

Prikaz slučaja**ANESTEZIJA ZA TRANSKATETERSKU
IMPLANTACIJU AORTNE VALVULE:
PRIKAZ SLUČAJA (anestezija za tavi)**

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Case report**ANESTHESIA FOR TRANSCATHETER
AORTIC VALVE IMPLANTATION:
A CASE REPORT (anesthesia for tavi)**

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Sažetak

Uvod: Transkateterska implantacija aortne valvule (TAVI) je manje invazivna tehnika koja je postala alternativni terapijski pristup kod bolesnika sa visokim perioperativnim rizikom. Glavni cilj anestezije tokom TAVI je postizanje i održavanje hemodinamske stabilnosti. Mogu se koristiti lokalna ili opšta anestezija zavisno od zdravstvenog statusa bolesnika i karakteristika same procedure. **Prikaz slučaja:** Prikazujemo slučaj bolesnice stare 80 godina koja je primljena u našu bolnicu zbog pogoršanja dispneje uzrokovane teškom stenozom aortnog ušća. Urađen je TAVI pod lokalnom anestezijom i laganom sedacijom, koja je protekla bez komplikacija. **Zaključak:** Za uspešno izvođenje TAVI neophodan je multidisciplinarni timski rad u kome kardio-anestezijolog predstavlja značajnu kariku.

Ključne reči: Transkateterska implantacija aortne valvule, stenozna aortnog ušća, anestezija

Introduction

Aortic stenosis (AS) is the most commonly acquired valvular heart disease. Surgical aortic valve replacement (AVR) is indicated after the development of symptoms (angina, syncope, or cardiac failure) or worsening left ventricular function. Surgical AVR is a very successful procedure with a low mortality and morbidity. However, operative mortality is increased in patients with severe left ventricular dysfunction, advanced comorbidity (notably renal and respiratory disease), and previous sternotomy (especially if patent coronary grafts are present).¹ On the other hand, mortality for untreated symptomatic severe AS in high-risk patients reaches 50-60% at 2 years.² The transcatheter

Abstract

Introduction: Aortic Valve Implantation (TAVI) is less invasive and becomes an alternative therapy reserved for patients with high operative risk. Hemodynamic stability is the main objective of anesthetic management during TAVI. Local anesthesia or general anesthesia are both valid alternatives and can be applied according to the patient's characteristics and procedural instances. **Case Report:** We report a 80-year-old woman who was admitted to our hospital for worsening dyspnea caused by severe aortic stenosis. TAVI was performed under local anesthesia and light sedation without complications. **Conclusion:** Successful TAVI requires a multidisciplinary team of which cardiac anesthesiologists are a crucial part.

Keywords: Transcatheter Aortic Valve Implantation, Aortic Stenosis, Anesthesia

ter aortic valve implantation (TAVI), a minimally invasive transcatheter technique, is a therapeutic option for inoperable and high risk patients with severe symptomatic calcific aortic stenosis.

European and American guidelines indicate that a decision for performing TAVI should be made by the multidisciplinary Heart Team as well as TAVI should only be performed in hospitals with cardiac surgery on-site.^{3,4} According to the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS), TAVI should be restricted only to patients with severe symptomatic AS who are not suitable for surgical aortic valve replacement, have a >1-year life expectancy and are likely to gain improvement in quality of life and, also, should be considered in

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high-risk patients with symptomatic AS who may still be suitable for surgery but in whom TAVI is favored by the Heart Team.^{3,4} It is important to note, that TAVI is not recommended in patients with comorbidities precluding a significant benefit from the intervention.

Here, we present the case with severe symptomatic AS who underwent successful TAVI with CoreValve 29 mm because of high-risk of performing surgery.

Case Report

A 80-year-old woman was admitted to our hospital for worsening dyspnea caused by severe AS. Her medical history included aortic valvular disease and pulmonary sarcoidosis with chronic respiratory insufficiency. The electrocardiography (ECG) findings included normal sinus rhythm, heart rate of 68 bpm. Echocardiogram revealed severe aortic stenosis with an aortic valve area of 0.8 cm², a mean aortic pressure gradient of 67 mm Hg and peak pressure gradient of 106 mmHg. The aortic valve was thickened and slightly calcified. She had a depressed left ventricular ejection fraction of 25%. Systolic pulmonary artery pressure was 45 mm Hg. Coronary angiography showed normal epicardial coronary arteries. She was in New York Heart Association functional class III dyspnea. She was declined for surgery on the basis of poor pulmonary function and poor left ventricular function. The patient and her family were offered TAVI and informed consent was obtained. Her significant co-morbidities included: hypertension, hyperlipidemia, anemia and chronic respiratory insufficiency.

