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Impact of non-significant right coronary ostial involvement on coronary events in type A aortic dissection surgery

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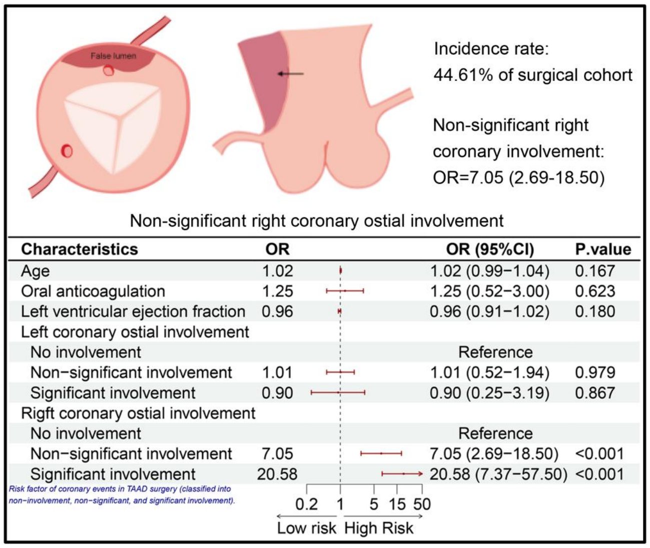
Impact of Non-Significant Right Coronary Ostial Involvement on Coronary Events in Type A Aortic Dissection Surgery

Summary

In an ambidirectional cohort study of 1,168 consecutive TAAD patients who underwent surgical repair, patients were stratified into non-COI (non-involvement) and COI (non-significant and significant involvement) groups. Associations between COI subtypes and coronary events were analyzed. In addition to significant right COI, non-significant right COI also increases the risk.



TAAD: type A aortic dissection, COI: coronary ostial involvement.

Abstract

OBJECTIVES: Coronary-related technical complications constantly occur during type A aortic dissection surgical repair and are potentially fatal, yet their risk factors require further investigation. The intricate morphology of coronary ostial involvement may have a substantial impact.

METHODS: From June 2019 to January 2024, consecutive type A aortic dissection patients who underwent open surgery were included. Patients were divided into the coronary involvement group (non-significant involvement: Neri A—dissected intima involving the margin of the coronary ostium; significant involvement: Neri B and Neri C) and the non-involvement group. Coronary events were defined as coronary-

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related technical complications necessitating bailout coronary revascularization or coronary ostial repair. Logistic regression analysis identified risk factors associated with coronary events. Overall survival was estimated using Kaplan–Meier method and Cox regression analysis.

RESULTS: Of 1168 patients, 660 patients had coronary involvement, while 508 did not. Coronary events occurred in 58 patients (4.97%), including 53 (4.54%) who required bailout coronary revascularization. Patients with coronary involvement had a higher incidence of coronary events (8.18% vs 0.79%, $P < 0.001$). Logistic regression analysis revealed that significant right coronary involvement was associated with coronary events (odds ratio: 20.58, 95% confidence interval: 7.37–57.50, $P < 0.001$). Notably, non-significant right coronary involvement, accounting for 44.61% of patients, was also associated with coronary events compared to those without involvement (odds ratio: 7.05, 95% confidence interval: 2.69–18.50, $P < 0.001$).

CONCLUSIONS: Coronary events occurred in 4.97% patients. Significant right coronary involvement is strongly associated with coronary events; non-significant right coronary involvement, which is relatively common in surgical patients, also poses a substantial risk for coronary events and warrants attention.

Keywords: type A aortic dissection • bailout coronary revascularization • coronary ostial involvement • coronary events

ABBREVIATIONS

CABG	Coronary artery bypass grafting
CAD	coronary artery disease
COR	Coronary ostial repair
CTA	Computed tomography angiography
TAAD	Type A aortic dissection

INTRODUCTION

Type A aortic dissection (TAAD) frequently leads to sudden death, necessitating urgent surgery [1, 2]. The surgical complexity and operative mortality increase sharply when TAAD involves the coronary ostium [3–6]. However, the morphology of coronary ostial involvement (COI) varies widely and is highly complex, and the current understanding of coronary involvement remains inadequate.

The management of complex coronary involvement is technically challenging. Although surgical techniques to treat coronary involvement are well established [4–6], coronary events—defined as coronary-related technical failures and complications—occur constantly. These complications are primarily attributable to suboptimal management of coronary involvement, such as improper construction of the coronary ostia and incomplete closure of the false lumen, which often leads to bleeding at the anastomosis site and compressed peri-coronary haematoma, ultimately resulting in acute myocardial infarction and a dismal prognosis [5, 7]. Identifying specific patterns of coronary involvement is crucial to avoid such complications.

Despite their clinical implications and the tremendous interest among surgeons, coronary events are poorly reported. We hypothesized that coronary involvement may influence the development of coronary events. Complete preoperative computed tomography angiography (CTA) data enable us to assess the extent of coronary involvement. This study aimed to determine the incidence of coronary events and the association between different severities of coronary involvement and coronary events.

