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Single-Surgeon Outcomes of Left Ventricular Aneurysm Repair in Wartime Syria: A 10-Year Retrospective Study at Damascus University Cardiac Surgery Hospital

Ahmad Mohammad Ramadan[1] | Safana Abdullah Algutaini[2]* | Nada Muhammad Eid Alsabbagh[3] | Mohammed Kamel Hasan[4] | Mohannad Adnan Saleh[5]

[1]Consultant Cardiac Surgeon,University Cardiac Surgery Hospital, Damascus, Syria.

[2]Epidemiologist, East Carolina University, North Carolina, USA.

[3]Consultant Cardiologist,University Cardiac Surgery Hospital, Damascus, Syria.

[4]Specialist Cardiac Surgeon,University Cardiac Surgery Hospital, Damascus, Syria.

[5]Specialist Cardiac Surgeon,University Cardiac Surgery Hospital, Damascus, Syria.

***Corresponding Author:** Safana Abdullah Algutaini , Epidemiologist, East Carolina University, North Carolina, USA

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Abstract

Background:

Surgical ventricular reconstruction (SVR) is a key procedure for patients with ischemic left ventricular aneurysms, particularly in low-resource and conflict-affected regions. This 10-year retrospective study evaluates the clinical, hemodynamic, and structural outcomes of SVR performed by a single surgeon (Dr. Ahmad Ramadan) at Damascus University Cardiac Surgery Hospital in Syria.

Methods:

We reviewed 90 patients who underwent SVR between October 2012 and January 2022. Two surgical techniques were used: linear closure (n = 51) and Dor procedure (n = 39). All surgeries were performed using cardiopulmonary bypass with mild hypothermia and intermittent antegrade cold blood cardioplegia, administered in the aortic root and in venous grafts every 15–20 minutes. Grafts included the left internal mammary artery and a saphenous vein. A temporary intraventricular sizing balloon was used to guide reconstruction, and Dacron or bovine pericardial patches were utilized in Dor repairs to preserve optimal ventricular geometry and prevent low cardiac output syndrome. Additional procedures included mitral valve repair (n = 16), mitral valve replacement (n = 6), and tricuspid valve interventions (n = 9).

Echocardiographic data were collected preoperatively and postoperatively, including left ventricular diameters (LVEDD, LVESD), volumes (LVEDV, LVESV), indexed volumes (LVEDVI, LVESVI), ejection fraction (EF), and pulmonary arterial pressure (PAP). About 70% of patients underwent left ventriculography, and 100% underwent nuclear imaging for myocardial viability assessment.

Results:

Postoperative outcomes showed a significant improvement in mean ejection fraction (from 42.5% to 47.4%), NYHA functional class (from 3.12 to 1.74), and pulmonary arterial pressure (from 44.6 mmHg to 31.1 mmHg). Indexed left ventricular volumes were markedly reduced: LVEDVI and LVESVI declined by an average of 14.2 and 10.5 mL/m², respectively. Among patients initially in NYHA class IV (n = 21), 90.5% improved to class II or lower at follow-up. The need for inotropic support was categorized as mild (34.4%), moderate (48.9%), and severe (16.7%).

Postoperative complications included pneumonia (6.6%), atrial fibrillation (3.3%), bleeding (4.4%), wound infection (4.4%), arrhythmia, conduction blocks, acute renal failure, and cardiopulmonary bypass (CPB)-related effects. The 30-day mortality rate was 10%, primarily due to heart failure (33.3%), cardiogenic shock (22.2%), CPB-related complications (22.2%), septic shock (11.1%), and pulmonary complications (11.1%). Mortality was slightly higher in Dor group (12.8%) compared to linear repair (7.8%).

Conclusion:

Surgical ventricular reconstruction—when performed by an experienced surgeon even under wartime constraints—can yield substantial improvements in left ventricular geometry, function, and clinical status. While both Dor and linear techniques were effective, linear repair showed slightly lower mortality, whereas Dor repair provided greater reverse remodeling. These findings support the feasibility and safety of complex cardiac surgery in resource-limited settings when guided by structured surgical protocols and individualized patient care.

Key words: surgeon; left ventricular; cardiac surgery; surgical ventricular reconstruction (svr)

Introduction:

Left ventricular aneurysm (LVA) is a well-recognized mechanical complication of transmural myocardial infarction (MI), characterized by localized thinning and dyskinesia of the ventricular wall, most often affecting the anterior or apical segments. This structural abnormality leads to paradoxical systolic bulging, reduced ejection fraction, ventricular remodeling, and increased risk of arrhythmias, thromboembolism, and heart failure (Gholampour Dehaki et al., 2019) [1].

The diagnosis of LVA relies on multimodal imaging. Transthoracic echocardiography (TTE) remains a frontline tool for assessing wall motion abnormalities and aneurysmal segments. However, cardiac magnetic resonance imaging (MRI) provides superior tissue characterization and delineation of nonviable myocardium, making it invaluable for preoperative planning (Pennell, 2004; Wu et al., 2003) [6]. Other techniques such as contrast-enhanced computed tomography and left ventriculography may further assist in anatomical clarification.

Surgical intervention remains the treatment of choice for symptomatic patients, especially those with heart failure or refractory arrhythmias. The two most widely used surgical techniques are linear closure and endoventricular circular patch plasty, commonly referred to as the Dor procedure (Dor et al., 1998) [2]. Both approaches aim to exclude nonviable myocardial segments, restore physiologic ventricular geometry, and improve hemodynamic performance. While evidence supports the benefits of surgical ventricular reconstruction (SVR), comparisons between techniques remain equivocal (Xie et al., 2018) [8].

Despite significant research in high-resource settings, little is known about outcomes of SVR in low-resource or conflict-affected environments. Syria has faced major infrastructure challenges during prolonged armed conflict, yet cardiac surgery services have remained operational in select university hospitals.

