

Initial Experiences of Young Cardiologists with Balloon-Expandable Transcatheter Aortic Valve Implantation in Turkey: A Case Series of Eleven Patients

Türkiye'de Balon ile Açılan Trans Kateter Aort Kapak Yerleştirilmesinde Genç Kardiyologların İlk Deneyimleri

Tayyar Gokdeniz, Ahmet Cagri Aykan, Mustafa Tarik Agac, Ali Ihsan Parlar, Orhan Veli Dogan, Sukru Celik
Department of Cardiology, Ahi Evren Chest and Cardiovascular Surgery Education and Research Hospital, Trabzon, Turkey

Abstract

Objective: Surgical aortic valve replacement is the gold standard of treatment for symptomatic severe aortic stenosis in all age groups. Transcatheter aortic valve implantation (TAVI), which is performed by senior interventional cardiologists in experienced centers, is an alternative therapy for patients considered to be at high risk for surgery. The aim of this study is to describe the procedural success and short-term results of TAVI performed by young interventional cardiologists in Trabzon, Turkey.

Materials and Methods: Eleven patients, 10 women and 1 man, who were treated by balloon-expandable TAVI through transfemoral access between January 2012 and April 2012, were included in the study. The clinical and echocardiographic parameters of the patients were compared before and three months after the procedure.

Results: The median calculated logistic EuroSCORE and Society of Thoracic Surgeons (STS) score of patients were 28% (24%-34%) and 14% (12%-18%), respectively. The median age of the patients was 83 years and ranged from 80-85 years. The mean aortic valve pressure gradient and the aortic valve area were significantly improved after TAVI. The mean aortic valve pressure gradient was 48 (46-53) mmHg before treatment and 20 (16-23) mmHg after treatment ($p=0.003$). The aortic valve area was 0.65 (0.55-0.70) cm^2 before treatment and 1.7 (1.6-1.8) cm^2 after treatment. The functional status of the patients improved from NYHA class 3-4 to NYHA class 1-2. Intraprocedural mortality was not observed, and the overall 3 month mortality was 9%.

Conclusion: TAVI can be performed successfully by young cardiologists. In centers with high patient loads, we encourage young cardiologists to perform TAVI if they have received the appropriate training and to form specialized, cooperating teams with a focus on TAVI.

Key Words: Aortic stenosis, first experience, transcatheter aortic valve implantation

Özet

Amaç: Gelişmiş ülkelerde artan yaşam beklentisine bağlı olarak kalıfık aort darlığı en sık görülen kalp kapağı hastalığıdır. Cerrahi kapak ameliyatı semptomatik, ileri aort darlığı tedavisinde tüm yaş gruplarında altın standart tedavidir. Cerrahi için yüksek riskli kabul edilen hastalarda trans kateter aort kapak yerleştirilmesi (TAKY) alternatif bir tedavi seçeneğidir. TAKY deneyimli merkezlerde kıdemli girişimsel kardiyologlar tarafından yapılmaktadır. Bu çalışmada genç kardiyologlar tarafından yapılan TAKY'nin işlem başarısı ve kısa dönem sonuçlarının değerlendirilmesi amaçlandı.

Gereç ve Yöntem: Ocak 2012 ile Nisan 2012 tarihleri arasında balon ile açılan TAKY işlemi uygulanan 11 hasta (1 erkek) çalışmaya dahil edildi. Hastaların işlem öncesi ve işlemden 3 ay sonraki klinik ve ekokardiyografik verileri incelendi.

Bulgular: Hastaların ortalama yaşı, hesaplanmış EuroSCORE ve STS skorları sırasıyla 89.8 ± 3.4 yıl, 28.4 ± 5.4 ve 14.9 ± 2.9 olarak bulundu. Ortalama aort kapak basıncı ve aort kapak alanı işlem sonrası anlamlı olarak düzeldi (sırasıyla 49.8 ± 5.9 mmHg to 20.5 ± 3.6 $p=0.003$ ve 0.66 ± 0.08 cm^2 'den 1.7 ± 0.1 $p=0.003$). Hastaların fonksiyonel kapasiteleri NYHA class 3-4 den NYHA class 1-2 ye arttı. İşlem sırasında mortalite görülmedi, üçlük aylık toplam mortalite ise %9'dur.

Sonuç: TAKY pahalı ve çok komplike bir işlem olduğu için iyi eğitilmiş ve kopere ekipler tarafından yüksek hasta sayılı merkezlerde yapılmalıdır.

