Transseptal Approach for Mitral Valve Replacement

RAÚL A. BORRACCI[MTSAC, 1, 2, 3, 4], MIGUEL RUBIO[MTSAC, 1, 2, 3], ARNALDO MILANI[4], FÉLIX RAMÍREZ[4], CARLOS BARRERO[MTSAC, 1], CARLOS A. RAPALLO[MTSAC, 2], CARLOS A. INGINO[MTSAC, 3], JUAN C. MEDRANO[4]

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Address for reprints:
Dr. Raúl A. Borracci
La Pampa 3030 - 1° B
(1428) Buenos Aires, Argentina
e-mail: raborracci@gmail.com

SUMMARY

Background
Although the access to the mitral valve through transseptal approach is technically more demanding, it allows a better exposure of its leaflets and subvalvular apparatus, specially, in small atria, in reoperations or when it is combined with tricuspid valve treatment.

Objective
To evaluate technical difficulties and complications associated with the transseptal approach for mitral valve replacement.

Material and Methods
Between 2006 and 2009, 62 consecutive patients who underwent mitral valve replacement alone or associated with myocardial revascularization through a transseptal approach extended to the left atrial roof were included. Technical difficulties and morbimortality of the procedure were evaluated.

Results
In all patients, the transseptal approach could be done with no technical difficulties with an appropriate exposure of the mitral valve. The rate of conduction disorders in the postoperative period was 9.7% and the need of a permanent pacemaker implantation was 4.8%. From patients who had previous atrial fibrillation (n = 18), 83.3% recovered high sinus or junctional rhythm during the postoperative period.

Conclusions
The transseptal approach extended to the left atrial roof constituted an access alternative to the mitral valve, with an exposure better than the traditional approach, at the expense of a more demanding technique. Surgical times, mortality and complications were similar to those which belong to the conventional technique, except for a probable greater incidence of junctional rhythm and AV block. Possibly, there is certain benefit in the recovery of sinus rhythm in patients with previous chronic atrial fibrillation.

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Key words > Surgery - Technique - Mitral valve - Interatrial septum – Complications

Abbreviations >

AV	Atrioventricular	**CEC**	Extracorporeal circulation

BACKGROUND
The transseptal approach for mitral valve surgery was described by Dubost (1) and subsequently modified by different authors. (2-5) The development of this technique was based on the advantages that would have on the usual approach through a left atriotomy below the interatrial sulcus. Although the access through transseptal approach is technically more demanding, it allows a greater exposure of the mitral leaflets and subvalvular apparatus, specially in small atria, in reoperations or when it is combined with the tricuspid valve treatment. (6-8)

The spreading of this approach has been limited due to greater technical requirements and potential effects on sinus rhythm that patients with no atrial fibrillation could have, in view of that the incisions on the right atrial wall, left atrial roof and interatrial septum have been associated with temporary

[MTSAC]Full Member of Sociedad Argentina de Cardiología
[1]Clínica Bazterrica. Buenos Aires, Argentina
[2]Sanatorio Prof. Itoiz. Avellaneda, Buenos Aires, Argentina
[3]Clínica Sagrada Familia. Buenos Aires, Argentina
[4]Clínica y Maternidad Suizo Argentina. Buenos Aires, Argentina

junctional rhythm and atrioventricular block. (9-11)

Considering that exhibition and visibility of the mitral valve with transseptal approach is superior to the one obtained with the traditional approach of the left atriotomy, the objective of the present work was the evaluation of technical difficulties and complications associated with the transseptal approach for mitral valve replacement.

MATERIAL AND METHODS

Between January, 2006 and December, 2009, 62 consecutive patients who underwent mitral valve replacement alone or associated with myocardial revascularization through a transseptal approach extended to the left atrial roof were included. These patients corresponded to all mitral replacements performed in this period over a total of 728 cardiac surgeries (8.5%). The clinical characteristics of the patients are summarized in table 1, whereas the echocardiographic findings which defined the mitral pathology are shown in table 2. In order to describe the complications, AV block or junctional rhythm was defined in the postoperative period during admission and it could spontaneously revert it or not into sinus rhythm; if it is not reverted and a permanent pacemaker implantation is required, it is called AV block or persistent junctional rhythm. The output of extracorporeal circulation (ECC) with difficulty was the one that needed more than one attempt of pump stop and low expenditure at the output of ECC which required inotropes or the use of balloon pump counterpulsation. Renal failure was defined as the increase of urea or creatinine associated with oligoanuria which required a treatment with diuretics, while moderate-severe dysfunction of the left ventricle was the one informed in the ventriculogram and it corresponded to an ejection fraction less than 40%