This study aims to evaluate the outcomes of SVR performed over a 10-year period by a single surgeon at Damascus University Cardiac Surgery Hospital. All procedures were conducted during wartime under severe resource constraints. By analyzing changes in left ventricular geometry, ejection fraction, pulmonary arterial pressure, functional class, and surgical complications before and after surgery, this study offers valuable insight into the feasibility, safety, and effectiveness of SVR—using both linear and Dor techniques—in conflict-affected and limited-resource settings. This study spans a 10-year period (2012–2022) and represents one of the few investigations of left ventricular reconstruction conducted in the Middle East. Over the past 25 years (2000–2025), only four studies have been published from the region addressing left ventricular restoration. Notably, this is the second study from Syria, both conducted at the same center. The first was published in 2003 by Professor Sami Kabbani, highlighting the rarity and regional significance of such research.

Methods:

Study Design and Patient Population:
This retrospective cohort study included 90 patients diagnosed with ischemic left ventricular aneurysm who underwent surgical ventricular reconstruction (SVR) between October 2012 and January 2022 at Damascus University Cardiac Surgery Hospital. All procedures were performed by a single experienced cardiac surgeon. Data were extracted from medical records, operative reports, and echocardiographic archives. Ethical approval was obtained from the institutional review board.
Surgical Techniques:
All surgeries were performed by a single experienced surgeon using cardiopulmonary bypass (CPB) with mild hypothermia. Intermittent cold blood cardioplegia was administered into the aortic root and venous grafts every 15–20 minutes. A temporary intraventricular sizing balloon was inserted in all cases to guide reconstruction of the left ventricular geometry based on body surface area. In Dor procedures, a Dacron or bovine pericardial patch was used to prevent excessive ventricular volume reduction and minimize the risk of postoperative low cardiac-output syndrome.
The left internal mammary artery was used in 84% of patients, and the saphenous vein was used in 92%. The average number of grafts per procedure was 2.67. The mean cardiopulmonary bypass (CPB) time was 183.6 minutes, and the mean aortic cross-clamp time was 126.8 minutes.
Concomitant Valve Procedures:
Additional procedures included mitral valve repair via left atriotomy with a rigid ring (mostly size 28 mm; n = 9), mitral valve repair via the left ventricle (n = 7), mitral valve replacement with mechanical prosthesis via left ventricular approach (n = 2) and via left atrium (n = 4). Tricuspid valve repair using ring annuloplasty or DeVega technique was performed in 9 patients. Tricuspid valve repair was performed with a ring in 4 cases and without a ring in 5.
Data Collection:
Preoperative and postoperative echocardiographic parameters included left ventricular end-diastolic and end-systolic diameters (LVEDD, LVESD), volumes (LVEDV, LVESV), and indexed volumes (LVEDVI, LVESVI), as well as ejection fraction (EF) and pulmonary arterial pressure (PAP). Left ventriculography was performed in 70% of patients, and all patients underwent myocardial viability assessment using nuclear imaging.
Inotropic support was classified based on requirement severity: mild (34.4%), moderate (48.9%), and severe (16.7%). Hemodynamic profiles and New York Heart Association (NYHA) class were documented pre- and postoperatively. NYHA class was tracked to assess clinical improvement across class I–IV strata.
Complications and Outcomes:
Postoperative complications were recorded, including atrial fibrillation (AF), complete heart block, nonspecific arrhythmias, acute renal failure (ARF), CPB-related effects, bleeding, wound infection, and pneumonia. Mortality was assessed within the first 30 days postoperatively, and causes of death were categorized into heart failure, cardiogenic shock, CPB-related complications, septic shock, acute renal failure, and pulmonary complications.
Ethical Considerations and Intraoperative Documentation:
Intraoperative photographs were obtained during surgery for clinical documentation, education, and potential academic dissemination. All images selected for publication were de-identified to ensure patient anonymity and contain no personally identifiable information. Verbal and institutional consent was obtained from the surgical team prior to image use, in alignment with ethical standards. No additional interventions or risks were introduced for the purpose of documentation. The study protocol was reviewed and approved by the institutional ethics committee.

Results:

Patient Demographics and Comorbidities
A total of 90 patients underwent surgical ventricular reconstruction over a 10-year period. The mean age was 57.4 ± 9.9 years, with 84.4% (n = 76) males and 15.6% (n = 14) females (Table 1).
Common comorbidities included hypertension (43.96%) and diabetes mellitus (41.76%). A history of previous myocardial infarction was present in 87.7% of patients, confirming the ischemic etiology of their ventricular aneurysm.
Operative Details and Techniques
Linear closure was performed in 51 patients (56.7%), and Dor procedure in 39 patients (43.3%). All surgeries were conducted by a single surgeon using cardiopulmonary bypass under mild hypothermia. Cold blood cardioplegia was administered into the aortic root and venous grafts every 15–20 minutes. Internal mammary and saphenous vein grafts were used in 84% and 92% of patients, respectively.
A temporary intraventricular sizing balloon was utilized in all cases. In Dor procedures, a Dacron or bovine pericardial patch was used to prevent excessive volume reduction and minimize the risk of postoperative low cardiac-output syndrome.
Concomitant Valve Procedures:
Mitral valve repair was performed in 16 patients, including 9 via the left atrium using prosthetic rings (mostly size 28), and 7 via the left ventricle. Mitral valve replacement was done in 6 cases, and tricuspid repair was completed in 9 (via De Vega or ring techniques). Details are presented in **Table 3**.

