



COMPARISON OF OUTCOMES BETWEEN CENTRAL VS PERIPHERAL CANNULATION FOR REDO-CARDIAC SURGERY

Cardiovascular

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ABSTRACT

Background: Cannulation strategy during redo-cardiac surgery is critical for minimizing intraoperative and postoperative complications. Central and peripheral cannulation each offer distinct advantages and risks, yet comparative outcome data remain limited. **Methods:** This retrospective observational study included 40 adult patients undergoing redo-cardiac surgery with cardiopulmonary bypass over a 24-month period. Patients were divided into two groups: central cannulation (n=20) via the ascending aorta and right atrium, and peripheral cannulation (n=20) via femoral or axillary vessels. Demographics, intraoperative parameters, and postoperative outcomes were compared using appropriate statistical tests, with $p < 0.05$ considered significant. **Results:** Baseline demographics and comorbidities were similar between groups. Mean CPB and cross-clamp times did not differ significantly. Intraoperative blood loss was significantly lower in the peripheral group (650 ± 180 ml) compared to the central group (780 ± 210 ml, $p=0.04$). Limb ischemia occurred only in the peripheral group (10%). Rates of stroke, acute kidney injury, wound infection, ICU stay, ventilation time, and mortality showed no significant differences. **Conclusion:** Peripheral cannulation reduced intraoperative blood loss but carried a risk of limb ischemia. Both strategies were safe when appropriately selected, highlighting the importance of individualized cannulation planning in redo-cardiac surgery.

KEYWORDS

Redo-Cardiac Surgery, Cannulation Technique, Cardiopulmonary Bypass

INTRODUCTION

Cannulation technique is a critical component of cardiopulmonary bypass (CPB) during redo-cardiac surgery, influencing both intraoperative safety and postoperative outcomes. (1) Redo-cardiac operations present unique challenges due to dense adhesions, distorted anatomy, and potential injury to cardiovascular structures during re-entry. (2) In such settings, establishing CPB before sternotomy can minimize catastrophic bleeding and myocardial injury. Two principal approaches for initiating CPB in redo-cardiac cases are central cannulation (via the ascending aorta and right atrium) and peripheral cannulation (commonly via the femoral or axillary vessels). (3,4)

Central cannulation allows direct access to major cardiac structures, providing optimal flow and hemodynamic control; however, it may require partial dissection in high-risk re-entry scenarios. Peripheral cannulation offers the advantage of rapid institution of CPB before sternotomy, potentially reducing blood loss and cardiac injury, but is associated with risks such as limb ischemia, retrograde aortic dissection, and suboptimal venous drainage. (5,6,7) The choice between central and peripheral cannulation is influenced by patient comorbidities, previous surgical interventions, and surgeon experience. Comparative evaluation of these strategies is essential to optimize perioperative safety, reduce complications, and improve long-term outcomes in redo-cardiac surgery. Our study aims to assess and compare clinical outcomes between central and peripheral cannulation techniques in this high-risk surgical population.

METHODOLOGY

This retrospective observational study was conducted in the Department of Cardiothoracic and Vascular Surgery at GIPMER, New Delhi over a period of 24 months. A total of 40 adult patients who underwent redo-cardiac surgery requiring cardiopulmonary bypass (CPB) were included. Patients were selected based on inclusion criteria: age ≥ 18 years, previous history of median sternotomy, and requirement for elective or urgent redo-cardiac procedures. Cases with emergency aortic dissections or those requiring hybrid procedures were excluded.

The study population was divided into two equal groups based on the cannulation technique employed: the central cannulation group (n=20) and the peripheral cannulation group (n=20). Central cannulation was performed via the ascending aorta and right atrium following limited adhesiolysis, while peripheral cannulation was performed via femoral or axillary artery and femoral vein before sternotomy. The choice of cannulation strategy was determined by preoperative imaging, intraoperative findings, and the operating surgeon's discretion.

Demographic details, comorbidities, preoperative risk scores, operative data, and intraoperative complications were recorded. Postoperative outcomes included duration of CPB, cross-clamp time, blood loss, transfusion requirement, incidence of stroke, renal dysfunction, limb ischemia, infection, re-exploration, and mortality. Data were extracted from hospital medical records, operative notes, and intensive care charts.

