Emerging scholar article

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The intensive care unit (ICU) nurse's role in reducing complications after cardiac surgery: An integrative review

Abstract

Introduction: Perioperative nursing begins at the start of a surgical admission and continues until patient discharge, thus encompassing nursing care provided in the intensive care unit (ICU). Cardiac surgery is associated with high rates of post-operative complications that significantly increase mortality, morbidity and length of hospital stay. Many of these complications occur early in the post-operative period within the ICU, where nurses are central to monitoring, prevention and timely intervention. Despite this, nursing contributions are often under-represented in the literature compared with medical or surgical perspectives.

This integrative review investigated the common post-operative complications following cardiac surgery and the role of ICU nurses in reducing the risk of such complications.

Methods: A comprehensive search was conducted across Scopus, HealthSource: Nursing/Academic Edition, CINAHL and MEDLINE. Studies published in English within the last five years were included if they focused on the nursing role in the ICU following cardiac surgery. A total of 26 studies met the inclusion criteria and methodological quality was appraised using appropriate EQUATOR Network tools.

Findings: Four key themes emerged: respiratory complications, cardiovascular complications, acute kidney injury and post-operative delirium. Evidence highlighted that vigilant monitoring, structured assessment protocols, pre-operative education, early mobilisation, advocacy for pharmacological interventions and family involvement are pivotal nursing strategies that improve outcomes. However, limited standardisation of protocols and inconsistent implementation were noted across studies, possibly reflecting gaps in the literature rather than clinical practice.

Conclusion: Intensive care unit nurses play a critical role in the early post-operative phase following cardiac surgery. Nurse-led, evidence-based interventions can significantly reduce the incidence of post-operative complications, improve recovery and enhance survival. Further multicentre, nursing-focused research is needed to validate interventions, strengthen implementation strategies and develop standardised guidelines for practice.

Keywords: cardiac surgery, intensive care nursing, post-operative complications, nursing interventions, pre-operative education, early detection, prevention

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Introduction

Perioperative nursing begins at the start of all surgical admissions and continues until surgical patient discharge, thus encompassing nursing care provided in surgical wards and the intensive care unit (ICU). Cardiac surgery, such as coronary artery bypass grafting (CABG) and valve repair or replacement, often necessitates sternotomy and cardiopulmonary bypass, which can be associated with substantial risks[1]. Major post-operative complications affect nearly one in six cardiac surgery patients and are associated with a sharp rise in mortality, longer ICU and hospital stays, and poorer long-term survival[2]. Five-year survival rates fall from 85 per cent in patients without severe complications to 42 per cent in those with three or more complications, underscoring the profound and lasting human cost of these events[2]. The incidence of complications increases with advancing age, a trend of particular significance given that older adults are a growing proportion of the cardiac surgical population[1]. Scholarly literature on post-operative cardiac surgical complications is extensive, with much of the focus directed towards medical management and surgical and anaesthesia approaches[1–3]. While these perspectives are critical, they have the potential to overshadow the important role of nursing care in this equation.

Many major post-operative complications, including cardiovascular, respiratory, renal and neurological dysfunction, present early in the ICU. Early signs of complications may range from low-output states (such as low cardiac output syndrome), arrhythmias, pulmonary complications, acute kidney injury and delirium[4]. These conditions may lengthen ICU and hospital stays, as well as increase the risk of both short-term and long-term mortality[4]. ICU nurses are uniquely positioned to detect subtle deterioration, initiate early interventions and escalate care, which can reduce failure-to-rescue events and improve patient outcomes[5].

Given the pivotal role of ICU nurses in the early post-operative period, examining their actions offers an important opportunity to understand how nursing interventions can influence patient outcomes and reduce the impact of complications after cardiac surgery.

The primary aim of this review is to outline common complications that may be seen in the ICU after cardiac surgery and highlight evidence of nursing interventions aimed at reducing these complications.

Review methods

Design

This review used an integrative design where quantitative, qualitative and mixed-methods research were included. One systematic review was also included. The review design applied Whittemore and Knafl's method for integrative reviews[6].

Search strategy

A comprehensive literature search was undertaken in Scopus, HealthSource: Nursing/Academic Edition, CINAHL and MEDLINE. Search strategies combined keywords and Boolean operators relating to the ICU (e.g. 'intensive care,' 'ICU'), cardiac surgery (e.g. 'cardiac surgery,' 'cardiothoracic surgery'), post-operative complications (e.g. 'complications,' 'deterioration,' 'failure to rescue') and nursing roles in prevention, detection or response (e.g. 'prevent', 'detect,' 'detection,' 'respond,' 'response,' 'escalation').