METHODS

Ethical statement

This study was approved by the Ethics Committee of Fuwai Hospital on 25 November, 2021 (approval ID: 2021-1490). Clinical data were retrospectively collected and analysed anonymously. Written or oral informed consent was obtained from all participants during follow-up. The study followed the Declaration of Helsinki.

Study population and data collection

This study was designed as an observational, am-bidirectional study. The clinical data of consecutively aortic dissection patients who underwent surgical repair between June 2019 and January 2024 were retrieved from the electronic medical records system. Inclusion criteria were: (I) patients diagnosed with TAAD and (II) those who underwent open surgery. Patients diagnosed with non-A-type aortic dissection, those with a history of previous aortic root surgery, previous coronary artery bypass grafting (CABG) and those who underwent type II hybrid procedure were excluded. Patients were divided into two groups: those with COI (COI group) and those without (non-COI group). The study flowchart is illustrated in Fig. 1.

Follow-up was conducted via phone interviews and outpatient clinical revisit records. Three months after surgery, patients who could not be contacted through telephone interviews or who lacked a medical record in our electronic medical record system were considered lost to follow-up. All follow-up interviews were completed by July 2024.

Coronary involvement

All patients underwent preoperative coronary CTA at our institution. COI was diagnosed based on the intraoperative descriptions from the surgical record and CTA reports. Intraoperative examination was prioritized due to the delay between CTA and surgery (Supplementary Video S1). However, owing to the inherent limitations of the retrospective nature of perioperative data, COI was not documented in all the surgical notes. Therefore, when COI was not reported in the surgical notes, CT images were reviewed by two experienced radiologists. If there was any inconsistency, a senior imaging specialist made the final diagnosis.

In this study, COI differed from coronary artery dissection or coronary artery involvement described in previous literature [3, 4]. The extent of coronary involvement was classified into three categories, primarily based on the Neri classification with modifications [8]: non-involvement, non-significant ostial involvement (Neri A—aortic dissection adjacent to the coronary ostium) and significant involvement (Neri B and C). We specifically classified

