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Contents

Anesthetic management of a large mature cystic teratoma with severe right atrial compression: a case report

Submission ID

223

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INTRODUCTION

Fluid-filled cysts within the pericardium in adults are most commonly pericardial cysts, with an estimated incidence of 1 in 100,000[1]. In contrast, intrapericardial teratomas are typically detected in utero or during infancy due to symptoms related to cardiac compression, although rare cases have been reported in asymptomatic adults. Clinical manifestations may include shortness of breath, chest pain, and pleural effusions, and can be life-threatening depending on size and location [2]. Surgical excision is indicated for symptomatic lesions and is most commonly performed via video-assisted thoracoscopic surgery[3]. While prior reports [4,5] have described the anesthetic management of pericardial cysts, this case represents the first description of a large (9 × 11 × 11 cm) mature cystic teratoma causing severe compression of the right atrium and inferior aspect of the superior vena cava.

CASE PRESENTATION

A 37-year-old 81-kg man with asthma, schizophrenia, and an 11-pack-year smoking history developed progressive exertional dyspnea. A chest radiograph obtained for pneumonia suggested cardiomegaly, prompting subsequent imaging that demonstrated right atrial compression from a pericardial cyst; he was consented for VATS excision.

He tolerated the supine position. We placed a 16-gauge IV and 1L fluid bolus was administered, and a left radial arterial line was placed prior to induction. He received midazolam 2mg during arterial line and block placement. Induction with TCI-propofol at an effect-site concentration of 4µg/mL, ketamine 0.4mg/kg, remifentanil 1.5mcg/kg, and rocuronium 1.2mg/kg. The airway was secured using a McGrath MAC 4 blade with a 41Fr left double-lumen tube.

Analgesia included a pre-induction paravertebral block with 40mL of 0.5% bupivacaine and 10mg preservative-free dexamethasone. Intraoperatively, he received hydromorphone 1 mg,

dexmedetomidine 0.3mcg/kg loading followed by 0.3mcg/kg/hr, and remifentanil at 0.03mcg/kg/min. A right internal jugular triple-lumen catheter was placed for CVP monitoring. The patient was positioned left lateral decubitus.

Thoracoscopic inspection identified the phrenic nerve, and cyst incision released murky off-white fluid with sebaceous material. The patient remained hemodynamically stable; CVP increased with CO_2 insufflation of the thoracic cavity and decreased following cyst incision and suctioning, consistent with relief of right atrial compression. He was extubated in the operating room. Initial cultures suggested gram-negative organisms, and he received piperacillin–tazobactam followed by amoxicillin–clavulanate to complete a ten-day course. Final cultures showed no pathogenic growth. Pathology unexpectedly demonstrated a mature cystic teratoma, and further surgical management is under discussion.

CONCLUSION

This case highlights anesthetic considerations associated with a large intrapericardial mass causing significant right atrial and SVC compression. Careful preoperative assessment, emphasizing clinical symptoms given incomplete correlation with imaging findings, was crucial in guiding anesthetic planning to minimize cardiovascular compromise. Lung isolation and patient positioning warrant particular attention due to the effects of positive pressure ventilation on an already compressed right atrium. The unexpected diagnosis of a mature cystic teratoma underscores the importance of maintaining a broad differential for pericardial masses in adults. Awareness of these perioperative challenges is critical to optimizing patient safety and outcomes.

