7 Fr right internal jugular vein catheter was secured. The intervention team infiltrated the femoral area with local anesthetic (around 5 ml of 2% lignocaine+5 ml of 0.5% bupivacaine) before femoral cannulations. The left femoral artery cannulation port was also used to demonstrate blood pressure, and cardiac output monitoring was done using flotrac (vigileo) monitoring system. Dexmedetomidine maintenance infusion at 0.2–0.5 µg/kg/h was started during cannulation. The patient had minimal discomfort during femoral cannulation. After femoral vascular access, an intravenous dose of 7000 U of heparin was given, and an ACT of more than 250 s was achieved. Following balloon dilatation of the native aortic valve under rapid ventricular pacing, 21.5-mm Myval prosthesis (Meril Lifesciences Private Limited, Gujarat, India) was successfully implanted (Figure 5). Any hemodynamic disturbance during procedure was successfully managed by phenylephrine and ephedrine. Transthoracic echocardiography confirmed the proper placement of the aortic prosthesis with no paravalvular leaks. Total procedure duration was 2 h, with additional 3000 U of heparin was administered after 1 h to maintain the desired ACT, after which the dexmedetomidine infusion was tapered and stopped, and the patient was transferred to the cardiac intensive care unit for overnight observation. The patient was subsequently discharged 2 days after the procedure.

Discussion

SAVR has been considered gold standard treatment, improving survival and quality of life. In-hospital and 30-day mortality for SAVR is low at 3.2%, with life expectancy after procedure returning to that near a

Figure 2



PULMONARY FUNCTION ANALYSIS

Spirometry

		Ref	Pre	Pre%Ref	Post	Post%Ref	Post%Chg
FVC	L	2.33	0.82	35.3	0.94	40.3	14.0
FEV 0.5	L		0.64		0.70		8.7
FEV 1	L	1.94	0.76	39.0	0.81	41.8	7.3
FEV 6	L						
FEV 1 % FVC	%	77.70	92.12	118.6	86.74	111.6	-5.8
MFEF 75/25	L/s	2.79	1.17	41.8	1.13	40.3	-3.5
FEF 25	L/s	5.03	2.64	52.5	2.60	51.7	-1.6
FEF 50	L/s	3.41	1.38	40.6	1.44	42.1	3.9
FEF 75	L/s	1.22	0.44	36.2	0.39	32.1	-11.4
PEF	L/s	5.51	2.64	48.0	2.61	47.4	-1.1
PIF	L/s		2.69		3.13		16.4
FET	sec		2.31		3.19		37.9
IC	L	1.65					
ERV	L	0.76					
VT	L	0.56					
MV	L/min	11.29					
BF	1/min	20.00					
IRV	L						
MVV	L/min	82.84					
Visit date			24.01.20		24.01.20		