Inclusion and exclusion criteria

Inclusion criteria consisted of primary research and systematic literature reviews; research exploring the role of nurses in the prevention of, detection of or response to post-operative complications in the ICU following cardiac surgery; cardiac surgery including CABG, valve surgery or combined CABG and valve procedures; literature from peer-reviewed journals and papers of high quality, written in English and published within the past five years.

Exclusion criteria consisted of research not focusing primarily on the nursing role; research only focusing on heart transplantation, vascular or other cardiothoracic procedures; literature with a medical rather than nursing focus and papers of poor quality, not peer reviewed, older than five years or not written in English.

Quality appraisal

Research studies identified through the search were appraised using the appropriate methodological tools from the EQUATOR Network to assess the quality of the evidence, in terms of reliability and rigour.

Results

A total of 243 studies were initially retrieved. 27 studies fit the inclusion criteria after assessing their titles and abstracts. Of the 27 articles, there were four randomised controlled trials (RCTs), 15 observational studies, four qualitative studies, one quality improvement project, one retrospective study, one mixed-methods study and one quasi-experimental study.

The studies were conducted in the United Kingdom (2), European Union countries (6), Canada (3), United States of America (4), Turkey (3), Iran (1), China (2), Brazil (2), Jordan (2), Australia (1) and Pakistan (1). These studies were then analysed to identify key themes relating to complications that commonly occur in the ICU after cardiac surgery and the roles of the ICU nurses. Four themes were identified: respiratory complications, cardiovascular complications, acute kidney injury and post-operative delirium.

Discussion of findings

The four themes and related ICU nursing interventions are presented under their respective subheadings.

Respiratory complications

Respiratory complications are common after cardiac surgery, contributing substantially to morbidity, mortality and lengthened hospitalisation[7,8]. Prolonged intubation after cardiac surgery, defined by the Society of Thoracic Surgeons as ventilation exceeding 24 hours[9], is an important risk marker for respiratory complications and is closely associated with poorer clinical outcomes[10].

In a retrospective study of 314 post-cardiac surgery patients, respiratory complications occurred in 42 per cent of the patients within 12 hours of surgery, with pleural effusion being the most common (28.3%), followed by atelectasis (14%), pulmonary oedema (7.9%) and pneumothorax (2.9%)[8]. Another larger retrospective study (n = 2098) reported severe respiratory complications in 24.3 per cent of cardiac surgery patients

requiring non-invasive ventilation, re-intubation or prolonged intubation, which were associated with longer ICU stays (2.1 vs 0.9 days), extended hospitalisation (10.6 vs 7.2 days) and higher mortality (2.9% vs 0.1%)[7]. Across both studies, parameters routinely monitored by ICU nurses, such as post-operative hypoxaemia, anaemia and hypoalbuminaemia were also identified as key predictors, underscoring the role of ICU nurses in early detection and timely escalation of care[7,8].

Furthermore, prolonged intubation was studied in a large retrospective cohort study (n = 14 865) to develop and externally validate a predictive model for prolonged intubation using ICU data from the first 12 hours after cardiac surgery[10]. Unlike earlier models reliant on pre- and intra-operative variables, this approach captures the cumulative impact of surgical and anaesthetic factors on early post-operative physiology[10]. Key predictors included vasopressor use, low pH, elevated lactate, raised central venous pressure and increased plateau pressures, all routinely monitored by ICU nurses[10]. The model showed strong internal validity (AUROC 0.867) but lower external accuracy (AUROC 0.704) underscoring the need for prospective testing[10]. However, the findings from this study offer a method tailored to the early post-operative ICU period for identifying patients at high risk of prolonged intubation. This will enable nurses to implement targeted strategies to shorten ventilation and reduce respiratory complications.

One such strategy is advocating for the use of post-operative sedation regimens, like dexmedetomidine, to facilitate early extubation. In a retrospective cohort study of 401 patients, those sedated with dexmedetomidine had a statistically significant shorter duration of mechanical ventilation (7.4 hours) compared with those who received propofol (12.9 hours, p = 0.042)[11]. Although limited by a non-randomised design in a single-centre setting, the findings suggest that dexmedetomidine may support earlier extubation, thereby reducing the risk of respiratory complications and facilitating recovery[11].

This review identified only limited literature addressing pharmacological sedation strategies after cardiac surgery; additional multicentre randomised trials in cardiac and other surgical populations, along with research examining nursing advocacy and implementation of sedation protocols, are needed to strengthen the evidence base for nursing practice.