Surgical technique

The approach technique was the one previously described by several authors. (2-4) After a conventional median sternotomy, the ascending aorta and two venae cavae were separately cannulated. The cannula for the inferior vena cava was inserted through a purse in the right atrium, near the output of vena cava, while the superior vena cava was directly cannulated with an angular cannula. During ECC, hypothermia of 33-34°C and St. Thomas' antegrade cardioplegia were used. After adjusting both tourniquets around the venae cavae, a longitudinal right atriotomy of 4-5 cm between the handle and the atrioventricular sulcus was performed in cephalic direction (Figure 1 A). Once the foramen ovale was individualized in the interatrial septum, it was opened by an incision up to the left atrial roof, avoiding the contact behind the aorta and the damage in the coronary branch that reaches the sinus node (Figure 1 B). Mitral valve exposure was satisfactorily obtained through traction sutures at the confluence of the atria and septum. After mitral replacement, the interatrial septum and left atrial roof were sutured with a continuous suture of polypropylene 3-0 or 4-0. After purging the left cavities, the aorta was unclamped and the suture of the right atrium was performed.

Statistical analysis

Qualitative variables are expressed as absolute values and percentages and quantitative variables are expressed as means and standard deviations after checking the normal distributions with the goodness of fit test. Software SPSS 10.0® and Microsoft Office Excel 2003® spreadsheet were used for the descriptive statistical analysis.

RESULTS

In all patients, the transseptal approach was performed with no technical difficulties and an appropriate exposure of the mitral valve was achieved with no need to use separators or retractors for its visualization. In one case (1.6%), the reintroduction of the patient into the ECC to repair a loss in the left mitral roof was necessary. Surgical findings and characteristics of the surgery are summarized in table 3. From the patients who had previous atrial fibrillation (n = 18), 83.3% recovered high sinus or junctional rhythm during the postoperative period.

Regarding postoperative complications and mortality, major cardiovascular events and rates of AV block in different surgical and postoperative stages are summarized in table 3. 57 complications were observed in 13 patients, 79% (49/62) of them did not have any event. On the other hand, residual defects in the interatrial septum during the immediate postoperative period were not verified.

DISCUSSION

In this series, the transseptal approach extended to the left atrial roof allowed an appropriate access and with no technical complications to carry out the mitral valve replacement. Visibility and the approach to the

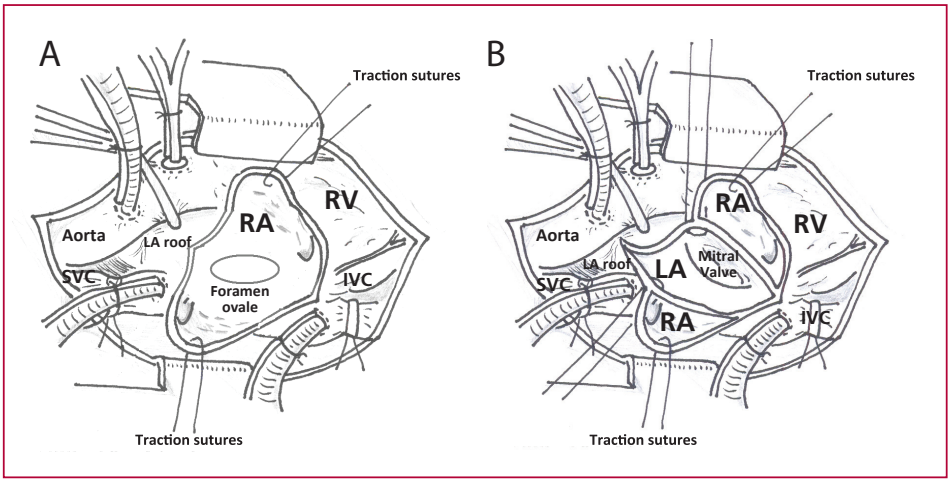

Table 3 A. Inicial right atriotomy which shows the foramen ovale. The dotted line shows the incision over the interatrial *septum* which goes up to the left atrial roof. **B.** Exhibition of the mitral valve through the transseptal approach extended to the left atrial roof.
RA: Right atrium. LA: Left atrium. RV: Right ventricle. SVC: Superior vena cava. IVC:Inferior vena cava.