Anahtar Kelimeler: Aort darlığı, deneyim, TAKY

Received: March 21, 2013 / Accepted: May 8, 2013

Correspondence to: Tayyar Gökdeniz, Trabzon Ahi Evren Göğüs ve Kalp Damar Cerrahisi Eğitim ve Araştırma Hastanesi, Soguksu Mahallesi, Çamlık Caddesi, 61040 Trabzon, Turkey Phone: +90 506 456 67 88, Fax: +90 462 231 04 83 e-mail: tgkdeniz@hotmail.com
doi:10.5152/eajm.2013.21



Introduction

Aortic stenosis, the obstruction of blood flow across the aortic valve, has several etiologies, including congenital, senile (degenerative) and rheumatic causes. Calcific aortic stenosis is present in 3-5% of adults over 75 years in industrialized countries and currently is the most common valvular disease due to increasing life expectancies [1, 2].

Surgical aortic valve replacement (SAVR) is currently the gold standard of treatment for symptomatic severe aortic stenosis in all age groups [3]. Without surgical intervention, the mortality rate of patients with severe aortic stenosis increases from the onset of symptoms, rising to 25% at 1 year and 50% at 2 years. More than 50% of deaths are sudden [3]. A third of patients with aortic stenosis are not suitable for SAVR because of advanced age, left ventricle dysfunction, reduced pulmonary functions, and other comorbidities. Neither medical treatment nor percutaneous balloon aortic valvuloplasty have been shown to reduce mortality in these patients.

Transcatheter aortic valve implantation (TAVI) is a new treatment option for high-risk patients. The first human TAVI procedure was performed with a balloon-expandable device by Cribier in April 2002 [4]. The Edwards Lifesciences SAPIEN THV device is a balloon-expandable valve. It has three leaflets made of bovine pericardium, and the balloon is mounted on the tip of large delivery catheter. The valve is sewn onto the stainless steel balloon-expandable stent and is firmly crimped over the balloon before implantation [5].

Two large registries, PARTNER (Placement of AoRTic traNscatheter) and SOURCE (SAPIEN Aortic Bioprosthesis European Outcome), have been published and have shown excellent short- and mid-term results after TAVI [6, 7]. The European System for Cardiac Operative Risk Evaluation (EuroSCORE) [8] and the Society of Thoracic Surgeons (STS) [9] now offer TAVI for the effective treatment of patients who are at high risk for conventional open-heart surgery. The SOURCE registry revealed that the success rate of the procedure was 95% and the one-year survival rate was 69.3% and 81% for the transapical and the transfemoral approaches, respectively [7].

The first percutaneous aortic valve implantation in Turkey was performed by Yücel G et al. [10] in 2009. Although the interest in TAVI has been growing in recent years, only a limited number of centers currently perform the TAVI procedure. Our hospital is one of the TAVI centers in Turkey but in contrast to other centers in Turkey, our hospital TAVI team consists of young interventional cardiologists.

In this study, we present the initial experiences and the short-term results of TAVI with Edwards-SAPIEN THV performed by young cardiologists in our center.

Materials and Methods

Study design

A total of 11 patients, comprising 10 women and 1 man, who were treated by TAVI between January 2012 and April 2012, were included in the study. All patients were evaluated three months after the procedure. The patients' clinical and echocardiographic variables were compared before and three months after the procedure. All patients gave informed consent before enrollment, and the study protocol was approved by the Kartal Kosuyolu Yüksek İhtisas Education and Research Hospital Ethics Committee (2012/3/17).

Patient selection

The study population was comprised of patients with symptomatic severe aortic stenosis who were at high risk for open-heart surgery. Aortic valve replacement surgery was indicated, according to the guidelines from the American College of Cardiology/American Heart Association for the management of patients with valvular heart disease [3]. The best treatment option for these patients with high surgical risk was evaluated by a team consisting of two cardiovascular surgeons and three cardiologists. High surgical risk was defined by advanced age, severe obstructive airway disease, impaired renal functions, reduced left ventricular functions and other comorbidities. The patients were considered suitable for TAVI if they had a logistic EuroSCORE of >20% or a STS score of >10%, at least one-year life expectancy, resistance to medical therapy and anatomical suitability. A total of 11 patients underwent the TAVI procedure.

Patient screening

All patients underwent transthoracic and transesophageal echocardiography, thoracoabdominal and peripheral computed tomographic angiography (CTA), conventional coronary and peripheral angiography to select the appropriate intervention methods for TAVI and to determine the anatomical suitability of patients for the procedure.

Echocardiographic assessment

Comprehensive transthoracic echocardiography was performed in all patients according to the guidelines of American Society of Echocardiography [11]. Severe aortic valve stenosis was defined by echocardiography as an aortic valve area ≤ 0.8 cm² and/or mean pressure gradient ≥ 40 mmHg or peak aortic velocity ≥ 4 m/sec. To assess the suitability of the patients for the procedure, particular attention was given to left ventricle function, mitral regurgitation, the presence of sigmoid septum and aortic valve annulus diameter, which was measured as the distance between the hinge points of the aortic valve

leaflets in the parasternal long-axis view. All patients were evaluated by transesophageal echocardiography to accurately measure the diameter of their aortic valve annulus (Figure 1). The valve size was determined by transesophageal echocardiographic measurements. The 23 mm and 26 mm diameter valves were used for patients whose annulus measured 18 to 21 mm and 22 to 25 mm in diameter, respectively.