Pre-operative education emerged from the review as a complementary, non-pharmacological strategy. Structured pre-operative education delivered by ICU nurses has been shown to reduce ventilation time and improve post-operative outcomes[12]. In an RCT of 200 elective cardiac surgery patients, those who received nurse-led pre-operative education experienced statistically significant lower anxiety scores (30.2 ± 8.9 vs 44.5 ± 9.6, p < 0.001), reduced sedation requirements (2.2 ± 1.2 vs 3.3 ± 1.0, p < 0.001) and shorter mechanical ventilation times (154 ± 54 vs 210 ± 58 minutes, p < 0.001) [12]. Despite limitations, including its single-centre design and lack of blinding, this study highlighted the multifaceted contribution of ICU nurses in pre-operative preparation and post-operative recovery to support earlier extubation and minimise respiratory complications. Larger, multicentre trials would help determine the generalisability of these findings and guide broader implementation[12].

Early mobilisation represents another key nurse-led intervention to reduce respiratory complications after cardiac surgery. In an RCT investigating the specific effects of mobilisation on respiratory complications after cardiac surgery (n = 120), a three-phase protocol of breathing exercises and chest physiotherapy and a four-phase protocol of progressive physical activity revealed statistically significant findings of lowered complication rates compared with routine care (2.5% vs 32.5%, p < 0.001)[13]. Routine care involved only sitting patients in a chair on day one after extubation, whereas intervention groups included walking twice on day one alongside structured breathing exercises, suggesting that ambulation rather than passive mobilisation was more beneficial[13]. These findings highlighted key nursing interventions, such as early ambulation and use of respiratory protocols, which are central to individualised patient care. Limitations include single-centre design, short follow-up and exclusion of higher-risk patients, underscoring the need for further nurse-led research to refine mobilisation strategies.

Cardiovascular complications

The principles of vigilant assessments in respiratory management also apply to cardiovascular complications which, like respiratory complications, may arise in the early post-operative period and thus demand close nursing surveillance. Atrial fibrillation (AF) is the most common arrhythmia after cardiac surgery, affecting 30 to 50 per cent of patients, and is associated with longer ICU stays, increased stroke risk and higher mortality[14].

To support early identification, a risk prediction model for post-operative atrial fibrillation (POAF) was developed to enable nurses to target high-risk patients for ECG monitoring, timely recognition and escalation of care[14]. Although the model's moderate predictive accuracy (AUROC 0.62) requires further validation, it shows potential for integrating predictive tools into nurse-led surveillance protocols[14].

Building on these insights, Egan et al.[15] demonstrated how a multidisciplinary, nurse-led protocol with a preprinted order set could operationalise risk stratification, guiding prophylaxis with beta-blockers and/or amiodarone. Nurses were instrumental in escalating care for prescription initiation, reducing POAF incidence from a baseline of 39 per cent to 30 per cent, with more pronounced decreases in high-risk procedures (89% to 56%)[15]. Amiodarone adherence improved from 13 to 41 per cent, although early beta-blocker uptake was limited by hypotension and bradycardia[15]. While the single-centre, quality improvement design limits generalisability, the study underscores the potential of combining predictive models with structured, nurse-led interventions to reduce POAF and improve outcomes.

Further evidence supports system-level protocols as seen in enhanced recovery after surgery (ERAS) program implementation to reduce complications such as POAF. In a qualitative study, representatives from multiple European cardiothoracic ICUs were surveyed and interviewed to assess existing standards and identify best practices, highlighting

the potential of ERAS protocols in cardiac surgery[16]. ERAS has demonstrated substantial benefits in other surgical specialties with emerging evidence suggesting their feasibility and advantage in patient care after cardiac surgery[16]. In a single-centre Swiss cohort of 483 patients, ERAS protocol implementation was associated with lowered POAF incidence ($p \leq 0.005$)[17].

In the first Australian implementation of an ERAS program for paediatric cardiac surgical patients, findings revealed decreased duration of post-operative mechanical ventilation and decreased length of both ICU and hospital stay[18]. While the study consisted of a paediatric cohort, international consensus also recognises ERAS as a promising strategy to enhance recovery and reduce complications in adult cardiac surgery; however, further multicentre trials may be required before widespread adoption[16,18].

