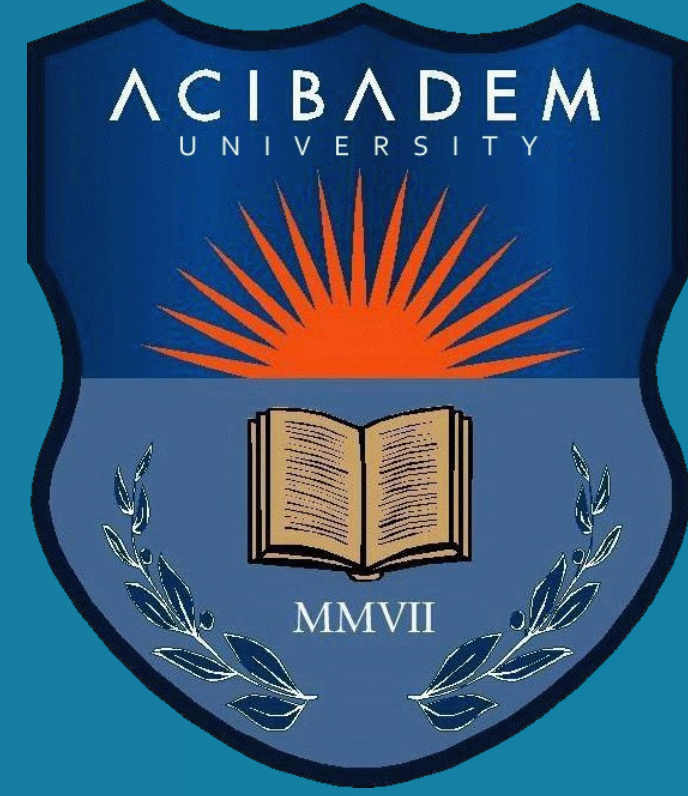




Robotic Assisted Minimally Invasive Coronary Revascularization: Midterm Results

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Introduction

Robotic assistance adds many advantages for both the surgeon and the patient in minimally invasive coronary bypass surgery such as harvest of a longer portion of the left internal mammarian artery (LIMA), avoidance of sternotomy, thus offering a less invasive approach for multivessel revascularization and accelerated recovery.^{1,2} We present the midterm clinical outcomes of robotic-assisted minimally invasive coronary bypass (RA-CABG) operations of our center.

Methods

Between April 2010 and May 2024, 150 consecutive patients who underwent RA-CABG under preoperative computed tomography angiography guidance were included. Pre-operative patient demographics, perioperative and post-operative data of the patients were retrospectively collected and analyzed. The mean age of the patients was 61.7 ± 9.6 years, and 122 patients were male (81%). The mean EuroSCORE of the patients was 2.0 ± 1.8 . Robotic assisted LIMA harvest was performed for all patients. Among 150 patients, 52 (34.6%) were operated off-pump. 10 patients among those operated off-pump underwent robotic totally endoscopic coronary artery bypass surgery (TECAB). In the remaining 98 patients, axillary cannulation was the choice of perfusion in 61 (62%) because of prohibitive findings in the iliac vessels and aorta, and femoral cannulation in 37 (38%) patients. The mean cross-clamp times were 69.5 ± 20.3 mins and cardiopulmonary bypass times 152.4 ± 43.5 mins. The main outcome measure was the midterm survival and the incidence of major adverse cardiovascular events (MACE) up to five years. MACE was defined as coronary reintervention, cerebrovascular event or mortality.

Table 1. Preoperative characteristics of patients (n=150).

Demographics	Mean $\pm$ SD or n (%)
Age (years)	61.7 $\pm$ 9.6
Female Gender	28 (19%)
Euroscore II	2.0 $\pm$ 1.8
NYHA	
Class 1	70 (47%)
Class 2	75 (50%)
Class 3	5 (3.3%)
BMI	29.0 $\pm$ 5.9
Diabetes Mellitus	69 (46%)
Hypertension	94 (63%)
Hypercholesterolemia	98 (65%)
Smoking	
Never smoker	46 (31%)
Ex-smoker	51 (34%)
Current smoker	53 (35%)

BMI: Body Mass Index, NYHA: New York Heart Association



Figure 1. Skin markings for the thoracotomy incision and placement of the robotic ports

