Original Research Article

Right minithoracotomy approach for mitral valve replacement: A retrospective analysis of safety and effectiveness

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Abstract

Background: Mitral valve replacement (MVR) through minimally invasive approaches has grown in popularity over past few decades as it offers multiple advantages over conventional full sternotomy approach. We analysed our single centre experience of MVR through the right minithoracotomy (Mini-MVR) performed over a three year period. **Methods**: This study was a retrospective analytical study done at CHL hospital, Indore. Fifty eight patients undergoing MVR through the right minithoracotomy between January 2018 and December 2021 were included. Records of perioperative data were collected and retrospectively evaluated. **Results**: Total 58 patients were included in the study, of which 42 were females (72.4%). Mean age was 41.2+/- 8.9 years. Overall 30-day mortality was 1.72% (n = 1). Mean operative time, cardiopulmonary bypass, and aortic cross-clamp times were 261.9 ± 52.7, 149.5 ± 42.8, and 91.8 ± 24.6 minutes, respectively. Tricuspid valve annuloplasty was performed in 11 patients (18.9%). Two patients (3.45%) required conversion to median sternotomy and three patients (5.2%) underwent re-explorations due to bleeding. Median intensive care unit stay (ICU) was 36 hours and median postoperative hospital stay was 5 days. There was no incidence of stoke in any patient during hospital stay. Wound healing of chest and groin wound was excellent. **Conclusions**: MVR through the right minithoracotomy approach is feasible, reproducible, safe and effective with low mortality and morbidity. Mini-MVR is good alternative to conventional sternotomy. Besides certain cosmetic advantage, it avoids potentially devastating infective complications of mediastinitis/sternal dehiscence while shortening ICU and total hospital stay and reducing recovery time with early return to work.

Keywords: minimally invasive, minithoracotomy, mitral valve replacement, mini-MVR.

Introduction

Significant advances have been made in minimally invasive cardiac surgery (MICS) over the past three decades and MICS has grown into popularity. However, the acceptance and practice of MICS continue to remain low in the developing countries like India[1]. A variety of techniques have been described to reduce surgical access in mitral valve surgery. The most common minimally invasive approach to the mitral valve includes a partial sternotomy and a right minithoracotomy. The use of the right minithoracotomy for MVR (Mini-MVR) has been facilitated by advancements in management of cardiopulmonary bypass (CPB) and advent of special surgical instruments. Compared to conventional full sternotomy, this approach offers many advantages. It avoids potential risk of mediastinitis/ sternal dehiscence and is cosmetically appealing, especially to young females. It has shown to reduce postoperative pain and morbidity, enables faster recovery, return to full activities, and improved lung functions, and decreases ICU and hospital stay[2]. Although initiated as early as 2013, this approach was used frequently towards the later part of last decade at our center. The purpose of this study was to review early outcomes of Mini-MVR at our center and to examine the feasibility, safety, and effectiveness of Mini-MVR.

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Materials and methods

Patients

Fifty eight patients, who underwent Mini-MVR through right minithoracotomy at our center from January 2018 to December 2021, were included in this study. Being a retrospective study consent could not be obtained, however written informed consent was obtained from all the patients prior to surgery. Patients with dilated ascending aorta (>40 mm), severe right pleural adhesions, aortic regurgitation >grade 1, ascending aorta calcifications and severe peripheral vascular disease were excluded from the study.

Surgical technique

Patients were intubated with a single lumen endotracheal tube. General anesthesia was instituted and the right femoral vessels were exposed. Right minithoracotomy (5–7 cm) was performed through the 4th intercostal space and pericardium opened. Additional small incision was made in mid axillary line in 2nd intercostals space for transthoracic aortic chitwood clamp placement. Femoral arterial and venous cannulation done after systemic heparinisation. Correct positioning of venous cannula was achieved under transesophageal echocardiographic guidance. The ascending aorta was clamped with Chitwood clamp. An antegrade cold crystalloid cardioplegia was delivered directly into the ascending aorta by a needle vent catheter. The mitral valve was approached with a traditional left paraseptal atriotomy and exposed using an atrial retractor. The procedure was performed under direct vision.

Statistical analysis

Data are expressed as mean ± standard deviation (median, interquartile range [IQR]), and categorical data are expressed as frequencies or ratios. Testing of variables was compared by paired *t* test. A p value <0.05 was considered significant. Statistical analysis was performed with NCSS 11 Statistical Software 2016 (NCSS, LLC, Kaysville, UT, USA).

