



## Cost-Effectiveness of Intraoperative Transesophageal Echocardiography in Cardiac Valve Surgery

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### ABSTRACT

**Introduction:** Being a unique diagnostic technique, transesophageal echocardiography (TEE) has influenced many different aspects of cardiac surgery including valve repair surgery. The cost-effectiveness of this method however is questioned considering the conditions of every region and country. In this study we aimed at answering the question if utilizing TEE throughout valve repair surgery could be cost-effective. **Methods:** Twenty four patients were studied within two groups of case "valve repair operation plus intraoperative TEE (IO-TEE)" and control "valve replacement operation". Variables including age, gender, left ventricle ejection fraction (LVEF), re-operation, intensive care unit (ICU) stay, hospital stay and cost were studied and compared. **Results:** There was no significant difference regarding age, gender and LVEF between two groups ( $p=0.559$ ,  $p=0.413$ , and  $p=0.408$ , respectively). ICU stay in repair group was less than replacement group ( $p=0.009$ ). Hospital stay difference however was not statistically significant ( $p=0.928$ ). The cost of valve repair under IO-TEE monitoring was significantly less than valve replacement ( $p=0.001$ ). **Conclusions:** IO-TEE not only would assist surgeons by increasing their interest toward valve repair operation instead of replacing impaired cardiac valves but also consequently decrease hospital costs. It is also advised for the cardiac anesthesiologists to use IO-TEE routinely in the valve repair operations provided that there are no contraindications.

### Introduction

At the time being valve repair is considered the first approach toward valve surgery, especially for mitral valve pathology.<sup>1</sup> Transesophageal echocardiography (TEE) is the most powerful cardiovascular diagnostic technique available in the present practice of perioperative medicine<sup>2</sup> and its impacts on surgical management and outcome are well established.<sup>3</sup> TEE indications are presented in guidelines.<sup>4</sup> Cost-effectiveness of TEE in cardiac valve surgery has been demonstrated as well.<sup>5-7</sup> No similar study however has been performed in this regard in our region. Therefore in the present study we were to evaluate cost-effectiveness of TEE in heart valve surgery in our region.

### Materials and methods

Previously there was no intraoperative TEE in cardiac surgery operating room of Tabriz Aalinasab hospital, Tabriz, Iran. Therefore, cardiac surgeons were less likely

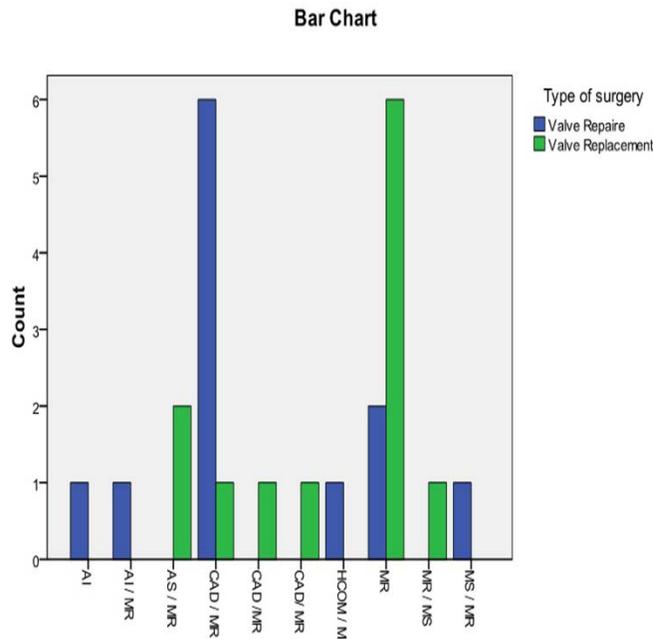
to repair valve regurgitations due to lack of adequate monitoring of quality of repair. Being monitored by cardiac anesthesiologists using intraoperative TEE (IO-TEE), valves of 12 patients having valvular regurgitation were repaired. Consequently, we compared them with 12 patients who had undergone valve replacement due to lack of IOTEE. We compared two groups regarding age, gender, left ventricle ejection fraction (LVEF), re-operation, intensive care unit (ICU) stay, hospital stay and cost. Collected data were analyzed using SPSS 17 (SPSS Inc. Chicago, IL, USA). Kolmogorov-Smirnov (K-S) test was used for testing normal distribution of continuous variables. K-S test revealed that age, LVEF and cost presented a normal distribution ( $p=0.876$ ,  $=0.129$  and  $=0.173$ , respectively) but ICU and hospital stay data distribution were skewed ( $p=0.026$  and  $p=0.002$ , respectively). Thus, we used independent samples t-test for comparing means of age, LVEF and cost and Mann-Whitney test for analysis of differences

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in ICU and hospital stay. Categorical variables were analyzed using Chi-Squared or Fisher's Exact Test as appropriate. Level of statistical significance was considered as  $P \leq 0.05$ .

