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Exploring the application value of preoperative femoral artery and vein cannulation in redo cardiac surgery

Yi Hui Yu^{1†}, Xun Li Zhang^{2†}, Lei Wang^{2†}, Li Qiong Xiao², Fu Hua Huang^{2*} and Zhen Hong Wang^{3*}

Abstract

Background To explore the clinical value of preoperative femoral vessel cannulation in redo cardiac surgery.

Methods A retrospective analysis was performed on the clinical data of 106 patients who underwent redo cardiac surgery in our hospital from January 2022 to December 2024. According to the cardiopulmonary bypass (CPB) cannulation technique adopted, the patients were divided into the Femoral Cannulation group (n = 79) and the Traditional Central Cannulation group (n = 37). Preoperative baseline data, intraoperative CPB-related parameters, blood product consumption, and the incidence of postoperative complications were recorded and compared between the two groups.

Results There were no statistically significant differences in preoperative baseline data or intraoperative parameters between the two groups (all $P > 0.05$). Similarly, no significant statistical differences were found in postoperative mortality, extracorporeal membrane oxygenation (ECMO) utilization rate, acute kidney injury (AKI) incidence, or cognitive dysfunction incidence between the two groups. However, compared with the Traditional Central Cannulation group, the Femoral Cannulation group had significantly lower intraoperative packed red blood cell (PRBC) transfusion volume and a significantly lower incidence of major cardiovascular injuries (all $P < 0.05$).

Conclusion In redo cardiac surgery, preoperative femoral vessel cannulation can significantly reduce the incidence of major cardiovascular injuries and the demand for intraoperative blood transfusion, which is worthy of promotion and application in clinical practice.

Keywords Redo cardiac surgery, Femoral vessel cannulation, Conventional central cannulation, Surgical safety, Red blood cell transfusion

[†]Yi Hui Yu, Xun Li Zhang and Lei Wang were contributed equally to this work and share first authorship.

*Correspondence:
Fu Hua Huang
huaianjiyuanzmy@126.com
Zhen Hong Wang
huaianzmy@163.com

¹Department of Cardiology, Nanjing First Hospital, Nanjing Medical University, Nanjing 210006, Jiangsu, China

²Department of Thoracic and Cardiovascular Surgery, Nanjing First Hospital, Nanjing Medical University, Nanjing 210006, Jiangsu, China

³Department of Anesthesiology, Perioperative and Pain Medicine, Nanjing First Hospital, Nanjing Medical University, Nanjing 210006, Jiangsu, China



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Introduction

Cardiovascular surgery serves as a primary intervention for organic heart diseases and is widely adopted worldwide. With the continuous increase in population life expectancy, the number of patients undergoing open-heart surgery has been on the rise [1–2]. Furthermore, the annual number of patients requiring re-sternotomy due to primary cardiac diseases or other cardiovascular pathologies is also increasing [3–4]. Despite the continuous advancements in surgical techniques, anesthesiology, and related perioperative critical care—which have gradually reduced the risks associated with redo cardiac surgery—factors such as pericardial adhesions, altered normal anatomical structures, and increased tissue fragility render these procedures more complex. This complexity, in turn, elevates the perioperative mortality and complication rates [5]. In addition, re-sternotomy, characterized by extensive tissue trauma, prolonged cardiopulmonary bypass (CPB) time, and severe coagulopathy, can increase patients' intraoperative requirements for blood product transfusion [6–7].

Currently, there are two main strategies for establishing CPB in redo cardiac surgery. The first is the conventional approach, which involves standard cannulation of the aorta and the right atrium (or superior/inferior vena cava) following sternotomy and dissection of pericardial adhesions. The second is peripheral closed cannulation, wherein CPB is established via peripheral vessels (e.g., femoral artery and vein, or axillary artery) prior to sternotomy [8]. Several studies have indicated that peripheral closed cannulation can provide a safety guarantee for subsequent sternotomy and cardiac procedures, thereby reducing the risk of hemorrhage during the initial surgical phase. However, there remains a paucity of comparative research regarding the impact of these two cannulation strategies on perioperative patient outcomes [9]. Based on this research gap, the present study aims to compare the clinical efficacy and the incidence of perioperative complications associated with these two distinct cannulation methods in patients undergoing redo cardiac surgery, with the goal of providing an evidence-based medical basis for the selection of cannulation strategies.

