

In-Hospital Cost Comparison of Transcatheter Closure versus Surgical Closure of Secundum Atrial Septal Defect

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Abstract

Introduction: We compared transcatheter and surgical closure of secundum atrial septal defects (ASDs) in terms of cost in this study. **Materials and Methods:** Between 2006 and 2015, 291 consecutive patients having secundum ASD, in whom percutaneous or surgical closure was performed, were included in this study. We compared the in-hospital cost of transcatheter versus surgical ASD closure in these patients. **Results:** We collected totally 291 patients, 214 transcatheter and 77 surgical closure procedures, retrospectively. Patients with a surgical closure had a longer length of stay (11.8 ± 3.8 days vs. 2.8 ± 1.6 days, $P < 0.001$). There was no in-hospital mortality in two groups. Costs denominated in Turkish lira (TL) and United States Dollar (USD) of transcatheter closure were higher than that of surgical closure (TL 10955.6 ± 183.4 vs. TL 6016.7 ± 371.9 $P < 0.001$; USD 6531.2 ± 149.62 vs. USD 3896.2 ± 234.7 $P < 0.001$). The cost of percutaneous ASD closure increase does not correlate with the dollar rate on the annual basis. This with the supplier firms has excessive profits in the first year of the study. **Conclusion:** Compared with other countries with regard to cost, transcatheter ASD closure is a more expensive treatment than surgical closure in our country.

Keywords: Cardiac surgical procedures, cost analysis, ostium secundum atrial septal defect, septal occluder device

INTRODUCTION

Atrial septal defects (ASDs) are among the most common congenital heart disease.^[1] ASD can be closed either surgically or with a transcatheter device; however, transcatheter strategy as a less invasive procedure, it has become the accepted treatment in patients with appropriate anatomy.^[2] The outcomes of percutaneous ASD closures have been compared with surgical closures. It has been shown that transcatheter ASD closure is as effective as the surgical ASD closure.^[3,4] Since transcatheter closure is commonly used in ASD, it is important to examine its cost as an important dimension of comparative effectiveness. Many small studies have previously reported that ASD closure is generally associated with lower hospital costs than that of surgical ASD closure.^[5-7] However, recently, it has been shown that surgical or transcatheter ASD closure has diversity regarding hospital costs between individual centers.^[8] We aimed to compare the costs of transcatheter and surgical ASD closure in Turkey.

MATERIALS AND METHODS

This is a retrospective study that included patients with a diagnosis of secundum ASD who were treated by transcatheter occlusion or surgical closure between December 2006 and September 2015. Our study's Ethics Committee and Institutional approval were obtained from Izmir Katip Çelebi University. For a proper cost evaluation, ASD patients with other concomitant congenital anomalies and those who underwent additional procedures such as percutaneous transcatheter coronary intervention, coronary bypass surgery, or valve operation were excluded from this study. Therefore, 214 patients with transcatheter closure and 77 patients with surgical closure were included in the study. Patient demographics, hospital length of stay (LOS),

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and total charges were evaluated using the hospital records. The complaints on application or presenting symptoms were dyspnea, palpitation, recurrent stroke, and chest pain. Concomitant valve diseases were mild-to-moderate pulmonary regurgitation/stenosis, tricuspid regurgitation, and mitral regurgitation.

The percutaneous ASD closure procedure was performed under general anesthesia using ASD closure device in accordance with the techniques described in the literature.^[9] The patients undergoing surgical treatment were operated under general anesthesia using the standard approach. The right atrium was opened following median sternotomy, and the ASD was closed with a primary suture or pericardial patch under cardiopulmonary bypass. Only one patient underwent a minithoracotomy without sternotomy. The patients were fully informed of the treatment options, which were decided on with the heart team and patients.

Bleeding complications were divided into two categories. Major bleeding was defined as the need for transfusion of >2 units of erythrocyte suspension; otherwise, it was minor bleeding. Minimal leakage was defined as leakage without associated hemodynamic complications.

The cost data were obtained directly from the accounting and resource departments of our hospital. This is a government hospital; there are no items invoiced from outside, and all cost items are invoiced to a reimbursement agency. All prices were calculated in Turkish lira (TL) and converted to the United States dollars (USD) based on the exchange rate given by the Central Bank of the Republic of Turkey on the invoice date.^[10] Considering the cost analysis of the study, the period from the day of the patients' hospitalization to the day when they were discharged was assessed. In terms of the study perspective, our work is a direct cost analysis based on the reimbursement agency (Social Security Institution).

