Minimally Invasive Video-assisted Closure of Atrial Septal Defects: Report of Three Cases

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This paper received the 97' National Surgery Award by the Academia Mexicana de Cirugía. The subject is a video-assisted thoracoscopic novel technique to perform cardiac surgery with closed chest. We report three cases of atrial septal defects closed by this way.

ABSTRACT

Background. Painful sternotomy is a major problem in cardiac surgery. The development of minimally video-assisted cardiac surgery decrease pain and provide a faster recovery avoiding sternotomy. There are no reports about the use of an Inohue catheter to perform aortic clamp nor the insertion of high flow cannula in the jugular vein to drain the superior cavae, in order to complete a peripheral cardiopulmonary by pass to perform minimally invasive cardiac surgery.**Methods.** Three patients were successfully submitted to video-assisted closure of ASD without sternotomy by cardiopulmonary bypass (CCCPB), peripheral bicaval cannulation, endoaortic balloon occlusion (EBO), cardioplegia delivery and aortic venting with the Inoue catheter. **Results.** Although EBO and CCCPB times were elapsed by the procedure, pain score was < 4 (Analogue Visual Score) and the hospital stay was of 3, 5 and 5 days for each patient. **Conclusions.** Video-assisted cardiac surgery performed by port-access minithoracotomies with new endoscopic instruments, closed-chest cardiopulmonary bypass, endoaortic balloon occlusion and cardioplegic heart arrest is feasible. Further randomized prospectives studies must be performed.

Key Words. Atrial septal defect, minimally invasive cardiac surgery, endoaortic clamping, peripheral cardiopulmonary by pass.

Introduction

Video-assisted cardiac surgery **(VACS)** performed by trocars, port-access minithoracotomies or ministernotomies (1-4) with new endoscopic instruments, closed-chest cardiopulmonary bypass **(CCCPB),** endoaortic balloon occlusion **(EBO)** and cardioplegic heart arrest is as feasible (table 1), safe and effective as conventional open chest methods (5,6).

Closure of atrial septal defects **(ASD)** with electrically induced fibrillatory arrest and hypothermia of 22º C, without aortic clamping or venting are reported by Shetty´s group and Chang group, respectively (3,7). Here we report our preliminary experience of ASD closure with CCCPB, bicaval cannulation and EBO with an Inoue catheter.

TABLE 1

Port-access and minithoracotomies for ASD * Closure by VACS

Type	Author	Features	Complications	Current status
Minithoracotomy (4-7 cm)	Chang et al (1996)	No aortic clamping or venting Hypothermic fibrilatory arrest †	None	Cases report (n=8)
Port-access	Shetty (1996)	Electrical fibrillatory arrest without cardioplegia	Hospital stay of 20 days	First case report with bicaval clamping.
Minithoracotomy	Honek et al. (1996)	Venous cannulas placed in the Surgical field. Electrical fibrillatory arrest	None	Cases report (n=4)

* ASD= Atrial septal defect † 22º C (rectal)

Case Reports

Case 1.

With diagnosis of atrial septal defect a 12 years old female complaining of mild disphnea was studied in the service of cardiology. At physical examination, we found her in good general condition, weighting 39 kg, no cyanosis, and a soft ejection systolic murmur with fixed split-second sound. Chest X-ray showed grade I cardiomegaly. EKG: Sinus rhythm and incomplete right bundle-branch block. Echocardiogram: aortic ring of 18 mm, Pulmonary ring 22.8 mm (pulmonary / aortic rate of 1.26:1). An atrial septal defect of 19x11 mm with a left to right shunt and a Qp/Qs ratio of 1.8:1, paradoxical septal movement and a pulmonary artery pressure of 37 mmHg. The ASD was closed by VACS successfully in July, 15, 1997. The EBO and CCCPB time (min), hospital stay (HS) and Visual Analogue Score (VAS) were of 11.5 , 35, 3 days and 2, respectively. Patient was discharged uneventfully.

Case 2

A 16 years old male, 42 kg. of weight. The echocardiogram shows an ASD of 25x20 mm, pulmonary artery pressure of 45 mmHg and a Qp/Qs ratio of 2.37:1. This patient was successfully submitted to an ASD closure by VACS on July, 28,1997. In this case a fourth 5 mm. trocar avoided the minithoracotomy, as we did in the first and third case, providing a totally thoracoscopic approach. At first postoperative day an exploratory minithoracotomy to role out active bleeding was mandatory. No bleeding sites were founded. EBO, CCCPB times, HS and VAS were of 36,100, 5 and and 4, respectively.

Case 3.

The third case was a 21 years old female, weighting 51 kg, complaining of severe orthopnea with clinical signs of cardiac failure. Echocardiography detected an ASD of 24x28 mm, a pulmonary artery pressure of 52 mmHg and a Qp/Qs ratio of 3.2:1. The surgery was performed at August 4, 1997. During the procedure we found that the right atrial free wall was the external border of a posteroinferior ASD. With this finding and continuous bleed from the inferior cavae the ASD identification was difficult. EBO, CCCPB times, HS and VAS were of 45, 95 , 5 dy and 2, respectively.

The informed consent was obtained from the patients and their parents in each case.

Surgical Technique Details.

Total CCCPB was performed trough right femoral vessels dissection and right jugular vein percutaneous cannulation with fluoroscopic guidance (Siemens Siremobil 2000). Three trocars of 5 mm (ETHICON, Johnson & Johnson) was placed at fourth, third and fifth right intercostal spaces (Figure 1). A 30 º, 4 mm. thoracoscope connected to an endocamera (Karl Storz- Endoskope) was introduced in the chest cavity. A controlled pneumothorax was sustained with a continuous flow of CO2 at 1l/min to maintain an intrathoracic pressure below 5 mm/Hg.