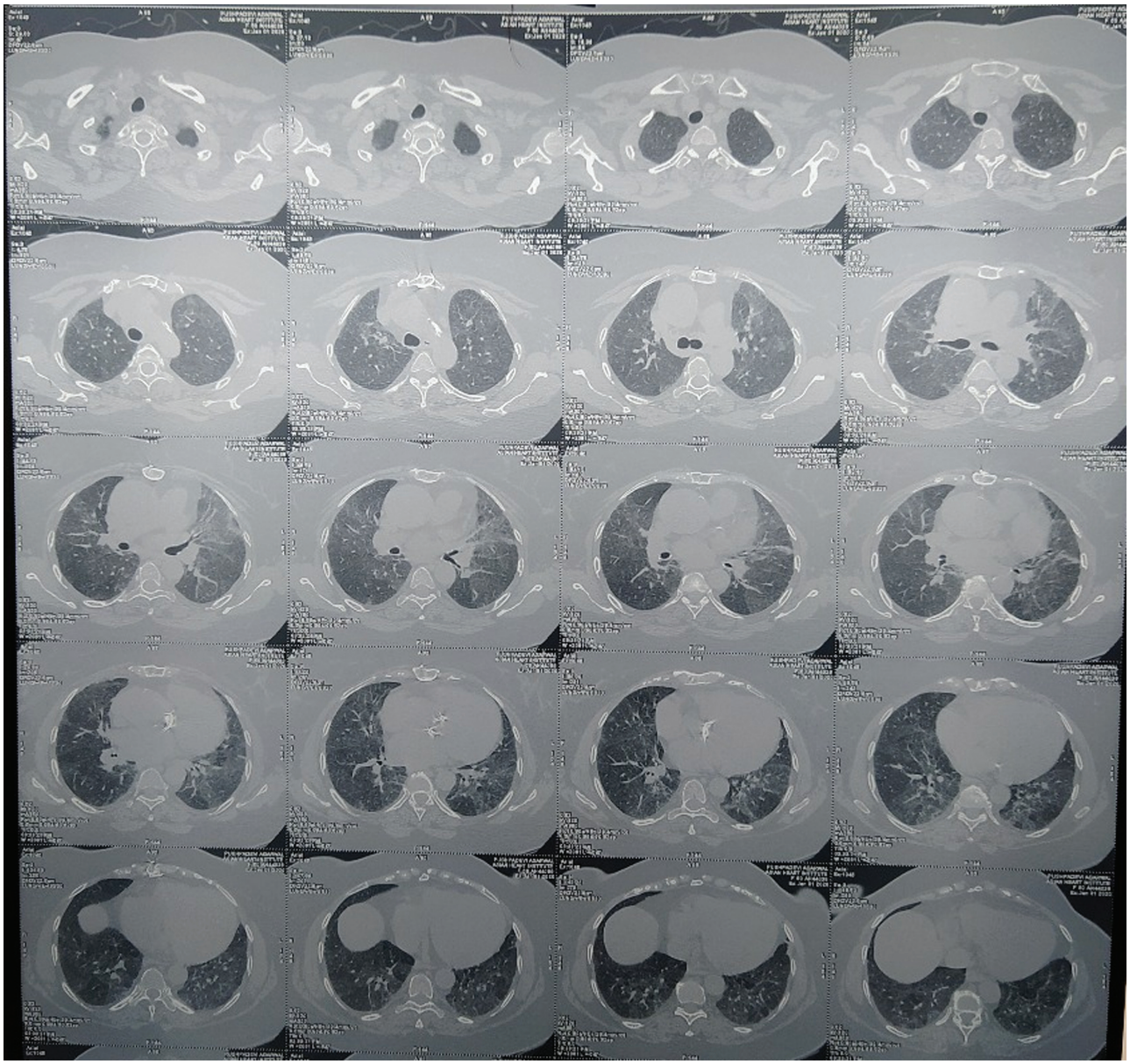
Pulmonary function test depicting severe restriction with airway obstruction with poor reversibility.

control population [4,5]. SAVR, although the mainstay in the treatment of severe aortic stenosis, is still unsuitable for a major part of population having significant comorbidities and advanced medical conditions. This group comprises ~30% of patients with severe aortic stenosis, and the number is likely to increase in the future owing to improving therapeutic options and advanced age of presentation [6].

TAVI is a catheter-based treatment alternative in unsuitable/high-risk SAVR patients who do not respond to medical therapy. During the time of advent of this procedure, GA was the mainstay as it used to provide excellent immobility and better airway control and to allay the anxiety for both patient and operator. This moreover allowed the use of intraprocedural transechocardiographic evaluation (TEE) as well. It is important to note that TEE is very vital in assessment of valve positioning and helps in early detection of complications as well. With advancement of technique of TAVI, and evolution of valve types over the last two decades, femoral approach of TAVI is becoming a common practice owing to its less invasive nature. TEE in such cases can be avoided and substituted by transthoracic echo. Similarly, the anesthetic requirement has also reduced. With the aim to provide less-invasive anesthesia/analgesia without compromising on the safety and comfort of the patient, local anesthesia with conscious sedation (LACS) has come up as newer approach for intraoperative patient management. Thus, we see that the technique of TAVI is improved a lot in the past two decades; however, the anesthetic management still remains controversial in terms of whether to use GA or LACS and if LACS is used, then what kind of LACS technique to be deployed [7].