Pre-assessment was performed individually by cardiologists, cardiothoracic surgeons and the cardiac anesthetists. Patient was given her antihypertension drugs (angiotensin-converting enzyme inhibitors and calcium antagonist amlodipine) as well as aspirin and clopidogrel.

Standard antibiotic prophylaxis for valve surgery was used in this case. Large bore IV cannula, invasive lines: intra-arterial (IA) line and central venous catheter (CVC) were inserted under standard monitoring and light sedation (IV midazolam 2 mg). Monitoring was applied as following: 5 leads ECG, pulse oximetry, and external defibrillator

pads, invasive arterial blood pressure, central venous pressure, and urine output. Urinary catheter and nasopharyngeal temperature probe were inserted. Arteriotomy was performed to obtain an appropriate femoral access under local anesthesia. Remifentanyl infusion (0.05 to 0.1 µg/kg/min) was used during procedure, after the institution of local anesthesia with lidocaine. Coordination between anaesthesiologists and cardiothoracic surgeons was retained at crucial steps. It was given heparin (100 ij/kg) in aim to maintain of anticoagulation (ACT >250 s) throughout the procedure. Balloon aortic valvuloplasty (BAV) was done under rapid ventricular pacing (RVP) at 180 bpm, followed by deployment of aortic valve prosthesis during second RVP. Prior to rapid ventricular pacing, i.v. bolus of vasopressor phenylephrine was given to support mean arterial pressure (MAP) around 70 mmHg (Figure 1). Figure 2 shows the TAVI valve and the fluoroscopic image after deployment. Follow-up echocardiography showed a well functioning prosthesis, with a peak pressure gradient of 19 mm Hg, respectively. Interventions were performed without complications. The patient was transferred to the cardiac surgery intensive care unit for further monitoring. She was discharged on the 11th postprocedure day. The patient was clinically stable at 30 days follow up after the procedure.



Fig. 1. Rapid ventricular pacing at 180 bpm.