RESULTS

Of 291 of the included patients, 214 underwent transcatheter procedures and 77 underwent surgical closure. The baseline clinical and demographic characteristics of the two groups are demonstrated in Table 1. There was no difference in terms of sex, age, or comorbidities between the two groups. The presenting symptoms were similar in the groups. The surgical closure group had longer LOS (11.8 ± 3.8 days vs. 2.8 ± 1.6 days, $P < 0.001$). There was no in-hospital mortality in either groups. The number of concomitant valve diseases was higher in the surgery group ($P < 0.05$) [Table 1].

Periprocedural complications are presented in Table 2. Minimal leakage after the procedure was seen in 7% of the patients treated with transcatheter closure. Device embolization was observed in three patients, and reintervention was performed. Dehiscence was seen in three patients after the procedure, and surgery was performed in these patients. In addition, 78% of the transcatheter patients underwent balloon sizing. The

Table 1: Baseline clinical characteristics of patients

Variable	Transcatheter ASD closure (n=214)	Surgical ASD closure (n=77)	P
Age (years)	36.5±14.7	33.2±13.8	0.082
Sex (male/female)	68/146	20/57	0.400
Hypertension, n (%)	28 (13)	6 (7)	0.197
Diabetes mellitus, n (%)	9 (4)	2 (2)	0.507
Chronic renal failure, n (%)	1 (0.4)	0	0.544
Complaint on application, n (%)			
Dyspnea	100 (45)	48 (59)	0.094
Palpitation	44 (20)	18 (22)	
Recurrent stroke	2 (1)	0	
Chest pain	2 (1)	0	

Table 2: Procedural complications

Variable	Transcatheter ASD closure- (n=214), n (%)	Surgical ASD closure-(n=77), n (%)	P
Periprocedural shunt	15 (7)	0	0.016
Bleeding	4 (1.4)	50 (61)	<0.01
Pleural effusion	0	2 (2.4)	0.065
Pericardial effusion	6 (3)	11 (14)	<0.01
Pneumothorax	0	2 (2.4)	0.019
Arrhythmia	5 (2.4)	0	0.393
Repeat operation	1 (0.4)	0	0.544

ASD: Atrial septal defect

Amplatzer occluder device was used in 55%, Cardi-O-Fix occluder device was used in 42%, and BioSTAR occlude device was used in 3% of the patients. The surgical closure was performed with primary suture in 53%, and patch usage for closure was in 47% of patients. Both major and minor bleeding were more common in the surgery closure group than in the percutaneous closure group (9% vs. 3%, $P < 0.05$ and 5% vs. 0%, $P < 0.05$, respectively). The rate of pneumothorax requiring surgical intervention was higher in patients treated with surgery [Table 2].

The procedural success rate was similar between the percutaneous closure and surgical closure groups (95% vs. 99%, $P = 0.139$). In this study, the cost of transcatheter closure, denominated in TL and USD, was higher than that of surgical closure (TL $10\,955.6 \pm 183.4$ vs. TL 6016.7 ± 371.9 , $P < 0.001$; USD 6531.2 ± 149.62 vs. USD 3896.2 ± 234.7 , $P < 0.001$) [Figures 1 and 2]. The increase in the cost of percutaneous ASD closure did not correlate with the USD/TL exchange rate on an annual basis.

DISCUSSION

Following the first percutaneous ASD closure procedure, parallel to the developing technology, this technique has become an alternative to surgical therapy in the appropriate

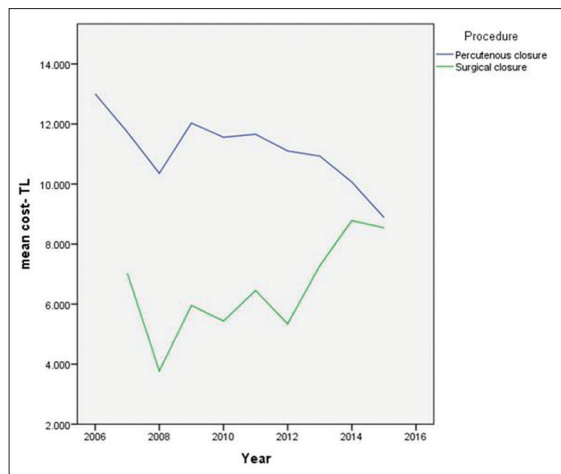


Figure 1: Turkish Lira (TL) based cost change over years in both surgical and transcatheter closure

