The Heart Surgery Forum #2000-45956
4 (1):26–30, 2001 Online address: www.hsforum.com/vol4/issue1/2000-45956.html

Comparison of Minithoracotomy With Conventional Sternotomy Methods in Valve Surgery

(#2000-45956 … June 8, 2000)

Tufan Sener, Hakan Gerçekoglu, Serdar Evrenkaya, Bige Aydin, Serdar Çimen, Murat Demirtas, Remzi Tosun, Ergin Eren, Azmi Özler

Department of Cardiovascular Surgery, Siyami Ersek Cardiovascular and Thoracic Surgery Center, Istanbul, Turkey

ABSTRACT

Background: To determine the differences in the operative findings between the two groups of patients who had undergone either minithoracotomy or conventional sternotomy.

Methods: We compared 12 valve operations that were performed in our clinic with minithoracotomy (group I) between January 1997 and November 1999 with 13 valve operations that were performed with conventional median sternotomy (group II) in the same period in regard to preoperative, perioperative and postoperative variables, retrospectively. Preoperative variables were age, sex, bleeding time, clotting time, platelet count, and additional diseases like diabetes mellitus, hypertension, etc. Perioperative variables were extracorporeal circulation (ECC) time, cross-clamp (CC) time, and operation time. Postoperative variables were mechanical ventilation period, stay in the postoperative intensive care unit and hospital, mediastinal drainage amount, the amount of blood and blood products for transfusions, and costs. Group I consist of six mitral valve replacements (MVRs), three aortic valve replacements (AVRs), one aortic valve replacement combined with mitral valvuloplasty, and two tricuspid valve replacements (TVRs). Group II consist of nine MVRs and four AVRs.

Results: Statistical results are given with mean standard error (SEM) deviations. There were significant differences between the two groups in respect to operation time (in group I, mean operation time was 328 ± SEM 22 minutes in group II, 271 ± SEM 14 minutes ($p < 0.04$)); mediastinal drainage (in group I, mean drainage time was 283 ± SEM 57 cc/m^2, in group II, 490 ± SEM 74 cc/m^2 ($p < 0.04$)); and amounts of transfused blood and blood products (in group I, mean transfused blood products amount was 375 ± SEM 115 cc/m^2, in group II, 874 ± SEM 184 cc/m^2 ($p < 0.03$)).

Conclusion: The operation times are apparently longer in the minithoracotomy group. On the other hand, less mediastinal drainage occurred and less blood and blood products transfusion needs were determined to exist in the minithoracotomy group.

INTRODUCTION

Although performing open heart surgery with a thoracotomy is not new, this approach became popular once again among heart surgeons in the years after the first introduction of thoracic incisions in mitral valve operations by Lillehei and colleagues (4). The thoracotomy incisions that are used in minimally invasive surgery are much smaller than those used in routine thoracic surgery and those used at the beginning of heart surgery. During minimally invasive heart surgery, the length of the incisions might range from several centimeters to 10 centimeters depending on the surgical methods. Some additional incisions, like groin incisions for cannulation of arterial and venous systems and other small thoracic incisions for visualization equipment, may be required in thoracoscopic procedures and in the most of the less invasive operations. Carpentier et al. [Carpentier 1996] performed the first thoracoscopic mitral valve repair through a minithoracotomy in February 1996. Chitwood et al. [Chitwood 1997] performed the first micromitral valve repair under direct vision through a minithoracotomy three months after the thoracoscopic valve repair of Carpentier.

In our study, we reviewed our clinical experience with less invasive approaches and compared the results of

Presented at the Third Annual Meeting of the International Society for Minimally Invasive Cardiac Surgery, Atlanta, Georgia, June 8–10, 2000

Address correspondence and reprint requests to: Hakan Gercekoglu, Tunek Sk.No:23 Sozen Apt. 7/32 81080 Goztepe Istanbul, Turkey, Phone: 90 216 3688574, Fax: 90 216 3379719, Email: hakangercekoglu@siyami-ersek.com

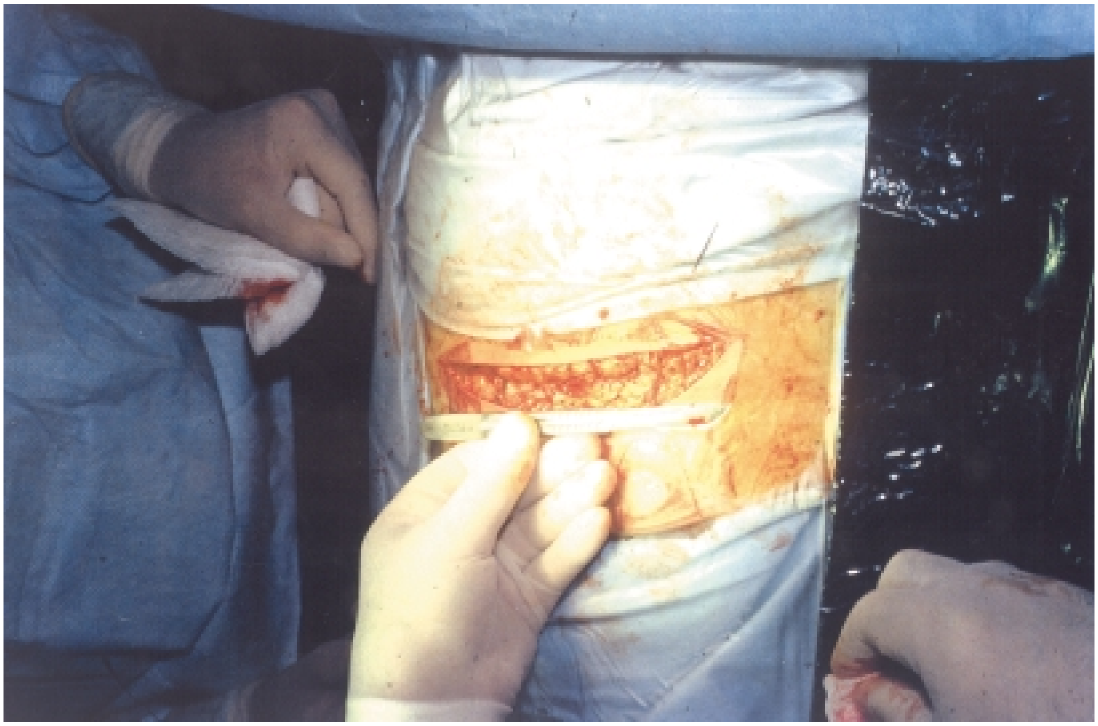

Figure 1.

minithoracotomy incisions in heart valve operations with those of sternotomy.

MATERIALS AND METHODS

The patients who were operated upon either by minithoracotomy (group I) or conventional sternotomy (group II) in our clinic between January 1997 and November 1999 were compared retrospectively.

In group I, a limited right anterolateral thoracotomy (10-15 cm long) was used. In only one case in group I was a ministernotomy used in an aortic valve replacement (AVR) operation. In group II, all cases were done through a median sternotomy (Figure 1, ◎).

The right minithoracotomy incision was made directly over the fifth intercostal space, which is closest to the area of pathology. In one case, the fourth intercostal space was used for access to the aortic valve.

In both groups, standard cannulation methods were used for extracorporeal circulation, except that in one tricuspid valve replacement (TVR) case in group I the right femoral artery was used for arterial cannulation. All standard cannulations, including aortic arterial cannulation, bicaval venous cannulation for mitral and tricuspid valve operations, right atrial two-stage venous cannulation for aortic valve operations, and right superior vein vent cannulation, were done through the same limited minithoracotomy (Figure 2, ◎).

The preoperative, perioperative and postoperative findings of the two groups that were operated upon either via minithoracotomy (group I) or conventional sternotomy (group II) in our clinic between January 1997 and November 1999 were compared retrospectively. Group I consisted of five female and seven male patients who had isolated heart valve disease and no other complicating cardiac lesions or systemic disorders. Mean age of patients was 31 years in group I. Likewise, group II consist of six female and seven male patients with the same kind of indications as those of the group I patients. The mean age of patients in group II was 44 years. All the patients were prepared for the operation with the same kind of anesthetic evaluation and open heart surgery procedures (ECG and arterial blood pressure monitoring, Swan-Ganze catheter insertion, and monitoring of pressures of right and left sides of heart, Foley catheter insertion, etc.). Extracorporeal circulation was initiated after performing routine cannulation methods and achieving appropriate levels of ACT (>400 sec) in all of the patients. The standard cannulation (ascending aortic arterial cannulation and bicaval venous cannulation for mitral and tricuspid valve diseases and two-stage venous cannulation for aortic valve disease) was employed in both groups. In one patient in group I, femoral artery cannulation was used in conjunction with a minithoracotomy. All of the materials used during extracorporeal circulation and operation other than the thoracic retractor used in minithoracotomy were the same in both groups. Myocardial protection provided for both groups was 28°C systemic hypothermia, cold crystalloid cardioplegia and local cold application. In TVR operations in group I, surgery was performed on the beating heart. Having achieved almost identical preoperative conditions, the two

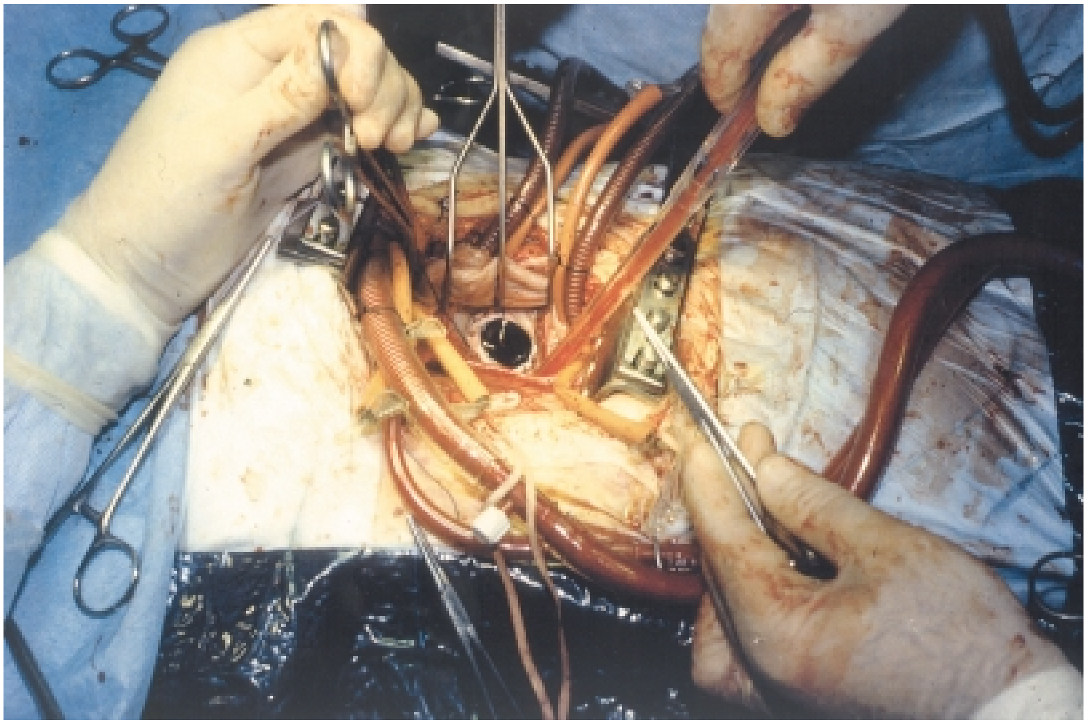

Figure 2.

groups were operated upon in the usual way in regard to their specific heart valve lesions, either through a minithoracotomy or a sternotomy incision.

The preoperative variables were age, gender, and persistence of other additional systemic diseases, all of which would influence the surgeons in deciding for a less invasive procedure through a limited route (Table 1,). The surgeons were careful to select patients for a minimally invasive operation who were normal in regard to hematologic values, who exhibited minimal additional diseases, and whose physical characteristics were favorable for performing an easy minithoracotomy. The perioperative variables that were compared in this study included extracorporeal circulation (ECC) times, cross-clamp (CC) times, and total operation times of the two groups (Table 2,). The postoperative variables examined were mechanical ventilation times, stay in the intensive care unit and the hospital, mediastinal drainage amounts in the first 24 hours, amounts of transfused blood and blood products, and earnings achieved with the alternative operative approaches (Table 3,).

ECC times, CC times, operation times, and mechanical ventilation times were estimated in minutes; postoperative stay in the intensive care unit was recorded in hours; postoperative stay in the hospital was recorded in days; mediastinal drainage amounts were calculated as ml/m^2/day (in the first 24 hours); and total amounts of transfused blood and blood products were measured in ml/m^2. Lastly, mean earnings were calculated in Turkish liras (TL) and U.S. dollars ($).

For the purpose of deciding to administer transfusion of blood and/or blood products, the hemoglobin lower limit of individual patients was taken as 9 gm./100ml. Since the price of eight packs of blood and its products was included in the total programmed cost of open heart surgery, only the cost of transfused blood and its products in excess of eight packs was considered in the calculation of earnings.

In calculating the costs, all of the expenses for the open heart surgery procedure itself were excluded from the price ($3952.50 for any open heart surgery) as a benefit covered under the social safety system of Turkey. The expenses are: $823.20 for equipment used in open mitral valve surgery; $889 for equipment used in open aortic valve surgery; $740.40 for open tricuspid valve surgery equipment; $777.20 for open heart surgery anesthesia equipment; $964.50 for open heart surgery pump equipment; $112.80 for a one-day stay in a postoperative intensive care unit; and $6.50 for a one-day stay in the cardiac surgery clinic. Costs for eight units of whole blood are included in this amount, and any additional usage of blood or blood products is added to the expenses — for an additional unit of whole blood the cost is $18, and for an additional unit of plasma or erythrocyte sus-

Table 1. Preoperative variables

	Gender			Diagnosis					
	Female	Male	Mean age	MS	MY	MS+MY	AS	AS+AY	TY
Group I	5	7	31	3	1	2	0	4	2
Group II	6	7	44	7	0	2	3	0	0

Table 2. Perioperative variables

	Operations				Mean ECC times minute	Mean CC times minute	Mean Operation times minute
	MVR	AVR	TVR	AVR+Mitral annuloplasty			
Group I	6	3	2	1	128	87	328
Group II	9	4	0	0	105	76	272

Table 3. Postoperative variables

	Mean ICU stay Hour	Mean hospital stay Day	Mean mechanical ventilation times Minute	Mean drainage amounts in first 24 hours cc/m^2	Mean blood and blood products transfusions cc/m^2	Mean earnings Dollars
Group I	46	8	491	260	345	834
Group II	44	8	769	491	874	938

pension the cost is $9. All of the calculations were initially based on the Turkish monetary unit, the Turkish lira (TL) ($1 = 445,000 TL at the time of the study). Thereafter, the costs were converted to dollars. There was no difference between the two groups in the cost of the operation and extracorporeal circulation equipment. Variables that reflected differences in costs between the two groups were time of postoperative intensive care unit stay, total time of postoperative hospital stay, and additional blood and blood product transfusions. Since there is no defined price for operating room use, operation times are not added to the costs.

In the stasistical analysis, for the comparison of variables that fit within the normal distribution, the Student t-test and the Chi-square test were used, and in the comparison of variables that did not fit within the normal distribution, the Mann Whitney U test and Fisher's exact test were used. The values were given as ± SEM (mean standard error). $P < 0.05$ is regarded as meaningful.

RESULTS

Extracorporeal times in both groups were close to each other; there was no statistically significant difference between the two groups in respect to ECC times ($p < 0.1$), and no statistically signifcant difference was found for cross-clamp times ($p < 0.4$). Only in some individual cases in group I were ECC and CC times longer than expected. There was a statistically meaningful difference between the two groups in operation times: mean operation time for group I was 328 ± SEM 22 minutes and in group II it was 271 ± SEM 14 minutes ($p < 0.04$) (Table 1,). Operation times were higher in the minimally invasive group because of the surgeons' limited experience in viewing the surgical field through a very small port. Since there is no defined price for operating room use, this difference does not cause an additional expense in our institution. On the other hand, in other institutions any additional time spent in the operating room is included in calculating the cost of the operation [Cooley 1998]. Although shorter postoperative intensive care unit stays and postoperative hospital stays were expected in the minimally invasive surgery group, and the shortest stays were indeed achieved in this group, the overall times for these parameters in both groups were almost the same. Mechanical ventilation times in group I were shorter than those in group II, but differences were not statistically meaningful. Mediastinal drainage (mean for group I: 283 ± SEM 57 cc/m^2; mean for group II: 490 ± SEM 74 cc/m^2 ($p < 0.04$)) and blood and blood product transfu-

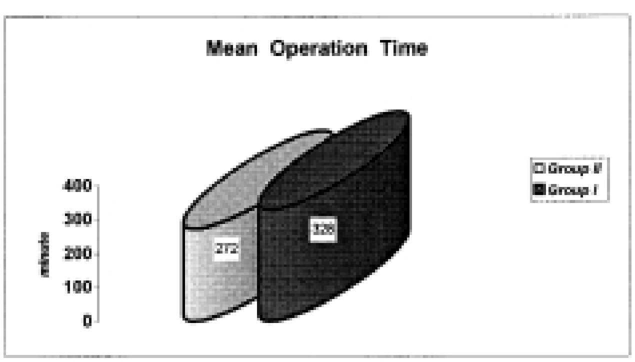

Figure 3.

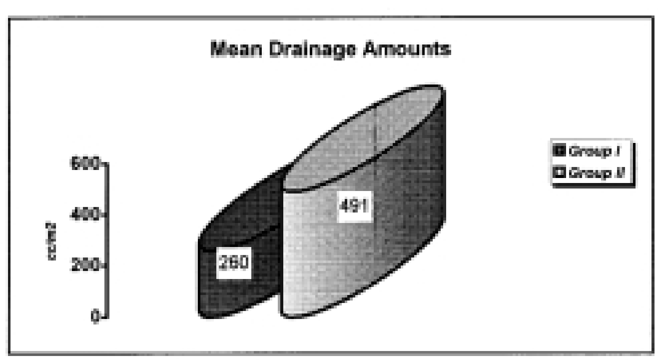

Figure 4.

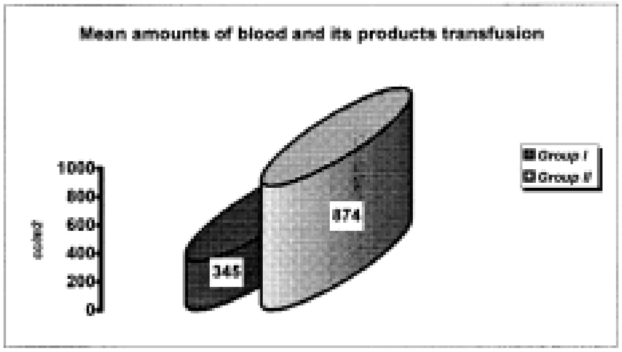

Figure 5.

sion (mean for group I: 375 ± SEM 115 cc/m^2; mean for group II: 874 ± 184 cc/m^2 ($p < 0.03$)) were higher in amount in the median sternotomy group and the differences were statistically meaningful (Table 2, ◎, Table 3, ◎). Lastly, earnings from each group were almost the same since, as mentioned previously, the statistically meaningful differences that existed between the two groups had little effect on the total of expenses because of the absence of defined operating room expenses and the inclusion of eight units of blood and blood products in the uniform price of open heart surgery under the Turkish social safety system.

In group I, one patient (MVR) was lost during the early postoperative period because of posterior myocardial rupture and masive bleeding (mortality in group I was 8.3%). We observe that performing open heart resuscitation on this kind of patient is very difficult and requires the immediate intervention of a well-informed surgical team.

CONCLUSION

It is obvious that not only cosmetic reasons drive surgeons to perform less invasive heart surgery procedures. The less invasive procedures are also intended to minimize harm to patients by reducing blood loss, reducing the danger of infection by minimizing wound dimensions, and lessening thoracic wall immobilization, thereby shortening the patient's ICU and hospital stay and decreasing costs. In our less invasive study group, we achieved less mediastinal drainage and blood loss, so that less blood and blood products were required for transfusion. The operation times were longer in this group as a result of the greater difficulty of working through a small incision. Additionally, performing cannulation through the minithoracotomy left only a very narrow space for performing the surgical procedures, but we think that with more experience in practicing the less invasive technique, operation times will begin to approach those of median sternotomy in well-selected cases. Lastly, we observed that patients, especially women, were more satisfied with the cosmetic results achieved with minithoracotomy (see Figures 3, 4 and 5, ◎). Less invasive surgery can be a good alternative to the classic open heart surgery approach in well-selected cases when it is performed by an experienced surgeon and surgical team.

REFERENCES

1. Carpentier A, Loulmet D, Le Bret E, et al. Chirurgie a coeur ouvert por video-chirurgie et minithoracotomie premier cas (valvuloplastie mitrale) opere avec success. C R Acad Sci Ser Vie 319:219–23, 1996.
2. Chitwood WR, Elbeey JR, Chapman WHH, et al. Video-assisted minimally invasive mitral valve surgery: the micromitral operation. J Thorac Cardiovasc Surg 113:413–4, 1997.
3. Cooley DA. Minimally invasive valve surgery versus the conventional approach. Ann Thorac Surg 66:1101–5, 1998.
4. Lillehei CW, Gott VL, Dewall RA, et al. Surgical correction of pure mitral insufficiency by annuloplasty under direct vision. Lancet 1:446, 1957.