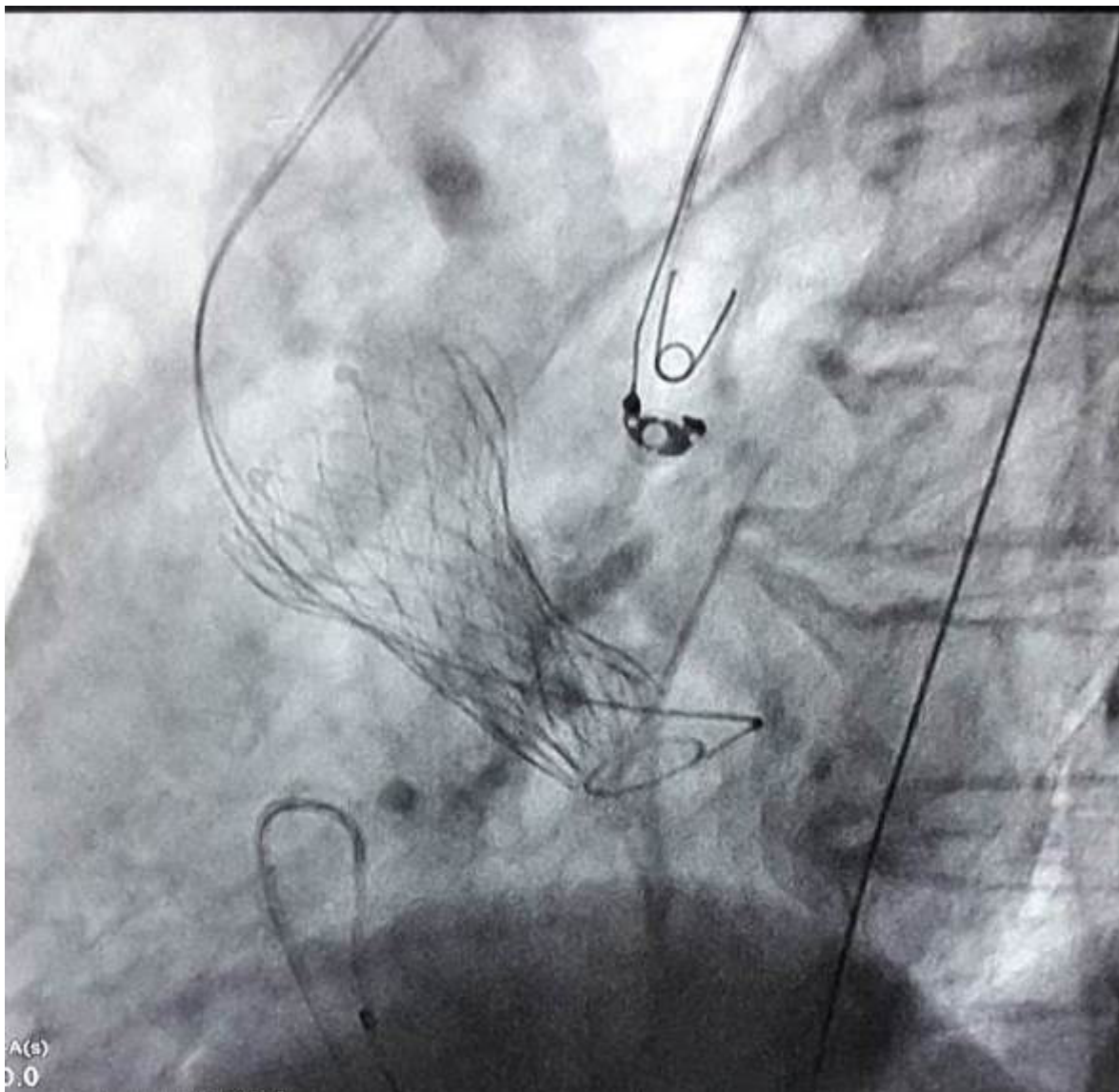


Fig. 2. The fluoroscopic image after deployment of the prosthetic valve

Discussion

The transcatheter approach to the aortic valve can be performed: antegradely (transapical approach TA-TAVI) and retrogradely such as transfemoral approach (TF-TAVI), and the other transarterial approaches (through the subclavian, axillary (Tax-TAVI) and iliac arteries, transbrachial or even radial arteries).⁵ In our patient, it was used transfemoral TAVI, that represents the standard approach, performing in approximately 80% of all TAVI procedures, due to its least invasive character.

Preoperative risk assessment is important as the current indication is restricted to high surgical risk or nonoperable patients, because of significant comorbidities or contraindications.

Concerning the preoperative evaluation of TAVI patients, particular attention should be paid to a variety of factors known to be predictive for a high risk of intraprocedural instability, such as impaired ventricular function, pulmonary hypertension, significant mitral or tricuspid regurgitation, significant coronary artery disease, chronic obstructive pulmonary disease (COPD), and kidney disease.⁵ All patients are evaluated in a detailed fashion and undergo several examinations, including (but not limited to) an echocardiogram, coronary angiogram and computed tomography scan.

The common practice is to administer a loading dose of aspirin ranging from 300 mg to 325 mg and clopidogrel 300 mg before the procedure and in the postoperative period. This approach was used in

our patient. The antihypertension drugs, including angiotensin-converting enzyme inhibitors, should be administered until the day of the procedure. On the contrary, the antiarrhythmic drugs should be discontinued.⁶

Baseline haematological and biochemical testing should be performed and 2 U of blood should be cross-matched.

TAVI has to be performed under strict sterile conditions, in the cardiac catheterization laboratory or in a hybrid operating room. In our case, TAVI was performed in a cath lab and there was cardiac surgical backup in the hospital. Standard antibiotic prophylaxis for valve surgery should be administered according to local protocol.