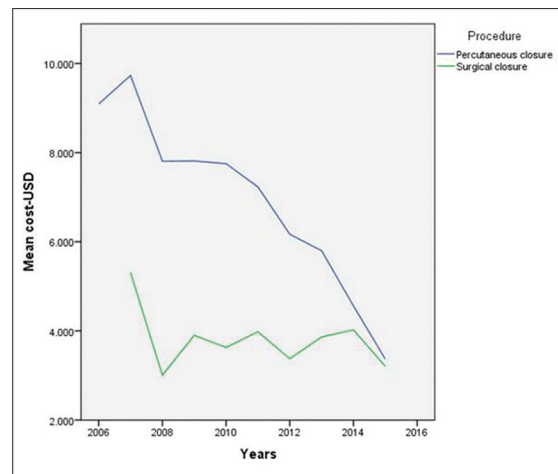


Figure 2: United States dollar (USD) based cost change over years in both surgical and transcatheter closure

direction.^[11] The outcomes of percutaneous ASD closure have been compared with those of surgical closure. It has been shown that transcatheter ASD closure is as effective as surgical ASD closure.^[3,4] However, the results of cost-effectiveness analysis for ASD closure are still considered controversial. In a Guatemalan study by Vida *et al.*,^[12] surgery costs 3.330 USD, while percutaneous closure costs 4.521 USD. Moreover, in Thomson *et al.*'s^[5] study from the United Kingdom, the surgical procedure cost was 5375 Sterling, while the percutaneous procedure cost was 5.412 Sterling. Conversely, a study carried out in the United States, by O'Byrne *et al.*,^[13] reported that the cost of operative closure was 60.992 USD, while that of transcatheter closure was 55.841 USD. From the USA again, Ooi *et al.*^[14] reported that the costs of the transcatheter procedure were lower than those of surgical closure (mean of 19.128 USD vs. 25.359 USD). In a Canadian study, Mylotte *et al.*^[7] reported that the cost of surgical closure costs 15.304 Canadian Dollars, while it costs 11 060 Canadian Dollars for the transcatheter closure group.

Based on the previous studies, transcatheter closure has lower costs compared with surgical closure. However, from Turkey, Ayık *et al.*^[15] reported that the median cost was significantly higher in the percutaneous group (10.698 TL vs. 5.572 TL). In this study, we found that the cost of transcatheter closure was higher than that of surgical closure (TL 10.955.6 ± 183.4 TL vs. 6.016.7 ± 371.9 TL, 6.531 2 ± 149 62; USD vs. 3.896.2 ± 234.7 USD, *P* < 0.001). The most noticeable finding was that, while the USD/TL exchange rate increased from 2006 to 2015, the cost denominated in TL for ASD closure devices did not increase concordantly.

Transcatheter closure has a higher price than surgical closure because an imported device is not used in the surgical option, and the operation fee is the main cost. For transcatheter closure, the main cost is the imported device for this procedure. However, in both surgical and transcatheter closures the fee paid to doctors for the operation is too low, i.e. 20%–25% of the total cost. To import an ASD occluder device depends to foreign exchange

rate, and the low value of the TL in foreign exchange is the first reason for the high prices in Turkey; the other and most noticeable reason is that, while the USD/TL exchange rate had been increasing from 1.03 to 3.03 in 2006–2015, the TL-based transcatheter ASD closure versus surgical ASD closure costs were as nearly the same. This shows that importer companies had high profits in the first few years [Figures 1 and 2].

Study limitations

Even in prospective studies, because the earnings of people can be in very large spectrum, it is difficult to standardize the cost of lost work. This is a short-term and retrospective study, so the main limitation of our study is that we could not reach the datas about patients' cost of labor loss. Therefore, we cannot know whether the cost difference between surgical and percutaneous ASD closure will be different in the long-term period.

CONCLUSION

Compared with the european countries, the high cost of imported closure devices and supplier firms' high profit rates in the percutaneous group conversely for the surgical group, lower doctor fees in Turkey and no need to imported device, in Turkey surgical closure becomes more cost-effective than transcatheter closure.

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Conflicts of interest

There are no conflicts of interest.

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