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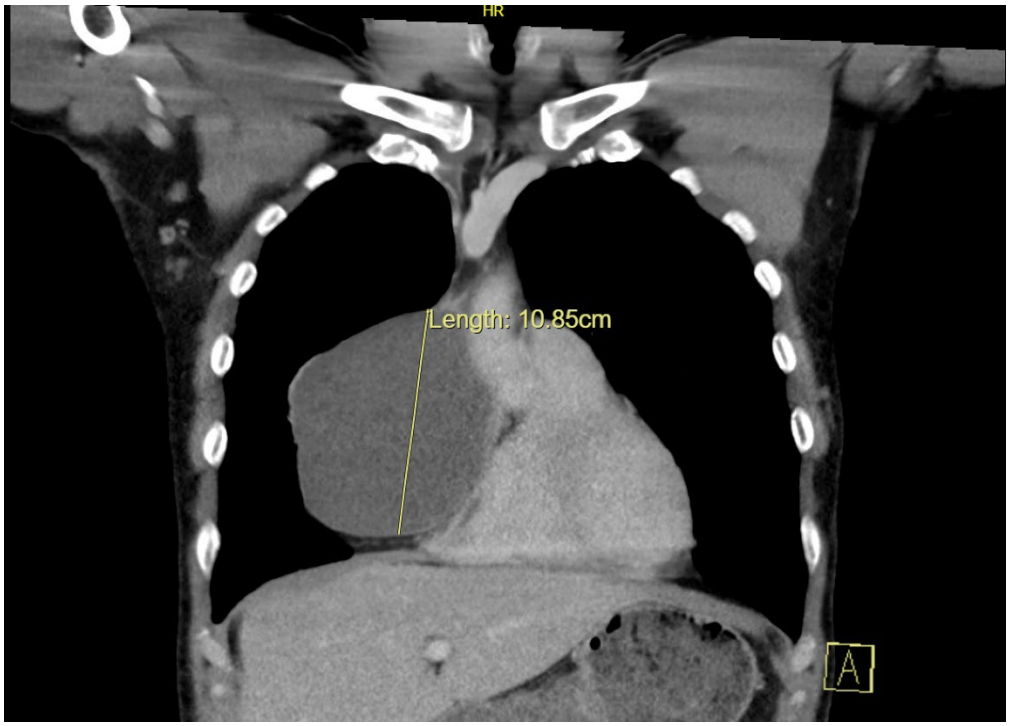

Figure 1

Breathing new life into donor lungs: exploration of various gaseous and inhaled therapies in ex vivo lung perfusion

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26

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INTRODUCTION

Every year, thousands of patients with end-stage lung disease await life-saving lung transplantation, yet only 20% of donated lungs are suitable for use. Traditionally, donor lungs are preserved on ice, but this approach exposes them to ischemic injury that limits viability. Ex vivo lung perfusion (EVLP) is an innovative technology that maintains physiologic conditions by ventilating and perfusing lungs outside the body, extending preservation time and enabling rehabilitation of marginal organs that would otherwise be discarded. Despite its impact, EVLP can contribute to ventilator-induced lung injury (VILI) similar to injury observed with mechanical ventilation in critical care settings. Prolonged shear forces on lung tissue trigger inflammatory cascades, oxidative stress, pulmonary edema formation, and impaired gas exchange, ultimately compromising graft quality. In this study, we compared the effects of delivering anesthetics, liquid ventilation, different gas compositions, and inhaled pharmacologic agents on their ability to reduce VILI during EVLP and improve post-transplant graft performance.

METHODS

A systematic search of PubMed and Embase was conducted for human and animal studies evaluating inhaled and gaseous interventions administered during EVLP. Articles published from database inception to September 22, 2025, were screened. A total of 1,225 titles and abstracts were evaluated, 85 full texts were reviewed, and 24 studies met the inclusion criteria. This review followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and was registered on the Open Science Framework (10.17605/OSF.IO/8E4CR). All included articles were written in English. Study quality was assessed using the SYRCLE Risk of Bias 2 tool: 15 studies were rated as low risk, 5 as moderate risk, and 4 as high risk of bias. Outcomes of interest included weight gain, dynamic compliance, pulmonary artery pressure, pulmonary vascular resistance, peak

airway pressure, minute ventilation, oxygen partial pressure, oxygenation capacity, inflammatory markers, lactate levels, pulmonary edema formation, histological lung tissue analysis, and markers of cell death.

RESULTS

Protection against ventilator-induced lung injury (VILI) was most directly indicated by reduced airway pressure and increased lung compliance, which are known indicators of lung distention or stretch. Among the interventions assessed, administration of 10% carbon dioxide (CO_2), carbon monoxide (CO), 40% oxygen (O_2) gas, hydrogen (H_2) gas, 40 ppm nitric oxide (NO) with 60% O_2, 2% sevoflurane with 40-50% O_2, 2-S-amino-6-boronohexanoic acid, fasudil and β_2-adrenoreceptor agonists was associated with reduced VILI. Notably, the beneficial effects of H_2 and CO on these VILI-related parameters reached statistical significance after transplantation following EVLP rather than during EVLP itself, suggesting delayed or sustained protective mechanisms. Additional synergistic effects were observed when 40-60% O_2 was combined with either CO, NO, or sevoflurane compared to O_2 alone. Minimal improvements were seen when 200 ppm NO or sevoflurane with 6% O_2, liquid ventilation, argon gas, xenon gas, and N-acetylcysteine nebulization were provided.

