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Cardiovascular & Thoracic Abstracts

Contents

Association of perioperative echocardiographic right ventricular function with outcomes after cardiac surgery: a retrospective cohort study

Submission ID

4

AUTHORS

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INTRODUCTION

The perioperative assessment of cardiac function is integral to planning cardiac surgical procedures and predicting postoperative outcomes. Currently, the use of at least one quantitative measure of right ventricular (RV) function, such as RV fractional area change (RVFAC) and tricuspid annular plane systolic excursion (TAPSE), are recommended in routine preoperative echocardiography exams for cardiac surgery.[1] Despite these recommendations, RV function is oftentimes only qualitatively reported as 'normal,' 'reduced,' or 'poor' based on visual estimation. However, qualitative assessments show poor reliability and reproducibility.[2,3] Moreover, there is limited information on the comparative utility and prognostic significance of perioperative quantitative measures in predicting postoperative outcomes. Therefore, we aimed to estimate the association between measures of perioperative RV function (RVFAC and TAPSE) and postoperative outcomes in patients who underwent cardiac surgery.

METHODS

This single-centre, retrospective cohort study included all adult patients (over 18 yr old) who had undergone coronary artery bypass grafting (CABG) or valve surgery between 1 January 2016 and 31 December 2021. Our outcomes of interest were 30-day in-hospital mortality, hospital length of stay (HLOS), and postoperative acute kidney injury (AKI). Multivariable logistic and negative binomial regression models were used to determine the association between pre- or intraoperative TAPSE and RVFAC with our outcomes. Multivariable models adjusted for age, sex,

hypertension, congestive heart failure, chronic lung disease, preoperative serum creatinine, procedure length, and procedure type. We present odds ratios (ORs) or risk ratios (RRs) with 95% confidence intervals (CIs) as effect estimates, and $P < 0.05$ was considered statistically significant. Ethical approval for the secondary use of data from clinical care was obtained from the institutional Research Ethics Board (University Health Network, Toronto, ON, Canada).

RESULTS

Of 5,822 patients who underwent CABG or valve surgeries between 2016 and 2021, preoperative or pre-bypass intraoperative TAPSE and RVFAC were reported within one year of index surgery in 2,050 (35%) and 1,234 (21%) patients, respectively. Median perioperative TAPSE was 20 mm and 393/2,050 patients (19%) had a TAPSE < 17 mm. Median perioperative RVFAC was 39% and 386/1,234 patients (31%) had a RVFAC < 35%. One thousand, seven hundred and ninety-two out of 2,050 (87%) of reported TAPSE were from transesophageal echocardiograms and 713/1,234 (58%) of reported RVFAC were from transthoracic echocardiograms. After adjusting for confounding variables in our multivariable models, both TAPSE (per mm and < 17 mm) and RVFAC (per % and < 35%) were significant associated with postoperative mortality and HLOS. However, neither variable was significantly associated with postoperative AKI.

DISCUSSION

In our study, TAPSE and RVFAC measured before or during surgery before initiation of bypass were significantly associated with postoperative in-hospital mortality and HLOS, but not AKI. Patients with TAPSE < 17 mm or RVFAC < 35% were at an increased risk of mortality and longer HLOS. This study revealed the potential prognostic importance of RV function parameters in predicting patient risk. We also highlight the inconsistent quantitative reporting of RV function in routine echocardiography, hindering larger studies that want to examine these markers. Future studies should further explore which measures of RV function are reliably prognostic for outcomes.

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Table Unadjusted and adjusted results of regression model for primary and secondary outcomes

Group	N (%) experiencing event	Predictor	Unadjusted risk estimate		Adjusted risk estimate	
			OR/RR (95% CI)	*P value*	OR/RR (95% CI)	*P value*
30-day mortality						
TAPSE	54 (3%)	per mm	0.91 (0.86, 0.95)	**<.01**	0.92 (0.87, 0.98)	**0.01**
	22 (6%)	<17 mm	3.01 (1.73, 5.24)	**<.01**	2.37 (1.29, 4.34)	**0.01**
RVFAC	39 (3%)	per %	0.95 (0.92, 0.98)	**<.01**	0.94 (0.91, 0.97)	**<.01**
	19 (5%)	<35%	2.14 (1.13, 4.06)	**0.02**	2.51 (1.22, 5.19)	**0.01**
Hospital length of stay						
TAPSE	9 [6, 14] days*	per mm	0.98 (0.98, 0.98)	**<.01**	0.99 (0.99, 0.99)	**<.01**
	10 [7, 19] days*	<17 mm	1.24 (1.22, 1.26)	**<.01**	1.15 (1.13, 1.17)	**<.01**
RVFAC	8 [6, 12] days*	per %	0.99 (0.99, 0.99)	**<.01**	0.99 (0.99, 0.99)	**<.01**
	8 [6, 16] days*	<35%	1.22 (1.20, 1.24)	**<.01**	1.17 (1.15, 1.19)	**<.01**
Postoperative acute kidney injury						
TAPSE	222 (12%)	per mm	0.96 (0.94, 0.99)	**0.01**	0.98 (0.95, 1.01)	0.28
	52 (16%)	<17 mm	1.43 (1.02, 2.00)	**0.04**	1.20 (0.77, 1.63)	0.55
RVFAC	126 (12%)	per %	0.99 (0.97, 1.01)	0.17	0.99 (0.97, 1.01)	0.34
	42 (13%)	<35%	1.10 (0.74, 1.63)	0.64	0.96 (0.62, 1.47)	0.84

*Values are presented as median [interquartile range]

CI = confidence interval; OR = odds ratio; RR = risk ratio; RVFAC = right ventricular fractional area change; TAPSE = tricuspid annular plane systolic excursion

Association of right ventricular function with outcomes after cardiac surgery: a systematic review

Submission ID

5

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INTRODUCTION

Growing recognition of the impact of right ventricular (RV) function on patient outcomes in heart failure and other populations has increased the volume of literature published in this area.[1,2] However, the association of RV function with outcomes in cardiac surgical patients is less well characterized, despite most of these patients undergoing comprehensive echocardiography assessments prior to, during, and after surgery. Therefore, the aim of this study was to determine which quantitative echocardiographic parameters that assess RV function have the strongest prognostic implications. We explored the reported associations between quantitative RV function parameters and postoperative outcomes in cardiac surgery patients.