General information

Study population and ethical considerations

A retrospective review was performed on the clinical records of 106 patients who underwent redo cardiac surgery at our institution between January 2022 and December 2024. Based on the cardiopulmonary bypass (CPB) cannulation strategy adopted, patients were divided into two groups: the Femoral Cannulation group ($n=79$) and the Traditional Central Cannulation group ($n=37$).

This study was conducted in compliance with the principles of the Declaration of Helsinki (2013 revision). The

study protocol was reviewed and approved by the Institutional Review Board (IRB)/Ethics Committee of Nan First Hospital (Approval No.: KY20190404-03-KS-01). Given the retrospective, non-interventional nature of the study—where no additional procedures beyond standard clinical practice were performed and minimal risk was posed to patients—the IRB waived the requirement for written informed consent. All patient data were anonymized prior to analysis to ensure confidentiality, and no patient-identifying information is included in this manuscript.

The inclusion criteria were as follows: (1) A history of exactly one previous cardiac surgery via median sternotomy; (2) Age ≥ 18 years; (3) Clear indications for reoperation, including prosthetic valve dysfunction, occlusion of previous bypass grafts or new-onset coronary lesions, or new pathologies in native valves; (4) Availability of complete clinical data.

The exclusion criteria included: (1) A history of two or more previous cardiac surgeries via median sternotomy; (2) Initial cardiac surgery performed via a non-sternotomy approach (e.g., right thoracotomy, video-assisted thoracic surgery); (3) Emergency surgery; (4) Concomitant severe, irreversible end-stage diseases, including malignancy, hepatic failure, and major neurological disorders; (5) Pregnancy or lactation.

Methods

CPB Priming solution and perioperative management

All surgical procedures were performed by the same surgical team. Upon entering the operating room, venous access was routinely established, with arterial monitoring conducted via the left radial artery and dorsalis pedis artery. Extracorporeal circulation was implemented using a Sorin S5 heart-lung machine, a Sorin (8 F) adult oxygenator, myocardial protection perfusion circuits manufactured by Shandong Weigao Company, and extracorporeal circulation circuits produced by Tianjin Plastic Research Institute.

The CPB priming solution consisted of 1000 ml succinylated gelatin injection, 500 ml acetate Ringer's solution, 150 g of 20% human albumin, 500 mg methylprednisolone, and 10 mg torasemide. During the procedure, mean arterial pressure was maintained at 60–80 mmHg, and blood gas management followed the alpha-stat strategy, with partial pressure of carbon dioxide (PCO_2) maintained within the range of 35–45 mmHg.

Arteriovenous cannulation procedures

Femoral Arteriovenous Cannulation

The choice between femoral artery cannulation and central cannulation (via the ascending aorta or subclavian artery) was made by the attending cardiac surgeon based on a comprehensive preoperative assessment. The

following factors were systematically evaluated for each patient:

1. Preoperative computed tomography angiography findings: The status of the aorta, iliac arteries, and femoral arteries was carefully reviewed. Femoral cannulation was preferred in patients with favorable peripheral vascular anatomy, defined as the absence of significant stenosis (<50% luminal narrowing), no severe circumferential calcification, and no evidence of dissection or aneurysm involving the iliofemoral segment.
2. Peripheral vascular disease history: Patients with a documented history of peripheral arterial disease, previous vascular surgery (e.g., femoral artery bypass, endarterectomy), or prior groin intervention (e.g., cardiac catheterization complicated by significant hematoma or pseudoaneurysm) were considered less suitable for femoral cannulation.
3. Body habitus and femoral vessel size: Patients with low body weight (<50 kg) or small femoral vessel diameter (<6 mm on preoperative imaging) were preferentially assigned to central cannulation to avoid vessel injury or limb ischemia.
4. Urgency of the procedure: In emergent cases (e.g., acute aortic dissection or unstable hemodynamics), femoral cannulation was often selected due to its rapid accessibility, which obviates the need for sternotomy or extensive dissection.
5. Surgeon preference and experience: The final decision also incorporated the surgeon's familiarity and comfort with each technique. Surgeons with greater experience in peripheral cannulation tended to favor the femoral approach when anatomical conditions were appropriate.