Computerized tomography assessment:

CTA was used to identify the presence of heavy aortic calcification, abdominal aorta bifurcation, calcification and angulation, the distance between the left main coronary artery and bottom cusps. Angulation of less than 10 mm length was considered to be a contraindication to the procedure (Figure 2A and 2B). Peripheral CTA was evaluated for the presence of tortuosity and calcification on both left and right common iliac artery, external iliac artery and common femoral artery (Figure 2C and 2D). The minimal luminal diameter was measured on both sides to decide the appropriate TAVI procedure, transapical or transfemoral, and the optimal side for the transfemoral approach. The transfemoral approach was aborted if there was severe peripheral tortuosity and if minimal peripheral sizes of both the ilio-femoral arteries were smaller than 6.0 mm and 6.5 mm for 23 mm and 26 mm valves, respectively.

Coronary and peripheral angiographic assessment

All patients underwent coronary and peripheral angiography before their procedures. Selective right and left coronary

angiography was performed according to the Judkins technique. Significant coronary artery disease was defined as a stenosis of above 70% luminal narrowing. Significant lesions in the proximal major epicardial arteries, which would require percutaneous coronary intervention were not observed. Aortography and peripheral angiography were performed with 6F Pigtail catheters to determine the line on which the three cusps were aligned and the presence of peripheral artery stenosis (Figure 3A and 3B).

The procedure

A catheterization laboratory, which was adapted to surgical sterilization rules, was used to perform all TAVI procedures. Extracorporeal circulation equipment was kept in the room for emergency situations. The number of personnel in the room was restricted to 3 interventional cardiologists, 1 cardiac surgeon, 1 senior interventional cardiologist to assist in the procedures, 1 anesthesiologist, 2 nurses and one technician for valve crimping. All laboratory personnel were prepared according to open-heart surgery preparation rules. All procedures were performed by transfemoral approach via the right femoral artery (RFA) under deep sedation and using Edwards SAPIEN balloon-expandable valves. In the first 8 cases, femoral access was achieved by surgical cut down. In the 3 last cases, femoral access was achieved with the Prostar XL device (Abbott Vascular Devices, Redwood City, CA, USA).

A dose of 300 mg acetylsalicylic acid was given orally at least 24 hours prior to the procedure, and antibiotic pro-

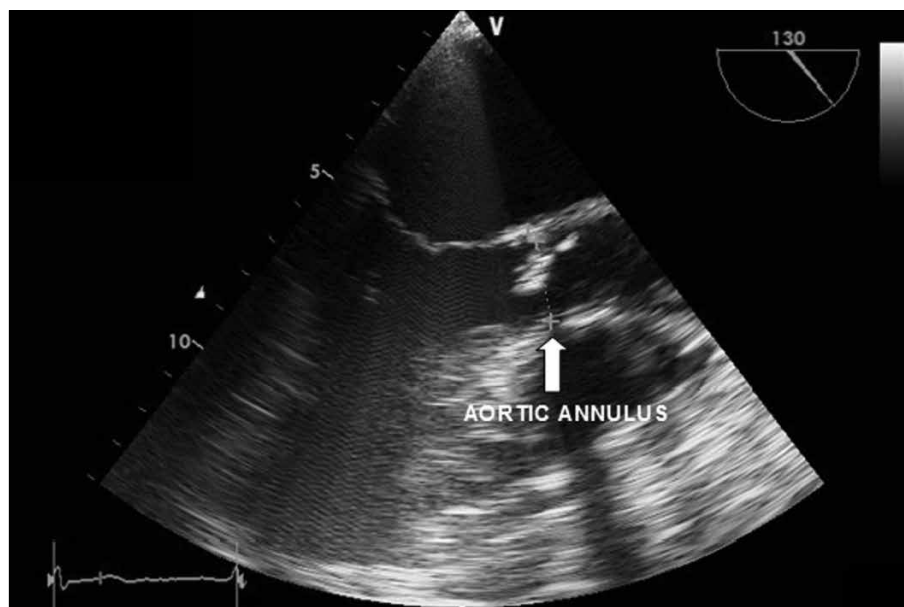


Figure 1. Aortic annulus measurement by the transesophageal echocardiography. It was measured between the hinge points of aortic valve leaflets.