Monitoring during TAVI procedure should include five-lead ECG, pulse oximetry, invasive arterial blood pressure, central venous pressure, and urine output as a standard monitors. Pulmonary artery catheterization (PAC) is not routinely performed and is reserved for specific situations, such as left ventricular dysfunction and/or pulmonary hypertension.⁷ Transesophageal echocardiography (TEE) monitoring provides useful information during TAVI in conjunction with fluoroscopy and contrast angiography and delivers more information useful to run hemodynamic management.⁸ However, procedural TEE is not standard monitoring and is used on a discretionary basis only. One disadvantage of TEE is the need for general anesthesia to facilitate probe placement in a patient population who may not tolerate general anesthesia well. A potential advantage of TEE during TAVI is to limit the use of intravenous contrast dye with its potential for exacerbating postoperative renal impairment.⁷ We did not use TEE during procedure.

Hemodynamic stability is the main objective of anesthetic management during TAVI. In these patients, it is needed to provide following: Preload augmentation of the hypertrophied left ventricle, avoidance of tachycardia to allow for a sufficient length of diastolic filling and coronary perfusion, maintenance of a sinus rhythm to preserve the atrial contribution to ventricular filling and systemic blood pressure must be maintained at a level to ensure coronary perfusion.⁵ Supraventricular arrhythmias and ventricular ectopy should be managed aggressively. Hypotension should be treated early with α -adrenergic agonists. As a

significant proportion of the left ventricular afterload is produced by the stenotic aortic valve, vasopressor agents such as phenylephrine or norepinephrine may be used without concern for adversely affecting ventricular performance, even in patients with poor left ventricular function.⁷

The most important anesthetic consideration in TAVI is the type of anesthesia that will be given to the patient. Both general anesthesia and local anesthesia, with or without sedation, have been reported for TF/Tax-TAVI. Trends vary within hospitals and countries, and numerous factors need to be considered before making a decision, including patient-related and operational factors as well as logistics. In the early years of TAVI, GA was the default option. The choice of anesthetic agent matters less than the manner in which it is administered, which should be slowly and titrated to effect.⁷ Short-acting agents allowing for rapid emergence and extubation at the end of the procedure are preferred. In our patient, we used local anesthesia and light sedation with continuous infusion of remifentanyl. A possible protocol for the local anesthesia plus sedation consists of lidocaine injected subcutaneously at the arterial and venous access sites (maximum dose 4 mg/kg), with sedation accomplished with remifentanyl infusion adjusted according to the patient's response (starting dose 0.025 μ g/kg/min, maximum dose 0.2 μ g/kg/min). Combined use of remifentanyl and propofol may be used. The use only sedation during procedure avoids hemodynamic instability frequently associated with induction of general anesthesia, enables the prompt detection of adverse neurologic events in awake patients, and associated with shorter procedural and recovery time times. If local anesthesia plus sedation is employed, the anesthesiologist must be ready to institute full general anesthesia at any moment. On the other hand, general anesthesia ensures patient immobility and control of respiration and provides the use of periprocedural TEE. Also, it provides cardioprotective properties and adequate attenuation of stress response. General anesthesia facilitates positioning of the valve prosthesis by maintaining patient immobility. Evidence guiding the decision of whether to perform TAVI under GA or conscious sedation is limited to nonrandomized trials and registry data. Furthermore, the heterogeneous nature of these

studies is an additional impediment to drawing any firm conclusions.⁹ The type of the anesthetic management has increasingly switched from GA to LA, especially in European centers.

The TAVI procedure could be categorised under four phases: pre-deployment, balloon aortic valvuloplasty, prosthetic aortic valve deployment and post-deployment.¹⁰ During the pre-deployment phase, it is needed to establish arterial access and introduce the right ventricular pacing.¹⁰ The aim of valvuloplasty is to adequately dilate the annulus so as to allow easy insertion of prosthesis. In our case, balloon aortic valvuloplasty was facilitated by using of RVP at a rate of 180-200 bpm to provide cardiac standstill. RVP is a key feature of the procedure and needs full attention and communication by the anesthesiologist and the entire team. We maintained MAP at more than 75 mmHg before the start of RVP due to a pre-emptive application of vasopressor prior to, or immediately after RVP facilitates rapid return of coronary perfusion. Although RVP is advantageous for valve positioning, the combination of rapid heart rate, myocardial hypertrophy, concomitant CAD, and low coronary perfusion pressure produces an ischemic deficit in the myocardium. In our case, the ischemic deficit is well tolerated, most likely because of the brief duration of the RVP (10-12 s on average). However, it is prudent to minimize the number and duration of RVP episodes and allow for hemodynamic recovery before further pacing. The deployment of prosthesis also places demands on RVP. In the case of ischemia-induced ventricular fibrillation during valve deployment, defibrillation should be avoided until after the valve is positioned to avoid malpositioning or embolization of the prosthesis when sinus rhythm is restored. Should chest compressions be required, postresuscitation evaluation of the stent position and expansion is required. In our patient, it was not needed to perform defibrillation, patient was hemodynamically and rhythmic stable after RVP. During post deployment, the device position and function is verified and patients transfer to the cardiothoracic ICU for further monitoring.¹⁰