Based on the above criteria, patients with unfavorable peripheral vascular anatomy (e.g., severe iliac atherosclerosis, vessel tortuosity, or previous groin surgery) were preferentially assigned to the central cannulation group. All decisions were prospectively documented in the operative records.

For femoral cannulation, the femoral artery was routinely exposed in the inguinal region. Under ultrasound guidance, the femoral artery was punctured with a needle, and a guidewire was inserted and confirmed to be positioned in the ascending aorta. An arterial perfusion catheter was selected based on the patient's weight and matched to the corresponding arterial internal diameter. The puncture tract was then progressively dilated using a dilator, followed by advancement of the arterial perfusion catheter along the guidewire. The same method was applied for venous puncture and cannulation, with the venous catheter size selected as 2Fr larger

than the arterial catheter size. To enhance intraoperative venous drainage, vacuum-assisted venous drainage was employed during the procedure. A pressure monitoring device was added at the venous blood inlet to the reservoir, with negative pressure controlled between -30 and +5 mmHg.

Central Venous cannulation procedure

The sternum was carefully divided using an oscillating saw or specialized instruments. A combination of blunt and sharp dissection was used to gradually separate the heart and ascending aorta from the posterior sternal wall. At the pericardial reflection, a sufficient segment (typically 3–4 cm in length) of the anterior wall of the ascending aorta was meticulously isolated. Extreme caution was exercised to avoid injury to the adjacent posterior structures, such as the right ventricle, pulmonary artery, and any potentially crossing previous bypass grafts. In a selected "safe window" area free of calcification and adhesions, the aortic perfusion catheter was inserted and securely fixed with purse-string sutures. Depending on the surgical approach, venous cannulation was performed using bicaval or right atrial two-stage cannulation.

Observation Outcomes

Primary observation outcomes

1. Perioperative mortality: Perioperative mortality was defined as death from any cause occurring within 30 days after surgery or during the same hospitalization, regardless of duration (in-hospital mortality). Both 30-day and in-hospital mortality rates were reported.
2. ECMO utilization: ECMO utilization was defined as the need for intraoperative or postoperative veno-arterial extracorporeal membrane oxygenation support due to failure to wean from CPB or refractory cardiogenic shock despite maximal medical therapy. Indications for ECMO initiation were determined jointly by the attending cardiac surgeon and intensivist.
3. Major cardiovascular injury: Major cardiovascular injury was defined as a composite endpoint including any of the following events occurring during or within 30 days after surgery: - Acute myocardial infarction (defined according to the Fourth Universal Definition of Myocardial Infarction: elevation of cardiac troponin above the 99th percentile upper reference limit with at least one of the following: ischemic symptoms, new ischemic electrocardiogram changes, development of pathological Q waves, or imaging evidence of new regional wall motion abnormality); - Cardiac tamponade requiring surgical drainage; - New-onset heart failure requiring inotropic support or

mechanical circulatory support (other than ECMO); - Significant arrhythmia requiring cardioversion or permanent pacemaker implantation (including sustained ventricular tachycardia, ventricular fibrillation, or complete heart block); - Major vascular complications (including aortic dissection, aortic rupture, or limb ischemia requiring surgical intervention).