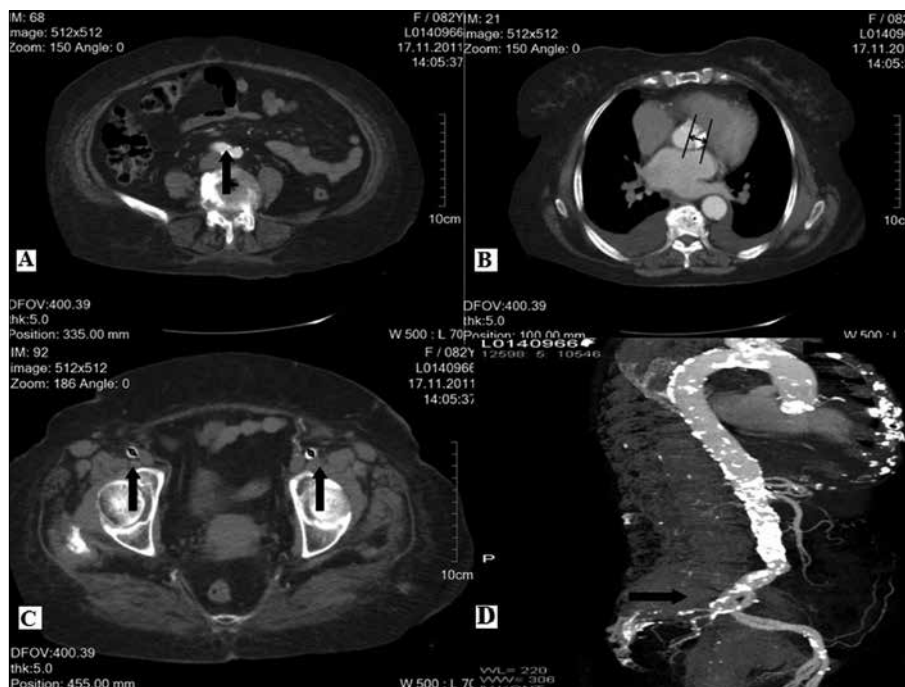


Figure 2. A) Calcification and angulations of abdominal aorta bifurcation analysis by CTA. B) Distance of left main coronary artery to bottom cusps, between lines. C) Minimal luminal diameter of both ilio-femoral arteries was measured in CTA. D) Three dimensional reconstruction of vasculature for the assessment of peripheral tortuosity. CTA (computed tomographic angiography).

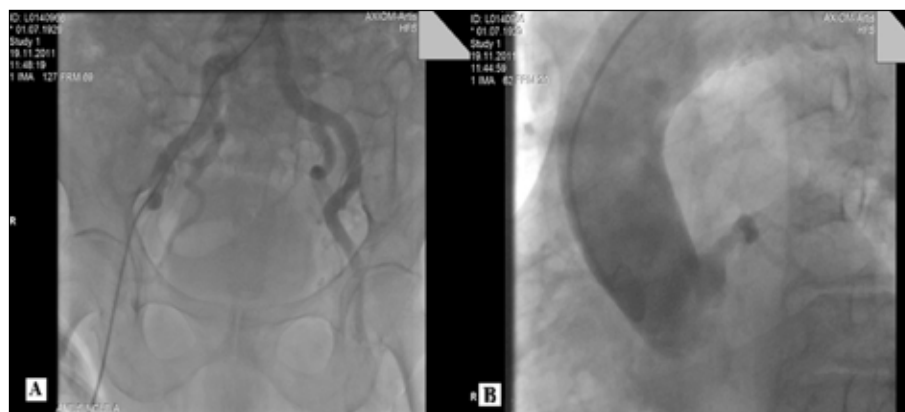


Figure 3. A) Peripheral artery angiography for detection of stenotic lesions. B) Aortography to establish the view, three cusps are aligned.

phylaxis was administered in the laboratory. A dose of 300 mg clopidogrel was given postoperatively to avoid bleeding complications. Clopidogrel administration was continued for one month at 75 mg/day, and acetylsalicylic acid administration was continued indefinitely.

6F sheath introducers were placed into the left femoral artery (LFA) and vein (LFV). A pigtail catheter and a transvenous pace maker electrode were positioned in the aortic root

and the right ventricle via the LFA and LFV, respectively. An Edwards e-sheath of 16F or 18F, for 23 mm and 26 mm THV, respectively, were placed to the level of the abdominal aorta over the stiff wire after RFA access was achieved. Dilators of 14F or 16F were used. A dose of 70 U/kg heparin was administered intravenously. The aortic valve was crossed with an Amplatz diagnostic catheter over the straight and soft tipped wire. The straight wire was exchanged with a preshaped,