DISCUSSION

Tailoring gas compositions and pharmacologic combinations improved lung preservation. CO and NO vasodilation may improve oxygen delivery, amplifying benefits of moderate oxygen. Sevoflurane with moderate oxygen reduced VILI-specific parameters but did not affect oxidative stress or inflammation, whereas reduced oxygen with sevoflurane decreased reactive oxygen species and TNF-α without affecting VILI, indicating a trade-off between oxidative stress and VILI mitigation. The delayed protective effect of CO and H_2 aligned with previous literature linking these treatments with improved airway remodeling and epithelial barrier integrity. Gas and pharmacologic strategies can maximize donor lung preservation, expanding access to life-saving transplantation and improving outcomes.

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Feasibility and safety of in-operating room extubation after cardiac surgery: a single-center pilot quality improvement initiative

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161

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INTRODUCTION

In-operating room extubation (ORE) is an emerging strategy to improve cardiac surgery outcomes[1-3], but has not been routinely adopted at many institutions. This quality improvement project evaluated the feasibility and safety of ORE at a tertiary academic cardiac surgery centre.

METHODS

A single pilot Plan-Do-Study-Act (PDSA) cycle was conducted at a tertiary academic cardiac surgery centre between August 2024 and June 2025 to assess ORE implementation in low-risk adult cardiac surgery patients. Patients undergoing elective cardiac surgery through median sternotomy with preserved cardiac function and no major comorbidities or intraoperative complications were included. Perioperative care followed Enhanced Recovery After Cardiac Surgery guidelines.[4,5] Data from 358 patients, including extubation timing, reintubation, pulmonary complications, surgical site infections, cardiovascular intensive care unit (CVICU) and hospital length of stay, and in-hospital mortality, were summarized using descriptive statistics.

RESULTS

Reintubation rates among patients undergoing ORE (n = 37; mean age 65 years), early extubation ≤6 hours (n = 108; mean age 65 years), and late extubation >6 hours (n = 213; mean age 66 years) were 0%, 1%, and 5%, respectively. Pulmonary complications occurred

in 16%, 16%, and 20% of patients, while surgical site infections occurred in 11%, 3%, and 7%. Prolonged CVICU stay was observed in 16%, 8%, and 29%, and prolonged hospital stay in 62%, 68%, and 75%. In-hospital mortality rates were 3%, 0%, and 6%.

DISCUSSION

ORE appears feasible and safe in low-risk cardiac surgery patients at this tertiary academic centre. Subsequent PDSA cycles will focus on refining care pathways and educating stakeholders to support the broader adoption of ORE.

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Intraoperative hypoxia during radical adrenalectomy for pheochromocytoma: the role of transesophageal echocardiography in differential diagnosis of intra-operative hypoxia

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216

AUTHORS

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INTRODUCTION

A 69-year-old male presented for elective open radical adrenalectomy for a suspected right-sided pheochromocytoma. His medical history was significant for a prior late-presenting ST-elevation myocardial infarction (STEMI), for which he had a coronary artery bypass graft (CABG) with left ventricular ejection fraction (LVEF) 30% post-operatively. Repeat transthoracic echo (TTE) demonstrated recovery of LVEF to 49% and he was discharged from outpatient Cardiology follow-up. History was also remarkable for chronic obstructive pulmonary disease, active marijuana smoking, diabetes, hypertension, and stroke.

Despite these comorbidities, the patient reported good functional capacity (metabolic equivalent > 4), with no recent chest pain, dyspnea, or symptoms of heart failure. Although there were initial adventitious sounds in the right lung field, after several coached deep coughs, physical exam was reassuring with clear breath sounds bilaterally.

CASE PRESENTATION

In the operating room, initial room air SpO2 was 90-91% but quickly improved with several deep breaths of room air. Following uneventful induction and intubation, the patient developed persistent hypoxia that only intermittently responded to recruitment maneuvers. Surgical procedure began and the surgical team observed a bulging right diaphragm. Intraoperative lung ultrasound was limited by the sterile field to the upper lung zones, which demonstrated a B-profile suggestive of increased pulmonary fluid content. Thus, transesophageal echocardiography (TEE) was performed to evaluate volume status and potential cardiac causes for the respiratory decline.