Secondary Observation Outcomes

1. Acute kidney injury (AKI): AKI was defined and staged according to the Kidney Disease: Improving Global Outcomes (KDIGO) criteria based on changes in serum creatinine within 7 days postoperatively: - Stage 1: Increase in serum creatinine ≥ 0.3 mg/dL (≥ 26.5 μ mol/L) within 48 h OR increase to 1.5–1.9 times the baseline value within 7 days; - Stage 2: Increase in serum creatinine to 2.0–2.9 times the baseline value; - Stage 3: Increase in serum creatinine to ≥ 3.0 times the baseline value OR increase to ≥ 4.0 mg/dL (≥ 353.6 μ mol/L) OR initiation of renal replacement therapy. Preoperative baseline serum creatinine was defined as the most recent value measured within 3 months prior to surgery.
2. Postoperative cognitive dysfunction (POCD): POCD was defined as new-onset cognitive decline following surgery, assessed using the Mini-Mental State Examination (MMSE) or Montreal Cognitive Assessment (MoCA) administered preoperatively (baseline) and on postoperative day 7 or at discharge. In accordance with the criteria of the International Study of Postoperative Cognitive Dysfunction (ISPOCD), POCD was defined as a decline of ≥ 2 points on the MMSE or ≥ 3 points on the MoCA compared with the baseline, or a postoperative score below the 5th percentile of the baseline distribution of a normative reference group.
3. Intraoperative red blood cell usage: Intraoperative red blood cell usage was defined as the total volume (in milliliters) or number of units of packed red blood cells transfused during the surgical procedure (from skin incision to skin closure). Volumes were extracted from anesthesia and perfusion records.

Statistical analysis

All statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA) and R version 4.2.0 (R Foundation for Statistical Computing, Vienna, Austria). The Shapiro–Wilk test was used to assess the normality of continuous variables. Normally distributed continuous data are presented as mean $\pm$ standard deviation ($\bar{x} \pm s$) and compared between groups using

independent samples t-tests. Non-normally distributed continuous data are presented as median with interquartile range (IQR) and compared using the Mann–Whitney U test. Categorical variables are expressed as frequencies (n) and percentages (%), and comparisons between groups were performed using the chi-square test or Fisher's exact test, as appropriate.

Multivariable regression analysis

To account for potential confounding factors inherent in this observational study, multivariable logistic regression analysis was performed to identify independent predictors of the primary outcomes (perioperative mortality, major cardiovascular injury, and ECMO utilization). Variables with a P-value < 0.10 in univariable analysis or those considered clinically important (age, sex, hypertension, diabetes, left ventricular ejection fraction, NYHA functional class, baseline renal function, peripheral vascular disease, interval since the first surgery, and operative risk scores) were entered into the multivariable model using a forward stepwise selection method. Results are reported as adjusted odds ratios (OR) with 95% confidence intervals (CI).

Results

Comparison of Baseline data between the two groups

The results of this study demonstrated comparable baseline characteristics between the two groups. All patients in both groups underwent median sternotomy as the initial surgical approach. No statistically significant differences were observed in surgery type (paravalvular leak, infective endocarditis, newly diagnosed valvular disease, coronary artery disease, and aortic dissection surgery), gender, age, interval since the first surgery, hypertension, or diabetes (all $P > 0.05$). Details are presented in Table 1.

Comparison of intraoperative data between the two groups

The results of this study demonstrated no statistically significant differences between the two groups in terms of cardiopulmonary bypass time, aortic cross-clamp time, operative duration, mean arterial pressure, serum lactate levels, or urine output. However, the femoral arteriovenous cannulation group showed higher intraoperative hemoglobin levels and greater volume of ultrafiltration, along with lower usage of suspended red blood cells and lower mean central venous pressure compared to the conventional central arteriovenous cannulation group. Details are presented in Table 2.

Comparison of intraoperative outcome incidence between the two groups

The results of this study showed no statistically significant difference in the rates of ECMO utilization and

