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Original Research Article

REDO MITRAL VALVE REPLACEMENT AFTER CLOSED MITRAL VALVOTOMY: A CLINICAL EXPERIENCE

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Abstract

Background: Rheumatic heart disease is the most common cause of valvular heart disease in developing countries. Unless timely intervention in the form of valve replacement is pursued, the condition progresses rapidly to disability and death. **Materials and Methods:** This retrospective study was based upon analysis of 101 patients with rheumatic valvular heart disease who underwent MVR following CMV from 1st January 2001 to 31st December 2008. The study was conducted in the Department of Thoracic & Cardiovascular Surgery, Christian Medical College & Hospital, Vellore. **Result:** The mean age at the primary operation (CMV) was 26.35 ± 8.75 years and at reoperation (MVR) was 44.23 ± 9.31 years with a mean interval of 17.88 ± 6.68 years. The most common indication for reoperation following closed mitral valvotomy was mitral restenosis in 58.40% patients followed by MS along with MR in 22.8% patients and predominant MR in 18.80% patients. Overall early mortality following reoperation was 2.0% (n=2) with no intra operative deaths. Low cardiac output syndrome was the major cause of early mortality. 80.2% patients had a follow up in the outpatient clinic of this hospital and the mean follow up was 24.80 ± 22.24 months (range 4 to 96 months). Late mortality was seen in only 2 (2%) patients. **Conclusion:** Redo mitral valve surgery is safe and offers excellent symptomatic improvement and favorable late survival. A strict adherence to optimal anticoagulation optimizes protection against thromboembolism and anticoagulation related hemorrhage and helps to provide the patient with a good quality of life.

INTRODUCTION

Rheumatic heart disease is still prevalent in developing nations.[1] It is a disease that predominantly affects the young in our country.[2] Mitral stenosis is the most frequently encountered valvular pathology in rheumatic etiology.

Closed mitral valvotomy (CMV) was the first effective intervention in valvular heart disease. After the development of cardiopulmonary bypass, open mitral valvotomy was performed under direct vision with improved hemodynamic results.[3] Redo CMV is still favored in developing nations due to its cost effectiveness and avoidance of anticoagulation.[4]

The introduction of valve replacement surgery in the early 1960s has dramatically improved the outcome of patients with valvular heart disease but it does not provide a definitive cure to the patient.[5] Despite the advances in techniques, myocardial protection and valve design, the problem of reoperation remains due to young age of the patients, progressive nature of the disease and thrombogenicity of prosthetic valves.[6]

Reoperations are technically more demanding because of adhesions around the heart and common association of pulmonary hypertension. Moreover, the operations are performed in functionally compromised group of patients who tolerate complications poorly.[7]

In this study, we reviewed our experiences with rheumatic mitral valve disease patients who had undergone mitral valve replacement (MVR) following closed mitral valvotomy (CMV).

MATERIALS AND METHODS

This retrospective study was based upon analysis of patients with rheumatic valvular heart disease who underwent mitral valve replacement following closed mitral valvotomy from 1st January 2001 to 31st December 2008. The study was conducted in the Department of Thoracic & Cardiovascular Surgery, Christian Medical College & Hospital, Vellore.

Inclusion Criteria

- All patients aged 20 years and above with rheumatic mitral valvular heart disease who

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underwent mitral valve replacement following closed mitral valvotomy (CMV) were included. Those patients who had balloon mitral valvotomy in addition to CMV or concomitant surgery such as tricuspid annuloplasty, left atrial clot removal & aortic valve replacement were also included in the study.

Exclusion Criteria

- Patients less than 20 years of age at reoperation.
- Patients with previous open mitral valvotomy, mitral valve replacement or balloon mitral valvotomy alone.
- Patients undergoing emergency redo mitral valve surgery following CMV or 2nd BMV.

During this period, 101 patients underwent reoperation for mitral valve disease following closed mitral valvotomy. For the retrospective analysis of these patients, their case notes were obtained from the Medical Records Department and data noted as per the proforma.