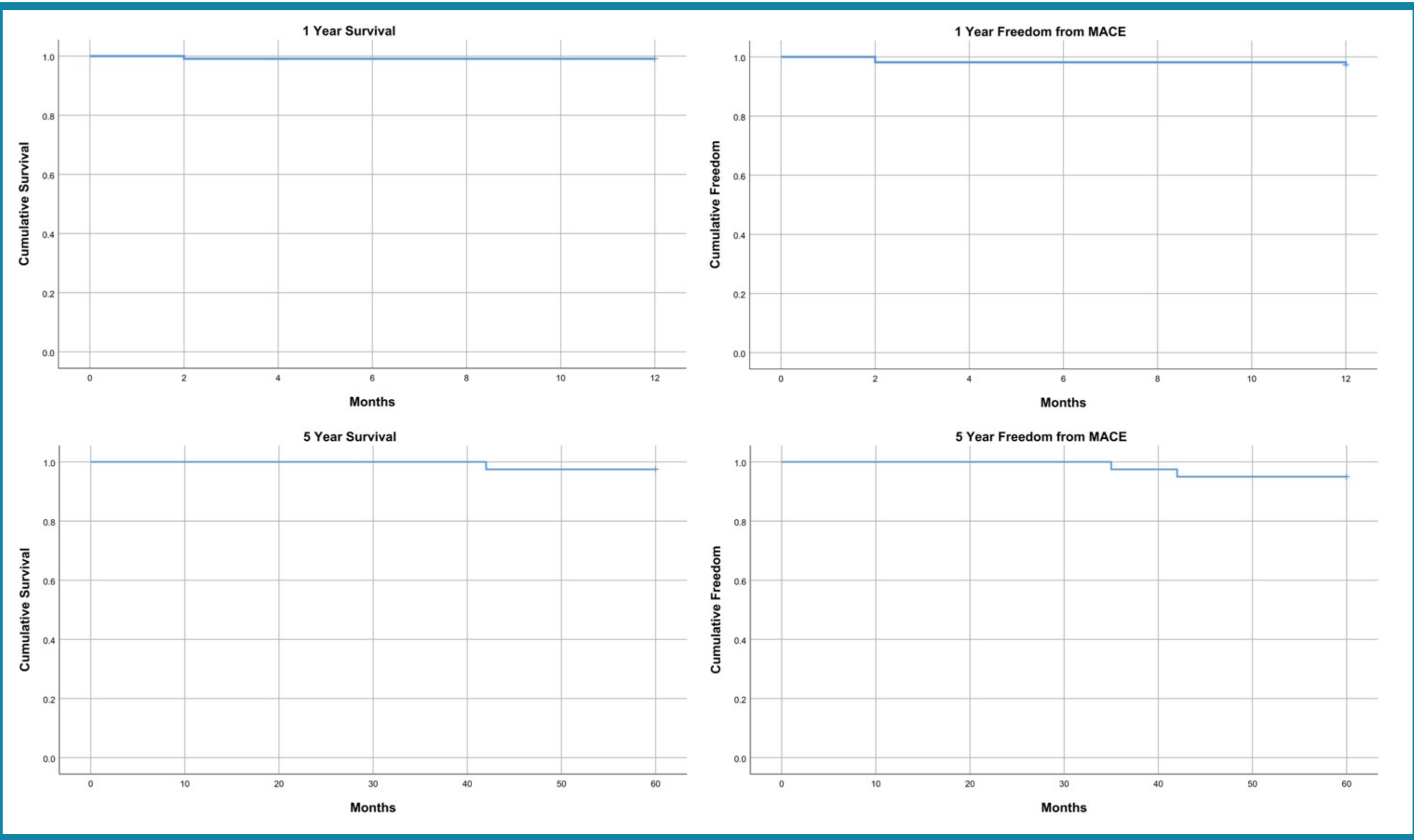


Figure 2. Kaplan Meier analyses for 1-year and 5-year survival; 1-year and 5-year freedom from major adverse cardiovascular events (MACE).

Results

The mean number of distal anastomoses was 2.3 ± 1.2 . The left internal mammary artery (LIMA) was anastomosed to the left anterior descending artery in all patients, and the LIMA was anastomosed sequentially to the diagonal artery in 21 (14%) patients. The mean mechanical ventilation time was 4.9 ± 2.8 hours. The mean intensive care unit stay was 20.2 ± 7.0 hours and the mean hospital stay was 6.9 ± 2.4 days. The mean chest tube output was 429.1 ± 412.5 mL. The median follow-up was 19.8 months. No early complications in the post-operative 30-day period were observed except in one patient who underwent reoperation due to bleeding. The late mortality was observed in 4 (2.7%) patients and 2 patients among them were lost due to non-cardiac reasons. MACE was observed in 13(8.7%) patients. In Kaplan-Meier survival analysis, 1-year survival was 99.1% and 5-year survival was 97.5%. In Kaplan-Meier analysis, 1-year freedom from major adverse cardiovascular events (MACE) was 97.3% and 5-year freedom from MACE was 95.0%.

Table 2. Operative Data of RA-CABG Patients.

	Mean $\pm$ SD or n (%)
CPB Time	152.4 $\pm$ 43.5
Cross Clamp Time	69.5 $\pm$ 20.3
Off-pump Cases	52 (34.6%)
On-pump Cases	98 (65.4%)
Axillary	61 (62%)
Femoral	37 (38%)
Thoracotomy incision	
2 nd ICS	1 (0.7%)
3 rd ICS	61 (41%)
4 th ICS	88 (59%)
Number of distal anastomoses	
1	54 (36%)
2	30 (20%)
3	44 (29%)
4	15 (10%)
5	7 (4.7%)
Number of proximal anastomoses	
0	72 (48%)
1	59 (39%)
2	17 (11%)
3	2 (1.3%)
Usage of Radial Artery Graft	19 (13%)
Lima Sequential Diagonal	21 (14%)

CPB:Cardiopulmonary Bypass; ICS:Intercostal Space



Figure 3. Operative set-up for robotic LIMA harvest after robotic docking is completed