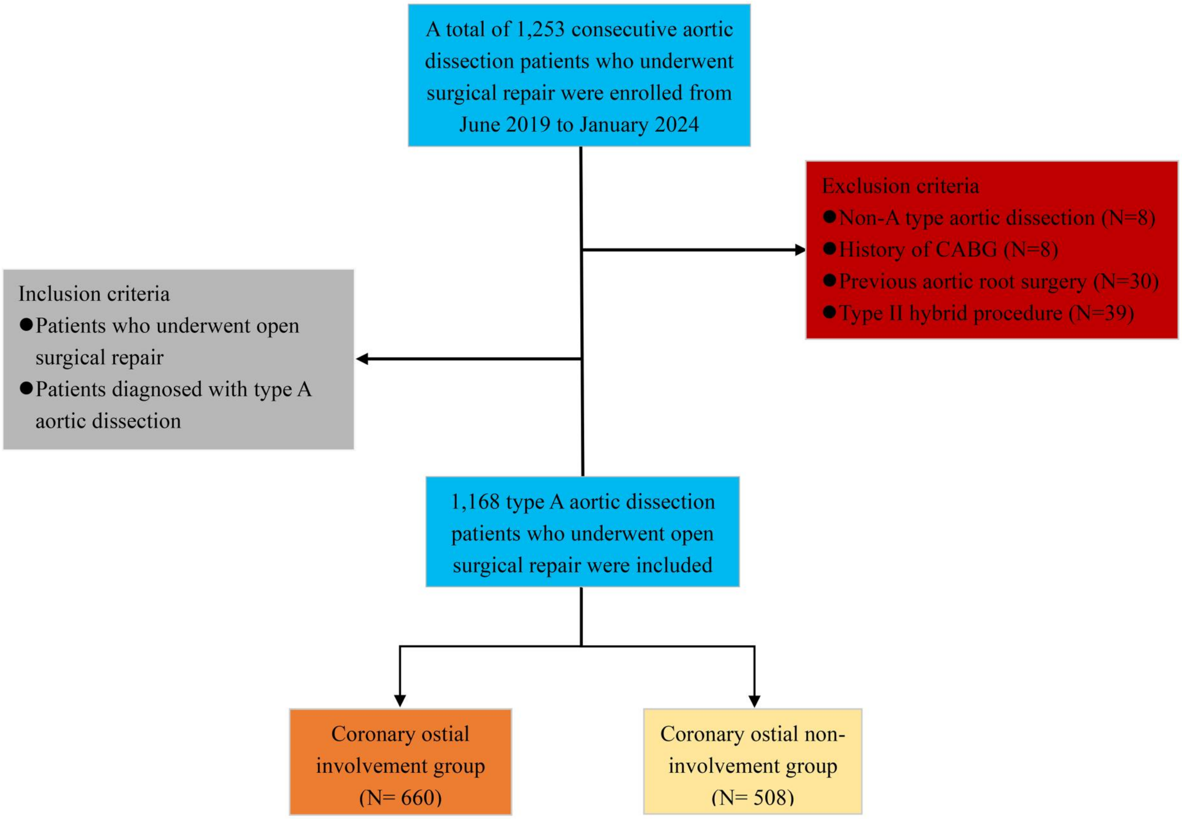

Figure 1: Patient selection flowchart

aortic dissection with an intimal tear that terminated at the margin of the coronary ostium as non-significant coronary involvement due to its potential risk of causing surgical-related coronary complications, as illustrated in Fig. 2, which depicted the most common anatomical morphology of the dissected aortic root, and also the most common morphology of COI, usually described in formal reports as the right coronary artery ostium being adjacent to the intimal flap.

Data definition

Coronary artery disease (CAD) was characterized by the presence of 50% or more stenosis of the major branches of the coronary artery on CTA images. CABG was performed for significant CAD (≥70% stenosis in at least one major branch or ≥50% stenosis in the left main coronary artery) and could also be considered for moderate stenosis (50–69%) or high-risk plaques [9, 10]. Coronary malperfusion was identified based on the presence of a perfusion deficit on enhanced CTA imaging or with new ST-segment elevation or higher levels of cardiac enzymes [11].

Combined branch procedures refer to revascularization of the carotid and femoral arteries, along with thoracic endovascular aortic repair. Surgical reintervention refers to any postoperative condition related to TAAD requiring surgical intervention during hospitalization, including re-exploration.

Definition of outcomes

Coronary events were defined, according to previous research [12], as coronary-related technical complications necessitating bailout coronary revascularization. We carefully selected only the most pertinent outcomes [13] to ensure clinical relevance; redo coronary ostial repair (COR) was also included.

Operative mortality was defined by the Society of Thoracic Surgeons as death before final discharge from the hospital (in-hospital mortality) or within 30 days following surgery (30-day mortality). All-cause mortality was defined as death due to any cause postoperative during follow-up period.

Surgical protocols

After general anaesthesia induction, patients were positioned supine, and median sternotomy was performed. The femoral and/or axillary artery was cannulated for arterial perfusion, with the right atrium cannulated for venous return. Once myocardial protection was achieved, the involved aortic root was treated with either a Bentall procedure, sinus of Valsalva reconstruction or valve-sparing root replacement. Aortic valve replacement or valvuloplasty alone was also possibly performed. The aortic arch was subsequently managed with hemi-arch replacement, total arch replacement or total arch replacement with frozen elephant trunk implantation (CRONUS, MicroPort Ltd), depending on the extent of the intimal tear. If circulatory arrest was necessary, selective antegrade cerebral perfusion was employed along with a significantly lower core temperature (18–25°C) [14].

Myocardial protection was essential for TAAD with coronary lesions. When preoperative assessment indicated CABG, the great saphenous vein was harvested during cardiopulmonary bypass (CPB) establishment. If antegrade coronary perfusion was not feasible, emergency CABG was performed for graft perfusion, with