Of the 101 patients in the study group, 56 (55.4%) were females and 45 (44.6%) were males with female to male ratio being 1.24:1. The mean age of the patients at the primary operation (CMV) was 26.35 ± 8.75 years (range 5 to 58 years) and at reoperation (MVR) was 44.23 ± 9.31 years (range 20 to 65 years). There was a mean interval of 17.88 ± 6.68 years (range 4 to 40 years) between primary CMV and reoperation (MVR). In addition, 8 patients underwent redo CMV after a mean interval of 11.62 ± 4.20 years followed by mitral valve replacement with a mean interval of 13.50 ± 8.75 years. The preoperative characteristics of the study population are presented in [Table 1].

84 patients (83.2%) had undergone prior CMV alone and 17 patients (16.8%) had undergone both CMV and BMV as a prior intervention. Out of 84 CMV patients, 7 (6.90%) patients had undergone redo closed mitral valvotomy followed by mitral valve replacement. In addition, 1 (1.0%) patient underwent both redo CMV and BMV before the MVR.

Cardiomegaly (cardiothoracic ratio >60%) was present in 40 (39.60%) patients while electrocardiogram revealed atrial fibrillation in 69 (68.30%) patients. On echocardiogram, 5 (5.0%) patients had left atrial clot, 40 (39.60%) patients had mitral valve calcification and 35 (34.70%) patients had a left atrial size of >60 mm. The left ventricular (LV) function was normal {LV ejection fraction (LVEF) >50%} in 76 patients (75.20%) and 25 patients (24.80%) had LV dysfunction (LVEF <50%). Coronary angiogram was performed preoperatively in all patients ≥ 40 years of age and in whom coronary artery disease was suspected on clinical basis.

Surgical approach: All patients underwent surgery on an elective basis. Out of 101 patients, 77 (76.20%) patients underwent mitral valve replacement alone and concomitant surgery was performed in 24 (23.80%) patients [Table 2].

In patients who had undergone MVR alone, the mean bypass and cross clamp time was 75.97 ± 17.42 min (range 42 to 121 min) and 42.19 ± 10.99 min (range 21 to 70 min) with an average blood loss of 305.8 ± 162.41 ml in the first 24 post operative hours. The requirement for transfusion of blood and blood products (Fresh frozen plasma and platelet rich concentrates) was 1.57 ± 2.22, 1.60 ± 2.88 and 1.01 ± 2.52 pints respectively in these patients. The mean duration of ventilation and ICU stay was 26.34 ± 11.18 hrs and 2.55 ± 2.61 days respectively in these patients.

Operative Technique: All operations were performed through midline sternotomy. After mid-sternotomy, pericardial adhesions were carefully dissected to expose aorta, right atrium, and both vena cavae. With aortic and bicaval cannulation, cardiopulmonary bypass was established and the heart was dissected free of adhesions. In all the patients, the femoral area was also painted and draped to keep it ready for dissection for establishment of femoro-femoral bypass if required although none of our patients required it.

All operations were performed with moderate hypothermia. Cardioplegic arrest was achieved by antegrade injection of cold blood cardioplegia with St. Thomas solution. The remaining procedure was performed in the conventional manner through left atriotomy anterior to the confluence of right pulmonary veins. Temporary ventricular pacing wires were inserted in all the patients. Attention was given to meticulous hemostasis and autologous blood was used in patients with hemoglobin <10g%.

Mechanical prosthetic mitral valves were used in 97 (96.0%) patients. Among these, Cage ball valve (Starr Edwards) was most commonly used in 75 (74.30%) patients, bileaflet valve in 16 (15.80%) and tilting disc valve (Medtronic Hall) in 6 (5.90%) patients. However, bioprosthetic valves were used in 4 (4.0%) patients. Various bileaflet valves used were St. Judes, ATS, Sorin Bicarbon and Edwards MIRA valve [Table 3].

Follow-up: All patients were seen in outpatient clinic at our institution. The latest follow up data available was collected from retrospective analysis of the outpatient clinic records and analyzed to assess the functional status (NYHA class), prosthetic valve function, late morbidity and mortality after cardiac valvular reoperation. A total of 81 (80.2%) patients had a follow up in the out patient clinic of this hospital and the mean follow up was 24.80 ± 22.24 months (range 4 to 96 months).