GA has its own advantages as it provides a secured airway with control over ventilation throughout the procedure with minimal risk of aspiration or apnea. It also provides complete immobility which is very essential especially during the deployment of valve. Moreover, transesophageal echocardiography can be easily done under GA which is an important tool for monitoring of cardiac functions along with assessment of proper positioning and functioning of the deployed valve. However, GA is not free of risks in frail elderly population with comorbidities, and it increases procedure time, ICU/hospital stay, and cost as well when compared with LACS [6]. However, there may be a conversion of LACS to GA owing to reasons like cardiac arrest, myocardial infarction, cardiac tamponade, stroke, and shock after balloon valvuloplasty. This failure rate is of ~4–11%, but it is mainly procedure related and unrelated to the

Figure 3

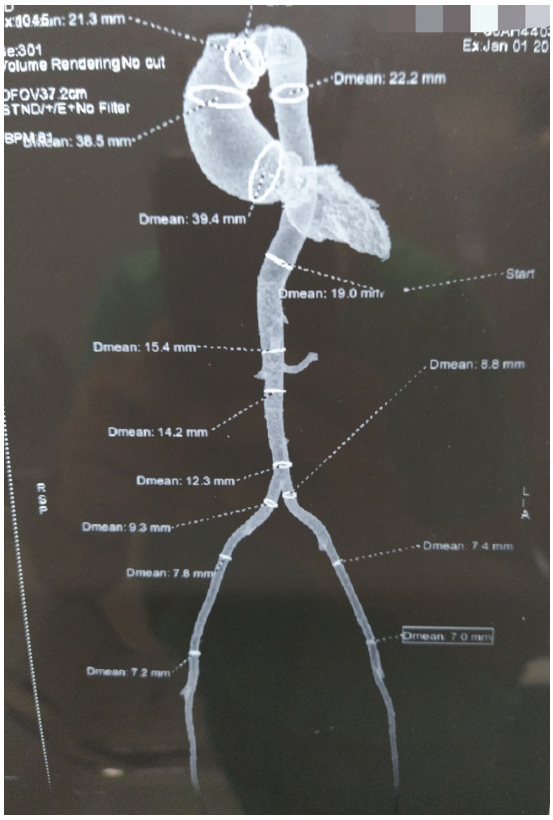


HRCT Chest showing multiple patchy areas of ground glass opacities with ill defined centrilobular nodules and mild interlobular septal thickenings are seen in the bilateral lung parenchyma suggestive of acute/subacute hypersensitivity pneumonitis.

anesthetic approach [8]. Whether GA is necessary for this procedure still remains controversial [9].

Our patients had chronic HP with multiple comorbidities like diabetes, hypertension, and hypothyroidism and was deemed relatively unsuitable for GA. Many varieties of drugs are used for the purpose of conscious sedation like midazolam, fentanyl, ketamine, propofol, and dexmedetomidine. Propofol is one of the most common day care anesthetic agents with smooth emergence; however, its association with hemodynamic disturbance could prove counterproductive in a case of severe aortic stenosis. Ketamine is an effective alternative for such case, and its bronchodilator property could additionally improve respiratory mechanics, but it is also associated with increased sympathetic stimulation and emergence delirium. Midazolam and fentanyl are good sedatives in terms of hemodynamic stability; however, they are notorious for their respiratory depressant effect, which may hamper the gas exchange during the intraoperative procedure. Dexmedetomidine is an α2 adrenoreceptor agonist with a unique mechanism of action, providing sedation and anxiolysis via receptors within the locus ceruleus, analgesia via receptors in the spinal cord, and attenuation of the stress response with no significant respiratory depression [10,11]. A recent study compared

Figure 4



CT aortogram showing narrowing of aorta (yellow arrow) at the level of annulus followed by post-stenotic dialatation.

dexmedetomidine with midazolam/ketamine for patients posted for TAVI and found that dexmedetomidine provides deep level of sedation with RASS and Ramsay scales without depression of respiratory function. Moreover, there was a good tolerability of operation and good conditions for long-term use of TEE as well, and no significant difference in terms of complications was noted [12].

Thus, taking into consideration the aforementioned fact, we decided to proceed with the case using dexmedetomidine as our primary anesthetic, and the procedure was successfully carried out without any major complication.

Conclusion

We describe here a successful case of TAVI in a patient presenting with multiplecomorbidities, including HP, diabetes, hypothyroidism, and hypertension, with a severely stenosed bioprosthetic aortic valve. To the best of our knowledge, this is the first reported case of TAVI with a new Myval prosthesis (Meril Lifesciences Private Limited), and there are limited reports in the literature of TAVI associated with such multiple comorbidities.

