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Minimally Invasive Surgical Valve Repair

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ABSTRACT

Background: Minimal-access valve repair was introduced in the 1990s and is becoming an accepted option for patients undergoing valve surgery. Minimally invasive surgical valve repair reduces the degree of surgical insult, produces less postoperative pain, uses less blood, and is associated with better cosmetic results.

Methods: Between July 2008 and February 2009, 17 cardiac surgical patients were treated with minimally invasive valve repair at 3 different institutions (Royal Spanish Hospital, Portuguese Hospital, and Cardio Pulmonar Institute, Salvador, Brazil). The heart was accessed via an incision between the ribs in the second or third intercostal space. A retrospective analysis was performed on the outcomes in the first 24 postoperative hours in the intensive care unit and on the fourth postoperative day before the patient's discharge from the hospital.

Results: Of the 17 patients who underwent minimally invasive valve repair and were evaluated, 8 patients (47.05%) underwent aortic surgery, 4 patients (23.52%) underwent mitral valve surgery, 4 patients (23.52%) underwent surgery for a congenital heart defect, and 1 patient (5.88%) underwent endocarditis treatment. The duration of cardiopulmonary bypass (CPB) was <120 minutes in all cases (median interval between lowest and highest CPB times, 90 minutes), and all cross-clamp times were <100 minutes (median interval between lowest and highest cross-clamp times, 70 minutes). There were no cases of reoperation for bleeding, incision infection, or myocardial infarction. The median hospital stay was 5 days; the operative mortality rate was 5.8%.

Conclusion: We conclude that by avoiding full sternotomy, the approach of minimal surgical access contributes to an improved postoperative stability of the chest and less surgical pain. On the other hand, the limited exposure of the heart is a disadvantage of minimally invasive valve repair. Minimally invasive surgical valve repair is safe and feasible with excellent outcomes and is well tolerated in the elderly. Care must be taken to follow the learning curve for operation duration and to treat surgical complications.

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INTRODUCTION

Minimal-access valve repair was introduced in the 1990s [Cosgrove 1996] and is becoming an accepted option for patients undergoing valve surgery. Minimally invasive surgical valve repair reduces the degree of surgical insult, produces less postoperative pain, uses less blood, and is associated with better cosmetic results.

Studies have shown that this kind of surgical approach leads to a shorter hospitalization period, earlier extubation, and less blood use during surgeries, compared with full open-chest surgery [Cohn 1997].

The most common minimal-access approach is the upper hemisternotomy for aortic valve surgery and other surgeries, such as subaortic myectomy and mitral valve procedures. A lower hemisternotomy is also useful for approaching the mitral and tricuspid valves, surgical repair of congenital diseases, and treating myxomas.

Minithoracotomy can also be used to access the heart via a small incision between the ribs in the right or left side of the chest, depending on the kind of surgery being performed.

MATERIALS AND METHODS

Between July 2008 and February 2009, 17 cardiac surgical patients were treated with minimally invasive valve repair at 3 different institutions (Royal Spanish Hospital, Portuguese Hospital, and Cardio Pulmonar Institute, Salvador, Brazil). The heart was accessed via an incision between the ribs in the second or third intercostal space. A retrospective analysis was performed on the outcomes in the first 24 postoperative hours in the intensive care unit and on the fourth postoperative day before discharge from the hospital.

The second evaluation was performed 1 month after surgery to determine whether the patients really had returned to their normal daily activities or still had any limitations.

Surgical Procedure

All patients received external defibrillator pads and were monitored in the standard manner. An incision between the ribs was generally made in the third intercostal space. The retractor was placed, and retraction stitches were placed on the right edge of the pericardium and anchored to the subcutaneous tissue to facilitate access to the heart. Cardiopulmonary bypass was established by peripheral arterial cannulation and femoral venous cannulation. Cardioplegia was injected

Table 1. Preoperative Characteristics of the Patients

Age, y	52 (19-85)*
Male sex, n	9 (52.4%)
Diabetes, n	2 (11.76%)
Renal insufficiency (creatinine >1.5 mg/dL), n	4 (23.52%)
Hypertension, n	10 (58.82%)
Atrial fibrillation, n	2 (11.76%)
Ejection fraction	>40% in all patients
Aortic stenosis, n	6 (35.29%)
Aortic insufficiency, n	1 (5.88%)
Double aortic lesion, n	1 (5.88%)
Congenital disease (osteum secundum), n	4 (23.52%)
Mitral insufficiency, n	3 (17.64%)
Mitral stenosis, n	1 (5.88%)
Endocarditis (pacemaker wire), n	1 (5.88%)

*Data are presented as the median (range).