The differential diagnosis of hemodynamic instability during TAVI includes coronary obstruction from embolism, the prosthetic valve, or a displaced native valve leaflet; aortic annular and/or root rupture; cardiac tamponade; mitral

valve injury; paraprosthetic aortic regurgitation; prosthesis embolization; structural valve failure; and major arterial bleeding or apical rupture.

Performing TAVI procedures without an anesthesiologist in order to save time or money is not standard compliant and this fact should be taken into account when waiving the anesthesiologist for financial reasons.⁹

Our procedure was performed without any complications, although TAVI may result in complications that may have a serious impact on the procedural success and on the patients' quality of life.

Common complications of transcatheter aortic valve insertion include poor recovery of cardiac function after rapid ventricular pacing, hemodynamic instability that may require inotropic support and embolization of aortic material or air, leading to neurological dysfunction or overt stroke. Paravalvular leakage (PVL) due to the malpositioning, undersizing, and underexpansion of the prosthesis, as well as severe calcifications impairing circumferential apposition of the valve frame.¹¹

Acute kidney injury (AKI) is frequently observed after TAVI because of multifactorial etiology, including: contrast-agent-induced nephrotoxicity, renal ischemia owing to calcific/atheromatous embolism of renal arteries, and renal hypoperfusion during hypotensive episodes (rapid ventricular pacing).⁵ The strongest predictors for AKI are, however, periprocedural complications including life-threatening bleeding, need for blood transfusion, major vascular complications, and perioperative inflammation.⁵

A continuous postoperative electrocardiogram monitoring should be performed for at least 3 days in all patients after TAVI procedures because of a risk of an intra- or periprocedural AV block. Because arrhythmias, especially AV block, may occur after the procedure, several centers maintain transvenous pacing in the intensive care unit.⁶

Vascular complications include a vascular damage during the decannulation process with significant hemorrhage.

During TAVI, the coronary ischemia or fatal myocardial infarction may occur because of obstruction of the coronary orifice by the native valve leaflets folded upwards or due to direct occlusion by parts of the valved stent.

Cardiac tamponade causing cardiovascular collapse may result from perforation of the right ventricle during the pacing wire placement and aortic or left ventricular perforation by guidewires or catheters.

After procedure, our patient was transferred to the cardiac surgery intensive care unit for further monitoring for 24 h. Initial postprocedural care in a critical care unit (either surgical or coronary unit) is required. Close attention should be paid to hemodynamics, vascular access, rhythm disturbances (especially late atrioventricular block), and renal function. After general anesthesia, it is suggested to extubate patients in the intervention room and transfer to the postanesthesia or ICU. Postoperative pain has been easily managed with nonsteroidal agents/paracetamol and low dose of opioids. Temporary pacemaker is usually left to prevent cardiac arrest in all patients with AV block. In our patient, it was not registered rhythm disturbance, and postprocedure pain was controlled with paracetamol.

In our case, according to recommendation, the dual antiplatelet therapy was continued at a daily dose of 75-100 mg of aspirin and clopidogrel 75 mg for 6 months consecutively.

Patients who re-present after TAVI for non-cardiac surgery can be managed similarly to patients after conventional (pericardial) AVR. There is no evidence that discontinuing antiplatelet drugs increases the risk of valve thrombosis perioperatively, and full heparinization is not required.¹

Conclusion

Transcatheter aortic valve implantation is a promising treatment strategy for high-risk surgical patients. The number of annually performed TAVI procedures will likely increase dramatically. Successful TAVI requires a multidisciplinary team of which cardiac anesthesiologists are a crucial

part. Anesthesiologists involved in TAVI must have extensive knowledge of valvular heart disease, hemodynamics, echocardiography, optimal medical therapy, application, complications and outcome of invasive therapies, and procedural and perioperative care.

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