Statistical Analysis: Data was analyzed with SPSS 16.0 software package (SPSS Inc, Chicago III). Continuous variables were provided as mean ± SD. Categorical data was analyzed univariately by Chi-square test and Fisher's Exact test. The significance of the difference of the mean values was analyzed by Student's t-test. A p - value of less than 0.05 was considered significant.

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RESULTS

Early mortality (defined as death occurring within 30 days of operation) was 2.0% (n=2) with no intra operative deaths. Low cardiac output syndrome was the major cause of mortality.

Out of 101 patients, 36 (35.60%) patients had postoperative non-fatal complications with 9 (8.9%) patients having more than one complication. Rhythm disturbances (atrial fibrillation with rapid ventricular rate, ventricular arrythmias) requiring medication were seen in 7 (6.90%) patients. Two patients (2%) required re-exploration for mediastinal bleeding during immediate postoperative period. Two patients (2%) required pericardiostomy for pericardial effusion during early postoperative period. Four patients (4%) had neurological deficits that recovered during follow up period. Nine patients (8.9%) required temporary pacing for bradycardia which gradually recovered. Post operative urinary tract infection was seen in 7 patients (6.9%) and sternal wound infection in 5 (5.0%) patients. Other complications include low cardiac output syndrome requiring inotropes for >48 hrs in 6 (5.90%), jaundice in 3 (3.0%), prolonged ventilation for >72 hrs in 2 (2.0%) patients [Table 4]. The average hospital stay in the post operative period was 9.28 ± 2.79 days.

Out of 81 (80.2%) patients who had followed up in postoperative period, 18 (17.80%) patients had late morbidity. Anticoagulation related hemorrhage was diagnosed when patients receiving anticoagulants presented with stroke or episodes of bleeding substantiated by prolongation of the prothrombin time and INR. The most common morbidity was a cerebrovascular accident leading to neurological deficit seen in 8 (7.90%) patients. 5 (5%) patients had a non-fatal bleeding episode that required hospitalization. One patient developed infective endocarditis which was successfully managed with appropriate antibiotics. Other late complications include congestive cardiac failure in 1 (1%) and wound infection in 3 (3%) patients [Table 5].

In our study, late mortality was seen in only 2 (2%) patients. One died of low cardiac output syndrome and the other died of non cardiac cause that is intracranial bleed.

Functional and Cardiac Performance Post MVR: In the present study, the hemodynamic data as detected by transthoracic echocardiography revealed a mean mitral valve gradient of 4.59 ± 1.90 mm Hg postoperatively as compared to 9.66 ± 3.42 mm Hg in the preop period. The mean functional class improved from 2.68 ± 0.56 before valve replacement to 1.2 ± 0.43 afterward and 75.2 % of all patients improved at least one functional class.

Parameters Influencing Survival: In the present study, ten variables were studied to correlate their influence on the late survival. These variables included age at reoperation, sex, NYHA functional class, previous intervention, cardiothoracic ratio, rhythm, left atrial size, mitral valve calcification, ejection fraction and the final diagnosis. Out of these variables, only high cardiothoracic ratio on radiological evaluation was shown to have statistical significance (p value: 0.024) influencing survival. However, other variables did not show any statistical significance to influence survival [Table 6].

Table 1: Preoperative clinical data of patients (n=101)

Variable	No. of patients
Gender	
Male	45 (44.6%)
Female	56 (55.4%)
Mean age (Years)	
At primary operation (CMV)	26.35 ± 8.75 (5-58)
At reoperation (MVR)	44.23 ± 9.31 (20-65)
Previous intervention	
CMV alone	77 (76.3%)
CMV twice	7 (6.9%)
CMV & BMV	16 (15.8%)
CMV twice & BMV	1 (1.0%)
Latency period (years)	
CMV → MVR	17.88 ± 6.685
CMV → Redo CMV	11.62 ± 4.207
Redo CMV → MVR	13.50 ± 8.751
NYHA class	
II	37 (36.6%)
III	59 (58.40%)
IV	5 (5%)
History of systemic embolism	5 (5%)
History of congestive cardiac failure	3 (3%)
Cardiomegaly (CTR >60%)	40 (39.6%)
Preoperative rhythm	
Sinus	32 (31.7%)
Atrial fibrillation	69 (68.3%)
Type of lesion	
Predominant MS	59 (58.4%)
Predominant MR	19 (18.8%)
Mixed	23 (22.8%)