METHODS

This was a systematic review of randomized controlled trials or observational studies (retrospective or prospective cohort or case control). Case reports and series were excluded. Databases included PubMed and MEDLINE from 1 January 1990 to 22 April 2024. Inclusion criteria were adult patients over 18 yr old undergoing coronary artery bypass grafting, valve repairs/replacements, or other major procedures that required the use of cardiopulmonary bypass with an echocardiogram report conducted within six months of surgery, intraoperatively, or shortly after surgery. All studies also had to include quantitative parameters assessing RV function reported in relation to postoperative outcomes. The primary predictors of interest were any quantitative RV function parameter. The primary outcome was postoperative mortality up to 5 years and the secondary outcome was all major adverse cardiac events (MACE). This systematic review was registered in PROSPERO (CRD42023387383). Institutional research ethics board approval was not required as data was already published and publicly available.

RESULTS

Our search identified a total of 7,187 potentially relevant studies, and 27 studies were ultimately included. Seventeen studies reported estimates for mortality in relation to the patient's perioperative RV function, and 17 studies reported estimates for MACE. Right ventricular fractional area change (RVFAC) was the most reported marker, though it was inconsistently associated with mortality and MACE. Despite it being the most frequently reported, several other parameters (tricuspid annular plane systolic excursion [TAPSE], RV myocardial performance index, peak RV systolic velocity of tricuspid annulus, RV global longitudinal strain, and RV longitudinal peak systolic strain) also emerged as potential predictors of clinical outcomes. Tricuspid annular plane systolic excursion and measures of strain were consistently significant predictors of mortality and RV Myocardial Performance Index (MPI) was the most consistent significant predictor of MACE.

DISCUSSION

Although a robust association between RV function parameters and outcomes was not found in each study, those reporting TAPSE, strain, or RV MPI found the most consistent associations with outcomes. Our findings suggest incremental prognostic value in reporting at least one or ideally two quantitative parameters in cardiac surgical patients. Larger, adequately powered studies with uniform patient samples and standardized timing of RV assessments are needed to better stratify perioperative risk according to RV function measures. Such studies would have the potential to change therapeutic interventions with the knowledge of how RV function effects patient outcomes.

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Hybrid thoracic endovascular aortic repair in high-risk arch dissection and the role of anesthesiologists in mitigating risks: a case report

Submission ID

76

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INTRODUCTION

Open surgical repair of thoracic aorta pathology is associated with significant morbidity and mortality, leaving many patients as suboptimal candidates for such procedures.[1] Alternatively, thoracic endovascular aortic repair (TEVAR) can offer reduced perioperative risk for patients but is not without its own hazards.[2] Potential complications include spinal cord ischemia (SCI), upper extremity ischemia, stroke, and inadvertent stent deployment into a false lumen with compromise of the true lumen;[3] these associated risks may offset the benefits. In close collaboration with vascular surgeons, anesthesiologists play a vital role in mitigating these potentially devastating risks via preoperative patient optimization, intraoperative monitoring for signs of ischemia through cerebral oximetry and arterial pressure changes, implementation of management strategies for spinal cord protection, and the use of transesophageal echocardiography (TEE) to help guide assessment and management intraoperatively (Fig. 1). We present a case illustrating the anesthetic management as part of the vital multidisciplinary approach to hybrid TEVAR.

CASE PRESENTATION

An 80-yr-old patient with hypertension presented with type A aortic dissection. They underwent ascending aorta and hemiarch replacement. Post-procedural TEE revealed persistent dissection at the arch into the descending aorta. Postoperative computed tomography (CT) scan showed rapid aneurysmal expansion of the false lumen. Given the high morbidity and mortality associated with open arch replacement, a hybrid approach via aortic debranching and zone 0 TEVAR with innominate artery branch was planned.

Pre-induction, a prophylactic lumbar drain and left radial arterial line were placed as well as a femoral arterial line given the need for surgical access to the right subclavian artery. General anesthesia was induced. The left common carotid artery (LCCA) was transected and transposed onto the left subclavian artery (LSCA) followed by a right common carotid artery to LCCA anastomosis. The LSCA was clamped prior to ligation, and maintenance of left radial arterial line pressure was confirmed. Cerebral oximetry was monitored throughout aortic

debranching and remained at baseline. A wire was inserted into the ascending aorta and position in the true lumen was confirmed by TEE. The thoracic branch endoprosthesis was deployed under rapid ventricular pacing (Fig. 2). A drop in cerebral oximetry was communicated to the surgical team and corrected after angioplasty of the innominate artery branch. Final TEE confirmed no flow into the false lumen. Following graft deployment, cerebral spinal fluid drainage commenced. Mean arterial pressure was maintained above 90 mm Hg with vasopressors for spinal and cerebral perfusion. The patient was transferred to the intensive care unit and recovered uneventfully with intact neurologic function.

CONCLUSION

This case underscores the critical role of anesthesiologists in mitigating the risks associated with hybrid TEVAR. Devastating complications such as SCI and false lumen graft deployment can be avoided through prophylactic measures for spinal cord protection and TEE, respectively. Additionally, vigilant monitoring of cerebral oximetry and arterial pressure changes at critical steps allows prompt detection and prevention of malperfusion and ischemia. Notably, the hybrid approach enabled a successful outcome in a high-risk patient for whom open surgery was prohibitive. Overall, through tailored, dynamic management and close collaboration with vascular surgery, anesthesiologists contribute to achieving favourable outcomes in hybrid TEVAR procedures.

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Fig. 1 Intraoperative transesophageal echocardiography: A) Descending thoracic aorta long and short axis views with wires in the true lumen and spontaneous contrast in the false lumen. B) Short axis descending thoracic aorta with defence in the dissection flap and flow into the false lumen. C) Descending abdominal aorta long and short axis with colour flow mapping showing flow through the true lumen with spontaneous contrast in the false lumen. D) Aortic arch at the level of the left subclavian artery and left common carotid artery with defect in the dissection flap and flow into the false lumen. True lumen: red asterisk, false lumen: red arrowhead, dissection flap: red arrow.