Echocardiographic and Hemodynamic Outcomes

Postoperative assessments demonstrated significant improvements across multiple parameters:

- Ejection fraction increased from 42.5% to 47.4%.
- NYHA class improved from a mean of 3.12 to 1.74.
- Pulmonary arterial pressure (PAP) declined from 44.6 mmHg to 31.1 mmHg.
- Left ventricular volumes and dimensions showed significant reductions in LVEDD, LVESD, LVEDV, and LVESV (Table 4, Table 6).
- Indexed values (LVEDVI and LVESVI) also decreased significantly.

These outcomes are further illustrated in Figures 1–3.

Functional Recovery:

NYHA class improved in the majority of patients. Among those in Class IV (n = 21), 90.5% improved to Class II or lower. Full NYHA data with mean, SD, and range are shown in Table 9 and Figure 2.

Interpretation: On average, patients improved by over one full NYHA class post-surgery, indicating significant functional recovery.

Inotropic Support:

Mild inotropic support was required in 34.4% of patients, moderate in 48.9%, and high-dose support in 16.7%.

Postoperative Complications:

Complications were observed in 27.8% of cases. Pneumonia (6.6%) and atrial fibrillation (3.3%) were the most frequent, followed by bleeding and wound infection (Table 5).

Additional complications such as CPB-related effects, acute renal failure, heart block, and arrhythmias were noted.

Mortality and Causes:

The 30-day postoperative mortality rate was 10% (9 of 90). Mortality was higher in the Dor group (12.8%) than in the linear closure group (7.8%) (Table 7).

Leading causes of death included heart failure (33.3%), cardiogenic shock (22.2%), and CPB-related complications (22.2%) (Table 11, Figure 4).

Hospital Stay Duration:

The mean postoperative hospital stay was 9.4 days. This reflects both early recovery and the effectiveness of perioperative management despite resource constraints.

Gender	Count	Mean Age	Standard Deviation	Minimum Age	Maximum Age
Female	14	60.71429	8.999389	47	74
Male	76	56.94737	9.877779	32	77

Table 1 : Patient Demographics

Comorbidity	Number of Patients	Percentage (%)
Hypertension	40	43.96%
Diabetes	38	41.76%
TIA/CVA	5	5.49%
Peripheral Vascular Disease	6	6.59%
Chronic Lung Disease	15	16.48%

Table 2 : Comorbidities Summary

Procedure Description	Number of Patients	Percentage (%)
Mitral valve replacement via left atrium	4	4.4%
Mitral valve replacement via left ventricle	2	2.2%
Mitral valve repair with ring via left atrium	9	10.0%
Mitral valve repair via left ventricle (suture)	7	7.8%
Tricuspid valve repair (De Vega technique)	5	5.6%
Tricuspid valve repair with rigid annuloplasty ring	4	4.4%

Table 3: *Valve Procedures Summary*

Clinical Parameter	Preoperative Mean	Postoperative Mean	Mean Improvement / Reduction
Ejection Fraction (%)	42.51	47.37	+4.35
NYHA Functional Class	3.12	1.74	-1.38
Pulmonary Arterial Pressure (mmHg)	44.61	31.07	-13.08
LVEDD (mm)	65.2	59.4	-5.8
LVESD (mm)	54.8	47.2	-7.6
LVEDV (mL)	180.4	149.6	-30.8
LVESV (mL)	122.3	96.5	-25.8

Table 4: *Clinical Outcomes Summary*

Complication	Number of Patients	Percentage (%)
Bleeding	4	4.40%
Wound Infection	4	4.40%
Pneumonia	6	6.60%
Atrial Fibrillation	3	3.3%

Table 5: *Postoperative Complications*

Parameter	Preoperative Mean ± SD	Postoperative Mean ± SD	Mean Reduction
LVEDD (mm)	65.2 ± 7.5	59.4 ± 6.8	-5.8 mm
LVESD (mm)	54.8 ± 6.9	47.2 ± 6.3	-7.6 mm
LVEDV (mL)	180.4 ± 42.7	149.6 ± 39.1	-30.8 mL
LVESV (mL)	122.3 ± 35.6	96.5 ± 31.2	-25.8 mL
LVEDVI (mL/m²)	92.1 ± 18.5	76.4 ± 16.9	-15.7 mL/m²
LVESVI (mL/m²)	61.3 ± 16.8	48.3 ± 14.1	-13.0 mL/m²

Table 6: *Comparison of Left Ventricular Dimensions and Volumes Pre- and Postoperatively*

Group	Deaths	Total Patients	Mortality Rate (%)
Linear Closure	4	51	(4 / 51) × 100 = 7.8%
Dor Procedure	5	39	(5 / 39) × 100 = 12.8%
Overall Mortality	9	90	(9 / 90) × 100 = 10.0%

Table 7: *Mortality Rate*

Variable	Mean (%)	Standard Deviation (%)	Minimum (%)	Maximum (%)
LVEF Before Surgery	42.5	10.7	19.0	67.0
LVEF After Surgery (Immediate)	41.7	9.6	17.0	66.0
LVEF After Surgery (6 Months)	47.4	8.0	30.0	76.0
EF Improvement (Immediate)	-0.9	9.5	-28.0	15.0
EF Improvement (6 Months)	+4.3	10.0	-27.0	40.0

Table 8: *Ejection Fraction (EF) Before and After Surgical Ventricular Reconstruction*

Variable	Mean	Standard Deviation	Minimum	Maximum
NYHA Before Surgery	3.12	0.68	1.00	4.00
NYHA After Surgery	1.74	0.72	1.00	4.00
NYHA Improvement	1.38	0.85	-1.00	3.00

Table 9: *NYHA Functional Class Before and After Surgical Ventricular Reconstruction*

Interpretation: On average, patients improved by over one full NYHA class post-surgery, indicating significant functional recovery.

