



## Post-operative nausea and vomiting in the cardiac surgery population: Who is at risk?



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### ABSTRACT

**Objectives:** Post-operative nausea and vomiting (PONV) is a common and distressing complication following cardiac surgery. Therefore, our primary objective was to explore the predictors of severe PONV in the cardiac surgery population.

**Methods:** A retrospective study was completed on cardiac surgery patients ( $N = 150$ ). A modified preoperative PONV risk assessment tool was utilized to identify patients at high and low risk for PONV.

**Results:** 54% of the high-risk group versus 13% of the low-risk group experienced  $\geq 2$  nausea events in the early post-operative period ( $p < 0.0001$ ). The high-risk group had a uniquely elevated and sustained number of PONV events post-operatively. History of PONV ( $p = 0.03$ ) and female gender ( $p = 0.01$ ) emerged as significant predictors of any nausea event.

**Conclusions:** A specific PONV risk assessment tool may be useful for predicting those at highest risk following cardiac surgery. Further research is required to identify strategies to reduce PONV.

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### Introduction

Post-operative nausea and vomiting (PONV) is one of the most frequently reported complications following anesthesia and surgery. Despite advances in anesthesia practice and anti-emetic therapies, the overall incidence of PONV has remained relatively unchanged over the past four decades.<sup>1–9</sup> While the incidence of PONV is 20–30% in the general surgery population, PONV rates in the cardiac surgery population are reportedly as high as 42–71%.<sup>10–15</sup> The higher incidence of PONV in cardiac surgery patients may be related to factors such as the duration of the anesthesia, the post-operative pain and anxiety often associated with this procedure, and the consequent

utilization of opiate analgesics.<sup>11,14,16,17</sup> However, accurate and reliable tools to predict PONV in this population have not been established.

PONV can have a significant impact on patient morbidity, which, in turn affects patient satisfaction, hospital length of stay, and overall health care costs. For example, PONV may result in complications such as aspiration pneumonia, dehydration, and electrolyte imbalance.<sup>2,18,19</sup> Patients experiencing PONV may also have inadequate absorption of *per os* medications (e.g., beta blockers, diuretics, analgesics), which, in turn may lead to complications such as increased rates of peri-operative dysrhythmias, fluid volume overload, and uncontrolled pain.<sup>20</sup> In a prospective study of gastrointestinal (GI) symptoms in cardiac surgery patients ( $N = 122$ ), Grap et al<sup>10</sup> found that nausea was the most distressing GI symptom reported during patients' hospital stay. Furthermore, PONV may impact on the patient's willingness and ability to participate effectively in their post-operative recovery (e.g., ambulating, deep breathing and coughing, dietary and fluid intake). This, in turn can lead to further post-operative complications, such as pulmonary infections and renal

Abbreviations: BMI, body mass index; CABG, coronary artery bypass graft; CSICU, cardiac surgery intensive care unit; GI, gastrointestinal; PONV, post-operative nausea and vomiting.

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dysfunction. In addition to pain, vomiting and retching can also cause significant mechanical complications for the cardiac surgery patient, including stress on the new graft sites and dehiscence of the sternal incision.<sup>21</sup>

Although PONV symptoms generally occur and resolve in the early post-operative period, cardiac surgery patients reportedly experience persistent GI symptoms for 4–6 weeks post-surgery.<sup>7</sup> Therefore, PONV has implications not only for immediate peri-operative outcomes, but also for post-discharge quality of life, cardiac rehabilitation attendance, and return to work. Finally, side effects associated with anti-emetic medications, such as delirium,<sup>22</sup> as well as complications of PONV may result in extended lengths of stay, which in turn directly affect costs to the health care system.

Over the past several decades, PONV has been the focus of numerous studies and systematic reviews. Consequently, various peri-operative predictors of nausea and vomiting have been identified, including: female sex, history of motion sickness and/or PONV, non-smoker, increased age, obesity, type of anesthetic agents, and type and duration of surgery. While several complex prognostic scoring systems and models have also been developed, validation studies suggest that the original, more simplified risk tools developed by Apfel et al<sup>20</sup> and Koivuranta et al<sup>1</sup> provide better discrimination and calibration for predicting PONV in patients who have undergone various surgical procedures.<sup>17,23,24</sup>

However, consistent evidence remains somewhat elusive, particularly in the cardiac surgery population. For example, in a prospective study of patients undergoing 'fast-track' or early extubation cardiac surgery ( $N = 1221$ ), risk factors for PONV included: age less than 60 years, female sex, and previous history of PONV.<sup>13</sup> Koizumi et al<sup>12</sup> reported a 70% incidence of PONV in female patients post-cardiac surgery; age and body mass index (BMI), dose of fentanyl, and duration of surgery were, however, not statistically significant. On another hand, Grap et al<sup>10</sup> found that antiarrhythmic, diuretic, and antihypertensive medications, as well as severity of depression were significantly associated with nausea during hospitalization post-cardiac surgery. The inconsistent evidence stems from a number of factors, including the lack of a satisfactory definition of severe nausea, and incomplete data capture. Moreover, the existing risk scores were developed as generic tools and therefore may not be valid in cardiac surgery patients. Risk stratification may facilitate the development of protocols for the prophylaxis and treatment of PONV in this population.