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Left atrial clot	5 (5%)
Mitral annular calcification	40 (39.6%)
Left atrial size (>60 mm)	35 (34.7%)

Values are mean ± SD (and range when applicable)
Values in parentheses are percentages
CMV = Closed mitral valvotomy, BMV = Balloon mitral valvotomy, MVR = Mitral valve replacement, CTR = Cardiothoracic ratio, MS = Mitral stenosis, MR = Mitral regurgitation

Table 2: Operative data of the patients (n=101)

Operation	Number of patients	%
MVR	77	76.20
MVR + Tricuspid annuloplasty	3	3.0
MVR + LA clot removal	4	4.0
MVR + LA clot removal + Tricuspid annuloplasty	1	1.0
MVR + AVR	14	13.80
MVR + CABG	2	2.0
Mean CPB time (min)	75.97 ± 17.42 (42-121)	
Aortic cross clamp time (min)	42.19 ± 10.99 (21-70)	

Values are mean ± SD (and range when applicable)
Values in parentheses are percentages
MVR: Mitral valve replacement; LA: Left atrium; AVR: Aortic valve replacement;
CABG: Coronary artery bypass grafting; CPB: Cardiopulmonary bypass

Table 3: Details of the implanted valves

Valve type		Number of patients (%)
Mechanical	Cage Ball	75 (74.30)
	Bileaflet	16 (15.80)
	Tilting	6 (5.90)
Bioprosthetic		4 (4.0)

Values in parentheses are percentages

Table 4: Causes of early morbidity

Postoperative complications	Number of patients (%)
Arrhythmias requiring medication	7 (6.9)
Re-exploration for bleeding	2 (2)
Pericardial effusion requiring drainage	2 (2)
Neurological deficits	4 (4)
Temporary pacing	9 (8.9)
Low cardiac output syndrome (On inotropes >48 hrs)	6 (5.9)
Prolonged ventilation (>72 hrs)	2 (2)
Jaundice	3 (3)
Urinary tract infection	7 (6.9)
Sternal wound infection	5 (4)
Deranged Renal function	1 (1)

Table: 5: Causes of Late Morbidity & Mortality

Late Morbidity	Number of patients (%)
Cerebrovascular accident	8 (7.9)
Bleeding episode	5 (4)
Infective endocarditis	1 (1)
Congestive cardiac failure	1 (1)
Wound infection	3 (3)
Late Mortality	
Low cardiac output	1 (1)
Intracranial bleed	1 (1)

Table: 6: Parameters Influencing Survival

Variables under study		Dead	Alive	P value
Age		47 ± 7.25	43.78 ± 9.34	0.50
Sex	Male	2 (50%)	36 (45.60%)	1.0
	Female	2 (50%)	43 (54.40%)	
NYHA class	II	0	32 (40.50%)	0.156
	III	4 (100%)	45 (57%)	0.141
	IV	0	2 (2.5%)	1.0
Previous intervention	CMV	1 (25%)	12 (15.2%)	0.50
	CMV + BMV	3 (75%)	67 (84.8%)	

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Cardiothoracic ratio			68.50 ± 8.88	59.84 ± 7.27	0.024
Rhythm	Sinus		1 (25%)	27 (34.2%)	1.0
	AF		3 (75%)	52 (65.8%)	
Left atrial size (mm)			56 ± 7.65	54.9 ± 13.22	0.88
Valve calcification		Yes	1 (25%)	33 (41.8%)	0.64
		No	3 (75%)	46 (58.2%)	
Variables under study			**Dead**	**Alive**	**P value**
Ejection fraction (%)			56.50 ± 1.73	58.8 ± 4.04	0.26
Final diagnosis	Predominant MS		1 (25%)	48 (60.8%)	0.116
	Predominant MR		2 (50%)	13 (16.5%)	
	Pred. MS + MR		1 (25%)	18 (22.8%)	

DISCUSSION

Rheumatic heart disease is a significant problem in children and young adults in the developing nations.[1] Closed mitral valvotomy (CMV) is a palliative surgical treatment that may require early reoperation.[3]

A large number of patients in the present study were in third decade (mean age 26.35 ± 8.75 years) at the primary operation (CMV) similar to age distribution seen by John et al,[8] in their long series of 3724 patients. There is a preponderance of female sex (55.4%) in our study comparable with other large series.