Variable	Mean (mmHg)	Standard Deviation	Minimum (mmHg)	Maximum (mmHg)
PAP Before Surgery	44.6	10.3	24.0	78.0
PAP After Surgery	31.1	8.9	16.0	60.0
PAP Improvement	13.1	9.0	-14.0	35.0

Table 10: *Pulmonary Arterial Pressure Before and After Surgical Ventricular Reconstruction*

Interpretation: On average, PAP decreased by 13.1 mmHg, indicating improved hemodynamics post-surgery.

Cause of Death	Number of Patients	Percentage (%)
Heart Failure	3	33.3%
Cardiogenic Shock	2	22.2%
CPB-Related Complications	2	22.2%
Septic Shock	1	11.1%
Pulmonary Complications	1	11.1%

Table 11: *Causes of 30-Day Postoperative Mortality (n = 9)*

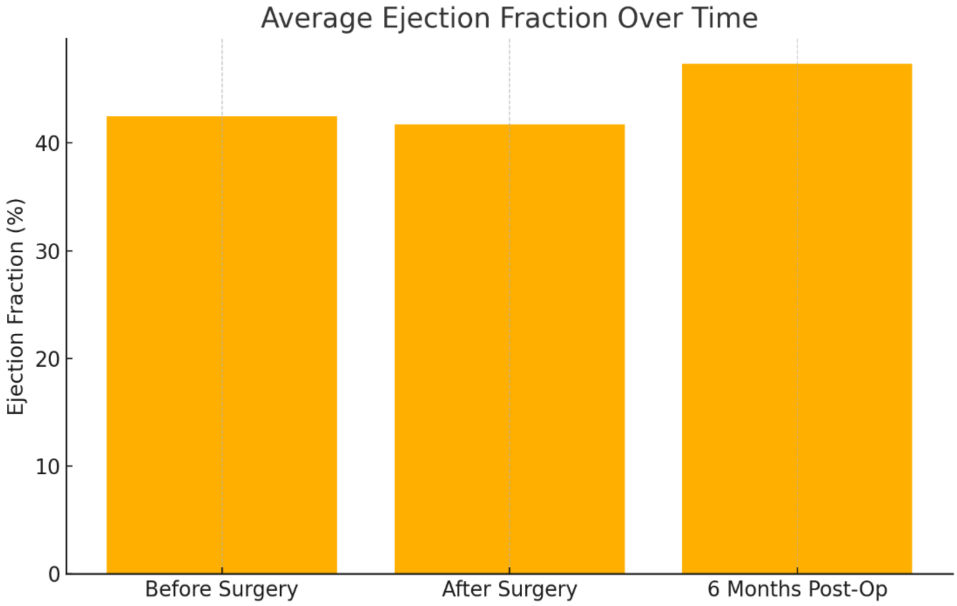

Figure 1: *Ejection Fraction Before Surgery, Immediately After, and at 6-Month Follow-Up*

Figure 1. The bar chart illustrates the progression of average left ventricular ejection fraction (EF) at three points: before surgery (42.5%), immediately after surgery (41.7%), and at six-month follow-up (47.4%), demonstrating significant improvement in systolic function postoperatively.

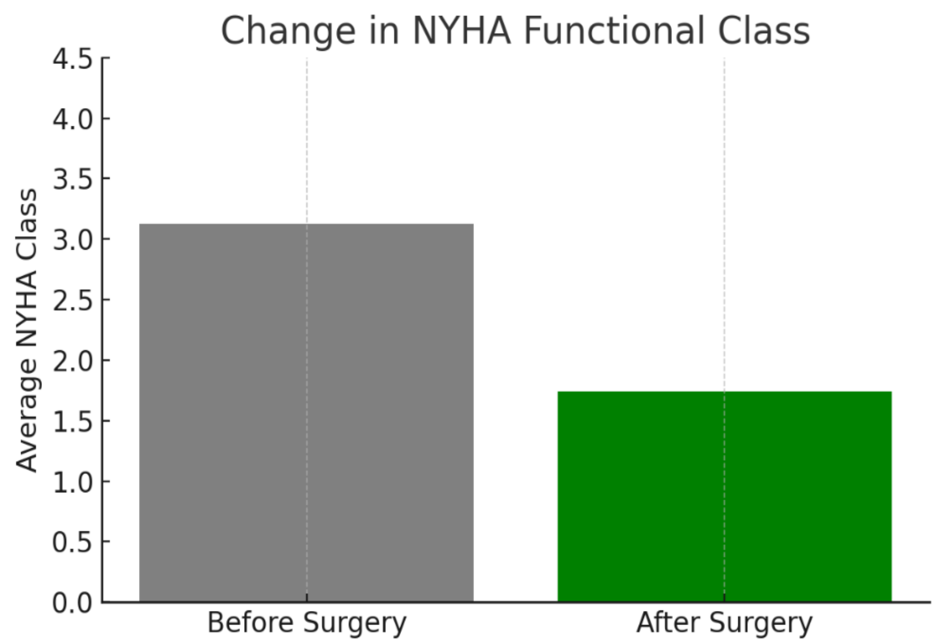

Figure 2: *Improvement in NYHA Functional Class Following Surgery*

Figure 2. Bar chart demonstrating the reduction in average New York Heart Association (NYHA) functional class from Class III (3.12) before surgery to approximately Class II (1.74) at six-month follow-up, indicating substantial symptomatic improvement in patients following surgical ventricular reconstruction.