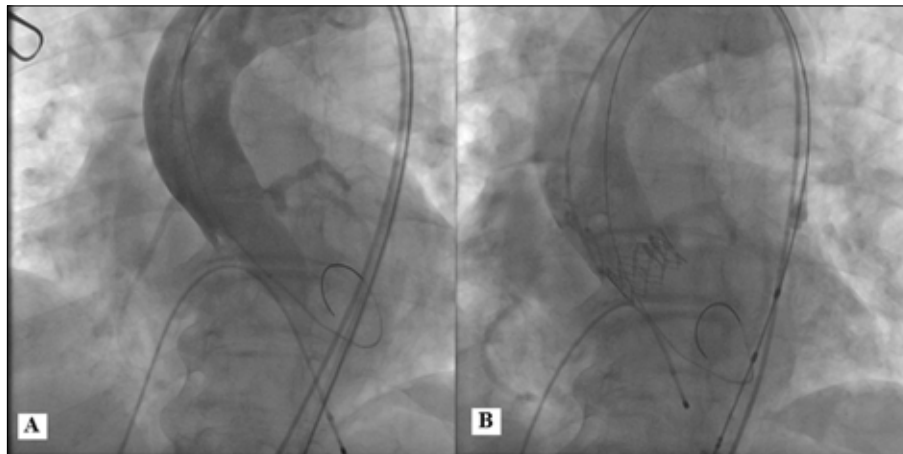


Figure 4. A) Aortography was obtained during balloon aortic valvuloplasty. B) Final aortography was interpreted for complication and paravalvular regurgitation after Edwards SAPIEN balloon expandable valve deployed successfully.

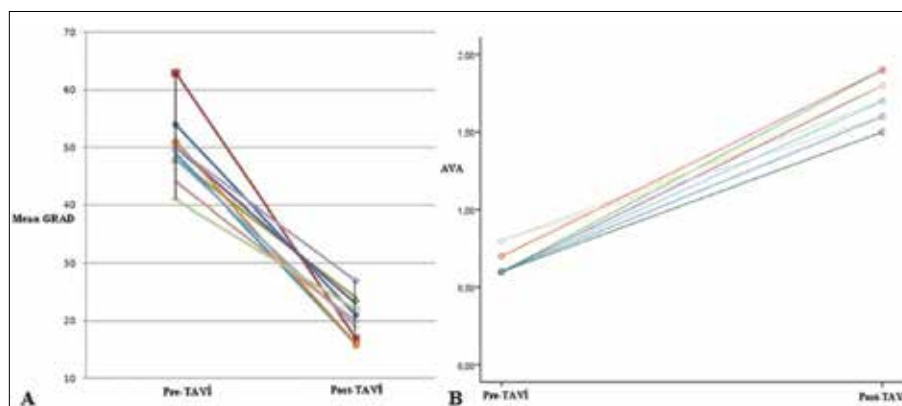


Figure 5. A) Decrease of mean aortic valve pressure gradients showed in colored lines for each patients, pre-TAVI and post-TAVI (3 months after procedure). B) Aortic valve areas before and 3 months after TAVI, increase of aortic valve areas for each patients displayed in colored lines.

Amplatz extrastiff wire. The pacemaker was tested to capture the threshold and blood pressure level during rapid ventricular pacing (RVP). A RVP rate at which the systolic blood pressure level was less than 60 mmHg was achieved. This was considered the optimum RVP rate. During rapid ventricular pacing, balloon catheters of 20 mm and 23 mm were used to perform balloon aortic valvuloplasty for 23 mm and 26 mm THV, respectively. Aortography and balloon aortic valvuloplasty were carried out simultaneously (Figure 4A). The valve that was to be implanted was crimped over the balloon mounted on the tip of a large delivery catheter by the technician. The valve was delivered to the aortic annulus by means of the RetroFlex delivery system. The angiographic view, in which the three cusps are aligned, was obtained and the valve was deployed during RVP. Aortography and transtho-

racic echocardiography was obtained after the implantation to assess complications and paravalvular aortic regurgitation (Figure 4B). The delivery system and the pacemaker electrode were retrieved, and the procedure was finished.

A senior interventional cardiologist, who was experienced in TAVI, was present during all the procedures but only supported the interventional cardiology team and did not interfere during TAVI.

Statistical analysis

SPSS 17.0 statistical software (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Continuous variables are expressed as the mean $\pm$ deviation (SD), and categorical variables are expressed as percentages. An analysis of normality of the continuous variables was performed with the

Table 1. Mean and range of the ACL concentration in the patients and controls

Patients	n=11	%
Age (years)	83 (80-85)	
Female (n, %)	10	90.1
Body mass index (kg/m ²)	23.0 (20.8-32.4)	
Hypertension (%)	11	100
Diabetes mellitus (%)	3	27.3
Severe CAD (%)	0	0
Severe COPD (%)	10	90.1
History of PAD	0	0
Sinus rhythm (%)	11	100
NYHA functional class:		
Class III (%)	10	91
Class IV (%)	1	9
Logistic EuroSCORE (%)	28 (24-34)	
STS score (%)	14 (12-18)	
Presence of angina (%)	6	54.5
Presence of syncope (%)	4	36.4
LVEF (%)	60 (55-65)	
AVA (cm ²)	0.60 (0.55-0.70)	
Peak AV gradient (mmHg)	70 (68-83)	
Mean AV gradient (mmHg)	50 (48-54)	
Mitral regurgitation:		
Grade 3 and/or 4 (%)	0	0
Aortic regurgitation:		
Grade 3 and/or 4 (%)	0	0