Post-operative bleeding is another significant cardiovascular complication after cardiac surgery. In a large English retrospective study of 7774 patients, significant post-operative bleeding affected approximately one in ten cardiac surgery patients, markedly increasing the risk of reoperation, massive transfusion, prolonged hospitalisation and mortality, emphasising the need for early recognition and intervention[19]. Qualitative research further illustrates the role of nurses in detection. In Brazil, in-depth interviews with 27 ICU nurses revealed that despite their reliance on the vigilant monitoring of chest drains, vital signs and invasive pressures, their responses were often limited by unclear thresholds, inconsistent training, staffing shortages and disorganised admissions[20]. A similar qualitative study explored 39 Canadian nurses' perspectives, highlighting the nuanced clinical judgment required when interpreting drainage and haemodynamic cues while emphasising the need for structured protocols and ongoing education to support decision-making[21]. Despite limitations such as potential recall bias, these studies highlighted the pivotal role of nurses in monitoring, interpretation and timely escalation, especially with the use of standardised protocols to optimise outcomes.

Cardiac arrest is another life-threatening complication after cardiac surgery and has a high mortality rate. Although relatively uncommon, it demands rapid detection and response from ICU nurses[22]. In a retrospective cohort of 1635 cardiac surgery patients, a 6.9 per cent incidence of post-operative cardiac arrest was reported, with survival linked to vigilant haemodynamic monitoring, early recognition of tamponade and continuous chest compressions during cardiopulmonary rescuscitation – core nursing practices[22]. Additional evidence from literature out of this review's scope suggests that up to a third of ICU cardiac arrests may be preventable, with nurses often recognising deterioration earlier than senior physicians, highlighting the critical role of nursing vigilance and timely escalation[23].

Furthermore, centres with specific cardiac surgical unit advanced life support (CSU-ALS) training certification had significantly lower odds of failure to rescue after cardiac arrest (OR 0.30, 95% CI 0.12–0.72), highlighting how structured training and standardised algorithms improve outcomes[24]. Of note, CSU-ALS certified centres did not differ in cardiac arrest incidence or operative mortality, their reduced failure-to-rescue rates suggest that structured training and team-based protocols enhance response to rather than prevent complications[24]. For nursing practice, this emphasised the value of advanced training and adherence to collaborative algorithms in reducing potentially preventable deaths, although certification may also reflect broader institutional resources and culture, limiting causal interpretation. These findings emphasise that nurses are central in early detection and effective resuscitation and that outcomes are enhanced when supported by clear protocols, CSU-ALS training and institutional preparedness.

Acute kidney injury (AKI)

Early recognition and prompt intervention similarly apply to renal complications, particularly acute kidney injury (AKI), a frequent and high-risk complication following cardiac surgery[25,26]. A single-centre retrospective study of 466 cardiac surgery patients reported a 38 per cent incidence of AKI, with reduced pre-operative glomerular filtration rates emerging as the strongest predictor[25]. A high proportion (89%) of the cases occurred within the first 72 hours post-operatively, highlighting a critical window for ICU nurses to monitor urine output, fluid balance and haemodynamics for early detection[25]. In a 15-year prospective cohort study of 2162 cardiac surgery patients, 43 per cent developed AKI, with AKI independently associated with increased 30-day mortality[26].

Despite the prevalence and clinical significance of AKI, the literature included in this review noted the limited guidance on structured, nurse-led interventions to mitigate AKI. From one of the ERAS studies, a lack of standardisation in practice was shown, with only 35 per cent of nurses actively monitoring haemodynamics and just 6.5 per cent considering haemoglobin levels to prevent AKI[16]. A retrospective single-centre study comparing coded to actual incidence of AKI after cardiac surgery identified significant under-recognition of AKI, with true rates over four times higher than those documented[25]. Post-operative management of hypotension and hyperglycaemia, as well as exposure to nephrotoxic medications and/or contrast agents, demonstrated poor adherence to recommendations by KDIGO (Kidney Disease: Improving Global Outcomes)[27], highlighting the need for improved vigilance in early detection and stricter implementation of preventive strategies, particularly through nursing surveillance of renal function, haemodynamic monitoring, glycaemic control and medication management[28].

These findings emphasise the need for enhanced monitoring and preventive strategies in the ICU, where nurses are positioned to contribute to early AKI detection and management. While this review did not identify standardised monitoring protocols or nurse-focused guidelines, this may reflect limitations in the included literature rather than a definitive absence in practice. Future recommendations should prioritise evidence-based, structured approaches to enable ICU nurses to contribute to the reduction of AKI incidence following cardiac surgery.

Post-operative delirium

Post-operative delirium is another major complication in which ICU nurses play a pivotal role in detection, prevention and

response. Reported incidence of delirium after cardiac surgery varies depending on assessment methods. Some of the assessment methods used include the confusion assessment method for intensive care unit (CAM-ICU) and nursing delirium screening scale (Nu-DESC). Segernäs et al.[29] reported 22 per cent prevalence with once daily screening using validated tools (CAM-ICU and Nu-DESC), whereas Habeeb-Allah et al.[30] reported only 9.0 per cent incidence with once-daily CAM-ICU screening. In contrast, Guo et al.[31] employed a nurse-led, twice-daily CAM-ICU and Richmond agitation and sedation scale (RASS) protocol, finding a higher incidence of 60.1 per cent, predominantly hypoactive delirium. These findings illustrate how screening frequency and tool selection influence delirium detection.