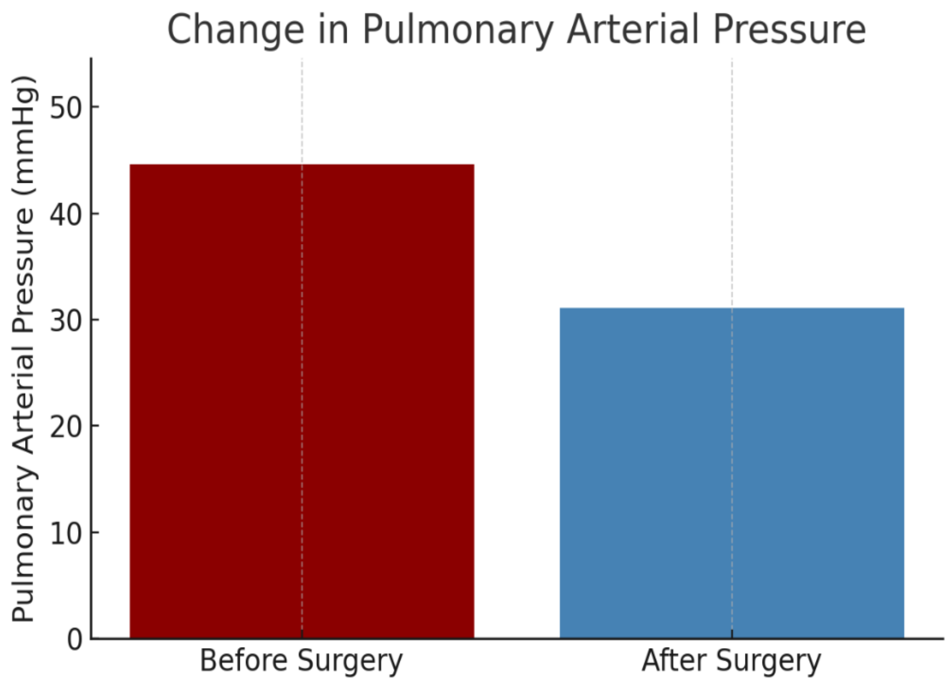

Figure 3: *Reduction in Pulmonary Arterial Pressure After Surgery*

Figure 3. Pulmonary arterial pressure (PAP) decreased significantly following surgical ventricular reconstruction, from a preoperative average of 44.6 mmHg to 31.1 mmHg postoperatively, indicating reduced pulmonary congestion and improved hemodynamic status.

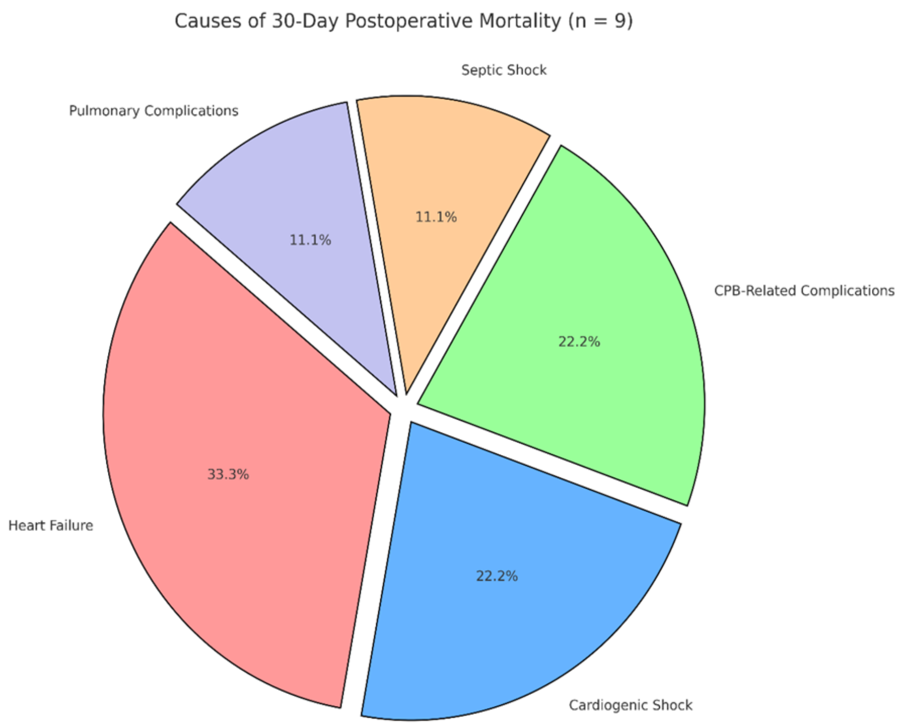

Figure 4: *Causes of 30-day postoperative mortality (n = 9)*

Intraoperative view showing a prominent left ventricular aneurysm prior to initiation of cardiopulmonary bypass. The aneurysm extends across the anterior and lateral walls to the apex. A median sternotomy was performed, and the pericardium opened to expose the heart before cannulation and initiation of extracorporeal circulation.