Data are expressed in numbers (percentages), mean or median and (interquartile range). Percentages are rounded.
 CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; PAD, peripheral artery disease; NYHA, New York Heart Association; STS, Society of Thoracic Surgeons; LVEF, left ventricular ejection fraction; AVA, aortic valve area; AV, aortic valve

Kolmogorov-Smirnov test. The comparisons of continuous variables were performed using nonparametric Wilcoxon test. A p value of <0.05 was considered statistically significant.

Results

Patient population

All patients, 90.1% women and 9.9% men, had severe symptomatic aortic stenosis. The patients' baseline clinical and echocardiographic data are shown in Table 1. The median age was 83 (80-85) years. The median calculated logistic EuroSCORE and STS scores were 28% (24%-34%) and 14% (12%-18%), respec-

Table 2. Mean and range of the ACL concentration in the patients and controls

Patients	n=11
Size of implanted valves (mm)	
23mm prosthesis (n)	9
26mm prosthesis (n)	2
Procedure time (minute)	80 (70-90)
Contrast volume (mL)	400 (210-480)
Hospital stay (day)	7 (6-8)
Procedure success (%)	100
Access route	
Surgical cutdown (n)	8
Prostar XL (n)	3
Intraprocedural mortality (n)	0
In-hospital mortality (n)	1
Paravalvular aortic regurgitation	
Grade 1&2 (n)	5
Grade 3&4 (n)	0
Permanent atrioventricular block	1

tively. Ten patients presented with New York Heart Association (NYHA) functional class III, while 1 patient presented with NYHA functional class IV. Six (54.5%) patients had angina and 4 (36.4%) patients had syncope. The left ventricular ejection fraction (LVEF) was 60 (55-65). The mean aortic valve pressure gradient was 50 (48-54) mmHg, and the median aortic valve area (AVA) was 0.60 (0.55-0.70) cm². All procedures were performed by three young interventional cardiologists aged thirty, thirty-one and thirty-three years. None of the patients had severe coronary artery disease. Thus, percutaneous coronary intervention had not been performed prior to the procedures.

In-hospital and procedural data

All procedures were performed with Edwards SAPIEN balloon-expandable valves via the transfemoral access route. The intraprocedural and in-hospital stay data are shown in Table 2. The procedural success was 100%. The 23 and 26 mm valves were implanted in 9 and 2 patients, respectively. The median procedure time was 80 (70-90) minutes. The total volume of contrast agent used was 400 (210-480) mL. After the procedures, paravalvular aortic regurgitation was assessed by angiography and was observed in 5 patients (Grade 1-2). However, hemodynamic intolerance due to paravalvular regurgitation was not observed in our patients. Neither peripheral vascular nor cerebral events were observed in our study population. Subtotal obstruction of the left main coro-

Table 3. Patients' Clinical and Echocardiographic Data Before and 3 Months after Procedure

Variable	Pre-TAVI (n=10)	Post-TAVI (n=10)
AVA (cm ²)	0.65 (0.55-0.70)	1.7 (1.6-1.8)
Mean AV gradient (mmHg)	48 (46-53)	20 (16-23)
NYHA functional class		
Class I-II (n)	0	10
Class III-IV (n)	10	0
NYHA, New York Heart Association; AVA, aortic valve area; AV, aortic valve; TAVI, transcatheter aortic valve implantation		

nary artery, which occurred after valve deployment, was seen in one patient. This was stented with a bare metal stent to maintain coronary blood flow. An atrioventricular block was observed in the same patient. One patient experienced cardiac perforation after transient pacemaker implantation. This was immediately treated by pericardiocentesis, and a pigtail catheter was placed into the pericardial space for drainage. At follow up, the pericardial fluid did not increase and the hemodynamic parameters of patient remained stable. The pigtail catheter was removed after the third day and the patient did not require surgical intervention. Major bleeding requiring blood transfusion was not observed in any patients.

The median hospital stay was 7 (6-8) days. The patient who was stented due to left obstruction of the main coronary artery was followed up for six days because of persistent atrioventricular block, after which the permanent pacemaker was implanted. On the eighth day, the patient died in the hospital due to acute heart failure, which could not be explained by any cause. A surgical access wound occurred in one patient, who was successfully treated with antibiotics.

