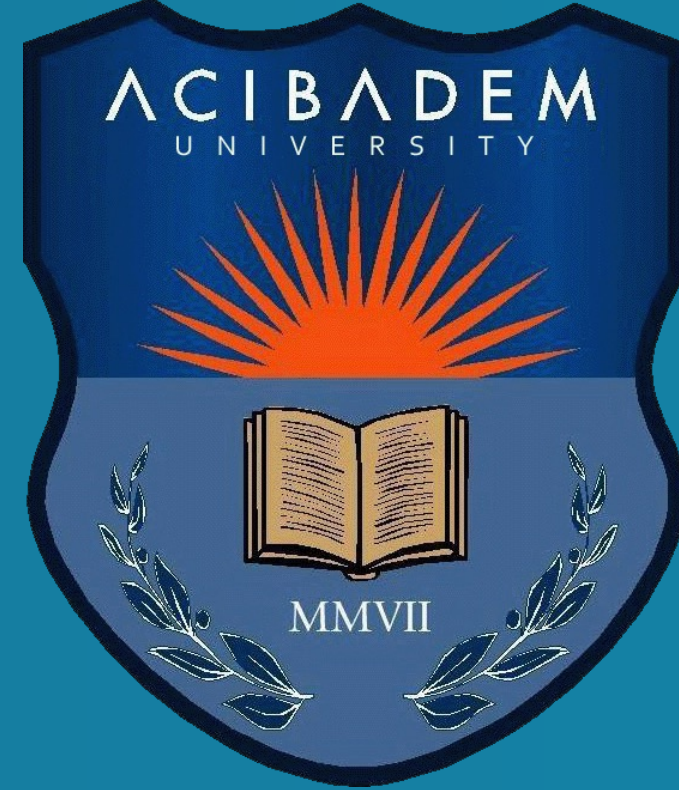




Should Direct Axillary Cannulation Be The First Choice In Robotic-Assisted Minimally Invasive Total Coronary Revascularization?

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Introduction

Axillary artery cannulation is associated with safer results and fewer complications compared to femoral artery cannulation in minimally invasive mitral valve surgery.^{1,2} Coronary artery bypass surgery patients present with an high atherosclerotic burden, thus may also benefit greatly from antegrade axillary artery cannulation. The aim of this study was to compare outcomes in axillary and femoral cannulation in robotic-assisted minimally invasive coronary artery bypass surgery to evaluate if axillary artery can be the first choice for cannulation.

Methods

Between March 2022 and May 2024, 104 consecutive patients underwent robotic-assisted minimally invasive coronary artery bypass surgery at our institution. Off-pump CABG procedures were excluded, resulting in a study population of 96 patients. Preoperative computed tomography (CT) scans were assessed for atherosclerosis to guide cannulation strategy. Axillary cannulation was performed in 57 (59.4%) patients and femoral cannulation in 39 (40.6%) patients. Patient demographics, perioperative data and postoperative outcomes were retrospectively analyzed. The primary endpoint of the study was peri-operative complications including stroke and in-hospital mortality.

Table 1. Preoperative characteristics of patients (n=96)

Demographics	Axillary Cannulation (59.4%)	Femoral Cannulation (40.6%)	p
Age (years)	64.5 ± 7.4	61.9 ± 9.5	0.082
Female Gender	8 (14%)	5 (13%)	0.864
Euroscore II	2.3 ± 1.7	1.8 ± 2.0	0.089
NYHA			0.441
Class 1	23 (40.3%)	18 (46%)	
Class 2	31 (54.4%)	21 (54%)	
Class 3	3 (5.3%)	0 (0%)	
BMI	27.8 ± 4.1	29.4 ± 3.6	0.072
Diabetes Mellitus	30 (53%)	20 (51%)	0.897
Hypertension	37 (65%)	21 (54%)	0.276
Hypercholesterolemia	40 (70%)	28 (72%)	0.864
Smoking			0.098
Never smoker	12 (21%)	16 (41%)	
Ex-smoker	24 (42%)	11 (28%)	
Current smoker	21 (37%)	12 (31%)	

