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Sedation/Delirium

Perioperative prediction of agitated (hyperactive) delirium after cardiac surgery in adults – The development of a practical scorecard

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ABSTRACT

Background: Delirium is a temporary mental disorder that occurs frequently among hospitalized patients. In this study we sought to develop a user-friendly scorecard based on perioperative features to identify patients at risk of developing agitated delirium after cardiac surgery.
Methods: Retrospective analysis was performed on adult patients undergoing cardiac surgery in a single center. A parsimonious predictive model was created, with subsequent internal validation. Then a simple scorecard was developed that can be used to predict the probability of agitated delirium.
Results: Among the 5584 patients who met the study criteria, 614 (11.4%) developed postoperative agitated delirium. Independent predictors of postoperative agitated delirium were age, male gender, history of cerebrovascular disease, procedure other than isolated Coronary Arteries Bypass Surgery, transfusion of blood products within the first 48 h, mechanical ventilation for >24 h, length of stay in the Intensive Care Unit. The scorecard stratified patients into 4 categories at risk of postoperative agitated delirium ranging from <5% to >30%.
Conclusion: Using a large cohort of adult patient's undergoing cardiac surgery, a user-friendly scorecard was developed and validated, which will facilitate the implementation of timely interventions to mitigate adverse effects of agitated delirium in this high risk population.

1. Introduction

Delirium or acute confusion is a temporary mental disorder that occurs frequently among hospitalized patients [1]. Delirium is certainly an adverse neurocognitive outcome after cardiac surgery; especially in vulnerable patients and it influences additional complications [2,3]. Royston and Cox state that "from the patient's point of view, delirium, and subsequent cognitive decline is among the most feared adverse events following surgery" [4].

Delirium symptoms range from a disturbance in consciousness (e.g.: coma, disorders related to concentration, and attention) to cognitive disorders involving disorientation and hallucinations. There is also a motor component, and presentation ranges from a depression-like inactive state, to an agitated hyperactive state. This diversity of possible presentations, along with its sudden onset and unpredictable course, makes early detection difficult.

Patients undergoing cardiac surgery are considered to be at higher risk of developing delirium. In several studies, delirium – especially after cardiac surgery – was linked to increased morbidity and mortality [3,5-7]. The effects of delirium can extend beyond the initial hospitalization; a retrospective review by Martin et al. discovered that patients with delirium following Coronary Arteries Bypass Graft surgery (CABG) exhibit an increased long-term risk of death and stroke [8]. One study identified delirium as a predictor of post-CABG sepsis [2]. Others have demonstrated a strong association between delirium and post-operative infections in cardiac surgery patients [8-11].

One of the most significant predisposing factors for delirium is the patient age at surgery [1,6,9,12-16]. Some authors have also linked delirium to frailty [17-21]. Recent studies indicate a substantial, and alarming, increase in the number of elderly frail patients undergoing cardiac surgery [22,23]. Several studies have shown that preventive interventions can decrease the incidence of delirium and improve outcomes [16,24-26]. Therefore, prevention or early recognition of delirium is essential.

The purpose of this study was to identify the peri-operative variables that influence the development of postoperative delirium after cardiac surgery. Key variables were then used to generate a risk model that allows the prediction of patients who are at risk of developing delirium after cardiac surgery. Then an easy-to-use, yet clinically relevant patient specific, dynamic scorecard was developed. The scorecard will be used to identify patients at risk of developing delirium after cardiac surgery

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in an attempt to initiate preventive measures and appropriate therapies, mitigating the negative effects of delirium.

2. Materials and methods

2.1. Data sources and study population

This single-center retrospective cohort study included patients who underwent cardiac surgery at the Queen Elizabeth II Health Sciences Centre (QEII HSC) in Halifax, Canada, between January 2006 and December 2012. The following procedures were included: isolated Coronary Arteries Bypass Grafts (CABG) surgery; isolated valve surgery, which includes: Aortic Valve Replacement (AVR), Mitral Valve Replacement (MVR), and Mitral Valve Repair (MV-Rep) or a combined CABG and valve procedure. Other cardiac operations (like: aortic valve repair, tricuspid valve repair, thoraco-abdominal aneurysm…) ventricular assist device implantations, and transplantations were excluded from the study population. