

# Comparative Study of Thoracic Approaches in Atrial Septal Defect Closure

Juan-Miguel Gil-Jaurena, Marcos Murtra, Arturo Gonçalves, Luis Miró, Ramón Vilá<sup>a</sup> and Manel García-Górriz<sup>a</sup>

Servicios de Cirugía Cardíaca y <sup>a</sup>Anestesiología. Hospital Universitario Infantil Vall d'Hebron. Barcelona. España.

Our early experience in approaching ASD by right thoracotomy as opposed to midline sternotomy is presented. Between July 2000 and December 2001, 15 patients (group A) were operated by right thoracotomy. Mean age of patients was 8.6 years and mean weight was 31.6 kg. In the same period, midline sternotomy was used in 16 patients (group B). Mean age was 4.7 years and weight was 16.5 kg. The duration of the procedure, by-pass, and aortic cross-clamping were similar. Bleeding was 265 ml (8.4 ml/kg) in group A, and 152 ml (9.2 ml/kg) in group B. The duration of the ICU stay and time of discharge were 2.4 days and 6 days in group A, and 2.23 days and 6.87 days in group B, respectively. No significant differences were found in ASD closure by thoracotomy and sternotomy. The cosmetic appearance acceptance of right thoracotomy was excellent.

**Key words:** *Atrial septal defect. Thoracotomy. Direct cannulation.*

Full English text available at: [www.revespcardiol.org](http://www.revespcardiol.org)

## Estudio comparativo de la vía de abordaje en el cierre de la comunicación interauricular

Presentamos nuestra experiencia inicial en cierre de la comunicación interauricular (CIA) por vía derecha, comparándola con esternotomía media. Entre julio de 2000 y diciembre de 2001, 15 pacientes (grupo A) fueron intervenidos por toracotomía derecha. La media de edad fue de 8,6 años y el peso medio, de 31,6 kg. En el mismo período, 16 pacientes (grupo B) fueron intervenidos por esternotomía media. La edad media fue de 4,7 años y el peso, de 16,5 kg. Las duraciones de la intervención, de la circulación extracorpórea y de la isquemia cardíaca fueron similares. El drenaje total fue de 265 ml (8,4 ml/kg) en el grupo A, y de 152 (9,2 ml/kg) en el grupo B. La estancia media en la UCI y postoperatoria fue de 2,4 y 6 días, respectivamente, en el grupo A, y de 2,23 y 6,87 días, respectivamente, en el grupo B. No encontramos diferencias significativas en el cierre de CIA por toracotomía o esternotomía. Por toracotomía derecha el resultado estético fue excelente.

**Palabras clave:** *Comunicación interauricular. Toracotomía. Canulación directa.*

## INTRODUCTION

Midline sternotomy is the incision generally used for heart surgery. Articles that describe alternative approaches appear regularly that are surgically less traumatic and eliminate the risk of sternal instability, in addition to improving cosmetic results.<sup>1-3</sup>

In this study we report our initial experience in the closure of atrial septal defects (ASD) in children using right anterolateral thoracotomy, with cannulation of the aorta and both cava veins through the same incision. The results obtained are compared with a control group of patients with ASD closed by midline sternotomy.

Correspondence: Dr. J.M. Gil-Jaurena.  
Servicio de Cirugía Cardíaca. Hospital Universitario Vall d'Hebron. Paseo Vall d'Hebron, 119-129. 08035 Barcelona. España.  
E-mail: [giljaurena@yahoo.com](mailto:giljaurena@yahoo.com)

Received 11 March 2002.

Accepted for publication 14 June 2002.

## MATERIAL AND METHODS

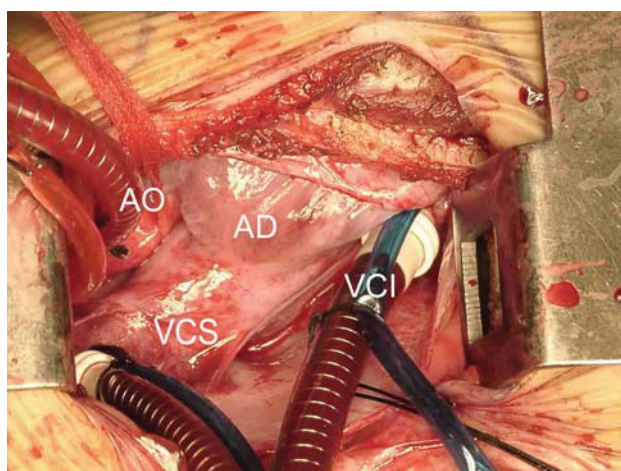
From July 2000 to December 2001, 15 patients (group A) underwent ASD closure via a right anterolateral thoracotomy. The surgical indication was ostium secundum ASD (8 cases), sinus venosus with partial anomalous drainage of pulmonary veins (4 cases), and ostium primum ASD (3 cases). In the same period, 16 patients (group B) underwent surgery using midline sternotomy (12 ostium secundum, 4 ostium primum). Patients were assigned to one approach or another at the discretion of the surgeon (Table 1).

## Inclusion criteria

Initially, female patients with complete breast development were chosen. Later, age was not an inclusion criterion. Similarly, the first cases were ostium secundum type ASD, then the indication was expanded to



**Fig. 1.** Preparation of patient. Scapular girdle tilted 30-45°. Continuous line: skin incision (sixth space). Dotted line: thoracotomy (fourth space).



**Fig. 2.** Cannulation through the thoracotomy. RA indicates right atrium; AO, aorta; IVC, inferior vena cava; SVC, superior vena cava.

include sinus venosus and ostium primum type ASD.

### Exclusion criteria

Age under 2 years; diseases not located in the atrial septum.

### Anesthesia

All patients received balanced general anesthesia with propofol, fentanyl, sevoflurane, and ropivacaine. In addition, thoracic epidural anesthesia was associated (puncture level T6-T8) in 10 patients in group A, with intraoperative ropivacaine and postoperative morphine (24-36 h). The epidural catheter was introduced after the patient had been intubated and withdrawn when the patient was discharged from the ICU.

**TABLE 1. Demographic data**

|                    | Thoracotomy                                             | Sternotomy                            |
|--------------------|---------------------------------------------------------|---------------------------------------|
| Sex, male/female   | 7/8                                                     | 9/7                                   |
| Age, years         | 8,6 (3-15)                                              | 4,7 (10 months-16 years)              |
| Weight, kg         | 31,6 (15-77)                                            | 16,5 (6,8-70)                         |
| ASD type           | 8 ostium secundum<br>4 sinus venosus<br>3 ostium primum | 12 ostium secundum<br>4 ostium primum |
| Associated defects | 1 VSD                                                   | 1 VSD, 1 PS, 2 ductus                 |

VSD indicates ventricular septal defect; PS, pulmonary valve stenosis.

### Access

After making the skin incision (Figure 1), the subcutaneous tissue (future mammary gland) and pectoral muscle are dissected en bloc. The latissimus dorsi and serratus muscles do not have to be sectioned. The thorax is opened in the fourth intercostal space. After removing the right lobe of the thymus, the pericardium is opened in front of the phrenic nerve and the incision is prolonged in cephalad direction over the aorta. Exposure of the aorta is facilitated by fixing the pericardium to the second rib, then passing a tape to facilitate aortic traction and manipulation.

### Cannulation

The aorta and both vena cava can be cannulated directly (Figure 2) through the thoracotomy. Ostium secundum type ASDs were closed by direct suture or a patch. Sinus venosus ASD was closed with a patch and enlargement of the atriotomy in the superior vena cava with another patch. Ostium primum ASDs were closed with a patch of autologous pericardium and closure of the cleft mitral valve.

### Associated procedures

In one patient in group A, a ventricular septal defect was closed (intermediate channel). In group B, a patent ductus arteriosus was ligated in 2 cases. In one patient, a pulmonary commissurotomy was made and in one patients, a small ventricular septal defect was closed.

After completing the correction, ventricular pacemaker leads were placed before unclamping the aorta. The ventilation and defibrillation maneuvers were similar to those used with sternotomy: in every case, the pericardium was closed and two drainages were left in place (intrapericardial and intrathoracic).

### RESULTS

The mean duration of the intervention was 152 min with the thoracotomy approach and 137 min with the sternotomy approach. Cardiopulmonary bypass lasted

TABLE 2. Results

|                               | Thoracotomy     | Sternotomy      |
|-------------------------------|-----------------|-----------------|
| Surgical time, min            | 152 (120-195)   | 137 (105-180)   |
| CPB time, min                 | 43.2 (22-72)    | 47.4 (25-74)    |
| Clamping time, min            | 25.8 (8-50)     | 24.3 (7-52)     |
| Drainage, ml                  | 265 (8.4 ml/kg) | 152 (9.2 ml/kg) |
| ICU stay, days                | 2.4             | 2.27            |
| Discharge after surgery, days | 6               | 6.87            |

CPB indicates cardiopulmonary bypass; ICU, intensive care unit.

43.2 min with thoracotomies and 47.4 min with sternotomies, and clamping lasted 25.8 min with thoracotomies and 24.3 min with sternotomies (Table 2). Thirteen of the 15 patients in group A and 2 of the 16 patients in group B were extubated in the operating room. The rest of the patients were extubated within the first 6 h of their stay in the ICU. The total amount of fluid drained was 265 ml (8.4 ml/kg) in group A and 152 ml (9.2 ml/kg) in group B.

The mean stay in the ICU was 2.4 days in group A and 2.23 days in group B. Patients were discharged at 6 days in group A and at 6.87 days in group B.

One patient in each group presented postoperative pericarditis. Specific complications of the approach were one case of transient phrenic paresis in the thoracotomy group and a surgical wound infection in the sternotomy group.

The chest radiograph and echocardiograph made before discharge were acceptable in every patient in both groups.

The preadolescents (5 patients) and parents of younger children who underwent thoracotomy described the cosmetic result as excellent.

## DISCUSSION

There is no doubt that midline sternotomy is the most common, convenient, and safe approach, and that it provides better exposure for the cardiac surgeon. Several authors have reported their experience with alternative approaches to sternotomy (less invasive, better cosmetic result, etc.) for the surgical treatment of certain congenital heart diseases:<sup>3-13</sup> all agree that the cosmetic results of the surgical approach are important, especially in girls and women.

In this context, right anterior thoracotomy is particularly attractive for two reasons: it uses a space below the breast for the incision (better cosmetic result), and it provides «easy» access to the right atrium, thus facilitating surgery in conditions that are approached this way. Consequently, surgical correction of ASD, particularly in young women, is the target of this approach. The cosmetic advantage in males is more debatable, considering that hair growth may dissimulate the effects of midline sternotomy.

On the other hand, there is controversy about compromising the future growth of breast tissue in young girls.<sup>14</sup> One French group recommends delaying right thoracotomy until the breasts are fully developed in these patients.<sup>10</sup> However, the real risk of affecting the breast tissue is scant if the skin incision is made below the sixth intercostal space and the subcutaneous tissue is dissected en bloc with the pectoral muscle before attempting thoracotomy in the fourth space.<sup>9</sup> The possibility of affecting the spine is remote, inasmuch as the anterolateral thoracotomy respects the latissimus dorsi and the spinal muscles.<sup>14</sup> In any case, only prolonged follow-up can provide evidence of cosmetic effects on the breasts or spine.

From a technical point of view, most groups attempt to reproduce the basic steps of sternotomy when using the thoracotomy approach: cannulation of the aorta and two vena cava, clamping and cardioplegia, all through the same incision (Figure 2).

Our work has several biases. In the first place, it is not a randomized study. The distribution in both groups was individualized way at the discretion of the surgeon. The first 3 cases for thoracotomy were selected (ostium secundum type ASD in girls with fully developed breast), then the indications were later extended. For this reason, the mean weight and age of group A is greater, and there are two peak ages (3-4 and 13-14 years). In contrast, 10 of the patients in group B were younger than 4 years. Secondly, several patients in the thoracotomy group were selected by anesthesiologists to undergo general anesthesia in addition to epidural anesthesia and they were extubated in the operating room. This explains the large number of extubations that took place in the operating room in group A.