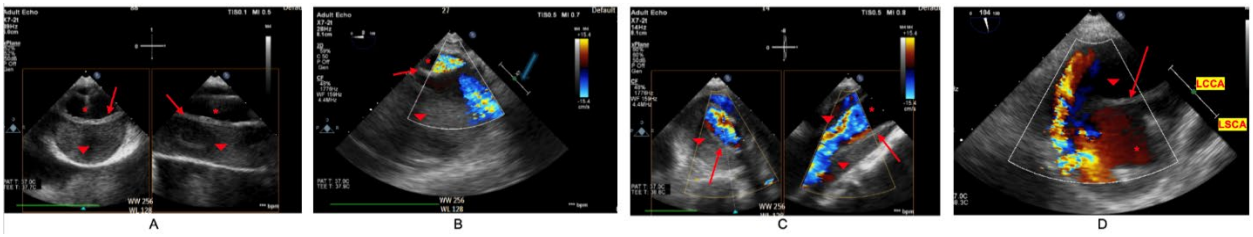
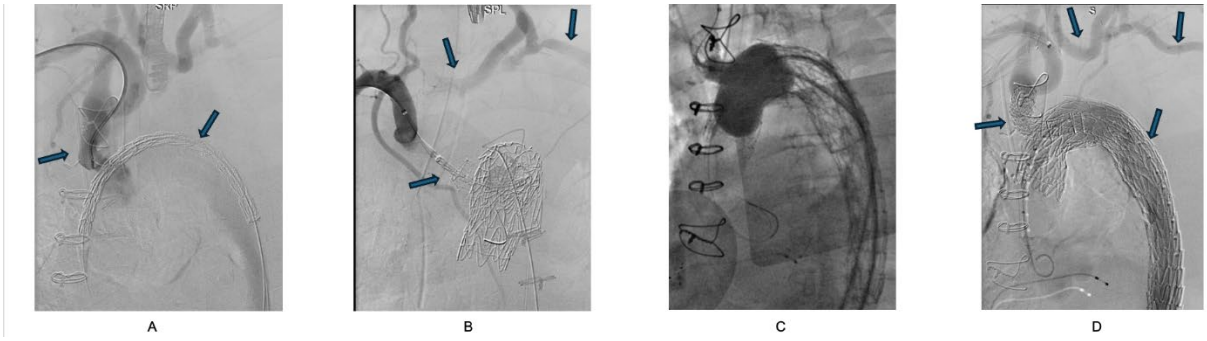


Fig. 2 Intraoperative angiography: A) Thoracic endovascular aortic repair graft in place before deployment with wires threading in the right innominate artery through the right radial artery access. B) Oblique view showing thoracic endovascular aortic repair graft deployed in place with appropriate placement of the port relative to the target great vessel branch. A wire can be seen from the right radial artery access with the branched graft extension nose cone into the thoracic endovascular aortic repair graft branch port to be deployed to improve cerebral perfusion. C) Balloon dilation of the main thoracic endovascular aortic repair graft and the branched port. D) Final confirmation of adequate flow through the right innominate artery as well as through the carotid-carotid bypass and left carotid-left subclavian bypass.



Intercostal nerve cryoablation for postoperative analgesia in minimally invasive valve surgery: a single-centre retrospective cohort study

Submission ID

98

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INTRODUCTION

Minimally invasive valve surgery (MIVS) through a minithoracotomy offers significant benefits, such as shorter recovery times and a more aesthetically pleasing result. However, management of acute postoperative pain remains a challenge. As part of the standard pain management care, opioids are often associated with adverse effects and regional anesthesia such as continuous intercostal nerve blocks (CINB) have a variable and limited analgesic effect.[1] Intercostal nerve cryoablation (INC) is a promising alternative, though its efficacy in MIVS is not well established.[2,3] Our study aims to compare the effectiveness and safety of INC in reducing postoperative pain after MIVS through a minithoracotomy.

METHODS

We conducted a retrospective cohort study and included 50 adult patients who underwent MIVS at our institution from May 2022 to October 2023. Intercostal nerve cryoablation was performed in 24 patients while a CINB was performed in 26 patients. Intercostal nerve cryoablation and CINB were performed by the surgeon under direct vision during the procedure. Every patient had a Patient Controlled Analgesia (PCA) for the first 3 postoperative days (POD). The main outcomes included Morphine Milligram Equivalent (MME) consumption and pain Visual Analog Scale (VAS) on POD 1. Secondary outcomes consisted of MME and VAS on POD 2, VAS and persistent opioid use at POD 7, 30, and 90 as well as incidence of chronic thoracic neuropathy as a safety outcome.

RESULTS

Mean age was 70.3 ± 11.2 in the INC group and 65.7 ± 10.9 in the control group. The main procedures were mitral valve replacement (34%), mitral valve plasty (32%), and aortic valve replacement (14%). On POD 1, MME was 6.30 mg [3.25–11.00 mg] in INC *vs* 7.38 mg [4.00–13.00 mg] in CINB ($P = 0.42$). Visual Analog Scale was comparable between both groups (2.0 [0–

3] in INC *vs* 1.0 [0–2] in CINB; *P* = 0.13). There was no difference in time to extubation (2.5 hr [1.75–4.25 hr] in INC *vs* 2.8 hr [2.00–4.00 hr] in CINB; *P* = 0.95). At one week, INC reported higher VAS (3.0 [2–5]) than CINB (0 [0–2]; *P* = 0.007). Persistent opioid use was 29.4% (INC) *vs* 35.7% (CINB; *P* = 0.71). At 1 month, INC VAS was higher (*P* = 0.02), but at 3 months, pain scores were similar between groups. Three cases of postoperative thoracic neuropathy occurred in INC, and none in CINB.

DISCUSSION

Intercostal nerve cryoablation did not significantly improve pain management nor reduce opioid consumption when compared to CINB in the immediate postoperative period of MIVS through minithoracotomy. Even more, patients in the INC group experienced higher pain levels at 1 week and up to one month, suggesting that cryoablation may not only be inferior to the standard of care, but even potentially harmful due to increased risk of chronic thoracic neuropathy.

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Isolated intraventricular hemorrhage following cerebrospinal fluid drain placement postthoracic endovascular aortic repair: a case report

Submission ID

56

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INTRODUCTION

Spinal cord injury (SCI) after thoracic endovascular aortic repair (TEVAR) is a devastating complication, with consequences ranging from temporary paraparesis and lower extremity weakness to permanent paraparesis.[1] Placement of a cerebrospinal fluid (CSF) drain is a prophylactic measure based on randomized control trials demonstrating their utility for open thoracic aortic aneurysm repairs. The largest trial demonstrated a decrease in paraplegia risk from 13% to 2.6%.[2] However, no large randomized control trials exist for their use in TEVARs. Earlier literature demonstrated the efficacy of CSF drains for reducing SCI[3] and in 2010, the American Heart Association endorsed prophylactic CSF drains for TEVARs.[4] Unfortunately, retrospective studies have cast doubt on the reduction of SCI in high-risk TEVARs.[5] To date, there is no consensus regarding preventative CSF drain use for routine TEVARs. This report presents a case showing a novel complication of prophylactic CSF drain use, which has not been reported in the literature and has implications for high-risk TEVAR management.