The prevention of PONV has been challenging for care providers, as the factors thought to increase the risk of these symptoms are difficult, if not impossible to manipulate. Although various researchers have explored both pharmacological and alternative treatments for the prevention of PONV following cardiac surgery, the incidence remains high.<sup>15,19,25–28</sup> Therefore, this research was designed to explore the predictors of severe PONV in the cardiac surgery population. Specifically, the study objectives were to: (1) identify the features associated with PONV in patients undergoing a cardiac surgery procedure, (2) determine if the modified Apfel et al<sup>20</sup> PONV risk assessment tool accurately predicts PONV in our cardiac surgery population, and (3) develop a predictive model to identify cardiac surgery patients at higher risk of developing PONV.

## Methods

### Research design

A retrospective cohort analysis of consecutive patients undergoing cardiac surgery over 2-year time period.

### Sample and setting

All cardiac surgery procedures were performed in a single, tertiary centre in western Canada, with an annual case volume of approximately 1100 patients. Data from all patients undergoing isolated coronary artery bypass graft (CABG), isolated valve, or combined CABG and valve surgery procedures between 2009 and 2011 were retrospectively analyzed ( $N = 2994$ ). A power analysis determined that a sample size of 55 patients per study arm was required to establish 80% power to detect a 25% point difference between groups, assuming a 50% PONV rate in the high risk group and a 25% PONV rate in the low risk group. Thus the final sample size of 150 patients allowed for the expectation of a 25% ineligible number of patients.

### Procedures

Study procedures were initiated following the approval of the university ethics review board and the hospital research review committee. Patients with severe PONV were identified using hospital pharmacy data. Granisetron (Kytril; Granisol) is an anti-nauseant/anti-emetic agent that acts on the 5-HT<sub>3</sub>; it is used for significant, refractory post-operative nausea in our cardiac surgery population. Accordingly, the existing routine post-cardiac surgery orders for PONV require evidence of persistent nausea or vomiting following at least two doses of a "standard" agent (i.e., dimenhydrinate) before administering a dose of granisetron. It follows that patients receiving granisetron are typically in considerable distress related to the PONV. Therefore, our operational definition of severe nausea included patients who had received a minimum of one dose of granisetron within the initial 24-hour post-cardiac surgery period.

Based on our preliminary analysis of all cardiac surgery procedures performed between 01/01/08 and 31/12/08 ( $N = 1174$  patients), approximately one quarter ( $n = 286$ ; 24%) of our patients had severe nausea requiring at least one dose of granisetron.

Therefore, consecutive cardiac surgery patients meeting the inclusion criteria were selected for the high risk for PONV ( $n = 74$ ; risk factor score  $\geq 3$ ) versus low risk for PONV ( $n = 76$ ; risk factor score  $< 3$ ) groups, based on the modified Apfel et al<sup>20</sup> PONV risk assessment tool.

### Instrumentation

Data abstracted from the patients' charts were based on the research literature related to predictors of PONV, to include: demographic information, co-morbidities, current medications, type of procedure, pre-operative variables (i.e., last oral intake, pre-op medications), intraoperative and post-operative variables (i.e., length of OR, cross-clamp, and pump times; medications, hemodynamic status, nasogastric tube status, fluid balance, intubation status, arrhythmias), and in-hospital outcomes (e.g., sternal dehiscence, length of ICU and hospital stay). In addition, data related to the validated PONV risk assessment tool developed by Apfel et al.<sup>20</sup> were also elicited. Because all post-operative cardiac surgery patients at our center receive opioids post-operatively, this tool was modified by deleting the risk factor of postoperative opioids. Thus, the modified Apfel tool included four equally weighted PONV risk factors: female sex, history of smoking; history of travel/motion sickness, and previous history of PONV, for a possible total score of 4.

Data specific to PONV were also recorded, including: nausea scores (4-point Likert scale: 0 = no nausea; 3 = severe nausea); vomiting/retching episodes; and anti-emetic medications given during the initial 24 hours post-operative period. This tool has been used in other studies, including those in cardiac surgery patients.<sup>29,30</sup> Previous studies have also used different variations of

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