The TEE identified large bilateral pleural effusions, more significant on the right side (Figure 1). His TEE also revealed moderately reduced LV systolic function with inferior basal akinesia and significant diastolic dysfunction with elevated left atrial pressure. Furthermore, the right ventricle (RV) was mildly dilated with moderate tricuspid regurgitation. Overall, his cardiac function had significantly worsened compared to his previous outpatient TTE.

Initial management with left lateral tilt provided temporary oxygenation improvement. Following successful removal of the tumor, the surgical team performed bilateral thoracentesis, draining a total of 2.4L from both pleural spaces. This provided immediate and significant respiratory improvement, allowing for successful extubation and transfer to the critical care step-down unit. Pleural fluid analysis subsequently confirmed that the effusion were likely secondary to heart failure. Internal Medicine and Cardiology were consulted and involved for post-operative management.

Patient consent was obtained for the case report.

CONCLUSION

This case serves as an important reminder that an unremarkable history and physical examination does not necessarily exclude significant disease. Clinicians must remain vigilant and be prepared to broaden the differential diagnosis as the clinical situation evolves. While pheochromocytoma can trigger acute cardiac dysfunction, large pleural effusions represent a critical mechanical cause of hypoxia that may be exacerbated by surgical positioning. When transthoracic ultrasound is limited by surgical access or the sterile field, TEE serves as an invaluable diagnostic tool, extending beyond cardiac assessment to visualize extra-cardiac thoracic structures and assist in the differential diagnosis of intraoperative hypoxia.

REFERENCES

N/A

Posterior pericardial ascending-to-descending aortic bypass in a patient with an atheromatous plaque causing severe obstruction of the aortic arch

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117

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INTRODUCTION

Atheromatous disease of the thoracic aorta can cause significant complications including aortic arch obstruction, heart failure, and aortic dissection.[1,2] Conventional management strategies such as subclavian approaches, endovascular stenting, or open aortic arch surgery, are associated with significant morbidity and mortality, including hematologic complications, renal injury, and neurologic complications.[3,4] An alternative approach employs a posterior pericardial ascending-to-descending aortic bypass, which has previously been successfully applied in the management of aortic coarctation and re-coarctation, aortic pseudoaneurysm, Takayasu's aortitis, complex descending aortic arch aneurysm and severe aortic atherosclerosis.[3,5] Given its potential to reduce perioperative complications, this approach represents a viable option for high-risk patients with aortic arch obstruction in whom conventional approaches carry an elevated risk. We report the anaesthetic management of an adult patient with a heavily calcified atheroma causing severe aortic arch obstruction in whom a posterior pericardial ascending-to-descending aortic bypass was performed.

CASE PRESENTATION

A 58-year-old female with history of hypertension and dyslipidemia presented with progressive dyspnea and heart failure symptoms. Transthoracic echocardiogram demonstrated reduced LVEF (46%) without significant valvular pathology but raised concern for plaque in the descending aorta. CT confirmed significant stenosis at the level of the subclavian artery and near-complete obstruction of the aortic arch due to heavily calcified plaque.

With this pathology, endovascular approach was not feasible, and considering the aforementioned risks associated with open repair, a posterior pericardial ascending-to-descending aortic bypass approach was deemed most appropriate. Pre-operatively, the patient was ASA IV with functional capacity < 4 METS.

Anaesthesia was induced using midazolam, lidocaine, propofol, rocuronium, and fentanyl, and maintained using sevoflurane and fentanyl with a propofol infusion for neuroprotection. A pre-induction arterial line was placed for invasive hemodynamic monitoring, and a Swan-Ganz Catheter was inserted post-intubation. Transesophageal echocardiography was used to assess perioperative cardiac function. Intraoperatively blood pressure was tightly controlled using a norepinephrine infusion. During pump, mild hypothermia (34°C) and moderate permissive hypercapnia were employed.

Through a median sternotomy, an extra-anatomical aortic bypass was constructed between the ascending and descending thoracic aorta using a graft tunnelled posterior to the pericardium.