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

Surgical Technique

After the completion of robotic-assisted LIMA harvest, robotic trocars are unlocked. Peripheral cannulation, either axillary or femoral as planned according to preoperative CT findings, is performed under TEE guidance. Femoral and axillary cannulations are carried out through a 2-3 cm mini-incision with ultrasound guidance. For axillary cannulation, after the skin incision is made, the pectoralis major muscle is divided and the infraclavicular fat tissue is dissected. The axillary artery is visualised. The artery is encircled with vascular tape proximal to the origin of the thoracoacromial branch and pulled superficially. A purse string suture with 5-0 prolene is placed with a snare on the axillary artery. The guidewire is then advanced through direct puncture of the vessel. The position of the guidewire is confirmed by its visualization inside the ascending or descending thoracic aorta with TEE. After systemic heparinization, direct cannulation of the axillary artery with Seldinger technique under TEE guidance is performed. A pulse oximeter is placed on the cannulated extremity until decannulation. Percutaneous femoral vein cannulation is performed along with axillary artery cannulation. If femoral cannulation is opted for, it is carried out in the same manner under TEE guidance with a 2-3 cm incision. Cardiopulmonary bypass is then initiated and minimally invasive coronary bypass surgery is performed.

Factors in favour of choosing axillary cannulation:

- ❖ Severe iliofemoral stenosis,
- ❖ Severe aortoiliac atherosclerotic disease,
- ❖ Any aortoiliac free floating thrombus/mural thrombus,
- ❖ Severe iliofemoral soft plaque formation,
- ❖ Small femoral vessel diameter,
- ❖ Previous injury or operation to femoral vessels/pseudoaneurysm formation,
- ❖ Local groin infection/lymphadenomegaly in the groin region.