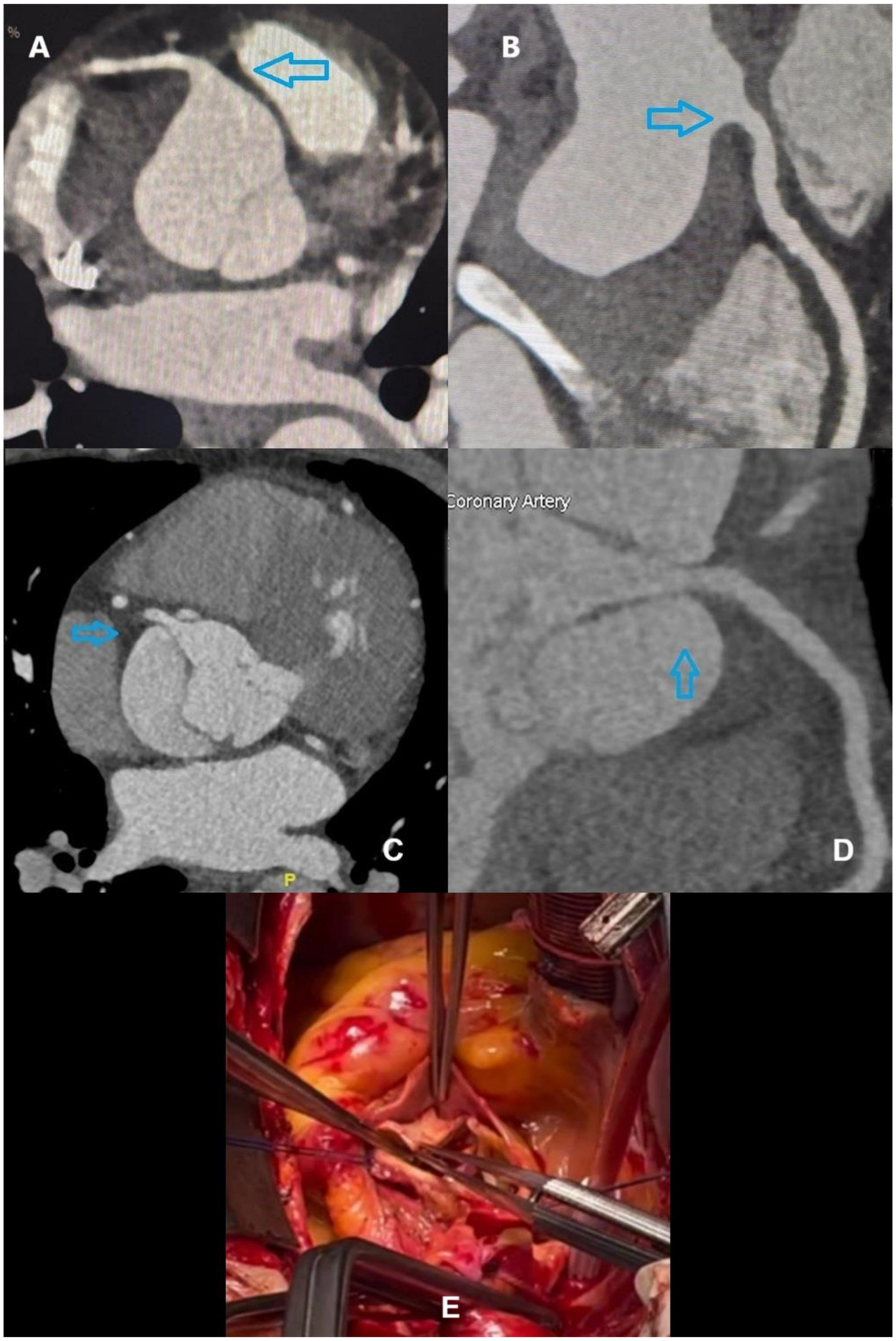

Figure 2: Illustration of non-significant right coronary ostial involvement. Panels (**A**) and (**B**) depict the most common morphology of TAAD involving the aortic root, which is also the most frequently observed form of coronary ostial involvement during surgery. This is typically described as the right coronary artery ostium being adjacent to the intimal flap. Panels (**C**) and (**D**) show another case, also classified as non-significant involvement (Neri-A), with Panel (**E**) confirming this through intraoperative examination. Direct repair is often risky for this anatomical pattern (C–E) and may lead to coronary events. TAAD: Type A aortic dissection

retrograde coronary sinus perfusion considered. If antegrade myocardial perfusion was achievable, various COR techniques, including direct ostial repair, ostial pledgeted suture repair and coronary button reimplantation, were employed for COI [8, 15, 16].

Surgical strategies for coronary involvement are not yet standardized, but are generally based on anatomical patterns observed on coronary CTA and intraoperative findings. At our institution, for Neri C lesions, suture closure of the coronary

Table 1: Demographic characteristics

Item	Coronary non-involvement (508)	Coronary involvement (660)	*P*-value
Age (years)	51.52 (12.59)	51.48 (11.62)	0.951
Male	378 (74.41)	490 (74.24)	1.000
Body mass index (kg/m^2)	26.20 (4.87)	26.63 (4.33)	0.111
Hypertension	405 (79.72)	554 (83.94)	0.074
Insulin-dependent diabetes	34 (6.69)	32 (4.85)	0.220
Marfan	28 (5.51)	21 (3.18)	0.068
Coronary artery disease	141 (27.76)	170 (25.76)	0.484
Oral anticoagulants	33 (6.50)	53 (8.03)	0.378
Coronary malperfusion	3 (0.59)	109 (16.52)	<0.001
LCA involvement classification			<0.001
No	508 (100.00)	436 (66.06)	
Non-significant	0 (0.00)	186 (28.18)	
Significant	0 (0.00)	38 (5.76)	
RCA involvement classification			<0.001
No	508 (100.00)	20 (3.03)	
Non-significant	0 (0.00)	521 (78.94)	
Significant	0 (0.00)	119 (18.03)	
≥Moderate pericardial effusion	12 (2.36)	19 (2.88)	0.718
Bicuspid aortic valve	18 (3.54)	21 (3.18)	0.603
Aortic regurgitation			<0.001
No	282 (55.51)	222 (33.64)	
Mild	106 (20.87)	174 (26.36)	
Moderate	74 (14.57)	164 (24.85)	
Severe	46 (9.06)	100 (15.15)	
LVEF (%)	60.67 (5.35)	60.40 (4.56)	0.363
Troponin-I (μg/l)	0.02 (0.08)	0.25 (2.44)	0.033
Serum creatinine (μmol/l)	87.90 (38.47)	96.35 (49.41)	0.002
Creatine clearance (ml/min)	100.69 (37.85)	97.27 (37.19)	0.123
Blood urea nitrogen (mmol/l)	6.89 (2.66)	7.77 (5.32)	0.001
Total bilirubin (μmol/l)	14.92 (8.20)	17.41 (9.41)	<0.001
Alanine transaminase (IU/l)	34.68 (105.08)	37.71 (89.24)	0.594
Aspartate transaminase (IU/l)	37.12 (135.43)	39.64 (93.72)	0.707