The patient was transferred to intensive care and extubated on postoperative day 1 with no neurological deficits. Postoperative course was uneventful. At 1-year post-procedure she reported marked improvement in quality of life, with resolution of heart failure symptoms and no functional limitations. Blood pressure was well-controlled with valsartan and bisoprolol and follow-up imaging confirmed good graft patency.

CONCLUSION

This case describes the successful use of a posterior pericardial ascending-to-descending aortic bypass procedure for the management of severe aortic arch obstruction due to a calcified atheroma. The favourable outcome suggests that this approach may be more broadly applicable in the management of complex aortic disease than the indications previously described, particularly in patients for whom conventional open repair or endovascular intervention is contraindicated or unfeasible. Key anaesthetic considerations in the management of this case included meticulous hemodynamic monitoring and goal directed fluid therapy, implementation of neuroprotective strategies, preservation of cardiac function, and careful management of coagulopathies.

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Figure 1

The use of raw or processed EEG to guide management during cardiac surgery: a systematic review and meta-analysis

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195

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INTRODUCTION

Adverse postoperative neurocognitive outcomes, including delirium and longer-term cognitive decline, remain common after cardiac surgery and are associated with increased morbidity, mortality, and healthcare utilization. Despite advances in surgical and anesthetic techniques, few intraoperative strategies have reliably reduced these complications. Electroencephalography (EEG) monitoring, including raw and processed indices, allows real-time assessment of anesthetic depth and cerebral activity and has been proposed to optimize anesthetic delivery and lessen neurologic injury. In non-cardiac surgery, EEG-guided anesthesia has been associated with reduced anesthetic exposure and lower rates of postoperative delirium; however, findings have been inconsistent, and applicability to cardiac surgery remains uncertain. Cardiac surgical patients represent a distinct, high-risk population due to cardiopulmonary bypass, embolic burden, and hemodynamic fluctuations. This systematic review and meta-analysis evaluates whether intraoperative raw or processed EEG monitoring reduces postoperative delirium, postoperative cognitive decline, stroke, intraoperative awareness, and mortality in adult patients undergoing cardiac surgery.

METHODS

This systematic review and meta-analysis followed PRISMA guidelines and Cochrane methodology, with a protocol prospectively registered in PROSPERO. With assistance from a medical librarian, MEDLINE, EMBASE, PsycINFO, CINAHL, CENTRAL, and Web of Science were searched from inception to July 2025. The search combined concepts for cardiac surgery and electroencephalography, including terms for bispectral index, patient state

index, cerebral state index, and entropy, and incorporated a validated Cochrane randomized controlled trial (RCT) filter. Only RCTs were eligible. Studies were selected using predefined criteria, enrolling adults undergoing cardiac surgery in whom intraoperative raw or processed EEG-guided anesthesia was compared with usual care and reporting neurocognitive, neurologic, or mortality outcomes.

Two reviewers independently screened titles, abstracts, and full texts, resolving disagreements by consensus. Data extraction was performed independently using a standardized form capturing study characteristics, patient populations, EEG modality, and outcomes. Risk of bias was assessed using the Cochrane Risk of Bias tool, and certainty of evidence was evaluated with GRADE. Where appropriate, outcomes were pooled using random-effects meta-analysis, with effect estimates reported as risk ratios and 95% confidence intervals. Statistical heterogeneity was assessed using the I^2 statistic. Authors were contacted for missing data, and statistical significance was defined as $p<0.05$.

RESULTS

Our search identified 2,209 citations, of which 27 RCTs were included in the final quantitative synthesis. The included RCTs were published between 1986 and 2024, representing 12 countries and a total of 6,894 patients undergoing cardiac surgery. All included studies evaluated intraoperative raw or processed EEG monitoring compared with usual care in adult patients undergoing cardiac surgery. 16 trials were judged to be at low overall risk of bias, while 8 were at high risk of bias. Preliminary meta-analyses demonstrated no statistically significant reduction in postoperative delirium (RR 0.87, 95% CI 0.67–1.13), postoperative cognitive decline (RR 0.56, 95% CI 0.08–3.74), stroke (RR 0.65, 95% CI 0.26–1.63), intraoperative awareness (RR 0.76, 95% CI 0.36–1.62), or mortality at in-hospital, 30-day, or 1-year follow-up. Although isolated small studies suggested potential benefit for select neurocognitive outcomes, these findings were not reproduced in larger trials.