Table 1 Comparison of Baseline Data Between the Two Patient Groups

Variable	Femoral arteriovenous cannulation group (n = 79)	Traditional central cannulation group (n = 37)	Statistical value	Unadjusted P	Adjusted P*
Demographics					
Age (years)	65.4 ± 8.7	64.1 ± 9.2	0.734	0.465	0.512
Male [n (%)]	45 (57.0)	19 (51.4)	0.347	0.556	0.603
Cardiac function					
Left ventricular ejection fraction (%)	55.2 ± 10.3	54.8 ± 11.1	0.189	0.851	0.874
NYHA functional class [n (%)]			0.425	0.935	0.951
I	12 (15.2)	5 (13.5)			
II	28 (35.4)	14 (37.8)			
III	26 (32.9)	12 (32.4)			
IV	13 (16.5)	6 (16.2)			
Baseline renal function					
Serum creatinine (μmol/L)	78.5 ± 18.6	80.2 ± 20.1	−0.445	0.657	0.689
eGFR (mL/min/1.73 m ²)	82.3 ± 15.4	80.9 ± 16.2	0.452	0.652	0.671
Comorbidities [n (%)]					
Hypertension	24 (30.4)	10 (27.0)	0.480	0.488	0.532
Diabetes	22 (27.8)	9 (24.3)	0.164	0.685	0.721
Cerebrovascular disease	8 (10.1)	3 (8.1)	0.118	0.731	0.755
Peripheral vascular disease	10 (12.7)	4 (10.8)	0.084	0.772	0.793
Surgical history					
Interval since first surgery (years)	8.5 ± 4.3	9.1 ± 4.8	−0.668	0.506	0.478
Presence of patent bypass grafts [n (%)]	15 (19.0)	6 (16.2)	0.131	0.718	0.742
Operative risk scores					
EuroSCORE II (%)	4.8 ± 2.5	5.1 ± 2.8	−0.573	0.568	0.592
STS score (%)	3.9 ± 2.1	4.2 ± 2.3	−0.693	0.490	0.512
Surgery type [n(%)]					
Paravalvular leak	18 (22.8)	7 (18.9)	1.802	0.772	0.801
Infective endocarditis	15 (19.0)	5 (13.5)			
Newly diagnosed valvular heart disease	20 (25.3)	12 (32.4)			
Newly diagnosed CAD	16 (20.3)	8 (21.6)			
Post-aortic dissection surgery	10 (12.7)	5 (13.5)			

Table 2 Comparison of Intraoperative Data Between the Two Patient Groups

Parameter	Femoral Arteriovenous Cannulation Group (n = 79)	Conventional Central Arteriovenous Cannulation Group (n = 37)	Statistical Value	P Value
Cardiopulmonary Bypass Time (min)	221.5 ± 25.3	218.2 ± 27.1	0.651	0.517
Aortic Cross-Clamp Time (min)	78.6 ± 18.9	75.4 ± 20.5	0.831	0.408
Operative Time (min)	245.8 ± 41.7	238.5 ± 45.2	0.873	0.385
Mean Arterial Pressure (mmHg)	72.3 ± 8.5	73.6 ± 9.1	−0.756	0.451
Mean Central Venous Pressure (mmHg)	6.5 ± 2.3	8.8 ± 2.5	4.642	<0.001
Serum Lactate Level (mmol/L)	2.1 ± 0.8	2.3 ± 0.9	−1.213	0.228
Urine Output (ml)	850 ± 320	890 ± 350	−0.618	0.538
Intraoperative Hemoglobin Level (g/L)	105.4 ± 12.8	98.2 ± 14.1	2.783	0.006
Ultrafiltration Volume (ml)	1850 ± 450	1550 ± 420	3.421	0.001
Suspended Red Blood Cell Usage (U)	2.1 ± 1.5	3.5 ± 2.0	−4.257	<0.001

operative mortality between the two groups ($P > 0.05$). However, the incidence of major cardiovascular injury in the femoral arteriovenous cannulation group was significantly lower than that in the conventional central arteriovenous cannulation group ($P < 0.05$). For details, see Fig. 1.

Comparison of other postoperative outcomes between the two groups

The results of this study indicated no statistically significant differences between the two groups in the incidence of AKI, cognitive dysfunction, postoperative assisted