LCA: left coronary artery; LVEF: left ventricular ejection fraction; RCA: right coronary artery.

ostium combined with concomitant CABG is generally accepted as standard practice, although exceptions do exist. In certain cases, the dissected adventitia and intima can be sutured together, followed by reimplantation as a coronary button [7]. For Neri A and B, COR is typically performed; however, in specific intraoperative circumstances, protective CABG is often conducted following COR or, if repair is not feasible, after coronary ostial closure (Supplementary Material, Fig. S1).

Despite various surgical strategies, coronary events occasionally occurred. When graft occlusion or direct ostial repair failure was present, such as leakage of cardioplegia during antegrade administration, bleeding detected around the coronary ostium after the heart resumed beating, or the formation of a progressive coronary dissection or a coronary anastomotic haematoma extending into or compressing the coronary orifice after releasing the aortic cross-clamp, along with the presence of significant wall motion abnormalities, impaired myocardial contractility or ST-segment changes during cardioversion, weaning from CPB or postoperative critical care monitoring, a coronary event was identified. The patient was promptly prepared for either bailout CABG or coronary ostial re-repair.

Statistical analysis

Statistical analyses were conducted using R 4.3.1 (R-project.org). The proportion of missing values was <2.5% across all variables. Missing data were imputed using the random forest multiple imputation method.

Continuous variables conforming to a normal distribution are presented as means (standard deviations), whereas those not following a normal distribution are presented as medians (interquartile ranges). Categorical variables are represented as frequencies and percentages. Statistical comparisons were made to assess the differences between the two groups. Logistic regression analyses were performed to identify risk factors associated with coronary events. Odds ratio (OR) and 95% confidence interval (CI) were estimated. Mediation analysis was conducted to assess the role of COR between the association of coronary involvement and coronary events. Kaplan–Meier estimate was utilized to build survival curve, which was compared with log-rank test. Cox regression analysis was conducted to determine hazard ratio. Two-tailed *P* values <0.05 were considered statistically significant.

RESULTS

Perioperative data

The final study cohort consisted of 1168 patients, of whom 660 were classified into the COI group and 508 into the non-COI group. The preoperative baselines are detailed in Table 1. Compared to the non-COI group, the COI group had a significantly higher percentage of patients with coronary malperfusion (16.52% vs 0.59%, $P < 0.001$). The level of troponin-I was also higher in the COI group (0.25 vs 0.02 μg/l, $P = 0.033$), as well as

Table 2: Operative details

Item	Coronary non-involvement (508)	Coronary involvement (660)	*P*-value
CABG	90 (17.72)	206 (31.21)	<0.001
CABG for coronary involvement	0 (0.00)	106 (16.06)	<0.001
CABG for CAD	88 (17.32)	93 (14.09)	0.152
Coronary events	4 (0.79)	54 (8.18)	<0.001
Bailout coronary revascularization	4 (0.79)	49 (7.42)	<0.001
Bailout CABG for COR failure	0 (0.00)	41 (6.21)	<0.001
Bailout CABG for untreated CAD	3 (0.59)	1 (0.15)	0.323
Re-do CABG	0 (0.00)	1 (0.15)	1.000
Bailout CABG for LCOS	1 (0.20)	4 (0.60)	0.395
Unable or refusal of bailout CABG	0 (0.00)	4 (0.60)	0.137
Re-do COR	0 (0.00)	5 (0.76)	0.073
CABG to right coronary artery	15 (2.95)	129 (19.55)	<0.001
Left internal mammary artery graft	24 (4.72)	16 (2.42)	0.048
Aortic valvuloplasty	24 (4.72)	67 (10.15)	0.001
Aortic valve replacement	18 (3.54)	22 (3.33)	0.973
David I	18 (3.54)	20 (3.03)	0.746
Bentall	83 (16.34)	171 (25.91)	<0.001
Combined branches procedure	74 (14.57)	105 (15.91)	0.583
Reinitiation of CPB	16 (3.15)	65 (9.85)	<0.001
Operative time (min)	350.00 [300.00, 421.50]	399.50 [338.00, 479.25]	<0.001
CPB time (min)	164.00 [131.00, 200.25]	196.00 [164.00, 241.00]	<0.001
Cross-clamp time (min)	103.00 [79.00, 131.00]	126.00 [103.00, 161.25]	<0.001
Circulatory arrest time (min)	16.00 [11.75, 22.00]	16.00 [12.00, 20.00]	0.947
Blood loss (ml)	720.00 [600.00, 900.00]	780.00 [660.00, 900.00]	<0.001
Red blood cell transfusion (U)	0.00 [0.00, 0.00]	0.00 [0.00, 2.00]	0.024
Plasma transfusion (ml)	0.00 [0.00, 400.00]	400.00 [0.00, 600.00]	<0.001
Platelet transfusion (unit)	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	<0.001