ICU nurses are central to delirium identification and management. Structured, nurse-led screening using validated tools improves recognition, including hypoactive delirium and hypoactive forms often overlooked in practice[31]. Hamadnalla et al.[32] demonstrated that twice-daily assessments over four days identified over 97 per cent of cases while reducing the assessment burden by 20 per cent, balancing feasibility with sensitivity. Vigilance with high-risk patients – such as those with advanced age, depression and prolonged ventilation – enables timely interventions including early extubation, nutritional optimisation and psychological support[31]. Collectively, these findings reinforce the need for frequent, structured, nurse-led delirium assessment in cardiothoracic ICUs; future work could explore protocolised or automated approaches.

Beyond detection, research also highlighted pre-operative education as a preventive strategy for post-operative delirium. In an RCT of 90 patients, a nurse-developed educational video was delivered before cardiac surgery resulting in statistically significant improvements in intensive care experience scores (74.5 ± 3.9 vs 63.9 ± 6.4, $p < 0.001$), particularly in awareness, frightening experiences and recall[33]. As disorientation and fear are recognised precipitants of delirium, these findings suggest that nurse-led preparatory education may help reduce psychological vulnerability and thereby lower delirium risk[33]. As noted earlier, Pazar et al.[12] similarly demonstrated that structured pre-operative education for elective cardiac surgery patients reduced anxiety, sedation requirements and ventilation duration – factors that are known contributors to the development of delirium[34]. Reduction in these factors also indicates improved coping and recovery[12]. Although both trials were single-centre and unblinded, they extend nursing interventions beyond surveillance and early recognition toward primary prevention.

There is evidence that family involvement, alongside patient education, helps mitigate post-operative delirium risk. In a non-randomised controlled study of 73 cardiac surgery patients, the presence of an informed family member during ICU awakening significantly lowered serum cortisol, anxiety and sedative requirements, as well as shortening intubation and ICU stay (all $p < 0.05$)[35].

As stress, anxiety and prolonged sedation contribute to delirium, structured psychosocial support from families at key recovery points may reduce physiological and psychological vulnerabilities that predispose patients to delirium[32,35].

Complementing this, a qualitative study using family systems nursing theory as a guide to explore ICU nurses' perceptions of family involvement in delirium care, found that nurses viewed families as integral to delirium detection and management through reassurance, safety promotion and recognising subtle behaviour changes[36]. However, effectiveness was constrained by structural barriers, inconsistent training and lack of pre-operative family education[36]. Further considerations beyond this review could explore nurse-led interventions to optimise family involvement and assess their impact on delirium detection and management.

This integrative review highlights the important role of ICU nurses in the early post-operative period following cardiac surgery in reducing common complications through preventative and targeted nursing interventions. Evidence from the included studies suggests that vigilant monitoring, timely escalation of care, structured interventions and integration of predictive tools and protocols can significantly influence patient outcomes.

The scarcity of standardised protocols and nursing-focused interventions may reflect limitations of the included literature rather than their absence in practice. Nurse-led strategies, such as pre-operative education, early mobilisation, advocacy for appropriate pharmacological interventions, structured family involvement and adherence to advanced life support protocols, emerged as key factors in mitigating complications and supporting recovery.

Gaps in the current literature are noted in the validation of predictive and screening tools, optimisation of early mobilisation protocols, standardisation of monitoring for AKI, evidence-based guidelines for enhanced recovery pathways in cardiac surgery and structured strategies for family involvement. Future research should prioritise multicentre studies, ERAS protocols and nursing-focused implementation investigations to address these areas and strengthen the evidence base.

While it is also acknowledged that further relevant evidence may exist beyond the research captured in this paper, this review has highlighted the significant and central role of ICU nurses in shaping post-operative outcomes. The provision of high-quality ICU nursing can provide safer patient outcomes and post-operative ICU patients should expect the same.

Conclusion

Intensive care unit nurses play a critical role in the early post-operative phase following cardiac surgery. Targeted, evidence-based nursing interventions have substantial potential to reduce complication incidence, shorten ICU and hospital stays, as well as improve both short- and long-term recovery for patients undergoing cardiac surgery. Further multicentre, nursing-focused research is needed to validate interventions, strengthen implementation strategies and develop standardised guidelines for practice.

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