Table 2. Operative Procedures*

Procedure	No. of Patients
Aortic valve repair (plasty)	1
Aortic valve replacement	7
Mitral commissurotomy	1
Mitral valve replacement	3
Surgery to treat endocarditis of the pacemaker wire	1
Congenital surgery	4

*Two surgeries were converted to full sternotomy.

directly into the aortic root or into the coronary osteum. A left atrium vent was placed through the right superior pulmonary vein when necessary.

All procedures were performed without optical instruments. Valve procedures, such as those involving repairs or changes, were performed with traditional techniques, as were the procedures for repairing congenital defects. This approach was not used for reoperations.

Patient Characteristics

The median age was 52 years (range, 19-85 years). Other patient characteristics are summarized in Table 1.

Operative Procedures

The operative procedures used are summarized in Table 2. All 17 patients were operated through the second, third, or fourth intercostal space; 2 patients were converted to full sternotomy.

The duration of cardiopulmonary bypass was <120 minutes in all cases (median interval between lowest and highest CPB times, 90 minutes), and aortic-cross clamp times were all <100 minutes (median interval between lowest and highest cross-clamp times, 70 minutes). All patients underwent their operation under moderate hypothermia. No significant correction was necessary to treat any surgical intercurrence in patients <75 years of age; 1 patient died from atrial ventricular disconnection during the surgery.

Table 3. Operative Early Outcomes

Operative mortality, n	1
Reoperation for bleeding, n	0
Incision infection, n	0
Myocardial infarction, n	0
Stroke, n	0
Blood transfusion, n	6
Median hospital stay, d	5
Life limitation 30 days postoperatively, n	0

Operative Outcomes

Early operative outcomes are shown in Table 3. The operative mortality rate was 5.8% for the entire group, and the majority of the patients returned to their normal activities just 20 days after surgery. No limitation was observed.

RESULTS

Seventeen patients who underwent minimally invasive valve repair were evaluated. Eight patients (47.05%) underwent aortic surgery, 4 patients (23.52%) underwent mitral valve surgery, 4 patients (23.52%) underwent surgery to correct congenital defects, and 1 patient (5.88%) underwent endocarditis treatment. Cardiopulmonary bypass durations were <120 minutes (median interval between lowest and highest CPB times, 90 minutes). Cross-clamp times were all <100 minutes (median interval between lowest and highest cross-clamp times, 70 minutes). There were no cases of reoperation for bleeding, incision infection, or myocardial infarction. The median hospital stay was 5 days. The operative mortality rate was 5.8%.

DISCUSSION

Our early experience with minimally invasive valve repair has shown that this kind of approach to valve surgery via a limited direct access can be performed safely. It appears not to carry a greater risk, and although it is more technically demanding, minimally invasive valve repair is associated with a short hospital stay and other advantages, such as reduced blood transfusion requirements, a decreased stay in the intensive care unit, a dramatic reduction in pain, earlier extubation (and consequently less pulmonary infection), and better cosmetic results than with conventional cardiac surgery [Stamou 2003; Mihalljevic 2004].

There is some controversy regarding whether the minimal surgical access approach reduces the surgical insult compared

with traditional cardiac surgery. Several earlier studies have reported no particular benefit other than patient satisfaction [Szwerc 1999].

We conclude that by avoiding full sternotomy, the minimal surgical access approach contributes to an improved postoperative stability of the chest and less surgical pain. On the other hand, the limited exposure of the heart is a disadvantage of minimally invasive surgical valve repair. Some studies have demonstrated longer cardiopulmonary bypass times compared with full open-chest cardiac surgery, and the surgical team must be careful to avoid air embolism.

Minimally invasive surgical valve repair is safe and feasible with excellent outcomes and is well tolerated in the elderly. Care must be taken to follow the learning curve for operation duration and to treat surgical complications.

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