CABG: coronary artery bypass grafting; CAD: coronary artery disease; COR: coronary ostial repair; CPB: cardiopulmonary bypass.

the levels of serum creatinine (96.35 vs 87.90 µmol/l, $P = 0.002$), blood urea nitrogen (7.77 vs 6.89 mmol/l, $P = 0.001$) and total bilirubin (17.41 vs 14.92 µmol/l, $P < 0.001$). The proportion of COI, especially non-significant right coronary involvement–Neri A, was high. There were 640 (54.79%) patients with right COI, whereas 521 cases (44.61%) had non-significant right coronary involvement. Additionally, the COI group had more severe aortic regurgitation ($P < 0.001$), while no statistically significant differences were observed in other demographic characteristics.

As shown in Table 2, during the procedure, the COI group underwent more concomitant CABG procedure (31.21% vs 17.72%, $P < 0.001$) and CABG for CAD (16.06% vs 0.00%, $P < 0.001$). The COI group had a significantly higher rate of reinitiation of the CPB (9.85% vs 3.15%, $P < 0.001$), a longer total operative time (399.50 vs.350.00 min, $P < 0.001$), CPB time (196.00 vs 164.00 min, $P < 0.001$) and aortic X-clamp time (126.00 vs 103.00 min, $P < 0.001$).

Notably, compared with the non-COI group, the COI group exhibited significantly higher incidences of coronary events (8.18% vs 0.79%, $P < 0.001$) and a higher proportion requiring bailout coronary revascularization (7.42% vs 0.79%, $P < 0.001$). In the COI group, 41 patients received bailout CABG after coronary repair failure. Among them, one with untreated CAD was also addressed, and another experienced graft occlusion after surgery and underwent redo CABG. Meanwhile, three patients in the non-COI group received bailout CABG due to untreated CAD. Four patients in the COI group were indicated for bailout CABG but declined: one due to financial constraints; one patient underwent re-exploration, during which postinfarction left ventricular rupture was confirmed, making bailout CABG unfeasible; and two others, who developed coronary dissection and myocardial infarction post-surgery, were discharged without further intervention and remain alive at follow-up.

Postoperatively, the use of continuous renal replacement therapy (9.55% vs 4.13%, $P = 0.001$) increased dramatically in the COI group. The rate of pneumonia (16.97% vs 9.45%, $P < 0.001$) significantly increased, as did ventilation duration (19.00 [11.00, 45.00] vs 15.00 [9.00, 31.25] h, $P < 0.001$), and intensive care unit stay (4.00 [3.00, 7.00] vs 4.00 [2.00, 6.00] days, $P < 0.001$) in the COI group. Postoperative high-sensitivity troponin-I levels also increased significantly (10.15 vs 4.71 ng/ml, $P = 0.001$) in the COI group, as did total bilirubin (44.17 vs 39.27 µmol/l, $P = 0.003$) and peak serum creatinine (192.85 vs 150.31 µmol/l, $P < 0.001$), as illustrated in Table 3.

Risk factors of coronary events

As presented in Supplementary Material, Table S1, coronary events occurred in 58 (4.97%) patients. Of the patients with coronary events, 27.59% experienced operative mortality, compared with 1.80% in patients without coronary events ($P < 0.001$). Major surgical complications occurred in 10.02% of surgical patients, but were significantly higher in patients with coronary events compared with those without (55.17% vs 7.66%, $P < 0.001$). Patients with coronary events also had higher rates of postoperative pneumonia, tracheostomy, along with longer hospital stays.

With coronary events as the dependent variable, based on a corresponding prior univariable regression model (Supplementary Material, Table S2), we selected variables with $P < 0.10$ to be included in the multivariable regression. Incorporating clinical significance to establish the regression