CASE PRESENTATION

We present a 78-yr-old female with complicated aortic disease who underwent TEVAR. A CSF drain was non-traumatically inserted preoperatively. The case proceeded with systolic blood pressure over 130 mm Hg and hemoglobin over 100 $g \cdot L^{-1}$. The CSF drain was maintained at 10 mm Hg and 13 mL of CSF was drained over the 2-hr case. After the procedure, the patient was extubated and documented moving all extremities on command before being transferred to the Cardiac Surgery Intensive Care Unit. There, the CSF drain was set to drain 15 $mL \cdot hr^{-1}$ at 12–21 mm Hg. Norepinephrine and dobutamine were administered for cardiac output and blood pressure goals according to a high-risk protocol. On postoperative day (POD) 1, she had nausea, vomiting, and bloody CSF drainage. The drain was clamped. Labs showed coagulopathies and the patient was transitioned to a low-risk protocol. On POD 2, she had ongoing nausea and vomiting, which is atypical for TEVAR cases. A non-contrast head computed tomography was ordered to rule out subarachnoid or subdural hemorrhage. A new small volume-dependent intraventricular hemorrhage with no clear intracranial etiology was found. It was postulated that bloody CSF had redistributed from the spinal canal given her supine position. Repeat

imaging the next day showed a marginal increase in the hemorrhage size and reduced attenuation consistent with the normal temporal evolution of blood. No new hemorrhage was seen elsewhere. The CSF drain was removed intact on POD 3. There was no blood at the site nor on the tip. The patient was transferred to the ward and quickly met her recovery milestones. She had no neurological deficits throughout her hospitalization.

CONCLUSION

Cerebrospinal fluid drains have been associated with complications ranging from headache to intracranial hemorrhage with neurological symptoms. We present a case demonstrating the novel complication of intraventricular hemorrhage, accompanied by significant nausea and vomiting. This report contributes to the literature regarding complications from CSF drain use for the prevention of SCI following TEVAR. It reminds us that we must be vigilant for unrecognized complications in the context of evolving expert recommendations for the use of prophylactic CSF drains in high-risk TEVARs.

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Multimodal neuromonitoring to identify high-risk cardiac surgery patients: a retrospective cohort study

Submission ID

30

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INTRODUCTION

Neurologic complications during cardiac surgery are linked to cerebral desaturation, deep anesthesia, and cerebral emboli.[1] Current neuromonitoring approaches often assess these parameters independently, potentially missing critical interactions.[1] A multimodal approach combining near-infrared spectroscopy (rSO_2), processed electroencephalography (pEEG), and transcranial Doppler (TCD) may enhance risk stratification.[2,3]

Aim: To describe the characteristics and outcomes of patients experiencing combined worst-case neuromonitoring states—severe cerebral desaturation, deep anesthesia (pEEG Patient State Index [PSI] < 25), and high cerebral embolic load (moderate-to-severe high-intensity transient signals [HITS])—during cardiac surgery.

METHODS

In a retrospective cohort of 374 cardiac surgery patients, 175 had complete data on rSO_2, pEEG, and TCD. Patients were grouped into eight combinations of monitoring parameters based on the presence or absence of desaturation, PSI < 25, and HITS severity. Descriptive statistics and logistic regression analyses assessed the association of these combinations with outcomes, including cardiopulmonary bypass (CPB) separation, ventilation duration, intensive care unit (ICU)/hospital stays, and mortality.

RESULTS

The group with combined desaturation, PSI < 25, and moderate-to-severe HITS had the poorest outcomes, including prolonged ICU ($P = 0.023$) and hospital stays ($P = 0.050$). These patients also exhibited higher odds of complex CPB separation (odds ratio, 6.75; $P = 0.055$). Multivariable analysis highlighted that the concurrent presence of adverse neuromonitoring states significantly impacts recovery trajectories.

DISCUSSION

Multimodal neuromonitoring combining rSO_2, pEEG, and TCD identifies high-risk cardiac surgery patients with compounded physiological vulnerabilities. This approach underscores the need for targeted intraoperative strategies to mitigate adverse outcomes and improve postoperative recovery. Further studies are warranted to optimize management protocols for this high-risk group.

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Overhead arm positioning for challenging fenestrated endovascular aneurysm repair in a patient with severe hypertrophic obstructive cardiomyopathy: a case report

Submission ID

36

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INTRODUCTION

Endovascular aneurysm repair is a less invasive approach to aortic repair that may be safer for frail patients or those with co-morbidities when compared to open abdominal aortic aneurysm repair. However, as endovascular approaches rely on radiologic views of the target aneurysm, they are not without challenges. Radiation exposure to both the patient and operators remains a concern, particularly during cases of increased complexity, such as during fenestrated endovascular aneurysm repair (FEVAR) procedures.[1] As the radiation dose required for visualization is directly dependent on the amount of tissue penetration required, overhead arm positioning has been considered as a means of improving endovascular visualization and reducing radiation exposure by removing arms from the field of view.[2] Studies have shown that overhead arm positioning resulted in 30% reduction of radiation exposure, improved views, and safety from a peripheral neurological standpoint.[2,3]

CASE PRESENTATION

An 80-yr-old patient with severe hypertrophic obstructive cardiomyopathy (HOCM) with resting gradient 172 mm Hg, atrial fibrillation, hypertension, and stage IIIA chronic kidney disease presented for FEVAR. He had previously undergone an aorto bi-iliac stent graft but subsequently developed a type 1a endoleak. Overhead arm positioning was used to improve surgical views while reducing radiation exposure during this complex and prolonged procedure.

Canadian Anesthesiologists' Society standard monitors, arterial line, two large bore intravenous lines, external defibrillator pads and transesophageal echocardiogram (TEE) probe were placed. At induction a crystalloid bolus and a phenylephrine infusion were started before proceeding with general anesthesia. The patient was then positioned with arms overhead and underwent successful FEVAR while remaining hemodynamically stable. He was extubated upon completion and admitted to a monitored step-down unit. Postoperative follow-up ruled out any neuropathies.