**Results**

Twenty four patients were studied in two groups (1=valve repair and 2=valve replacement).Types of cardiac pathology in two groups are presented in Figure 1.



**Figure 1.** Heart pathology in the study groups

There was no significant difference regarding age, gender and LVEF between two groups ( $p=0.559$ ,  $p=0.413$ , and  $p=0.408$ , respectively). Three patients in replacement group needed re-operation due to valve malfunction and bleeding (1 case and 2 cases, respectively) but the difference was not statistically significant ( $p=0.217$ ; Table 1).

**Table 1.** Clinical variables of the two study groups

	Valve repair(n= 12)	Valve replacement(n= 12)	P
Age(year)	56.9 ± 14.2	53.8 ± 11.0	0.559
Gender(male)	4 (33.3 %)	7 (58.3 %)	0.413
LVEF % *	43.3 ± 3.9	44.6 ± 3.3	0.408
Re-operation	0	3 (25 %)	0.217
ICU stay (day) **	2 (2-3)	3(2-7)	0.009
Hospital stay (day) **	8(7-10)	8(7-13)	0.928
Cost ( USD )	730 ± 237	2698 ± 801	0.001

\*LVEF=left ventricle ejection fraction, \*\* Median (min-max)

One patient in replacement group died in ICU 5 days after surgery. ICU stay in repair group was less than replacement group ( $p=0.009$ ) but hospital stay difference was not statistically significant ( $p=0.928$ ). TEE costs included machine costs calculated on basis of a mean value of 80000 USD, assuming a life span of 10 years and no trade-in value at the end of its working life, storage, cleaning, recording and cost of anesthesiologist performing the TEE (Table 2).

**Table 2.** Estimated costs of echocardiography machine

Cost of TEE machine	80000 USD
Years for use	10
TEE cases per year	400
Cost of machine for each case	20 USD

**Table 3.** Estimated cost of transesophageal echocardiography for each case (USD)

Machine	20 USD
TEE performer cost	50 USD
Cleaning, recording and other costs	10 USD
Total cost	80 USD

Costs calculated in this study included artificial valve and valve ring, physician visit, coagulation tests, warfarin, TEE and physician visit for r repair group which would be 4 times at first year and then 1 time annually (Total cost=120 USD). Coagulation tests are performed 9 times at first year and 4 times per year in the following years. Total cost for visit, laboratory tests and warfarin in replacement group is 850 USD. The cost of valve repair under intraoperative TEE (IOTEE) monitoring is significantly less than valve replacement ( $p=0.001$ ; Table 3).

**Discussion**

The present study revealed that using TEE intra-operatively in patients with impaired valvular function undergoing valve repair operation could assist surgeons with monitoring the quality and efficiency of valve repair, therefore increasing the interest of the surgeons in valve repair operation and consequently reducing unnecessary costs.

It is widely accepted that valve repair is the first choice in the management of patients with valvular diseases in case of possibility.<sup>1</sup> In the centers where IOTEE is not performed, cardiac surgeons are less eager to perform valve repair due to the following reasons: uncertain quality and efficiency of the repaired valve, probability of difficulty in discontinuing the pump and hemodynamic instability in the patients with residual valvular dysfunction, probable need of re-operation to

repair the remaining dysfunction, change in the reputation and the image of the surgeon among the cardiologists, other medical staff and patients and facing legal problems and complaints from the families of the patients.

Numerous studies have proven the efficacy of intraoperative TEE in increasing the quality of the operation and reducing the costs in adults and children undergoing cardiac surgery.<sup>8-11</sup>

Some other studies however have questioned the efficiency of IO-TEE in VHD (valvular heart disease) patients. We could not find any similar study having been carried out in this regard in our region. Equipping the cardiac surgery operating room with intra-operative TEE assisted the surgeons abundantly with the quality and efficiency of the repaired valves which in terms led to an increase in their interest toward valve repair. In addition to patients' benefits and reduction in complication rates, hospital costs significantly increased.

### Conclusion

The present study revealed the positive effect of IO-TEE in assisting surgeons not only by increasing their interest toward valve repair instead of replacing impaired cardiac valves but also consequently decreasing hospital costs. Considering the low number of the studied patients, further studies with more patients are suggested to be conducted. It is also advised for the cardiac anesthesiologists to use IO-TEE routinely in the valve repair operations wherever no contraindications exist.

*Ethical issues:* The study was approved by the Ethical Committee of Tabriz University of Medical Sciences, Tabriz, Iran. We kept personal information of patients as confidential. Also, patients signed informed consent form before launching of the study.

*Conflict of interests:* No conflict of interest to be declared.

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