Table 3: Surgical outcomes

Item	Coronary non-involvement (508)	Coronary involvement (660)	*P*-value
Operative mortality	13 (2.56)	23 (3.48)	0.461
Stroke	10 (1.97)	22 (3.33)	0.217
IABP	3 (0.59)	13 (1.97)	0.079
ECMO	3 (0.59)	11 (1.67)	0.160
CRRT	21 (4.13)	63 (9.55)	0.001
Pneumonia	48 (9.45)	112 (16.97)	<0.001
Sepsis	3 (0.59)	4 (0.61)	1.000
Tracheostomy	4 (0.79)	6 (0.91)	1.000
Surgical reintervention	23 (4.53)	50 (7.58)	0.044
Re-exploration for bleeding	13 (2.56)	30 (4.55)	0.103
High-sensitivity troponin-I (ng/ml)	4.71 (13.28)	10.15 (34.06)	0.001
Alanine aminotransferase (IU/l)	74.49 (270.73)	79.94 (335.02)	0.765
Aspartate aminotransferase (IU/l)	133.51 (577.75)	184.82 (834.30)	0.236
Total bilirubin (μmol/l)	39.27 (24.60)	44.17 (30.77)	0.003
Peak-serum creatinine (μmol/l)	150.31 (108.86)	192.85 (162.30)	<0.001
Ventilation time (hours)	15.00 [9.00, 31.25]	19.00 [11.00, 45.00]	<0.001
Intensive care unit stay (days)	4.00 [2.00, 6.00]	4.00 [3.00, 7.00]	<0.001
Hospital stays (days)	13.00 [9.00, 18.00]	12.00 [9.00, 16.00]	0.081

CRRT: continuous renal replacement therapy; ECMO: extracorporeal membrane oxygenation; IABP: intra-aortic balloon pump implantation.

Table 4: Multivariable logistic regression model for coronary events

Variables	Odds ratio	95% Confidence interval	*P*-value
Age, per 1 year	1.02	0.99–1.04	0.167
Oral anticoagulants	1.25	0.52–3.00	0.623
LVEF, per 1% increase	0.96	0.91–1.02	0.180
Left coronary involvement			
No		Reference	
Non-significant	1.01	0.52–1.94	0.979
Significant	0.90	0.25–3.19	0.867
Right coronary involvement			
No		Reference	
Non-significant	7.05	2.69–18.50	<0.001
Significant	20.58	7.37–57.50	<0.001

model, including age, oral anticoagulation, LVEF and left and right coronary modification classification as covariates, multivariable logistic regression revealed that significant right COI dramatically increased the risk of coronary events compared to patients without involvement (OR: 20.58, 95% CI: 7.37–57.50, $P < 0.001$). Notably, non-significant COI was also found to increase the risk (OR: 7.05, 95% CI: 2.69–18.50, $P < 0.001$), as seen in Table 4 and Fig. 3. The assumptions of the logistic regression model were verified, and the goodness-of-fit was tested (Supplementary Material, Part II).

The potential mediation effects in the relationship between right coronary involvement and coronary events were further explored. Significant indirect effects of COR were found, mediating 90.33% ($P < 0.001$) of the association after multivariate adjustment (Supplementary Material, Fig. S2). No significant interaction between right coronary involvement and COR was found (Supplementary Material, Table S3).

Impact of coronary involvement on late prognosis

Follow-up data were available for all the patients with TAAD, except for 71 (6.08%) who were lost to follow-up within 3 months after surgery. The median follow-up time was 25.37 (interquartile range: 11.47–38.97) months. There were 54 all-cause deaths. The Kaplan–Meier curve revealed that the overall survival rate differed significantly among the three groups (log-rank $P = 0.019$), with the significant right coronary involvement group showing the lowest overall survival, while the non-significant right coronary involvement group showed no difference compared to those without involvement. The Cox regression hazard model indicated that significant right coronary involvement predicted a 2.76-fold increase in the overall risk of mortality compared to those without involvement (HR: 2.76, 95% CI: 1.31–5.80, $P = 0.007$), as shown in Supplementary Material, Fig. S3. The Cox model did not violate the proportional hazards assumption (Supplementary Material, Part II).

DISCUSSION

An overview of the study is presented in Supplementary Material, Fig. S4. Coronary events were qualitatively described (4.97%) and were associated with higher operative mortality and major surgical complications. Significant right coronary

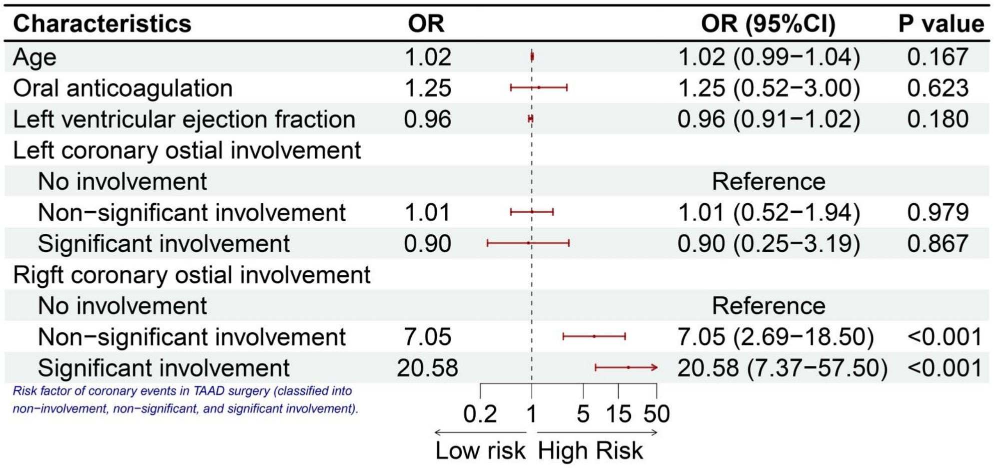

Figure 3: The forest plot reveals that significant right coronary involvement increases the risk of coronary events, and non-significant right coronary involvement also poses an increased risk

involvement was identified as a risk factor for coronary events in TAAD surgery. Notably, non-significant right COI, which affects a large proportion of TAAD surgical patients (44.61%), is also associated with coronary events and warrants careful attention.