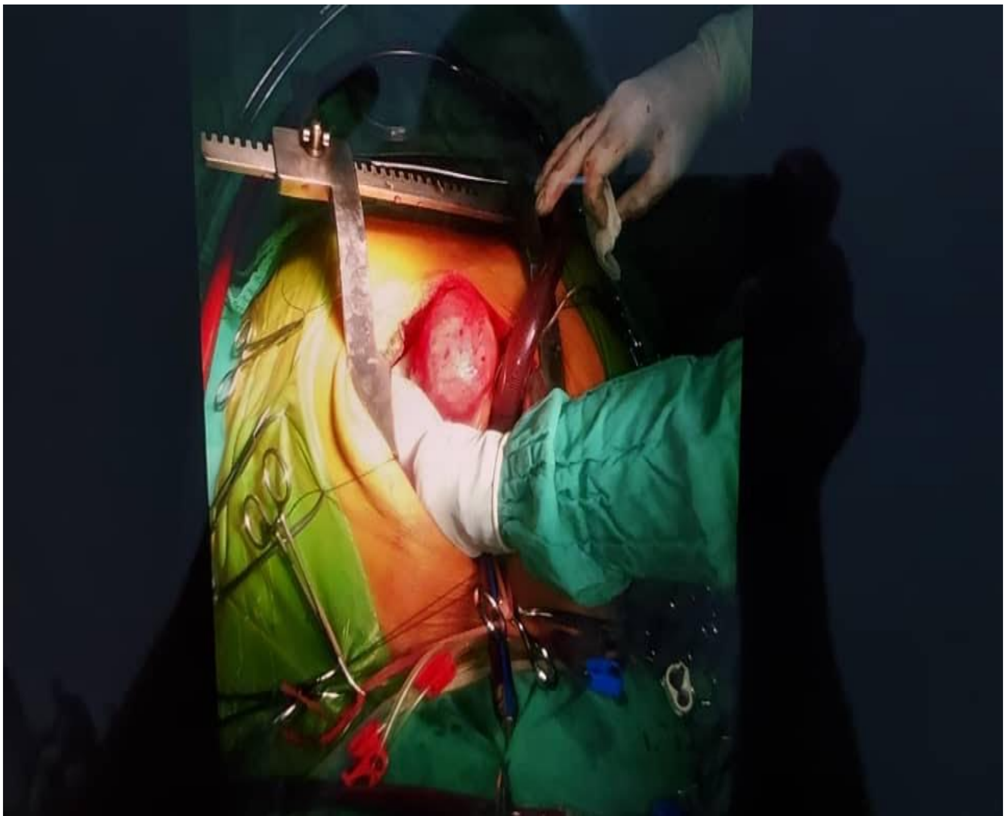

Figure 5: *Large Left Ventricular Aneurysm Involving the Anterior, Lateral Wall, and Apex*

Intraoperative view after aortic cross-clamp placement and administration of cold blood cardioplegia. Negative pressure was applied to the aortic root, resulting in the visible collapse of the aneurysmal wall. The heart is arrested, and cardiopulmonary bypass has been initiated.

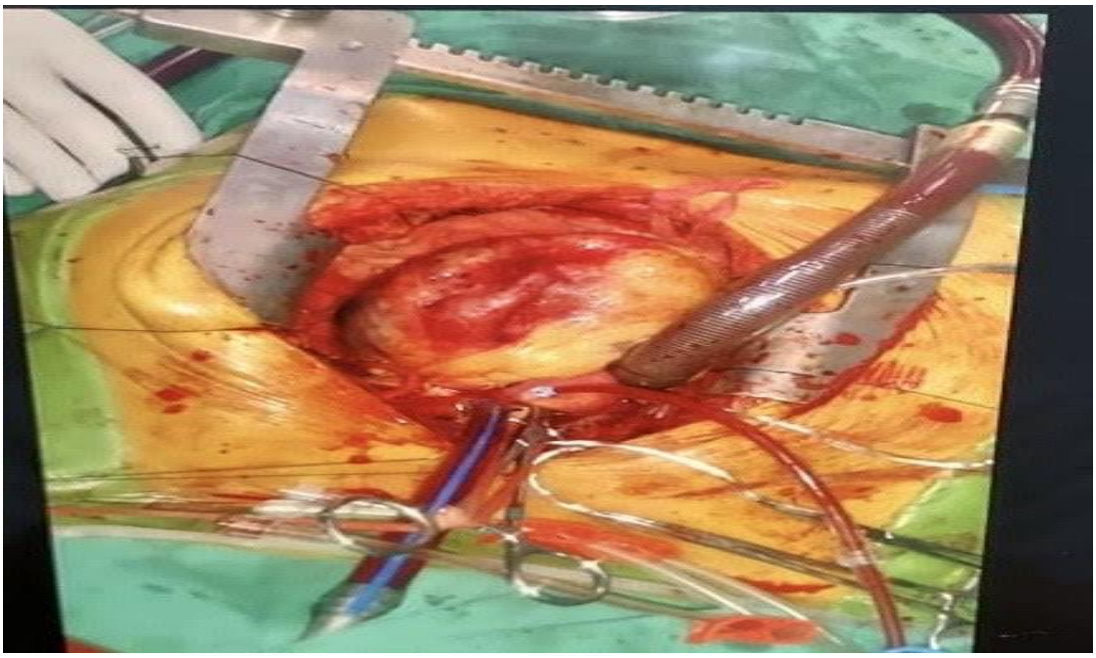

Figure 6: *Collapse of the Left Ventricular Aneurysm Wall Following Aortic Cross-Clamping and Cardioplegic Arrest*

Intraoperative view following incision of the left ventricular aneurysm wall. A large mural thrombus is visualized as adherent to the endocardial surface, typical of chronic post-infarction aneurysms. This step allows for precise thrombus evacuation and delineation of viable myocardial tissue for reconstruction.