Results

This retrospective analytical study was conducted at CHL hospital, Indore. A total of 58 Mini-MVR surgeries, performed at our center between January 2018 and December 2021, were included in the study. Baseline patient characteristics are summarized in table 1. The mean age was 43.2 ± 8.2 years and 69% were females (n = 29). Predominant valvular pathology was rheumatic comprising 53 (91.4%) cases.

Table 1: Preoperative patient characteristics

Variables	Patients (58)
Age (years)	41.2+/-8.9
Female gender	42 (72.4%)
BMI (kg/m2)	22.9+/- 3.9
LVEF (%)	55.2+/-11.7
DM-2	1(1.7%)
COPD	3(5.2%)
Arterial hypertension	5(8.6%)
NYHA class	
i)	8(13.8%)
ii)	17(29.3%)
iii)	28(42.3%)
iv)	5(8.6%)
Mitral valve pathology	
- Rheumatic	53 (91.4%)
- Degenerative	5(8.6%)
Tricuspid valve annuloplasty	11(18.9%)

Mean operative time, cardiopulmonary bypass time, and aortic cross-clamp times were 261.9 ± 52.7, 149.5 ± 42.8, and 91.8 ± 24.6 minutes, respectively.

Early outcomes

Overall 30-day mortality was 1.72% (n = 1). That patient had low LVEF of 20% preoperatively. Patient manifested with low cardiac output syndrome in the early postoperative period due to low LVEF requiring intra aortic balloon insertion and despite the best efforts could not survive.

Mean postoperative ventilation time was 7.2 ± 9.1 hours (median 6.0; IQR, 0.0–18.1); duration of intensive care unit stay was 38.7 ± 32.8 hours (median 36; IQR, 18.0–62.0), and total postoperative hospital stay was 4.3 ± 6.8 days (median 5 ; IQR, 4.0-10.0).

Two patients (3.45%) in our cohort required conversion to full median sternotomy. First patient required conversion to sternotomy because of injury to main pulmonary artery (MPA) while manipulating chitwood clamp. Second patient had AV groove rupture and required conversion to sternotomy to address the issue. Repair of injuries was successful in both patients and they recovered well postoperatively. Re-exploration was required in two patients (5.2%) because of bleeding. In all cases, the revision was possible through the same minithoracotomy incision. Bleeding sources included intercostal artery in three and cardioplegia cannulation site in one patient. All patients had good chest and groin wound healing with excellent cosmetic results. None of our patients suffered stroke or required acute renal replacement therapy. One patient (1.7%) developed acute limb ischemia due to thrombosis of femoral artery. Patient underwent emergent femoral thrombectomy and recovered fully.

Discussion

The first forays into minimally invasive cardiac surgery (MICS) mitral valve surgery were simultaneously reported by Cosgrove et al and Cohn et al[3,4]. Over the years, with advancements in surgical techniques and management of CPB, minimally invasive cardiac surgeries have refined considerably. Minimally invasive approaches have been used with increasing frequency for heart valve surgery in recent past, and Mini-MVR is associated with comparable efficacy and excellent long-term results[5,6]. As we stand today, most intracardiac pathologies have a parallel minimally invasive or transcatheter solution to the standard sternotomy route. MICS has been continuously gaining traction, so much so that, in some centres across the world, MICS is a default strategy for most cardiac procedures[1]. However, the acceptance and practice of MICS continue to remain low in the developing countries like India.

At our center, minimally invasive cardiac surgeries were started in 2013, but only recently, we started doing it rather regularly. Overall 30-day mortality in our study was 1.72%, which was consistent with results reported in Society of Thoracic Surgeons Database (STS) and by various groups for conventional approach through the sternotomy. Gammie et al reported result from STS database. Operative mortality was 1.4% in mitral valve repair group[7]. Perier et al reported operative mortality of 2.9% for the mitral valve repair of posterior leaflet prolapse[8]. Our results were also comparable to previous published studies on Mini-MVR. Glauber et al reported in-hospital mortality of 1.1%[5]. Seeburger et al from Leipzig group published 2.4% 30-day mortality[9]. Assessment of our patient cohort demonstrated that Mini-MVR is a safe procedure with excellent early outcomes and low incidence of intra-operative complications.