Financial support and sponsorship
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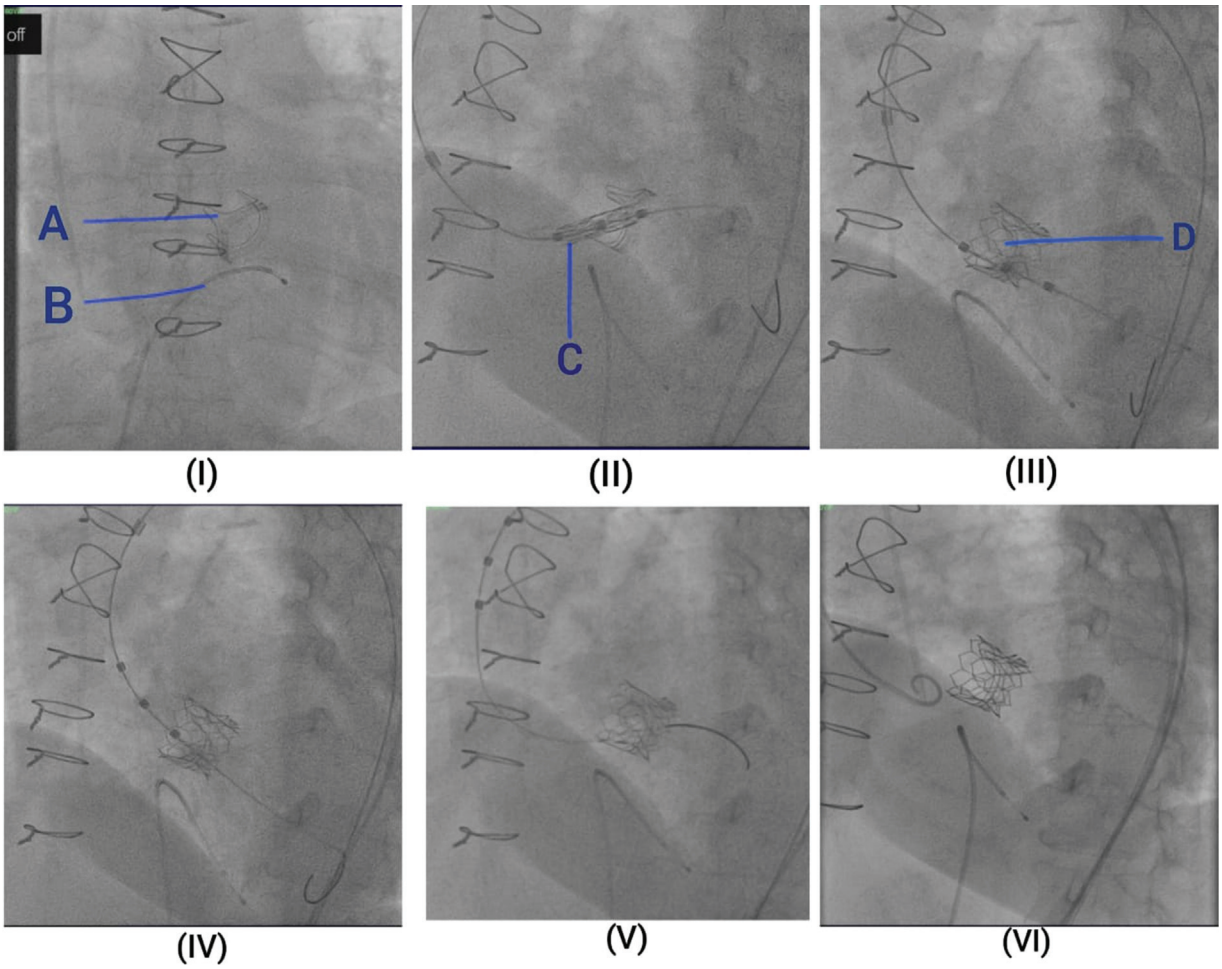
Conflicts of interest
There are no conflicts of interest.

Figure 5



Sequential fluoroscopic images showing various steps of transcatheter aortic valve implantation through femoral route. Note the native bioprostethic valve struts (A) in image (I) and the pacing lead (B) for rapid ventricular pacing during device deployment. Image (II) shows the initial wire placement using delivery systemand positioning of the valve (C) within the previous bioprosthetic valve. Image (III) shows the valve placement after balloon inflation marked as D. Image (IV, V, VI) shows subsequent deflation followed by removal of the delivery system.

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