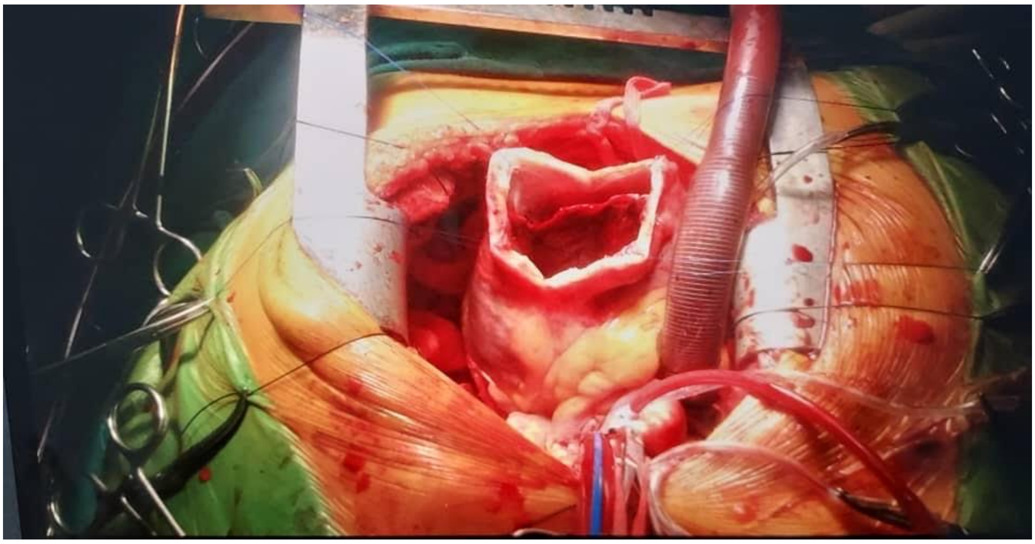

Figure 7: *Opening of the Aneurysmal Wall Revealing a Large Adherent Thrombus*

Intraoperative view showing advanced fibrosis and thinning of the anterior, lateral, diaphragmatic walls and apex of the left ventricle. The ventricle is markedly dilated, with visible displacement of the papillary muscles of the mitral valve—indicating severe geometric distortion consistent with ischemic remodeling.

Figure 8: *Fibrosis and Thinning of the Left Ventricular Walls with Severe Dilation*

A temporary intraventricular sizing balloon used during the Dor procedure to help restore the conical shape and optimal end-diastolic volume of the left ventricle. Balloon volume was tailored to each patient's body surface area to ensure accurate geometric remodeling and prevent postoperative low cardiac-output syndrome.

Figure 9: *Left Ventricular Sizing Balloon Used for Endoventricular Reconstruction*

Intraoperative view during placement of the Fontan purse-string suture. The sizing balloon has been inserted into the left ventricle and inflated with saline to simulate the desired end-diastolic shape and volume. This step guides the surgeon in choosing between linear closure or the Dor technique for optimal ventricular remodeling

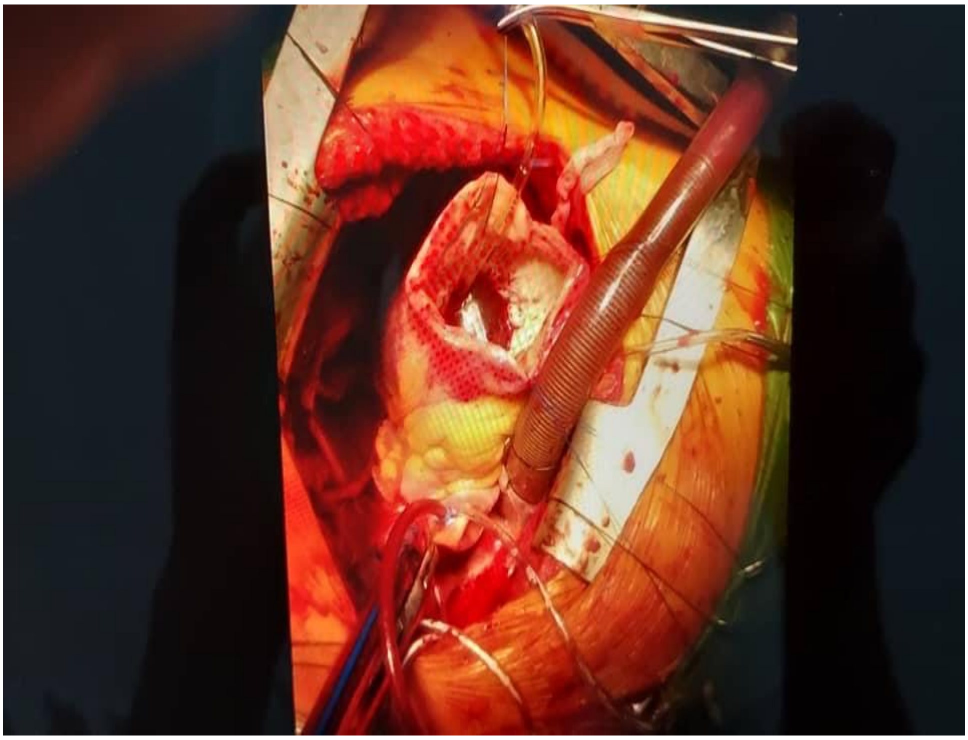

Figure 10: *Fontan Stitch Placement with Intraventricular Balloon Inflation Prior to Left Ventricular Reconstruction*

A Dacron patch is being sutured inside the left ventricle to isolate viable myocardium from fibrotic and non-contractile segments. This critical step in the Dor procedure re-establishes optimal ventricular geometry while preserving functional myocardial tissue and excluding the aneurysmal region.