Three-month follow up and echocardiographic evaluation

The overall 3-month mortality was 9.1%. Ten patients were reevaluated three months after the procedure. The patients' data before and 3 months after the procedure are shown in Table 3. Atrioventricular blockage and strokes were not observed. The aortic valve area was significantly increased from 0.65 (0.55-0.70) cm² to 1.7 (1.6-1.8) cm² ($p=0.003$), while the mean aortic valve pressure was decreased from 48 (46-53) mmHg to 20 (16-23) mmHg ($p=0.003$) (Figure 5). Moreover, the patients' functional status improved from NYHA class 3-4 to NYHA class 1-2.

Discussion

This study presents our initial experience with percutaneous aortic valve implantation using balloon-expandable

SAPIEN Edwards valves. Although our study population was relatively small, the results obtained from our initial experience are very similar to that which has been reported in the literature with regards to procedural success, mortality rates and post-implantation clinical and echocardiographic findings [12, 13].

Although SAVR is the first line therapy for symptomatic severe aortic stenosis, it cannot be performed on all patients due to high surgical mortality rates, especially in patients with advanced age [14, 15]. Because of increasing life expectancy, the number of patients having high surgical risk will increase. Percutaneous aortic valve implantation, a novel and sophisticated method, has been developed to solve this problem. While only a limited number of centers currently perform TAVI, the number of centers performing this procedure is increasing. The centers that currently perform TAVI have had extensive experience with BAV and European guidelines recommend that TAVI must be restricted to centers that have had extensive experience with SAVR and BAV [16]. Percutaneous aortic valve implantations have been performed in Turkey since 2009 [10]. The number of centers performing TAVI has been increasing and some complications and solutions encountered during TAVI that were published were from Turkey [17, 18].

Our center is the largest cardiovascular center in the Black Sea region of Turkey. It is a high-volume center for percutaneous coronary intervention, catheter therapy of structural heart disease and SAVR, although it has not had experience with BAV. Our percutaneous aortic valve implantation team consists of interventional cardiologists who are younger than those comprising other teams in Turkey. Our team is possibly the youngest team in Turkey. To avoid disadvantages due to a lack of experience with TAVI, we first obtained theoretical information about the procedure, and a multidisciplinary team was structured to include interventional cardiologists and cardiovascular surgeons. In our opinion, the selection and screening of patients are the most important parts of TAVI. Thus, we focused meticulously on these topics. All procedures were supervised by a skilled interventional cardiologist, who is one of the most experienced cardiologists in TAVI in Turkey.

Our initial results are similar to previously published data, although our study population was relatively small [10, 19]. To our knowledge, our study population is the oldest, with a mean patient age of 89.8 ± 3.4 . At the same time, the mean calculated logistic EuroSCORE of our study population was one of the highest. Neither cerebrovascular nor peripheral vascular complications were observed. A coronary occlusion and permanent AV block occurred in the same patient, and

unfortunately, she died in the hospital eight days after the procedure. In the three-month follow up, no complications were observed and the functional status of all patients was improved. The aortic valve area was significantly increased, while the mean aortic valve pressure gradient decreased. The procedures were performed under deep sedation, and anesthesia-related problems were not encountered. For the first case, surgical cutdown was preferred for femoral artery access due to the lack of experience with TAVI and Prostar XL. In all subsequent cases, Prostar XL was used. In our opinion, deep sedation can be safely applied for all TF procedures. However, for femoral artery access, surgical cutdown must only be selected if the operators are new to the procedure and lack experience with closure devices.

Limitations

This study has several limitations. Firstly, the study population was small. Additionally, only the immediate and short-term results are reported. In this study, balloon-expandable valves were used; however, results of using self-expandable valves were not investigated. Further studies with increased numbers, including long-term results and different markers of outcome, are necessary to confirm our results.

In conclusion percutaneous aortic valve implantation is the mainstay treatment option for patients who are not suitable for open-heart surgery. Worldwide, this procedure is performed in increasingly large patient populations. Accordingly, in Turkey, the number of centers that perform TAVI, a new treatment option for the patients who are not suitable for SAVR, will increase. TAVI is an expensive and highly complicated procedure, and as such, it should be performed in high-volume centers and by well-educated and specialized teams.

In the future, the technological advancements in devices will likely enable TAVI to be performed in younger patients and those who are at lower risk for SAVR. Young interventional cardiologists will play important roles in the implementation of these technical advancements. Here, we have shown that in centers with high patient load, young interventional cardiologists can successfully perform TAVI when they receive the appropriate training and form teams focused on TAVI.

Conflict of interest statement: The authors declare that they have no conflict of interest to the publication of this article.