Several considerations ensured safety of anesthesia with overhead positioning in a medically complex patient. Firstly, no lines were placed in the antecubital location to avoid

kinking. Pressure points were padded, and the position of lines, endotracheal tube, and pressure points were checked regularly. We have proposed a “positioning checklist for overhead arm positioning” that may be useful for care teams. Anterior/posterior defibrillator pads were placed to not obstruct radiological views. Apart from usual HOCM hemodynamic management, verapamil was avoided as 2024 American Heart Association Guidelines endorses that this is potentially harmful in HOCM patients with resting gradients > 100 mm Hg,[4] and intravenous beta-blockade was utilized to reduce left ventricular myocardial contractility and relieve left ventricular outflow tract obstruction[5] that the described patient benefited from an esmolol infusion intraoperatively.

CONCLUSION

With the increasingly aging population there will undoubtedly be more patients with complex comorbidities and living with frailty presenting for aortic aneurysm repair, favouring an endovascular approach. Overhead positioning provides a possible solution to optimize the visualization of complex and prolonged endovascular repair in a medically comorbid patient. This positioning does not interfere with advanced monitoring and optimizes radiologic views with 30% less radiation. To ensure safety and improve outcomes in these patients, we propose the utilization of a “positioning checklist” (Table).

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Table Proposed overhead positioning checklist for care team

1. Preoperatively discuss positioning with surgeon and expected procedure length. Rule out relative contraindications (weight limits, inability of patient to move arms overhead, pre-existing brachial plexus injuries).
2. Neurologic exam to screen for neuropathies.
3. Discuss and document patient consent for overhead positioning.
4. Awake trial of overhead positioning to determine if possible and assess for pressure points.
5. Placement of lines avoiding antecubital fossa and subclavian areas if possible. Consider use of ultrasound to minimize attempts.
6. Induction of anesthesia while supine, and then careful overhead arm positioning. Check adequacy of lines and pressure points following positioning. Pad pressure points.
7. Check and document eyes, face, pressure points, endotracheal tube, and lines every 30 minutes during the case.
8. Check and document eyes, face, pressure points, endotracheal tube, and lines whenever OR table is repositioned.
9. At end of procedure after fluoroscopy is completed, carefully remove patient from overhead positioning and check skin following removal of dressings.
10. Follow-up with patient following extubation and on post-operative day 1 to assess for new neurologic injuries.

Postoperative troponin elevation following liver transplantation: a retrospective cohort study

Submission ID

135

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INTRODUCTION

Elevated postoperative Troponin (TN) levels are associated with increased major adverse cardiac events (MACE) and overall mortality after surgery even in the absence of an identifiable precipitant.[1] In liver transplantation (LT) data is limited, but consistent that elevated troponin is common after LT.[2] However, it remains unclear how to interpret this elevated level in light of outcome and the standard reference for TN thresholds. The aim of this study was to evaluate TN following LT and its association with postoperative MACE and mortality, and to delineate a LT specific TN threshold.

METHODS

This was a retrospective cohort study in adult patients undergoing LT from January 2019 to June 2024. Exclusion criteria were combined kidney or multivisceral transplantation and preoperative hemodialysis. Primary endpoint was MACE (defined as arrhythmias requiring treatment, myocardial infarction, cardiac arrest, congestive heart failure, and pulmonary embolism) and secondary endpoints were in-hospital mortality, intensive care unit (ICU) and hospital length of stay (LOS), transfusion of red blood cells (RBC) and platelets. Descriptive, univariable and multivariable logistic analysis were used. For ICU days and LOS multivariable linear regression after log-transforming the outcome was used. For the TN threshold a receiver operating characteristic curve and the Youden index were used to determine the threshold with the best area under the curve, balancing specificity and sensitivity.

RESULTS

Six hundred and thirty-five patients had postoperative TN measurements, age was 58.9 (49.7–64.9) and 212 were female (34%). Troponin Threshold of 308 $\mu g \cdot L^{-1}$ was best predictive for MACE (odds ration [OR], 2.39; 95% confidence interval [CI], 1.08 to 5.00; $P = 0.02$). These 88

patients had a cardiac event in 25% (*vs* 8.2%; $P < 0.001$), had a lower model for end-stage liver disease (MELD) score (5.3 *vs* 7.8; $P = 0.01$), less often an etiology of alcohol (19% *vs* 30%), higher preoperative Hb (117 *vs* 102 $g \cdot dL^{-1}$; $P < 0.001$), longer cold-ischemia times (391 *vs* 364 min; $P = 0.03$), and more blood loss (3 L *vs* 2.6 L; $P = 0.03$).

The risk adjusted analysis showed that MACE was associated with intraoperative platelet (OR, 1.12; 95% CI, 1.01 to 1.26; $P = 0.04$) and RBC transfusion (OR, 8.4; 95% CI, 1.7 to 52; $P = 0.01$). However, in-hospital mortality was not. Days in ICU was associated with fulminant liver failure (53% increase; $P = 0.02$), platelet transfusion (11% increase; $P = 0.02$), and BMI (3.7% increase; $P = 0.003$). Finally, LOS was associated with body mass index (BMI) (2.0% increase; $P = 0.05$).

DISCUSSION

Patients with TN > 308 $\mu g \cdot L^{-1}$ after LT should be observed intensively as the risk of MACE is increased. Elevated TN is seen after longer ischemia times and severe blood loss. Platelets transfusion was independently associated with MACE and ICU stay, while higher BMI was associated with ICU and LOS in patients after liver transplantation. And of note, the patients with elevated TN were not necessarily sicker as their median MELD score was lower and preoperative Hemoglobin concentration was higher.

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Preoperative frailty and its associated outcomes in older adults undergoing cardiac surgery: a systematic review and meta-analysis

Submission ID

122

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INTRODUCTION

Frailty, characterized by reduced physiological resilience, has emerged as a pivotal risk factor in older adults undergoing major cardiac procedures.[1] Although previous analyses have linked frailty to adverse surgical outcomes, knowledge gaps persist regarding its overall prevalence across multiple validated measurement tools and its specific association with postoperative complications such as delirium, infection, and renal dysfunction. This systematic review and meta-analysis synthesizes contemporary evidence on frailty in cardiac surgery to refine preoperative risk stratification and guide targeted perioperative strategies. Identifying frailty and understanding its prognostic impact will enhance the quality of care and reduce the strain on health care systems. The objective of our systematic review and meta-analysis is to determine the prevalence of preoperative frailty and the associated adverse outcomes in older adults undergoing cardiac surgery.