The results of a meta-analysis conducted by the International Society of Minimally Invasive Cardiothoracic Surgery (ISMICS) were published in 2010[10,11]. This study evaluated the results of mitral valve surgery performed via a minithoracotomy versus results obtained using conventional sternotomy. The most important finding from this meta-analysis was a statistically comparable 30-day perioperative mortality confirming the safety of Mini-MVR. The meta-analysis concluded that Mini-MVR is a viable alternative to conventional mitral valve replacement, given the comparable short- and long-term mortality, comparable risk of postoperative complications (renal, pulmonary, cardiac, gastrointestinal), comparable reoperation rate, decreased sternal complications and blood transfusions, lower incidence of postoperative atrial fibrillation, shorter intensive care unit (ICU) stay, and shorter length of postoperative hospital stay.

A number of previous studies have shown the significant clinical benefits of minimally invasive approaches. Santana et al conducted a retrospective study of minimally invasive surgery in patients with COPD[12]. Patients treated with a minimally invasive approach had lower hospital-related mortality than patients undergoing conventional sternotomy (1% versus 5%) and a significantly lower incidence of all postoperative complications (30% versus 54%, p = 0.002). The shorter length of stay in the intensive care unit (47 versus 73 hours, p <0.001) and the shorter length of postoperative hospitalization (6 versus 9 days, p <0.001) emphasize the benefit of the minimally invasive approach. In another study, Santana et al investigated the benefit of a less invasive approach versus sternotomy in obese patients (body mass index [BMI] >30 kg/m^2)[13]. More postoperative complications were noted in the sternotomy group, with a higher incidence of acute kidney failure, prolonged intubation, higher reintubation rate, higher mortality, and higher incidence of deep sternal wound infections. In our study, median ICU stay was 36 hours and median postoperative hospital stay was 5 days. All our patients had good wound healing of chest and groin wounds with excellent cosmetic results.

Conversion from minithoracotomy to full median sternotomy is sometimes necessary during Mini-MVR. In our study, two patients (3.45%) required conversion to full sternotomy. In one patient, there was injury to MPA during placement of chitwood aortic clamp across the aorta. As visualisation of MPA is not good from right minithoracotomy, hence we proceeded with conversion to sternotomy. Adequate control was obtained and further surgery was completed uneventfully. There was AV groove rupture in other patient which

required conversion to median sternotomy. Repair was done through LA after explanting the valve using autologous pericardium. Valve was re-implanted and surgery proceeded uneventfully. Vollroth et al[14] reported conversion rate of 1% in their study of Mini-MVR in 3125 patients. Re-exploration was required in two of our study patients (5.2%) because of bleeding. In all cases, the revision was possible through the same minithoracotomy incision. Bleeding sources included intercostal artery in three and cardioplegia cannulation site in one patient. One of our patient developed thrombosis at femoral arterial canulation site. Patient required emergent femoral thrombectomy, and post intervention further postoperative course was uneventful.

Concerns has been raised about the potential increased risk of stroke associated with Mini-MVR because of perceived difficulty in dearing of heart chambers or the retrograde blood flow in the descending aorta or longer duration of cardiopulmonary bypass. However, in various propensity-matched comparisons no significant differences in the incidence of thromboembolic events were observed[15,16]. In our study too, there was no incidence of stroke.

Those patients who had undergone a previous surgery on right side of thorax were not included in this study as adhesions of the lung make dissection of the mediastinum a challanging proposition. Also, severe aortic or peripheral vascular disease in form of an atherosclerotic process of the ascending aorta or severe atherosclerotic involvement of the pelvic and femoral arteries compromises the safety of the procedure. Thus, all such patients were also not part of our study. It is recommended to perform CT-angiography of the aorta and femoral arteries in all patients, especially during early stages of learning curve. Where atherosclerosis is evident, some authors advocate the use an alternative approach for cannulation, that is, central cannulation of the ascending aorta or axillary artery[5].

Limitations

This study was retrospective in nature with its associated shortfalls. Also, it was a single center study, and only data of early outcomes were analysed. A study with longer periods of follow up is necessary.

Conclusion

Mini-MVR is a feasible, reproducible, safe and effective approach with low mortality and morbidity. It provides better cosmetic results, avoids potential complications of sternal dehiscence or mediastinitis, shortens ICU and total hospital stay, and leads to earlier recovery and return to work. However, a prospective multicenter randomised study with long follow up in Indian scenario is required to strengthen findings of our study.

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Conflicts of interest

There are no conflicts of interest.

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