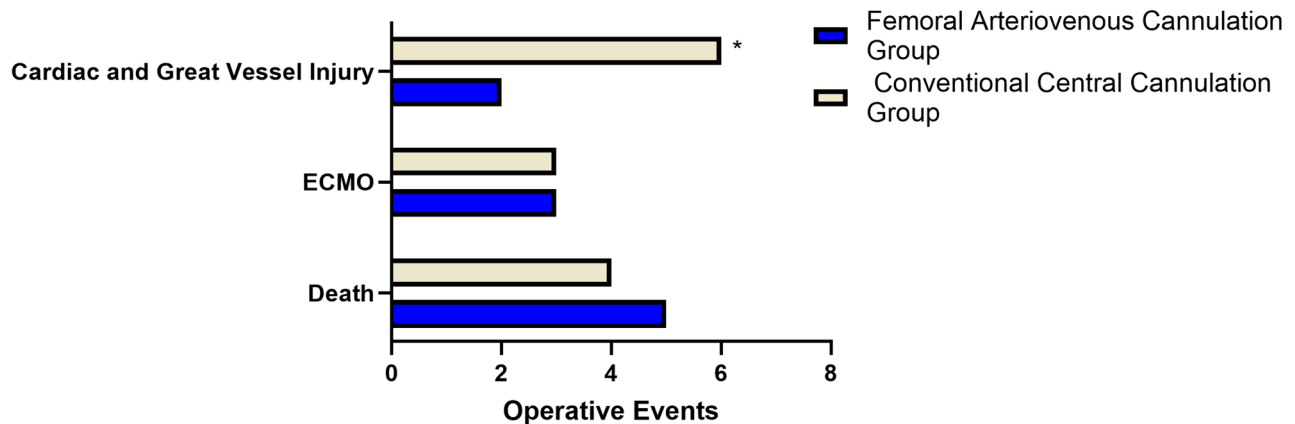


Fig. 1 Intraoperative outcome incidence between the two groups

Table 3 Comparison of Other Outcome Events Between the Two Patient Groups

Project	Femoral Arteriovenous Cannulation Group (n = 79)	Conventional Central Arteriovenous Cannulation Group (n = 37)	Statistical Value	P value
AKI	10 (12.7%)	6 (16.2%)	0.278	0.598
Cognitive Dysfunction	13 (16.5%)	8 (21.6%)	0.453	0.501
Stroke	4 (5.1%)	3 (8.1%)	0.577	0.670
Postoperative Assisted Ventilation Time (hours)	10.5 ± 4.2	11.2 ± 5.1	-0.782	0.436
ICU Length of Stay (days)	3.5 ± 1.8	3.8 ± 2.0	-0.802	0.425
Total Hospital Length of Stay (days)	14.2 ± 5.6	15.1 ± 6.3	-0.763	0.447