METHODS

A pre-specified protocol was registered with PROSPERO (CRD#42024574916), following PRISMA guidelines.[2] We systematically searched MEDLINE, Embase, and Cochrane databases (24 June 2024) for English-language studies enrolling older adults (≥ 60 yr) undergoing cardiac surgery (e.g., coronary artery bypass grafting, valve procedures). Studies had to use validated frailty instruments (Fried Frailty Phenotype, Clinical Frailty Scale, or Edmonton Frail Scale) to identify preoperative frailty and report at least one postoperative endpoint (e.g., mortality, delirium, infection, renal complications, hospital length of stay). Non-cardiac surgeries, minor procedures (e.g., pacemaker insertions), case reports, reviews, and non-English articles were excluded. Four reviewers independently screened titles, abstracts, and full texts, resolving disagreements with a fifth reviewer. Risk of bias was assessed using the Newcastle-Ottawa Scale for observational studies. We applied GRADE to evaluate overall evidence certainty. Random-effects meta-

analyses in RStudio and RevMan 5.4 generated pooled odds ratios (ORs) or mean differences (MDs) with 95% confidence intervals (CI), with heterogeneity quantified by the I^2 statistic. Funnel plots and Egger's regression tested publication bias, and leave-one-out sensitivity analyses identified potential sources of heterogeneity.

RESULTS

Twenty studies were included (*n* = 11,176; mean age 72 ± 4 yr, 29% female). The pooled prevalence of preoperative frailty was 18%. Frailty was significantly associated with higher odds of delirium (OR, 4.11; 95% CI, 2.00 to 8.45), infection (OR, 3.72; 95% CI, 2.27 to 6.13), and renal complications (OR, 2.72; 95% CI, 2.05 to 3.60). Lastly, hospital (MD, 2.43 days; 95% CI, 1.07 to 3.80) and intensive care unit (ICU) length of stay (MD, 1.07 days; 95% CI, 0.52 to 1.62) were significantly longer among frail *vs* robust individuals. Meta-analysis demonstrated that frail patients had higher odds of 30-day mortality (OR, 1.96; 95% CI, 1.09 to 2.82) and one-year mortality (OR, 1.86; 95% CI, 1.28 to 2.44) than robust patients (Figure). Overall evidence quality was moderate; heterogeneity ranged from low to high.

DISCUSSION

The prevalence of frailty, affecting 18% of older adults undergoing cardiac surgery, represents a significant burden. We found frailty was associated with a 4-fold increase in delirium, a 3.7-fold increase in infection, a 2.7-fold increase in renal complications, extended length of stay, and an almost 2-fold increase in mortality. Multidisciplinary interventions—including prehabilitation, nutritional optimization, and enhanced perioperative monitoring—may mitigate these risks. Future randomized trials are needed to determine best practices for systematic frailty assessment in cardiac surgery. This review highlights the urgency of recognizing and addressing frailty as a potentially modifiable factor in cardiac surgical care.

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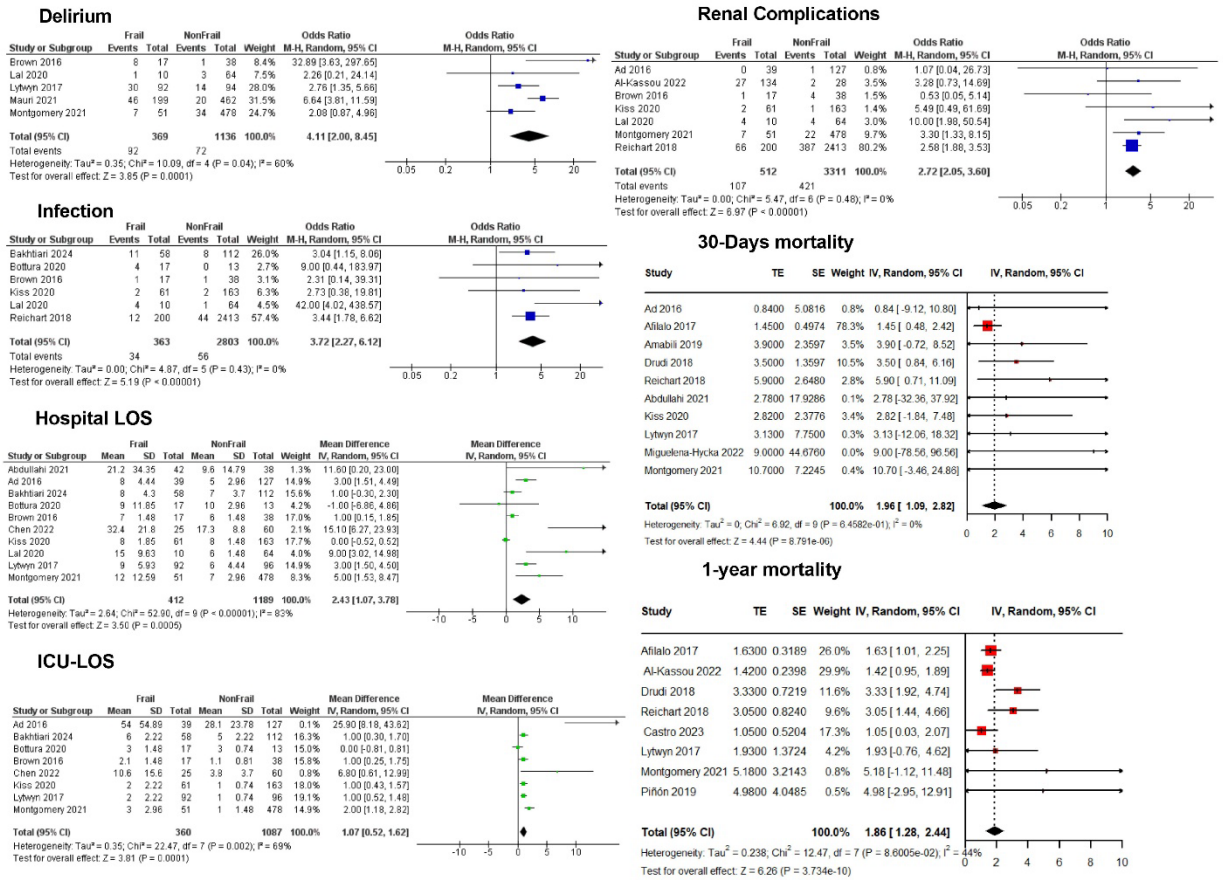
Figure Forest plots of postoperative complications and adverse outcomes



This figure contains forest plots of postoperative complications and outcomes in frail *vs* non-frail patients undergoing cardiac surgery. Frailty was associated with increased odds of delirium, infection, renal complications, 30-day and 1-year mortality, as well as longer hospital and ICU stays.