Table 1. Preoperative clinical features of the population (n = 62)

Age in years (mean ± SD)	63.3 ± 11.93
Male	34 (54.8%)
Hypertension	47 (75.8%)
Tobacco smoking (present or past)	14 (22.6%)
Diabetes	8 (12.9%)
Previous cardiac surgery	4 (6.5%)
Cerebrovascular accident	8 (12.9%)
Renal failure	3 (4.8%)
Atrial fibrillation	18 (29%)
Heart failure	26 (41.9%)
Endocarditis	
Active	13 (21%)
Treated	4 (6.5%)
Dyspnea	
Grade II	13 (21%)
Grade III	32 (51.6%)
Grade IV	17 (27.4%)
Surgery	
Schedule	41 (66.1%)
Urgent	18 (29%)
Emergency	3 (4.8%)

SD: Standard Deviation

Table 2. Echocardiographic features of mitral pathology (n = 62)

Diagnosis	
Failure	44 (71%)
Disease	7 (11.3%)
Stenosis	11 (17.7%)
Left atrial diameter (mean ± SD)	52.3 ± 11.9 mm
Broken chordae	16 (25.8%)
Ring calcification	7 (11.3%)
Vegetations	15 (24.2%)
LV dysfunction (moderate to severe)	4 (6.5%)

SD: Standard Deviation LV: Left Ventricle

valvular and subvalvular levels were clearly superior to the ones obtained with the conventional technique. Since patients who underwent a mitral valve replacement were included and plastics were excluded, echocardiographic characteristics of the mitral pathology showed some special conditions. For example, almost 30% of the patients showed mitral disease or calcified stenosis with no possibility to suffer from valvuloplasty and, a quarter of the cases had vegetations over the leaflets, as a consequence of a treated or active endocarditis.

Table 3. Surgical findings and surgery features (n = 62)

Intraoperative pathological findings	
Vegetations	16 (25.8%)
Perforated leaflets	11 (17.7%)
Myxomatous valve	17 (27.4%)
Broken chordae	10 (16.1%)
Type of implanted valve	
Biological	44 (71%)
Mechanical	18 (29%)
Conservation of posterior leaflet	6 (9.7%)
Associated coronary surgery	4 (6.5%)
ECC Time (mean ± SD)	
Perfusion	78.5 ± 23 min.
Clamp	52.5 ± 11.5 min.
Defibrillation at the output of ECC	14 (22.6%)
Fast-track (extubation at the operating room)	34 (54.8%)

SD: Standard Deviation ECC: Extracorporeal circulation

Table 4. Operative complications

Output of ECC with difficulty	8 (12.9%)
Pacemaker for output of ECC	13 (21%)
AV block or nodal rhythm in the postoperative period	6 (9.7%)
AV block or presistent nodal rhythm	3 (4.8%)
Low expenditure at the output of ECC	4 (6.5%)
Reoperation due to bleeding	1 (1.6%)
Sepsis due to endocarditis	4 (6.5%)
Cerebrovascular accident	3 (4.8%)
Dialysis	3 (4.8%)
Prolonged mechanical ventilation (> 48 hrs.)	7 (11.3%)
Mortality after 60 days	5 (8.1%)

Abdomen: indicates waist circumference above the superior limit.

Regarding the surgical procedure, although the opening and closure of the cardiac structures require more time in the transseptal approach, the obtained visibility and the comfort to work on the valve with this technique allow us to recover the time demanded by atriotomies and sutures of the atrium. The clamping time averaged out 52 minutes, although it is important to remember that the suture of the right atrium was performed with the aorta already declamped. This time was similar to the one communicated by other authors (47 min.). (7)

In connection with cardiac rhythm disorders in the postoperative period, although a fifth of the patients required pacemaker for the output of ECC, only half of them needed it in the immediate postoperative period. Other authors also reported numbers between 3.6% and 10% of temporary AV block in the postoperative

period. (8, 9) It is worth mentioning that temporary union rhythm was found in a comparative work in 12.5% of patients who underwent a conventional atriotomy versus 38% with the extended transseptal approach. (12) In the first case, all union rhythms reverted within 24 hrs, while 12% did not recover the sinus rhythm after 6 weeks of monitoring with the transseptal access. In our study, the need for a permanent pacemaker was 4.8% (CI 95% 2.1% to 7.5%), while other researchers found rates between 0% and 1.6%. (8, 10) This difference could be due to different basal characteristics in the compared populations, with a greater tendency to indicate permanent pacemakers in low atrial rhythms or some technical detail, such as the accidental lesion of the sinus node artery in the left atrial roof. According to the bibliography, the affection of this coronary branch was associated with a greater incidence of the AV block after this approach. (8) In 60% of the patients, the sinus node artery comes from the right coronary artery and crosses the left atrial roof, while in the remaining 40% it comes from the circumflex artery and does not cross the atrial roof. (8)