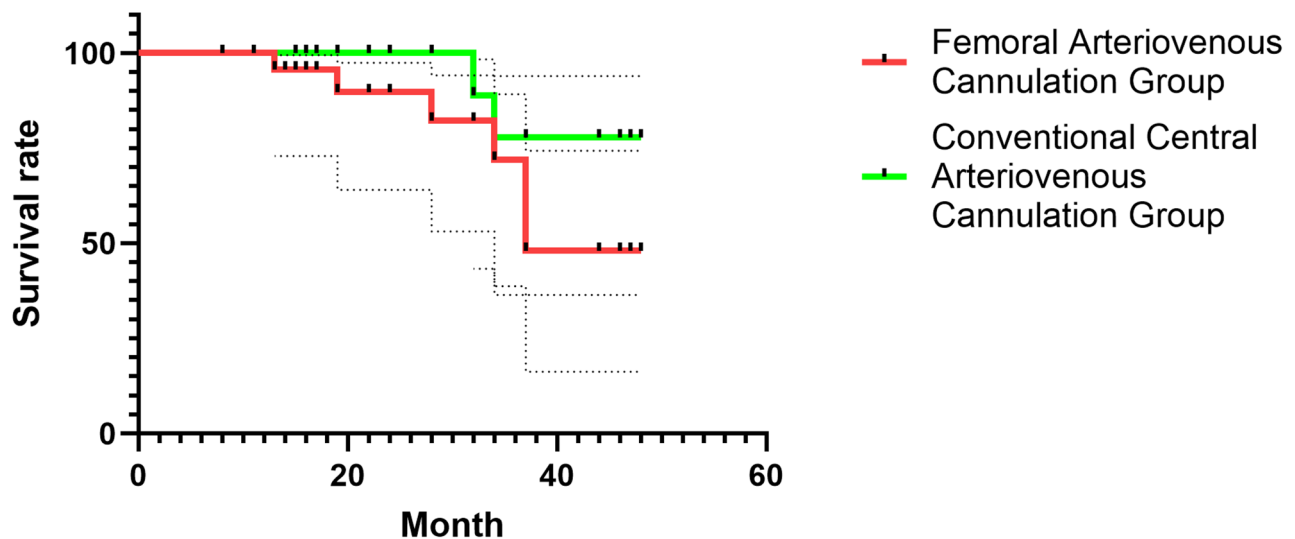


Fig. 2 Comparison of One-Year Survival Rates Between the Two Patient Groups

ventilation time, ICU length of stay, total hospital length of stay, or stroke (all $P > 0.05$). For details, see Table 3.

Comparison of survival rates between the two groups

The results of this study showed that the five-year survival rates for the two groups were 85.0% and 84.7%, respectively. Log-rank test analysis indicated no statistically significant difference in the five-year survival rates between the two groups ($P = 0.176$). For details, see Fig. 2.

Vascular access site complications between the two groups

There was no statistically significant difference in the overall incidence of vascular access site complications between the femoral cannulation group and the central cannulation group (12.7% vs. 13.5%, $\chi^2 = 0.016$, $P = 0.899$). The most common complication in the femoral cannulation group was puncture site hematoma (3.8%), followed by limb ischemia (2.5%) and lymphocele/wound infection (2.5%). In the central cannulation group, the

Table 4 Comparison of vascular access site complications between the two groups

Complication type	Femoral cannulation group (n = 79)	Central cannulation group (n = 37)	χ^2 value	P value
Puncture site hematoma	3 (3.8)	1 (2.7)	0.089	0.765
Pseudoaneurysm	1 (1.3)	0 (0.0)	0.471	0.493
Arterial dissection	0 (0.0)	1 (2.7)	2.143	0.143
Limb ischemia	2 (2.5)	0 (0.0)	0.945	0.331
Retroperitoneal hematoma	1 (1.3)	1 (2.7)	0.295	0.587
Lymphocele/wound infection	2 (2.5)	1 (2.7)	0.003	0.956
Vascular complication requiring surgical intervention	1 (1.3)	1 (2.7)	0.295	0.587
Total	10 (12.7)	5 (13.5)	0.016	0.899

most common complications were puncture site hematoma (2.7%), arterial dissection (2.7%), and retroperitoneal hematoma (2.7%). No fatal vascular complications occurred in either group. All vascular complications requiring surgical intervention (one in each group) were successfully repaired with complete recovery. In conclusion, the femoral cannulation technique was associated with a comparable rate of vascular access site complications to central cannulation, suggesting an acceptable vascular safety profile. Table 4.

Discussion

In recent years, there has been a dramatic increase in the number of patients undergoing reoperative cardiac surgery [10–12]. Reoperation may be required to address unresolved issues from the initial procedure (e.g., progression of the original valvular pathology) or to manage newly developed cardiac conditions. However, repeat sternotomy is associated with a risk of injury to the myocardium, native vessels, or previous grafts, which can potentially lead to major hemorrhage and increased transfusion requirements. These risks are most prevalent during sternal re-entry and tissue dissection and may be severe enough to result in mortality. The literature confirms that postoperative adhesion formation from scar tissue often obscures anatomical planes in reoperative surgery. Although various preventive strategies (such as pericardial closure or the use of anti-adhesion barriers) are employed to reduce adhesions and protect native anatomy, no method has been proven effective in preventing mediastinal scar formation [13]. Therefore, developing an effective and safe strategy for reoperative cardiac surgery is critical to improving patient safety.