CI = confidence interval; ICU = intensive care unit; LOS = length of stay; OR = odds ratio; TE = odds ratio of individual study

Successful non-surgical management with rFVIIa of transcatheter aortic valve implantation left sided related pericardial tamponade in non-bailout octogenarian

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70

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INTRODUCTION

Transcatheter aortic valve implantation (TAVI) has increased in popularity and is now a standard of care for patient's ineligible or at very high risk for surgery.[1] Additionally, due to bioprosthetic valve degeneration the rates of aortic valve-in-valve (ViV) procedures are increasing.[2] Despite increased experience with TAVI around 0.7% of cases may have serious complication requiring emergent cardiac surgery.[3] Our patient presented with severe aortic insufficiency due to failed Perceval valve and was deemed appropriate for TAVI intervention, however he was not a surgical bailout candidate. Here we present a case of cardiac tamponade following ViV procedure leading to aortic root rupture and administration of recombinant activated factor VIIa as part of a treatment approach for aortic root rupture in the non-surgical candidate.

CASE PRESENTATION

An 82-yr-old male with previous Perceval aortic valve replacement and coronary artery bypass grafting (CABG) presented with worsening dyspnea, NYHA class 3. Transthoracic echocardiogram (TTE) showed deterioration of the bioprosthetic aortic valve with severe aortic regurgitation, with effective regurgitant orifice area 0.69 cm^2, regurgitant volume 154 mL. The team planned a ViV implant with an Edwards SAPIEN 3 (Edwards Life-Sciences Corporation, Irvine, CA, USA). The patient had expressed his desire not to proceed with surgery or advanced extracorporeal life support, but brief compressions or defibrillation was allowed.

After monitoring, sedation and local anesthesia were performed, rapid pacing pre-dilation and valve deployment were well tolerated. Root aortogram showed some regurgitation and post-deployment dilation was performed. After this the patient immediately complained of retro-sternal pain, became dyspneic, and rapidly hypotensive (from 110/60 mm Hg to 50/30 mm Hg). A code was called, and chest compressions were initiated. Initially the monitor demonstrated ST segment elevation and a coronary stent was placed in the left main artery. A TTE was performed and demonstrated a large pericardial effusion. Active resuscitation

continued and a pericardial drain was placed. Return of spontaneous circulation was achieved and root angiogram confirmed aortic root rupture. Two hundred milligrams of protamine was given, along with 2 g of tranexamic acid. After 10 min 1 g of rFVII was administered and clots were visible in the pericardial drainage bag and the patient stabilized moved to the intensive care unit where he was extubated and survived without sequela.

CONCLUSION

This case represents the successful use of an approach to manage aortic root rupture in a non-surgical candidate. Aortic annulus rupture is a devastating complication of TAVI which has an estimated fatality rate > 50%.[4] The use of FVIIa for this crisis has been documented previously; however the literature on its use in ViV aortic annulus rupture is sparse.[5] Additionally, there is lack of a standardized approach to managing such emergencies. The use of FVIIa as part of a treatment algorithm for aortic rupture in non-surgical candidates undergoing TAVI may be considered.

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The effect of a novel multimodal analgesia protocol on acute poststernotomy pain and perioperative outcomes in adult cardiac surgical patients

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128

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INTRODUCTION

Cardiac surgery is associated with significant acute postoperative pain leading to deleterious consequences and poor patient experience. High dose opioids have traditionally been the mainstay of analgesia in cardiac surgery, but are commonly associated with multiple adverse effects and the potential for dependency.[1,2] These side effects are dose-dependent, and have been estimated to be experienced by approximately one-third of cardiac surgery patients.[3]

Current ERAS guidelines support the use of opioid-sparing multimodal analgesia in cardiac surgery, though specific protocols have yet to be defined.[4,5] Our study aimed to assess feasibility and safety of implementing a multimodal analgesia protocol for adult patients undergoing elective cardiac surgery for coronary artery bypass graft or valve replacement. Our multimodal protocol included the combined use of both Dexmedetomidine and Ketamine, which to our knowledge has not yet been published.

METHODS

Following local research ethics board (REB) approval, we conducted a single-centre prospective randomized controlled trial involving adult patients (aged 18–79) undergoing cardiac surgery. Patients were assigned to a multimodal analgesia protocol or a standard opioid-based regime based on the usual practice of the attending anesthesiologist. The multimodal protocol included preoperative Acetaminophen, Dexmedetomidine infusion at 0.2–0.7 $\mu g \cdot kg^{-1} \cdot hr^{-1}$ and a Ketamine bolus of 0.5 $mg \cdot kg^{-1}$ [max 40 mg] at induction, followed by an infusion of 0.5 $mg \cdot kg^{-1} \cdot hr^{-1}$. Sufentanil 5 µg *iv prn* was given for rescue analgesia. The standard opioid-based regime avoided the use of Dexmedetomidine or Ketamine intraoperatively.

Both patients and intensive care nurses recording outcome measures were blinded to group allocation. Our primary outcome was Numerical Rating Scale (NRS) pain scores over 24 hr at defined time-intervals. Secondary outcomes included: time to fulfill extubation criteria, opioid requirements and antiemetic use.

The Wilcoxon Rank-Sum test was used to determine significant differences between groups on all outcome variables. To compare opioid requirements between groups, all intravenous (IV) and oral opioids administered were converted to fentanyl-equivalents (expressed in mcg) using an opioid-equianalgesic table. All summary measurements were reported using median and interquartile ranges.

RESULTS

Fifty patients were randomized to a multimodal (*n* = 21) or standard opioid-regime (*n* = 29). Intraoperative opioid usage was significantly lower in the multimodal group (200 µg *vs* 600 µg; *P* < 0.0001). There were no deviations from the multimodal protocol and hemodynamic parameters were similar in both groups.

In the early postoperative period (6 hr), NRS scores were higher in the multimodal group (at rest: 4.0 *vs* 3.0; *P* = 0.04; with cough: 7.3 *vs* 5.0; *P* = 0.03) but similar 24 hr postoperatively (at rest: 3.0 *vs* 3.5; *P* = 0.91; with cough: 5.0 *vs* 6.0; *P* = 0.68). Total 24 hr opioid usage was significantly lower in the multimodal group (537 mcg *vs* 695 mcg; *P* = 0.002)**.** There was a signal towards earlier time to meet extubation criteria in the multimodal analgesia group (150 min *vs* 180 min; *P* = 0.78).