All data were analyzed using statistical software. Continuous variables were expressed as mean $\pm$ standard deviation and compared using Student's t-test, while categorical variables were analyzed using the chi-square or Fisher's exact test as appropriate. A p-value of < 0.05 was considered statistically significant. Ethical approval for the study was obtained from the institutional ethics committee, and patient confidentiality was maintained throughout the study.

RESULTS

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Central Cannulation (n=20)	Peripheral Cannulation (n=20)	p-value
Mean Age (years)	54.6 ± 8.2	55.9 ± 7.5	0.62
Male Gender (%)	14 (70%)	13 (65%)	0.74
BMI (kg/m^2)	26.3 ± 3.4	25.8 ± 3.1	0.65
Hypertension (%)	12 (60%)	11 (55%)	0.75
Diabetes Mellitus (%)	6 (30%)	7 (35%)	0.73
Previous CABG (%)	9 (45%)	8 (40%)	0.75
EuroSCORE II (%)	4.1 ± 1.2	4.3 ± 1.4	0.68

Table 2: Intraoperative Parameters

Parameter	Central Cannulation (n=20)	Peripheral Cannulation (n=20)	p-value
CPB Time (minutes)	145.3 ± 25.6	152.8 ± 28.1	0.34
Cross-clamp Time (minutes)	88.5 ± 15.2	91.2 ± 16.0	0.56
Intraoperative Blood Loss (ml)	780 ± 210	650 ± 180	0.04*
Transfusion Requirement (units)	2.6 ± 1.1	2.1 ± 0.9	0.09

Intraoperative Injury (%)	2 (10%)	1 (5%)	0.54
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*Statistically significant ($p < 0.05$)

Table 3: Postoperative Outcomes

Outcome	Central Cannulation (n=20)	Peripheral Cannulation (n=20)	p-value
Ventilation Time (hours)	9.8 ± 3.2	10.6 ± 3.4	0.42
ICU Stay (days)	3.1 ± 1.2	3.4 ± 1.3	0.48
Stroke (%)	1 (5%)	1 (5%)	1.00
Acute Kidney Injury (%)	2 (10%)	3 (15%)	0.63
Limb Ischemia (%)	0 (0%)	2 (10%)	0.15
Wound Infection (%)	2 (10%)	3 (15%)	0.63
Re-exploration for Bleeding (%)	2 (10%)	1 (5%)	0.54
30-day Mortality (%)	1 (5%)	2 (10%)	0.54

DISCUSSION

Redo-cardiac surgery represents a high-risk category in cardiac surgical practice due to the presence of adhesions, altered anatomy, and the potential for catastrophic re-entry injuries. The choice of cannulation technique for cardiopulmonary bypass (CPB) is a crucial determinant of perioperative safety and outcomes. In the present study, we compared outcomes between central and peripheral cannulation strategies in 40 patients undergoing redo-cardiac surgery, with 20 patients in each group. (8)

Baseline characteristics were comparable between the two groups, with no significant differences in age, gender distribution, body mass index, comorbidities, or operative risk scores. This similarity minimizes confounding effects and strengthens the validity of the observed outcome differences. The majority of patients in both groups had undergone previous coronary artery bypass grafting, reflecting the common indication for redo surgery in clinical practice. (9)

Intraoperatively, CPB and cross-clamp times were slightly shorter in the central cannulation group, although the difference was not statistically significant. However, intraoperative blood loss was significantly lower in the peripheral cannulation group ($p = 0.04$). This finding may be attributable to the ability to establish CPB prior to sternotomy in peripheral cannulation, thereby reducing the risk of major vessel injury during re-entry. Transfusion requirements were also lower in the peripheral group, although the difference did not reach statistical significance, likely due to the small sample size. (10)

Postoperative outcomes revealed no significant difference in major complications such as stroke, acute kidney injury, or wound infection between the two groups. Interestingly, limb ischemia occurred only in the peripheral group, affecting 10% of patients, which is consistent with the known vascular risks of femoral or axillary cannulation. Conversely, no limb ischemia was noted in the central group, emphasizing that while central cannulation may carry risks of bleeding and cardiac injury, it avoids peripheral vascular complications.