Coronary events were associated with poorer surgical outcomes, primarily because patients usually undergo a period of myocardial ischaemia while undergoing bailout coronary revascularization. If prolonged, this ischaemia could increase the risk of myocardial infarction, impair cardiac function and adversely affect patient outcomes [5, 7, 17].

Right COI was significantly more common than left COI, aligning with the clinical findings of previous studies [4, 5, 18]. Experienced surgeons could observe that the marginal of the right coronary ostium is frequently affected during surgical examination, whereas the left coronary artery is relatively less involved. Norton *et al*. [11] suggested that the high prevalence and severity of right coronary involvement might be due to the susceptibility of the right outer curvature of the aortic arch to intimal tears, in addition to the high risk of sudden death associated with TAAD involving the left coronary artery, which also explains the lower incidence of left coronary involvement in our surgical cohort.

Right COI is a significant risk factor for coronary events, with mediator analysis showing that COR has a significant indirect effect on the relationship. This is primarily due to the frequent failure of COR. Currently, several COR techniques have been proposed [8, 15, 16]. While CABG is widely accepted for Neri C lesions, COR is commonly employed for Neri B or Neri A lesions when antegrade coronary perfusion is feasible, as suggested by Maximilian Kreibich *et al*. [6]. However, technical failures are frequently reported and pose significant risks, especially in fragile or weakened tissues. Blood leakage at the repair site can result in a localized haematoma, which may compress the coronary ostium or extend into the coronary artery, leading to myocardial ischaemia. These complications often necessitate bailout coronary revascularization and contribute to poor clinical outcomes. Regarding left coronary involvement, patients are often in more critical and unstable condition, prompting surgeons to opt for CABG more aggressively, thus reducing the likelihood of repair failure (intervention bias), which also explains why left coronary involvement did not emerge as a significant risk factor for coronary events.

Pitts *et al*. observed that Neri B lesions account for the majority of bailout CABG cases, which are often associated with dismal outcomes [5]. This is in line with our finding that significant right coronary involvement is strongly associated with coronary events. The Kaplan–Meier analysis further confirmed its impact on late mortality.

While left coronary involvement and significant right coronary involvement have received considerable attention for their impact on prognosis, non-significant right coronary involvement has often been overlooked. Typically managed with COR, non-significant involvement carries a risk of repair failure, yet coronary events constantly occur. Despite its association with coronary events and high incidence in surgical cohorts, it remains underexplored. This highlights the need for greater clinical attention and potential modifications to surgical strategies, which warrants further investigation.

Limitations

There are several limitations. First, the data were sourced exclusively from a specialized cardiovascular hospital, potentially excluding high-risk patients with refractory peripheral end-organ malperfusion syndrome (e.g. coma, mesenteric malperfusion). Additionally, patients with left coronary involvement may not have been admitted, further affecting the reported incidence. Nonetheless, this did not impact the conclusions derived from the surgical cohort, and the large sample size lends clinical significance to the findings.

CONCLUSION

The incidence of coronary events is rare (4.97%) but fatal. Significant right COI markedly increases the risk of coronary events. Notably, non-significant right coronary involvement, which is relatively common among surgical patients, also increases the risk of coronary events and thus warrants careful attention.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *ICVTS* online.

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DATA AVAILABILITY

Data sharing is applicable from the first authors.

Author contributions

Ling-chen Huang: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Software; Validation; Visualization; Writing—original draft; Writing—review & editing. **Xiang-min Hu:** Data curation; Project administration; Supervision; Validation; Writing—review & editing. **Ai-kai Zhang:** Methodology; Project administration; Software; Visualization; Writing—original draft; Writing—review & editing. **Ze-hua Shao:** Data curation; Funding acquisition; Investigation; Resources; Writing—original draft. **Yang-xue Sun:** Data curation; Funding acquisition; Software; Writing—original draft. **Dong Zhao:** Project administration; Resources; Writing—original draft. **Yi Chang:** Investigation; Methodology; Project administration; Validation; Writing—original draft; Writing—review & editing. **Xiang-yang Qian:** Conceptualization; Funding acquisition; Project administration; Resources; Supervision; Validation; Writing—original draft; Writing—review & editing. **Hongwei Guo:** Conceptualization; Data curation; Funding acquisition; Methodology; Project administration; Resources; Software; Supervision; Validation; Writing—original draft; Writing—review & editing.

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