DISCUSSION

This systematic review found that intraoperative raw or processed EEG monitoring during cardiac surgery was not associated with statistically significant reductions in postoperative delirium, cognitive decline, stroke, intraoperative awareness, or mortality. Strengths include a comprehensive search and inclusion of RCTs across multiple clinically relevant outcomes. Interpretation is limited by heterogeneity in EEG modalities, anesthetic protocols, and outcome definitions, as well as small and underpowered studies. Although EEG monitoring informs anesthetic titration, current evidence does not demonstrate a clear neuroprotective benefit in cardiac surgery. Future large, multicentre trials should standardize EEG targets, outcome definitions, and follow-up to clarify potential subgroup effects.

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Thrombogenic potential of the novel TRIFLO artificial heart valve assessed using classical fluid mechanics and computational fluid dynamics.

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119

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INTRODUCTION

Aortic valve replacement is a common procedure; however, no existing prosthetic valve achieves optimal performance. Bioprosthetic options closely mimic native valve fluid dynamics but are limited by finite durability (10-15 years); and while their mechanical counterparts are more long-lasting, they have significant thrombogenic potential requiring lifelong anticoagulation.[1] The recently developed 3-leaflet TRIFLO valve (Novostia) aims to address these limitations by offering long-lasting durability without the need for long-term anticoagulation.[2]

To evaluate the thrombogenic risk of this novel design, we examined the mechanisms underlying thrombus formation in existing mechanical valves. This was accomplished by reviewing the performance of the St. Jude Medical (SJM) valve, historically one of the most frequently implanted mechanical valves,[3] using literature pertaining to both classical fluid mechanics and computational fluid dynamics. Insights from this review were then applied to evaluate the potential of the TRIFLO valve as an alternative to current prosthetic options.

METHODS

In order to assess possible sources of thrombogenicity in mechanical valves, we reviewed existing literature pertaining to the performance of bi-leaflet mechanical valves. Studies concerning both classical fluid mechanics and computational fluid dynamics (CFD) were considered, and we accessed studies from the PubMed database as well as additional peer-reviewed journals.

CFD involves the application of governing equations of mass, momentum and energy along with numerical techniques to predict aspects of fluid flow such as velocity and shearing stresses.

This review focused on the SJM aortic valve under normal physiologic conditions and consideration was not made for valves in states of dysfunction. Consideration was given to studies using CFD to directly predict platelet damage, along with those analyzing only bulk flow and shearing stresses. CFD studies constructed using both simplified and non-simplified aortic root geometry were included, and all studies were assessed for adequate validation of computational techniques.

Studies that fulfilled these criteria were then reviewed to determine the valve design properties most responsible for shearing stress generation and platelet damage. Following this and using the aforementioned design considerations as a framework, the pre-clinical performance of the novel TRIFLO valve was assessed with the aim of evaluating its projected future relevancy.

RESULTS

By means of a preliminary classical fluid mechanics analysis of flow through the three primary orifices of the SJM valve, we identified several mechanisms contributing to thrombus formation. The bileaflet design was found to disrupt physiologic flow patterns, generating regions of re-circulation with the potential to increase cell-to-cell contact time and promote platelet aggregation.[1] In addition, gaps in the hinge and peripheral regions of the valve combined with high post-closure pressure gradients were shown to produce high-velocity regurgitation flows, generating elevated fluid shear and increasing the potential for blood cell damage.[1]

CFD analyses corroborated these findings while identifying additional contributing factors. Simulations demonstrated high shearing stresses within the hinge pivot regions and areas of high platelet damage in the wake of rapidly closing leaflets, which further highlighted hinge design and closing speeds as additional determinants of a valve's thrombogenic potential.[4,5]

DISCUSSION

When assessed using the design criteria identified, the TRIFLO valve appears to demonstrate several advantages over existing bileaflet mechanical valves. Pre-clinical data indicates that this 3-leaflet polymer valve generates lower levels of physiologic flow disruption and stagnation and offers slower leaflet closing speeds more akin to native valves, thus addressing many of the thrombogenic factors identified.[2]
Along with the valve's recent progression into human clinical trials, these findings suggest that the TRIFLO valve represents a promising development in cardiovascular medicine, with the potential to offer long-term durability without the need for lifelong anticoagulation.

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