## CONCLUSIONS

Surgical closure of ASDs through a right anterolateral thoracotomy was feasible in our initial series. There were no significant differences in the results compared with midline sternotomy. The instruments used and surgical steps were the usual ones. The cosmetic results of thoracotomy were excellent.

## ACKNOWLEDGMENTS

We would like to that Dr. Guinot, of the Department of Plastic and Reconstructive Surgery of the Hospital Universitario Infantil Vall d'Hebron of Barcelona, for his collaboration and advice.

## REFERENCES

1. Komai H, Naito Y, Fujiwara K, Takagaki Y, Nishimura Y, Kawasaki S, et al. Lower mid-line skin incision and minimal sternotomy –a more cosmetic challenge for pediatric cardiac surgery. *Cardiol Young* 1996;6:76-9.

2. Cremer JT, Böning A, Anssar MB, Kim PY, Pethig K, Harringer W, et al. Different approaches for minimally invasive closure of atrial septal defects. *Ann Thorac Surg* 1999;67:1648-52.
3. Massetti M, Babatasi G, Rossi A, Neri E, Bhoyroo S, Zitouni S, et al. Operation for atrial septal defect through a right anterolateral thoracotomy: current outcome. *Ann Thorac Surg* 1996;62:1100-3.
4. Lancaster LL, Mavroudis C, Rees AH, Slater AD, Ganzel BL, Gray LA Jr. Surgical approach to atrial septal defect in the female. Right thoracotomy versus sternotomy. *Am Surg* 1990;56:218-21.
5. Rosengart TK, Stark JF. Repair of atrial septal defect through a right thoracotomy. *Ann Thorac Surg* 1993;55:1138-40.
6. Liu YL, Zhang HJ, Sun HS, Li SJ, Su JW, Yu CT. Correction of cardiac defects through a right thoracotomy in children. *J Thorac Cardiovasc Surg* 1998;116:359-61.
7. Wu YC, Chang CH, Lin PJ, Chu JJ, Liu HP, Yang MW, et al. Minimally invasive cardiac surgery for intracardiac congenital lesions. *Eur J Cardiothorac Surg* 1998;14:S154-9.
8. Cherian KM, Pannu HS, Sankar NM, Agarwal SK, Basavarj S, Rao SG, et al. Thoracotomy approach for congenital and acquired heart defects: its possible applications in the current era. *J Card Surg* 1996;11:37-45.
9. Dietl CA, Torres AR, Favaloro RG. Right submammary thoracotomy in female patients with atrial septal defects and anomalous pulmonary venous connections. Comparison between the transpectoral and subpectoral approach. *J Thorac Cardiovasc Surg* 1992;104:723-7.
10. Grinda JM, Folliquet TA, Dervanian P, Macé L, Legault B, Neveux JY. Right anterolateral thoracotomy for repair of atrial septal defects. *Ann Thorac Surg* 1996;62:175-8.
11. Metras D, Kreitmann B. Correction of cardiac defects through a right thoracotomy in children. *J Thorac Cardiovasc Surg* 1999;117:1040-1.
12. Däbritz S, Sachweh J, Walter M, Messner BJ. Closure of atrial septal defects via limited right anterolateral thoracotomy as a minimal invasive approach in female patients. *Eur J Cardiothorac Surg* 1999;15:18-23.
13. Riess FC, Moshar S, Bader R, Hoffmann B, Löwer C, Bleese N. Correction of congenital heart defects and mitral valve operations using limited anterolateral thoracotomy. *Heart Surg Forum* 2001;4:34-9.
14. Cherup LL, Siewers RD, Futrell JW. Breast and pectoral muscle maldevelopment after anterolateral and posterolateral thoracotomies in children. *Ann Thorac Surg* 1986;41:492-7.