ICU stay and ventilation times were slightly shorter in the central group, although these differences were not statistically significant. Re-exploration for bleeding occurred in both groups, suggesting that bleeding risks are not exclusive to either technique and may be more related to surgical complexity than cannulation site alone. Mortality within 30 days was low in both groups, with no statistically significant difference, reflecting that both strategies can be safe when applied in appropriately selected patients. (11,12)

Our findings align with previous reports suggesting that peripheral cannulation may reduce intraoperative bleeding risk in high-risk redo cases, especially when re-entry injury is anticipated. However, this benefit must be balanced against the risk of peripheral vascular complications. Central cannulation remains advantageous in patients where adhesions are minimal or when peripheral access is limited by vessel disease.

The clinical implication of these results is that cannulation strategy should be individualized, guided by preoperative imaging, prior surgical history, and vascular assessment. While peripheral

cannulation offers a safety margin against catastrophic bleeding during sternotomy, careful monitoring for limb ischemia and distal perfusion is essential. Central cannulation remains a viable option in experienced hands, particularly when anatomical exposure is favorable.

Further studies with larger sample sizes and long-term follow-up are warranted to confirm these findings and refine selection criteria for cannulation strategy in redo-cardiac surgery.

CONCLUSION

Peripheral cannulation reduced intraoperative blood loss but carried a risk of limb ischemia. Both strategies were safe when appropriately selected, highlighting the importance of individualized cannulation planning in redo-cardiac surgery.

REFERENCES

1. Roselli EE, Pettersson GB, Blackstone EH, Brizzio ME, Houghtaling PL, Hauck R, et al. Adverse events during reoperative cardiac surgery: frequency, characterization, and rescue. *J Thorac Cardiovasc Surg.* 2008;135(2):316-23.
2. Sabik JF, Blackstone EH, Gillinov AM, Smedira NG, Lytle BW, Cosgrove DM. Occurrence and risk factors for reexploration after coronary artery bypass grafting. *Circulation.* 2004;110(11 Suppl 1):II-85-90.
3. Matalanis G, Fanning JP, Shi WY, Hayward PA. Central versus peripheral cannulation for redo sternotomy: rationale and practice. *Ann Cardiothorac Surg.* 2019;8(5):605-12.
4. Muehrcke DD, Lytle BW, Cosgrove DM, Loop FD, Taylor PC, Gill CC. Reoperative cardiac surgery. *Circulation.* 1995;92(9 Suppl):II35-9.
5. D'Ancona G, Karamanoukian HL, Ricci M, Salerno TA. Cannulation strategies for cardiopulmonary bypass in reoperative cardiac surgery. *J Card Surg.* 2000;15(5):363-8.
6. Bical OM, de Riberolles C, de Canniere D, Gandon J, Bachet J, Guilmet D. Peripheral cannulation for cardiopulmonary bypass in reoperations: indications and limits. *Ann Thorac Surg.* 1997;63(2):701-5.
7. Lamelas J, Williams RF, Bonatti J. Strategies for safe reentry in redo cardiac surgery. *Innovations (Phila).* 2016;11(5):325-31.
8. Raanani E, Bolotin G, Sternik L, Smolinsky AK, Bizakis CS, Mohr R. Femoral versus central cannulation for redo sternotomy: morbidity and outcome. *J Card Surg.* 2001;16(3):186-90.
9. Takami Y, Masumoto H, Terazawa S, Kondo Y, Ina H. Cannulation strategy for reoperative cardiac surgery. *Eur J Cardiothorac Surg.* 2010;37(5):934-9.
10. Leontyev S, Borger MA, Davierwala P, Misfeld M, Mohr FW. Cannulation strategies for aortic reoperations. *Multimed Man Cardiothorac Surg.* 2013;2013:mmt006.
11. Orihashi K, Takahashi S, Hino Y, Sueda T. Axillary artery cannulation for cardiopulmonary bypass in aortic and reoperative cardiac surgery. *Interact Cardiovasc Thorac Surg.* 2005;4(4):379-83.
12. Yau TM, Borger MA, Weisel RD, Ivanov J, Cohen G, Feindel CM, et al. The changing pattern of reoperative coronary surgery: trends in patient characteristics and outcome. *J Thorac Cardiovasc Surg.* 2000;120(1):156-63.