In our study, an interesting observation is the possibility that the transseptal approach extended to the left atrial roof facilitates the recovery of sinus rhythm in patients with previous atrial fibrillation, in view of the high rate of reversion of this arrhythmia in the immediate postoperative period. In the near future, we have to evaluate the permanence in sinus rhythm in the long-term. Anyway, this reversion into sinus rhythm could have other explanations, as the size of the auricle, the evolution time of fibrillation or the underlying heart disease. All these confused variables have not been examined in this study due to the small size of the sample.

Additionally, some technical variables apart from the extended transseptal approach used in our study were described. On the one hand, there is a transseptal approach non-extended up to the left atrial roof and which consists in a right atriotomy parallel to the interatrial sulcus and the subsequent septum opening over the foramen ovale. (8) Another technical variant corresponds to the classical description of Dubost, (1) in which a vertical right atriotomy between the two venous cannulae was performed, extended to the right superior pulmonary vein and then to the interatrial septum. A last variant only uses the opening of the left atrial roof (described as “atrial dome”), without cutting off the right atrium or septum. (13) This incision, which goes from behind the aorta up to the left superior pulmonary vein, may be associated with the need of a permanent pacemaker in the postoperative period (4%).

CONCLUSIONS

The transseptal approach extended to the left atrial roof constituted an access alternative to the mitral valve, with a better exposure than the traditional transseptal approach, at the expense of a more demanding technique. This approach was specially recommended for patients with small left atrium, as it usually happens in endocarditis and acute mitral regurgitation secondary to ischaemias or myocardial infarction. Likewise, this access could be useful in elderly patients with friable tissues, in reoperations with previous aortic-valve implantation and when a concomitant procedure is required, such as tricuspid surgery or intraoperative radiofrequency ablation. Surgical times, mortality and complications were similar to the ones communicated with the conventional technique, except for a probable greater incidence of junctional rhythm and AV block. Finally, there could be certain benefit in the recovery of sinus rhythm in patients with previous chronic atrial fibrillation, although the atrium size and evolution time of fibrillation should be evaluated.

RESUMEN

Abordaje transeptal para el reemplazo valvular mitral

Introducción

A pesar de que es técnicamente más demandante, el acceso a la válvula mitral por vía tran-septal permite una exposición mayor de sus valvas y del aparato subvalvular, en especial en aurículas pequeñas, en reoperaciones o cuando se combina con el tratamiento de la válvula tricuspídea.

Objetivo

Evaluar las dificultades técnicas y las complicaciones asociadas con el abordaje transeptal para el reemplazo valvular mitral.

Material y métodos

Entre 2006 y 2009 se incluyeron 62 pacientes consecutivos a los que se les realizó reemplazo valvular mitral solo o asociado con revascularización miocárdica a través de un abordaje transeptal extendido al techo de la aurícula izquierda. Se evaluaron las dificultades técnicas y la morbimortalidad del procedimiento.

Resultados

En todos los pacientes se pudo realizar el abordaje sin dificultades técnicas con una exposición adecuada de la válvula mitral. La tasa de trastornos de conducción en el posoperatorio fue del 9,7% y la necesidad de implante de un marcapasos definitivo fue del 4,8%. De los pacientes que tenían fibrilación auricular previa (n = 18), el 83,3% recuperaron ritmo sinusal o nodal alto en el posoperatorio.

Conclusiones

El abordaje transeptal extendido al techo de la aurícula izquierda constituyó una alternativa de acceso a la válvula mitral, con una exposición mejor que el abordaje tradicional, aunque a expensas de una técnica más demandante. Los tiempos quirúrgicos, la mortalidad y las complicaciones fueron similares a los de la técnica convencional, a excepción de una probable incidencia mayor de ritmo nodal y bloqueo

A-V. Posiblemente exista cierto beneficio en la recuperación del ritmo sinusal en los pacientes con fibrilación auricular crónica previa.

Palabras clave > Cirugía - Técnica - Válvula mitral - Septum interauricular - Complicaciones

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