Currently, surgeons primarily determine the cannulation approach based on a comprehensive preoperative assessment. While chest computed tomography (CT) can indicate the distance between the sternum and mediastinal structures, it cannot accurately identify adhesive tissue planes. As a result, peripheral femoral arteriovenous cannulation is often the preferred clinical choice. Nevertheless, femoral arterial cannulation carries inherent

risks: retrograde perfusion may dislodge plaques from the aortic arch or descending aorta into the brachiocephalic trunk, leading to stroke or other organ embolism; retrograde flow may collide with the heart's native antegrade output in the aortic arch, increasing cardiac afterload and potentially causing left ventricular distension in patients with cardiac insufficiency; it may also result in inadequate perfusion pressure [14–15]. Additionally, femoral artery perfusion is associated with the risk of lower limb ischemia. Thus, investigating the incidence of complications related to femoral versus central arteriovenous cannulation is essential to guiding optimal preoperative cannulation strategy selection.

The findings of this study demonstrate that the incidence of major cardiovascular injury was significantly lower in the femoral arteriovenous cannulation group than in the central cannulation group, preliminarily suggesting that femoral cannulation may enhance procedural safety. A key advantage of femoral cannulation is the ability to rapidly establish cardiopulmonary bypass (CPB) prior to sternotomy, providing a stable life-support platform for subsequent surgical maneuvers. This allows the surgical team to perform sternal re-entry and mediastinal dissection more deliberately and safely, with the heart decompressed and under reduced tension. By fundamentally avoiding uncontrolled or forced dissection in high-risk adhesive areas without prior protection, the risk of injury to large vessels and cardiac structures is substantially reduced, which is consistent with previous research.

Furthermore, intraoperative hemoglobin levels were higher and transfusion requirements were lower in the femoral cannulation group compared to the central cannulation group. A potential explanation for this observation is the routine use of vacuum-assisted venous drainage (VAVD) in the femoral group, which enhances venous return, increases ultrafiltration volume, and thereby elevates hemoglobin concentration—ultimately reducing the need for blood transfusion. This finding is consistent with the results of earlier studies [16–18].

Further analysis of the impact of different cannulation strategies on perioperative complications revealed no statistically significant differences in perioperative mortality or extracorporeal membrane oxygenation (ECMO) utilization between the two groups, indicating that the cannulation approach did not affect mortality or the need for mechanical circulatory support. Additionally, the absence of significant differences in the incidence of acute kidney injury (AKI), cognitive dysfunction, and intraoperative lactate levels suggests that femoral arterial cannulation did not increase the risk of intraoperative hypoperfusion or compromise organ perfusion, supporting its relative safety. Finally, comparable postoperative hospital stays and two-year survival rates between the groups preliminarily confirm that the choice of cannulation method had no significant impact on short-term patient outcomes, which aligns with previous studies [19–20].

This study has several limitations. First, it was a single-center, retrospective, non-randomized study with a relatively small sample size. Selection bias and unmeasured confounding variables may have influenced the results. Therefore, our findings can only suggest an association between the femoral cannulation strategy and clinical outcomes, rather than establishing a causal relationship. Second, we did not evaluate axillary artery cannulation, which may further improve surgical safety and serve as an important alternative for patients with femoral artery stenosis or severe atherosclerosis. Third, the follow-up duration was relatively short; longer-term studies are needed to fully assess the impact of different cannulation approaches on patient outcomes. Fourth, although we performed multivariable regression analysis and propensity score matching to control for confounding bias, residual confounding may still exist. Consequently, our conclusions should be interpreted with caution and require validation in prospective, multicenter, large-sample studies.

Conclusions

In summary, compared with central arteriovenous cannulation, femoral arteriovenous cannulation in this study population was associated with a lower risk of major cardiovascular injury, improved safety of repeat sternotomy, higher intraoperative hemoglobin levels, and reduced transfusion requirements. However, given the retrospective design and potential confounding factors, these findings reflect an association rather than a causal relationship. Therefore, the broader clinical application of the femoral cannulation strategy should be considered cautiously, and further prospective, randomized controlled, multicenter studies are warranted to validate these observations.

Author contributions

Yi Hui Yu, XunLiZhang and Lei Wang wrote the main manuscript text and LiQiongXiao, FuHuangHuang, Zhen Hong Wang prepared figures. All authors reviewed the manuscript."

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Competing interests

The authors declare no competing interests.

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