The benefits of 24/7 in-house intensivist coverage for prolonged-stay cardiac surgery patients

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Objective: The objective of our study was to evaluate the efficacy of 24/7 in-house intensivist care for patients requiring prolonged intensive care unit (ICU) stay following cardiac surgery.

Methods: A propensity-matched retrospective before-and-after observational study comparing 2 models of ICU physician staffing was undertaken. Previously, residents (with intensivist backup) provided care for patients after cardiac surgery (surgical ICU cohort). ICU physician staffing was modified with the implementation of 24/7 in-house board-certified intensivist coverage in a cardiac surgery ICU (cardiac surgery ICU cohort) for postoperative care. Patients with a prolonged ICU stay (ie, >48 hours) were identified and their outcomes analyzed for both models of care.

Results: Propensity matching between cohorts was successful for 271 patients (75.7%), with matched patients being used for comparison. There was no difference in ICU or 30-day mortality. There was also no difference in ICU length of stay (LOS); however, the median hospital LOS was significantly shorter in the cardiac surgery ICU cohort (12.3 vs 11.0 days; $P < .01$). There was a decrease in the proportion of patients receiving transfused red blood cells in the cardiac surgery ICU cohort (80.8% vs 65.7%; $P < .001$). The cardiac surgery ICU cohort had reduced complications relating to sepsis (4.7% vs 0.7%; $P < .01$) and renal failure (22.5% vs 12.5%; $P < .01$); however, the identification of neurologic dysfunction was significantly higher (11.1% vs 20.7%; $P < .01$).

Conclusions: For patients requiring a prolonged ICU stay, our model of 24/7 in-house intensivist coverage was not associated with changes in ICU LOS, nor ICU and 30-day mortality. However a reduction in blood product use, ICU complications, and total hospital LOS was observed. (J Thorac Cardiovasc Surg 2014;148:290-7)

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During past decades there has been increasing complexity and burden of comorbidities in patients undergoing cardiac surgery.[1] Surgery is now frequently, if not routinely, being offered to patients with advanced age, recent coronary syndromes, higher New York Heart Association functional class, and lower left ventricular ejection fraction. As a result, this demographic change in typical patients undergoing cardiac surgery often results in a prolonged intensive care unit (ICU) length of stay (LOS).[2,3] Despite an improved ability to identify patients who are at risk for prolonged ICU stay,[4,5] our ability to address ICU factors leading to poorer outcomes remains limited.

The Society of Critical Care Medicine has previously recommended 24/7 in-house certified intensivist staffing for level-1 critical care centers.[6] Despite this recommendation, only a minority of centers have adopted this initiative.[7] Furthermore, the limited studies that have assessed the efficacy of 24/7 intensivist coverage possess significant heterogeneity in terms of patient population and physician staffing models, thereby generating equivocal results.[8-12] Recently we examined our initial experience with in-house consultant coverage, and found a reduction in allogeneic blood product use, a reduction in the requirement for mechanical ventilation, and an overall reduction in hospital LOS.[13] Although our study was inclusive of all individuals undergoing cardiac surgery, the majority of patients remained lower risk/acuity patients, typically suitable for discharge from the ICU during the proceeding 12 to 24 hours. A more relevant question may be regarding

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Abbreviations and Acronyms
CICU = cardiac surgery intensive care unit
ICU = intensive care unit
LOS = length of stay
SDU = step-down unit
SICU = surgical intensive care unit

the influence of 24/7 intensivist coverage on patients with prolonged ICU LOS following cardiac surgery. It is reasonably hypothesized that these are the patients who may benefit most from the higher acuity of care. Therefore the primary objective of our study was to evaluate the efficacy of having 24/7 in-house intensivists on ICU and postoperative outcomes of those patients with a prolonged ICU stay following cardiac surgery.

MATERIALS AND METHODS

Data Source and Collection

A retrospective analysis was undertaken using the Winnipeg Regional Health Authority ICU and Cardiac Sciences Program surgical databases (Winnipeg, Manitoba, Canada), which contain prospectively collected data. Approval for our analysis was obtained from the research ethics board of the University of Manitoba and informed consent was waived for this retrospective observational study.

Description of the Intensive Care Physician Staffing Models

St Boniface Hospital is the sole regional care center in the province of Manitoba for cardiac surgical procedures (~1.2 million patients referral base). Before 2007, patients undergoing cardiac surgery were admitted to a traditional, mixed discipline surgical intensive care unit (SICU) with a 5- to 6-bed capacity for cardiac patients. Daytime coverage of the SICU consisted of a consultant intensivist and a team of resident physician house-staff from various disciplines. The SICU intensivist would direct the team during daytime rounds for all patients. An in-house resident physician provided overnight coverage with the intensivist providing remote backup coverage. Most issues were dealt with remotely with the intensivist returning to the hospital on rare occasions. Following SICU discharge, patients were transferred to a step-down unit (SDU) for intermediate care before the general cardiac surgical ward. In the SDU, patients could retain invasive hemodynamic monitoring and receive restricted doses of a limited number of inotropic and vasopressor agents with a 3:1 patient to nursing ratio. The SDU environment was separate from the SICU, and was considered an extension of the general ward.