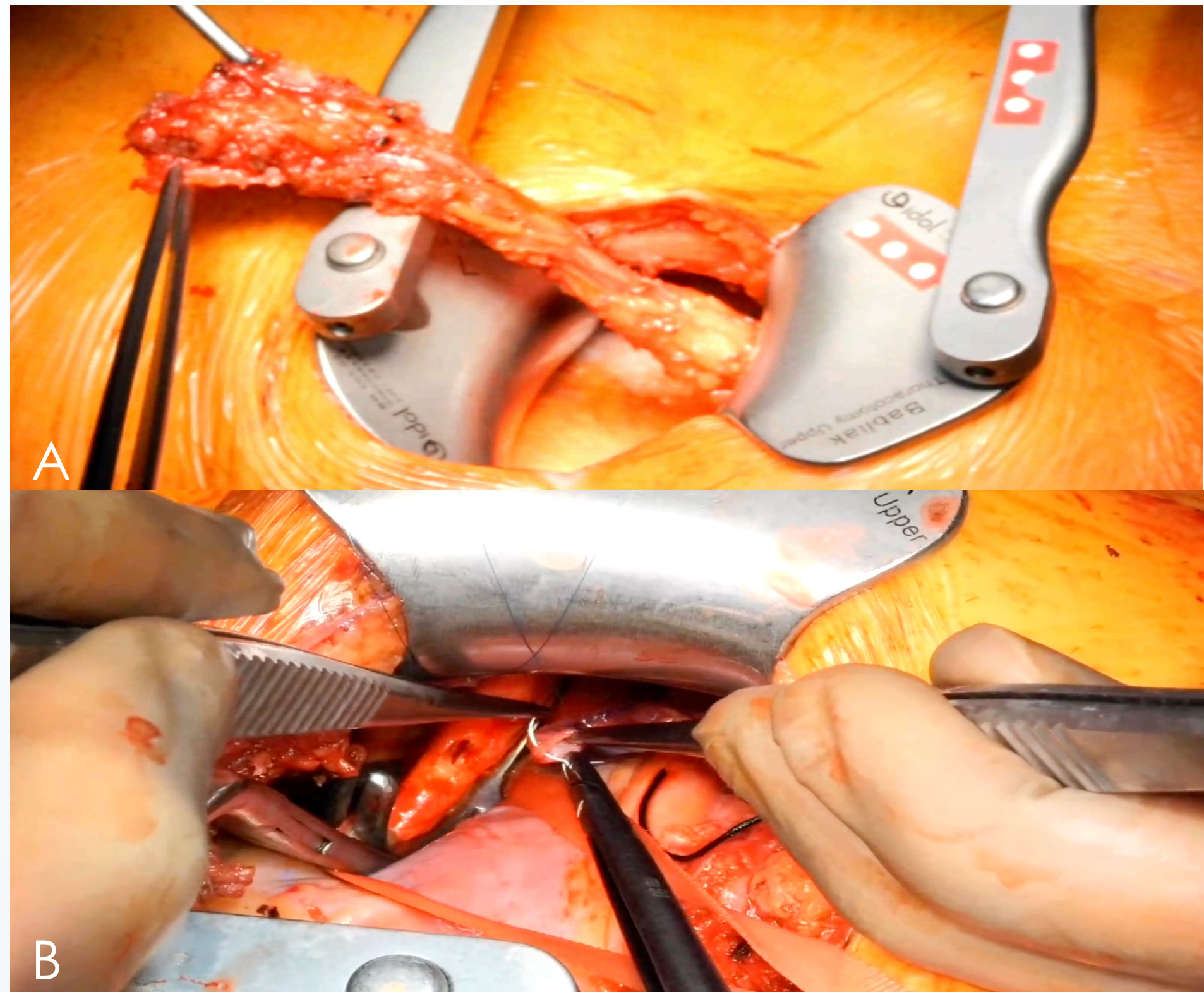


Figure 4 (A,B): A.Robotically harvested LIMA to its bifurcation; B.Operative view of the aorta during performing the proximal anastomoses

Table 3. Clinical outcomes.

	Mean $\pm$ SD or n (%)
Mechanical Ventilation Time (h)	4.9 $\pm$ 2.8
ICU Stay (h)	20.2 $\pm$ 7.0
Hospital stay (days)	6.9 $\pm$ 2.4
Chest tube output (ml)	429.1 $\pm$ 412.5
Postoperative Stroke (n)	0 (0%)
Postoperative Dialysis (n)	0 (0%)
Reoperation for bleeding (n)	1 (0.006%)
Reintubation (n)	0 (0%)
Hospital readmission (n)	0 (0%)
Late Coronary Reintervention (n)	9 (6%)
Late Mortality (n)	4 (2.7%)
MACE (n)	13 (8.7%)

ICU: Intensive Care Unit, MACE: Major Adverse Cardiovascular Events

Conclusion

Robotic-assisted minimally invasive coronary bypass surgery can be performed safely with excellent midterm outcomes. Complete target vessel revascularization can be safely and feasibly achieved with this technique.

References:

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