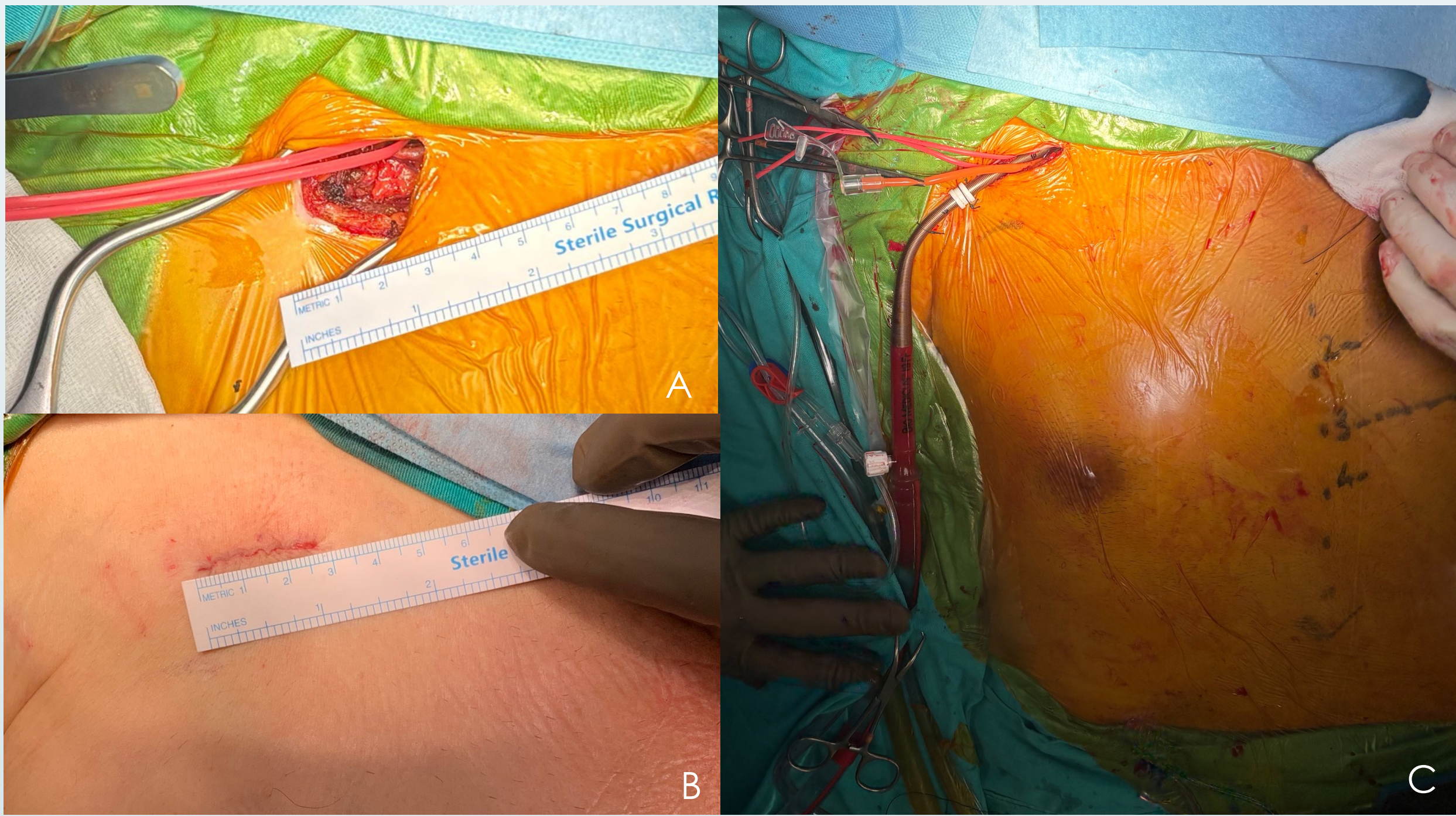


Figure 1 (A, B and C): Direct cannulation of the axillary artery through a 2-3 cm incision with Seldinger technique under TEE guidance of the guidewire.



Figure 2 (A and B): Evaluation of the aorta and the iliofemoral vessels on preoperative computed tomography. (A) Severe calcifications; (B) Thrombi prohibit femoral cannulation and axillary cannulation is opted for in these patients.

Results

There were no cases of post-operative mortality or stroke in either group. The cross-clamp times were 64.1 ± 16.9 mins in the axillary cannulation group and 80.3 ± 20.8 mins in the femoral cannulation group. Cardiopulmonary bypass times were 153.7 ± 40.3 mins and 155.6 ± 43.5 mins respectively. Mechanical ventilation times were 4.2 ± 1.9 hours and 5.3 ± 3.6 hours respectively in the axillary and femoral cannulation groups. The ICU stay was 19.7 ± 4.7 hours and 19.9 ± 5.4 hours; and the hospital stay was 7.3 ± 2.5 days and 7.6 ± 2.7 days, respectively. No complications including hematomas, cannulation site infections, emboli, dissection, neurovascular injury or brachial plexus injuries were observed in any of the patients in either groups. No other complications were encountered in the axillary cannulation group. One patient (2.6%) in the femoral cannulation group was reoperated for mediastinal bleeding. No other complications were encountered in patients with femoral artery cannulation except for seromas at the cannulation site in 3 (7.7%) of the patients, and this low rate of complications was attributed to the elaborative preoperative investigation of patients with severe calcification and the preference of axillary artery cannulation if atherosclerotic disease is present.

Table 2. Operative Data and Postoperative Outcomes (n=96)

Variables	Axillary Cannulation (59.4%)	Femoral Cannulation (40.6%)	p
Cross-clamp time (min)	64.1 ± 16.9	80.3 ± 20.8	<0.001
Cardiopulmonary bypass time (min)	153.7 ± 40.3	155.6 ± 43.5	0.830
Number of revascularized vessels	2.9 ± 0.8	3.0 ± 1.1	0.927
Mechanical ventilation time (h)	4.2 ± 1.9	5.3 ± 3.6	0.114
ICU stay (h)	19.7 ± 4.7	19.9 ± 5.4	0.997
Hospital stay (days)	7.3 ± 2.5	7.6 ± 2.7	0.695
Chest tube drainage in ICU (ml)	500 ± 463.1	514.9 ± 454.2	0.666
Post-operative stroke	0 (0%)	0 (0%)	
Post-operative dialysis	0 (0%)	0 (0%)	
Neurovascular Injury	0 (0%)	0 (0%)	
Hematoma	0 (0%)	0 (0%)	
Pseudoaneurysm	0 (0%)	0 (0%)	
Reoperation for bleeding	0 (0%)	1 (2.6%)	>0.999
Brachial plexus injury	0 (0%)	0 (0%)	
Infection at cannulation site	0 (0%)	0 (0%)	
Limb ischemia	0 (0%)	0 (0%)	
Dissection	0 (0%)	0 (0%)	
Emboli	0 (0%)	0 (0%)	
Reintubation	0 (0%)	0 (0%)	
Seroma	0 (0%)	3 (7.7%)	0.064
Pulmonary complications	0 (0%)	0 (0%)	
In-hospital mortality	0 (0%)	0 (0%)	

ICU: Intensive Care Unit

Conclusion

Direct cannulation of the axillary artery under TEE guidance is a safe method for the establishment of cardiopulmonary bypass in robotic-assisted minimally invasive total coronary revascularization patients. This approach can be used especially in patients with severe peripheral arterial and aortic calcification or thrombi. As severe peripheral arterial or aortic calcification and thrombi are more frequently encountered in coronary artery bypass surgery patients, axillary cannulation may be considered as the first choice of perfusion strategy with safe outcomes in robotic-assisted minimally invasive total coronary revascularization.

References:

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