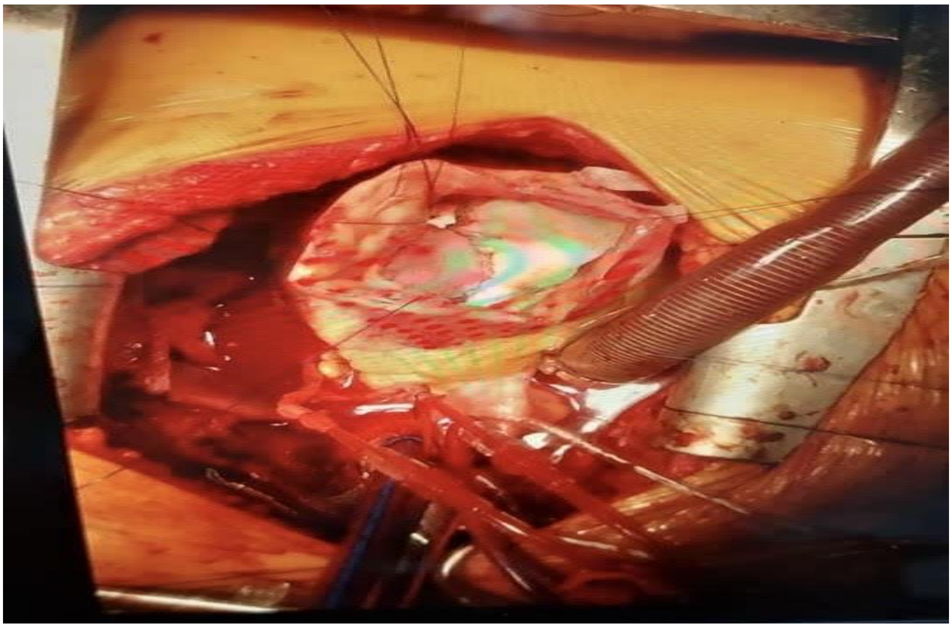

Figure 11: Dacron Patch Suturing for Endoventricular Reconstruction

The fibrotic edges of the left ventricular aneurysm are approximated and sutured using two reinforcing strips of Teflon felt.

Figure 12: *Closure of the Aneurysmal Wall Using Teflon Felt Strips*

Operative field showing the reconstructed left ventricle, with visible venous grafts anastomosed to the aortic root. The image illustrates the final stage of surgical ventricular restoration and coronary revascularization before chest closure.

Figure 13: *Final Appearance After Ventricular Closure and Completion of Aortocoronary Venous Grafts*

Discussion:

This 10-year single-surgeon retrospective study provides a comprehensive analysis of surgical ventricular reconstruction (SVR) outcomes in a low-resource, wartime setting at Damascus University Cardiac Surgery Hospital. Our findings demonstrate that both linear closure and Dor techniques are associated with significant improvements in cardiac function, ventricular geometry, and clinical status, even under the constraints of a conflict-affected healthcare system.

Functional and Hemodynamic Improvement

Patients experienced meaningful improvements in left ventricular ejection fraction (LVEF), NYHA functional class, and pulmonary arterial pressure (PAP). These results are consistent with prior studies suggesting that SVR, when performed in carefully selected patients, can effectively restore ventricular shape and improve myocardial efficiency (Dor et al., 1998; Xie et al., 2018) [2, 8]. The average EF improvement of +4.9% and NYHA class reduction by 1.38 points align with those reported in the STICH trial, although that trial focused on patients in high-resource environments (Jones et al., 2009).
In our study, the reductions in LV dimensions and volumes—including LVEDD, LVESD, LVEDV, and LVESV—reflect effective ventricular remodeling. Notably, the use of a temporary sizing balloon tailored to body surface area helped optimize the ventricular shape and minimize postoperative low-output syndrome, a practice supported in recent surgical literature (Ghosh et al., 2020).
Technique Comparison: Linear Closure vs. Dor Though both techniques resulted in favorable outcomes, mortality was slightly higher in the Dor group (12.8%) compared to linear closure (7.8%). This may reflect patient selection, as more complex or apical aneurysms were treated with Dor method. Moreover, Dor procedures often required use of a synthetic or pericardial patch, which, while effective in restoring ventricular geometry, may increase operative complexity.
Importantly, despite these challenges, Dor group still demonstrated comparable improvements in EF and NYHA class, suggesting that with meticulous technique, the benefits outweigh the procedural risks. This is particularly significant given the limited availability of advanced postoperative care in our setting.

Valve Interventions and Associated Outcomes:

Concomitant mitral and tricuspid valve procedures were performed in 31 patients. Most mitral valve repairs used prosthetic rings, consistent with current guidelines favoring annuloplasty in the presence of ischemic mitral regurgitation. The inclusion of valvular interventions did not appear to adversely impact overall outcomes or complication rates, though further subgroup analysis may be warranted.

Complications and Mortality:

The overall complication rate (27.8%) was acceptable given the case complexity and resource limitations. Pneumonia and atrial fibrillation were the most common events, aligning with known postoperative risks in cardiac surgery. Low cardiac-output syndrome and CPB-related effects were less frequent but carried a higher association with early mortality.
The 30-day mortality rate of 10% compares favorably with published rates in similar patient populations. Heart failure and cardiogenic shock were leading causes of death, as also reported in global cardiac surgery registries (Naseri et al., 2013). CPB-related complications and pulmonary events, though less frequent, underscore the importance of intraoperative precision and postoperative monitoring.

Surgical Feasibility in Wartime:

This study adds to the limited literature on complex cardiac surgery in conflict zones. The outcomes achieved—despite intermittent shortages of supplies, limited ICU capacity, and infrastructure damage—demonstrate the critical role of surgeon consistency, standard operative protocols, and selective patient inclusion. Notably, all surgeries were performed by a single, experienced surgeon (Dr. Ahmad Ramadan), contributing to procedural standardization.

Conclusion:

This 10-year retrospective study demonstrates that surgical ventricular reconstruction (SVR), whether performed using linear closure or the Dor technique, can be effectively and safely implemented in a low-resource, conflict-affected setting. Both techniques led to significant improvements in left ventricular dimensions, ejection fraction, pulmonary arterial pressures, and NYHA functional class. Notably, the Dor procedure showed superior outcomes in restoring physiological ventricular geometry and reducing postoperative volumes, albeit with a slightly higher rate of complications.
Postoperative morbidity and 30-day mortality rates remained within acceptable ranges, especially considering the complex pathology and surgical setting. Most deaths were attributable to heart failure, cardiogenic shock, and CPB-related complications.
To our knowledge, this is only the fourth study on left ventricular reconstruction published from the Middle East in the last 25 years and the second from Syria, both from the same surgical center. These findings reinforce the feasibility of advanced cardiac surgical techniques in developing countries and highlight the importance of long-term follow-up studies in this context.
Continued investment in cardiac surgery training and infrastructure is critical to improving patient outcomes in similar settings.

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