References

1. Iung B, Baron G, Butchart EG, Delahaye F, et al. A prospective survey of patients with valvular heart disease in Europe: The Euro Heart Survey on Valvular Heart Disease. *Eur Heart J* 2003; 24: 1231-43. [\[CrossRef\]](#)
2. Nkomo VT, Gardin JM, Skelton TN, et al. Burden of valvular heart diseases: a population-based study. *Lancet* 2006; 368: 1005-11. [\[CrossRef\]](#)
3. Bonow RO, Carabello BA, Chatterjee K, et al. 2006 Writing Committee Members; American College of Cardiology/American Heart Association Task Force. 2008 Focused update incorporated into the ACC/AHA 2006 guidelines for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease): endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *Circulation* 2008; 7; 118:523-661.
4. Cribier A, Eltchaninoff H, Bash A, et al. Percutaneous transcatheter implantation of aortic valve prosthesis for calcific aortic stenosis: first human case description. *Circulation* 2002; 106: 3006-8. [\[CrossRef\]](#)
5. Cribier A, Eltchaninoff H, Tron C, et al. Early experience with percutaneous transcatheter implantation of heart valve prosthesis for the treatment of end-stage inoperable patients with calcific aortic stenosis. *J Am Coll Cardiol* 2004; 43: 698-703. [\[CrossRef\]](#)
6. Lefèvre T, Kappetein AP, Wolner E, et al. PARTNER EU Investigator Group. One year follow-up of the multi-Centre European PARTNER transcatheter heart valve study. *Eur Heart J* 2011; 32: 148-57. [\[CrossRef\]](#)
7. Thomas M, Schymik G, Walther T, et al. One-year outcomes of cohort 1 in the Edwards SAPIEN Aortic Bioprosthesis European Outcome (SOURCE) registry: the European registry of transcatheter aortic valve implantation using the Edwards SAPIEN valve. *Circulation* 2011; 124: 425-33. [\[CrossRef\]](#)
8. Roques F, Nashef SA, Michel P, et al. Risk factors and outcome in European cardiac surgery: analysis of the EuroSCORE multinational database of 19030 patients. *Eur J Cardiothorac Surg* 1999; 15: 816-23. [\[CrossRef\]](#)
9. O'Brien SM, Shahian DM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 2-isolated valve surgery. *Ann Thorac Surg* 2009; 88: 23-42. [\[CrossRef\]](#)
10. Yücel G, Paker T, Akçevin A, et al. Transcatheter aortic valve implantation: the first applications and early results in Turkey. *Türk Kardiyol Dern Ars* 2010; 38: 258-63.
11. Gottdiener JS, Bednarz J, Devereux R, et al. American Society of Echocardiography recommendations for use of echocardiography in clinical trials. *J Am Soc Echocardiogr* 2004; 17: 1086-119. [\[CrossRef\]](#)
12. Eltchaninoff H, Prat A, Gilard M, et al. Transcatheter aortic valve implantation: early results of the FRANCE (FRench Aortic National CoreValve and Edwards) registry. *Eur Heart J* 2011; 32: 191-7. [\[CrossRef\]](#)
13. Bosmans JM, Kefer J, De Bruyne B, et al. Procedural, 30-day and one year outcome following CoreValve or Edwards transcatheter aortic valve implantation: results of the Belgian national registry. *Interact Cardiovasc Thorac Surg* 2011; 12: 762-7. [\[CrossRef\]](#)
14. Iung B, Cachier A, Baron G, et al. Decision-making in elderly patients with severe aortic stenosis: Why are so many denied surgery? *Eur Heart J* 2005; 26: 2714-20. [\[CrossRef\]](#)

15. Kvidal P, Bergström R, Hörte LG, Ståhle E. Observed and relative survival after aortic valve replacement. *J Am Coll Cardiol* 2000; 35: 747-56. [\[CrossRef\]](#)
16. Vahanian A, Alfieri O, Al-Attar N, et al. Transcatheter valve implantation for patients with aortic stenosis: a position statement from the European Association of Cardio-Thoracic Surgery (EACTS) and the European Society of Cardiology (ESC), in collaboration with the European Association of Percutaneous Cardiovascular Interventions (EAPCI). *Eur Heart J* 2008; 29: 1463-70. [\[CrossRef\]](#)
17. Dağdelen S, Karabulut H, Alhan C. Acute left main coronary artery occlusion following TAVI and emergency solution. *Anadolu Kardiyol Derg* 2011; 11: 747-8.
18. Gül M, Türen S, Sürgit O, Aksu HU, Uslu N. Acute severe occlusion of the left main coronary artery following transcatheter aortic valve implantation. *Anadolu Kardiyol Derg* 2012; 12: 282-3.
19. Vavuranakis M, Voudris V, Vrachatis DA, et al. Transcatheter aortic valve implantation, patient selection process and procedure: two centres' experience of the intervention without general anaesthesia. *Hellenic J Cardiol* 2010; 51: 492-500.