The mean age at reoperation (MVR) was 44.23 ± 9.31 years (range 20 to 65 years) with a mean interval of 17.88 ± 6.68 years (range 4 to 40 years) between the primary CMV and reoperation (MVR) in this study. This good long term result of CMV is comparable to study by Kumar et al in which the patients underwent redo MVR after a mean interval of 14.2 years following CMV.[6]

Restenosis is a known complication after closed mitral valvotomy.[4] Redo CMV is still favored in developing nations due to its cost effectiveness and avoidance of anticoagulation.[4] Fraser and Sugden suggested repeat CMV in selected non-calcific cases as a good means of palliation.[9] In our study, 8 patients underwent redo CMV after a mean interval of 11.62 ± 4.20 years followed by MVR after 13.50 ± 8.75 years.

This latency period correlated with studies by Suri et al,[4] in which the mean interval between first and second valvotomy was 9.4 years. In a study by Rutledge et al,[10] there was a span of 13.60 years between redo CMV and subsequent MVR. Thus, although repeat CMV is associated with late valve replacement, patients receive significant palliation from the second operation and benefit is sustained in majority of patients.[10]

In our study, the most common indication for reoperation following closed mitral valvotomy was mitral restenosis in 58.40% patients followed by MR along with MS in 22.8% patients and predominant MR in 18.80% patients. Similar observation was noticed in a study by Kumar et al,[6] in which following CMV, the predominant lesion requiring MVR was mitral restenosis in 73.7% patients. However, 10.4% had MR along with MS and 6.7% had MR as the predominant lesion as an indication for reoperation.

Surgical approach is a big dilemma in reoperations. Many surgeons recommend redo mitral valve surgery via right thoracotomy as this approach minimizes dissection of adhesions, avoids injury to right ventricle and prevents injury to coronary bypass grafts.[11] They report reduced blood loss and a decreased requirement of inotropic support.[11] Some authors describe reoperations without mobilizing the heart from the pericardium by opening the pleural cavities.[12] In our experience, median sternotomy was safe for re-entry into chest followed by careful lysis of pericardial adhesions as latter allows for adequate surgical exposure, proper myocardial protection and complete deairing.

Tsai et al,[13] reported their preliminary experience with video assisted reoperative mitral valve surgery. They felt that this approach was technically feasible in redo mitral valve surgery but more experience is needed.

Cohn et al,[7] suggest routine exposure of femoral vessels prior to sternotomy for repeat open heart procedures as a safeguard in case of catastrophic hemorrhage during sternotomy. In all our patients, the femoral area was also painted and draped to keep it ready for dissection for establishment of femoro-femoral bypass if required although none of our patients required it.

Preservation of the chordae tendinae and papillary muscles is now a standard procedure during MVR. Its effect on early and late left ventricular function is well proven. Rao et al,[14] believe that preservation of chordae is technically feasible and may improve outcome after MVR. In accordance with Lillehei,[15] preservation of the leaflet along with the chordopapillary attachment may be beneficial, both in the early and in the long term.

Operative variables, duration of hospitalization and early morbidity were determined in this study. On review of literature, there is no illustration of these variables for the patients undergoing redo mitral valve replacement following CMV. Thus, a comparison was made with data of the patients who had undergone primary MVR in previous studies.

In our study, the mean bypass and cross clamp time was 75.97 ± 17.42 min and 42.19 ± 10.99 min respectively. The average blood loss was 305.8 ± 162.41 ml in the first 24 post operative hours with post operative hospital stay of 9.28 ± 2.79 days. These results were similar to that for primary MVR with comparable postoperative morbidities as analyzed by Potter.[16] We believe that

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standardization of operative technique, meticulous attention to hemostasis and good surgical expertise has been responsible for the good results.