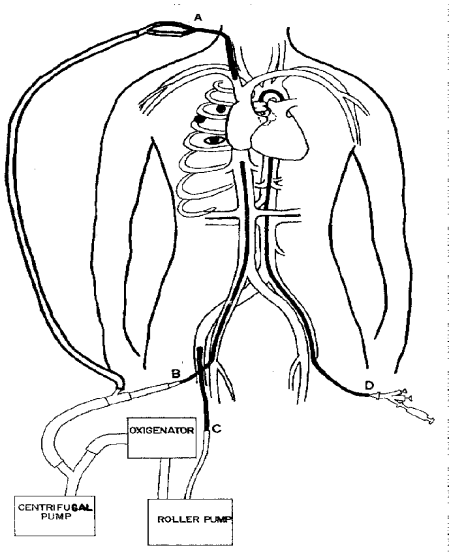

Fig. 1. Diagramatic draw of the system.

A= Internal jugular high flow cannula (Jostra Medizintechnik Gmb & Co,KG). **B=** Femoral Venous cannula (Medtronic Bio-medicus). **C=**Femoral arterial cannula (Jostra Medizintechnik Gmb & Co,KG). **D=** Inoue catheter-balloon inserted at left femoral artery and placed at the aortic root**.**

(Richard Wolf Endo-Chirurgie-Pneu+ Irrigator). Both cavae were clamped through the upper and inferior middle clavicular line punctions. The venous drainage was assured with a centrifugal pump (Lifestream, ST Jude) and the arterial return was performed by means of a roller pump (SARNS 7500). Under fluoroscopic guidance and video-assisted view , an INOUE catheter (Toray Industries,Inc.) for aortic occlusion, cardioplegic heart arrest and aortic root venting was placed in the ascending aorta by left femoral artery dissection (Figure 2) and later inflated until fixation was achieved. Once the CCCPB begun, we convert the inferior punction site to a 3 and 4 cm port-access in cases one and three, in order to facilitate aspiration, suture and thoracoscopic knotting handle. After right atriotomy, the ASD was identified and closed (Figure 3) with double running 4-0 prolene suture (Ethicon, Johnson & Johnson) and laparoscopic needle holder (Ethicon, Johnson & Johnson). The atriotomy was closed in the same way except in case 3 in which we used successfully a laparoscopic stapler (OMNITAC, Johnson & Johnson). Trocars were retired under thoracoscopic view verifying bleed absence. Tube was withdrawn from patients at the operating room. A pleurotomy tube was placed in each case and retired 24 hr later with a normal chest x-ray.

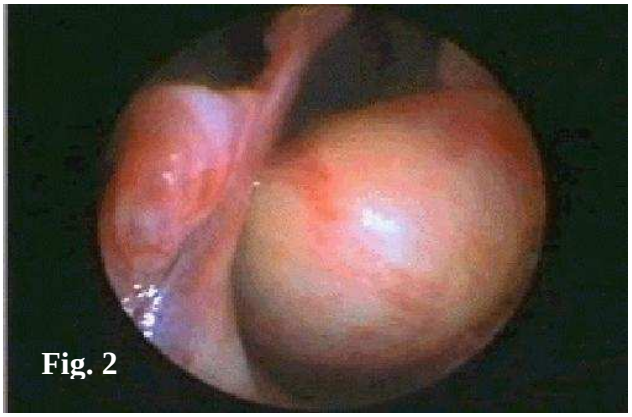

Fig. 2. This picture shows thoracoscopic view of the INOUE catheter-balloon placed at the aortic root**. PS=** Pericardial sac **ABD=** Aortic baloon dilatation.

Discussion.

ASD is the fifth most common congenital anomaly with a frequency of 3.2/10,000 live births (8). The unadvised patent foramen ovale have an autopsy prevalence of 27 to 35 %, meaning a risk for paradoxical embolism (9). Although Mavroudis (10) reasonably stated that traditional secundum ASD closure is a high-benefit, low-risk operation with excellent results occasional morbidity and mortality occurs. In attempt to avoid a painful sternotomy and hospital stay that expenses costs, the transcatheter closure of ASD by different devices are been used, but failures are reported (11). The closure of ASDs by minithoracotomies performed without aortic clamping or venting and by hypothermic fibrillatory arrest (2,3,6), is another modality of treatment (Table 1). Our model, based on Schwartz and Stevens works is a technique that improve this limitations making total

Fig. 3. Shows the closure of the atrial defect with running prolene 0000 suture. **ASD=** atrial septal defects. **RV=** right ventricle, **TV=** Tricuspid valve.

normothermic CCCPB and EBO feasible with an Inoue catheter-balloon that showed properties similar to those, experimentally and specifically designed (2,5,6). This catheter is a rubber nylon single balloon being used worldwide for performing valvuloplasties in any cardiac valve. Its popularity is attributed to its self-positioning configuration, size-adjustability, rapid inflation-deflation sequence and ease of performance (12-14).

Once CCCPB is obtained, VACS could be performed in two ways : 1) minithoracotomies with conventional instruments and 2) totally thoracoscopic with appropriate new design instruments. The new paradigm of VACS requires for its current application to decrease CCCPB and aortic "clamping" times by the development of new instruments and devices in which we are already working. In case 3, we performed a stapling atriotomy closure to decrease the elongated operative time (15-17). Further prospective clinical trials must be tested to asses the specific roll that this techniques plays in the treatment of cardiac diseases.

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