DISCUSSION

Our pilot study demonstrated the feasibility and safety of a multimodal analgesia strategy in cardiac surgery combining the use of Dexmedetomidine and Ketamine as an opioid-sparing technique. Postoperative pain scores were comparable in both groups with a significant reduction in 24 hr opioid usage and a trend towards earlier extubation in the multimodal group. The study was underpowered to detect differences in delirium or postoperative nausea and vomiting rates. Larger studies would be warranted to explore differences in opioid-related complications and to evaluate patient-centred quality of recovery scores following the use of multimodal opioid-sparing strategies.

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The effect of albumin *versus* hydroxyethyl starch for intravenous fluid therapy in cardiac surgery on major adverse events: a secondary analysis of the TRICS III randomized controlled trial

Submission ID

102

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INTRODUCTION

Colloid solutions are frequently administered for hemodynamic stabilization in cardiac surgery. Controversy exists regarding the safety profile of hydroxyethyl starch solutions (HES) in cardiac surgery patients and the literature in the perioperative period is limited.

METHODS

We identified adult patients at moderate-to-high risk for death who underwent major cardiac surgery from January 2014 to March 2017 from the TRICS III randomized clinical trial with 28-day follow-up postoperatively. Patients were categorized into two study groups: patients who received 5% albumin solution or HES solution for intravenous volume replacement. The primary outcome was the number of patients with at least 1 major adverse event: death, myocardial infarction, stroke, and acute renal failure at 28 days. Secondary outcomes included hospital and intensive care unit (ICU) length of stay, and mechanical ventilation time. Measured covariates selected a priori at the patient, procedure, and hospital-level were controlled using multi-level hierarchical mixed-effect model. Hospital site was controlled as a random effect.

RESULTS

Among 4,903 patients, 1,241 (mean age, 72.1 [SD, 10.3] yr; 36.2% female) were included for analysis. Eight-hundred and seventy-nine patients received 5% human albumin for volume replacement (median 500 mL; IQR, 500–1,000 mL) while 362 patients received HES (median 500 mL; IQR, 500–1,000 mL). Patients who received albumin had 119 composite adverse events (13.5%) compared to 26 events (7.2%) in the HES group. After adjusting for covariates, patients receiving albumin were more likely to experience at least one major adverse event (adjusted OR, 1.87, 95% CI, 1.06 to 3.30; *P* = 0.030) by 28 days compared to HES. There were no significant differences in odds of acute kidney injury or renal failure. Albumin patients had an average of

2.59 days of longer hospital length of stay (13.76 *vs* 11.17 days, 95% CI, 0.27 to 4.92; *P* = 0.030). There were no significant differences in ICU length of stay or mechanical ventilation time.

DISCUSSION

Among patients undergoing higher risk cardiac surgery in the TRICS III trial, administration of 5% albumin for intravenous volume replacement compared with HES was associated with a significantly increased risk of major adverse events over the following 28 days. Given the exploratory nature of this study, further prospective studies are needed.

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N/A

The effect of hypothermic compared to normothermic cardiopulmonary bypass temperature on postoperative outcomes in adults undergoing non-aortic cardiac surgery: a systematic review and meta-analysis

Submission ID

3

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INTRODUCTION

Cardiopulmonary bypass (CPB) is employed during cardiac surgery to replace the physiologic roles of the heart and lungs and allow for a bloodless field. Hypothermia is a technique used during CPB in ~90% of cases because of presumed cardioprotective and neuroprotective effects,[1] despite limited supporting evidence. Given that hypothermia in other settings is associated with adverse effects,[2,3] normothermia represents an attractive alternative. We undertook a systematic review and meta-analysis of randomized controlled trials (RCTs) evaluating the risks, benefits, and resource implications of hypothermic *vs* normothermic CPB. Our primary objective was to inform a large randomized controlled trial examining this question.

METHODS

We searched MEDLINE, EMBASE, Cochrane CENTRAL, and Web of Science for potentially relevant studies. We included trials in adults undergoing non-aortic cardiac surgery comparing normothermia (≥ 35 °C) with hypothermia (< 35 °C) during CPB. Outcomes of interest were categorized as direct measures of morbidity and mortality (e.g., mortality, stroke, postoperative cognitive decline), measures of resource consumption (e.g., CPB duration, length of hospitalization), and surrogate markers of morbidity and mortality (e.g., inotrope use). A pair of reviewers independently extracted outcome data and assessed risk of bias using a modified Cochrane risk of bias tool (RoB 2.0). We used a DerSimonian–Laird random-effects model for meta-analysis of all outcomes and performed indirect treatment comparison meta-analysis using a frequentist approach to compare mild and moderate hypothermia with normothermia.

We used the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach to assess the certainty of evidence across outcomes.[4]

RESULTS

We identified 4,905 publications, screened 134 full texts, and included 50 RCTs including 5,536 participants. Most trials (42/50; 84%) were at high risk of bias; the largest trial included 1,001 patients (Mean [SD], 111 [152]). For most outcomes, we found no difference between patients undergoing hypothermic *vs* normothermic CPB, including all measures of neurologic and cardiac injury (e.g., stroke, delirium, myocardial infarction, major arrhythmia, mortality; low to very low quality of evidence). Postoperative cognitive outcomes were poorly reported. Patients undergoing hypothermic CPB had a higher incidence and volume of transfusion (relative risk [RR], 1.3; 95% confidence interval [CI], 1.1 to 1.4, moderate quality; mean difference [MD], 1.5 units; 95% CI, 0.2 to 2.9, low quality]) and longer CPB and operative times (MD, 5 min; 95% CI, 2 to 8, low quality and MD, 15 min; 95% CI, 8 to 21, moderate quality). Indirect treatment comparison showed no difference between mild and moderate hypothermia across all outcomes.

DISCUSSION

In our systematic review and meta-analysis of 50 RCTs including 5,536 participants, hypothermia compared to normothermia had little to no effect on major morbidity and mortality after cardiac surgery, but the evidence is of low to very low certainty. Hypothermia compared to normothermia during CPB may slightly increase CPB and operative times, and the incidence and volume of perioperative transfusion (low to moderate certainty). A large and rigorous multicentre RCT is required to determine the optimal temperature management strategy during CPB.

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