In 2007, a dedicated cardiac surgery intensive care unit (CICU) was created with an 8- to 10-bed capacity. The dedicated CICU model employed 24/7 in-house intensivist coverage. At 1800 hours, the daytime intensivist signed over care to an incoming intensivist who remained in-house until 0800 hours the following day. The following morning, patients were either discharged directly to the ward or signed over to the daytime intensivist for continued CICU care. Concurrent with this change in intensive care physician staffing, the SDU was eliminated, with patients being directly transferred from the CICU to the ward.

Study Cohort

Prolonged ICU stay following cardiac surgery remains ill defined within the literature.[4,14,15] It can be argued that patients undergoing cardiac surgery in the modern era fall into 1 of 2 categories.[15,16] First, those who are generally healthy undergoing low-risk operations (ie, isolated coronary artery bypass grafting); these individuals are candidates for next-day ICU discharge.[17] A second group of patients are those with multisystem issues requiring complex surgical procedures. Because the majority of patients fall into the former category, we determined it prudent to define prolonged ICU stay following cardiac surgery as those individuals who are not eligible for next-day ICU discharge. In addition, to ensure the exclusion of those patients who remained within the ICU as a result of insufficient ward bed availability, prolonged ICU stay was defined as LOS > 48 hours.

All patients undergoing a cardiac surgical procedure, regardless of comorbidity or urgency status, with a prolonged ICU LOS were included in the study. The SICU cohort (ie, control group) consisted of patients admitted to the traditional ICU 2 years before creation of the CICU (January 2005-January 2007). The CICU cohort consisted of patients admitted to the newly created dedicated CICU (January 2007-September 2008). Variables assessed in all patients included baseline demographics, relevant comorbidities, laboratory parameters, and operative details, in addition to ICU and hospital outcomes. Society of Thoracic Surgeons definitions were used for operative characteristics and postoperative ICU and hospital outcomes. ICU outcomes were complete for 100% of the patients for a 10-day period following admission after surgery.

End Points

The primary objective of our study was to evaluate the efficacy of 24/7 consultant care. To this extent, primary end points of interest included ICU and hospital LOS, recidivism, and ICU and 30-day mortality. ICU recidivism was defined as readmission to the ICU during the same hospital stay.[18] Secondary end points included duration of mechanical ventilation and allogeneic blood transfusion.

The secondary objective of our study was to investigate common ICU complications (eg, respiratory failure, pneumonia, renal failure, sepsis, cardiac arrhythmias, central line infections, cardiac arrest, and neurologic dysfunction) and resource use (eg, vasoactive drug, hydroxyethyl starch, and pulmonary artery catheter use) of patients requiring a prolonged stay. See Table E1 for a complete list of ICU complications.

Statistical Analysis

Data are presented as mean ± standard deviation or median and corresponding interquartile range where appropriate. Baseline characteristics of patients in both ICU cohorts were compared using Student t test for continuous variables and χ^2 testing for categorical variables. ICU mortality and 30-day mortality were both expressed as a proportion and as an odds ratio (OR) with 95% confidence intervals. An OR < 1 signifies decreased mortality in the CICU model compared with the former SICU model of care. The median ICU and hospital LOS were compared using the Wilcoxon rank-sum test. All reported P values are 2-tailed, with $\alpha < 0.05$.

Because it was not possible to randomly assign the model of ICU care, a propensity analysis was undertaken to account for potential confounding factors and case selection biases. Methodology and the reporting of these data were based on a previous publication, which used propensity methods.[19] A propensity score derived from clinical and laboratory data was developed using multivariable logistic regression. Variables used included demographic data (eg, age, gender, body mass index, and acute physiology and chronic health evaluation II score), baseline comorbidities (eg, hypertension, dyslipidemia, diabetes, smoking history, chronic obstructive pulmonary disease, previous cerebral vascular accident, and peripheral vascular disease), cardiac history (Canadian Cardiovascular Society classification; congestive heart failure history; previous myocardial infarction; left ventricular ejection fraction grade; cardiogenic shock; and preoperative aspirin, beta-blocker, and angiotensin-converting enzyme inhibitor use), and operative data (eg, preoperative hemoglobin, reoperation, surgical status, surgical procedure, intra-aortic balloon pump

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