The adverse effect of associated tricuspid valve disease is well known.[17] After correction of left sided mitral lesion, moribund effect of functional tricuspid disease is expected to fall. However, additional morbidity is imposed due to low cardiac output, poor right ventricular function with associated tricuspid valve disease as seen in 5 out of 6 patients with low cardiac output syndrome having moderate to severe tricuspid regurgitation (TR). This highlights the need to avoid underestimation of the severity of lesion as it may deteriorate at a later stage and thus, it is advisable to repair TR at the time of initial surgery for mitral valve disease.

Reoperations for valvular heart disease are associated with higher overall mortality than in the primary operation. The mortality reported for redo MVR varies from 1.3 to 14.2 % with operative mortality after second or third reoperation is significantly higher than that after primary operation or first reoperation.

Kumar et al,[6] reported a mortality of 4.5 % for redo MVR. Our results were quite similar with mortality of 4% for reoperation following previous CMV. However, Rutledge et al,[10] in his series of patients observed high perioperative mortality of 13% for redo mitral valve replacement.

It has been reported that early and late mortality in patients with NYHA class I through III is significantly less than those patients who present in class IV. This may have an important bearing for good results in the present study as 95% of all patients were in class II & III. Other risk factors for increased mortality described are elderly age, female sex, preop atrial fibrillation, active endocarditis, emergency surgery, previous thromboembolism.

However, our observations don't suggest such correlation with mortality and survival except high cardiothoracic ratio (>70%) as a statistically significant predictor of mortality. This may be attributed to improved pre operative stabilization, advancements in surgical techniques, better postoperative care and early reoperation before severe cardiac exoskeletal damage occurs. However, 19.8% patients who were lost to follow up may have had important outcomes that were not accounted for.

Our study reveals that redo MVR provides excellent hemodynamic and long term symptomatic improvement. These patients demonstrated significant decrease in mean mitral valve gradient from 9.66 ± 3.42 mm Hg in the preop period to 4.59 ± 1.90 mm Hg postoperatively paralleled by marked improvement in functional status.

The mean functional class improved from 2.68 ± 0.56 before valve replacement to 1.2 ± 0.43 afterward and 75.2 % of all patients improved at least one functional class. The latter may be an underestimation as 19.8% patients were lost to follow up.

Rutledge et al,[10] also reported in their series a significant improvement of functional class from 3.3 to 1.5 post MVR with improvement of at least one functional class in 88 % of survivors. They showed a significant decrease in mean mitral gradient from 12.1 ± 0.9 to 6.6 ± 0.8 after valve replacement.

Mitral valve replacement carries the hazards of anticoagulation with the necessity of lifelong expenditure and strict treatment compliance. Because most of our population at risk has rural background and poor socioeconomic status, compliance with anticoagulation schedule is always doubtful in our country.

Thus, non-compliance often leads to serious post MVR complications as revealed in our study with 7.9% patients having cerebrovascular accident and 5% patients having bleeding episodes. However, on analysis, since benefits outweigh the risk, it is our responsibility as a health professional to educate these patients properly regarding postoperative care to sublime these complications.

Limitations Of Study

- First, its retrospective design.
- Second, in our study, 18 patients had no follow up data making it difficult to assess accurately the late results. These patients might have had important outcomes that were not accounted for.
- Third, the study spanned from Jan 2001 to Dec 2008. During this time, there have been numerous advances in the perioperative management, myocardial protection, prosthetic valve design and operative techniques including preservation of subvalvular apparatus which might have influenced the long term results contrary to previous studies.

CONCLUSION

Redo MV surgery is safe and can be undertaken with acceptable morbidity and mortality. With advances in cardiopulmonary bypass methods, operative techniques and myocardial protection, there has been a definite trend towards neutralization of risk between primary and redo surgery.

When symptomatic deterioration occurs late after CMV, MVR restores the clinical and hemodynamic improvement in many patients. However, for optimal results, myocardial damage should be prevented by adequate preoperative medical therapy and prompt reoperation when necessary.

However, in regard to patient's quality of life, anticoagulation therapy represents the most serious problem especially when using mechanical valves. A strict adherence to optimal anticoagulation optimizes protection against thromboembolism and anticoagulation related hemorrhage. The development of superior mechanical valve requiring less rigorous anticoagulation or a refined bioprosthetic valve with a better durability would definitely improve the quality of patient's life in the long term.

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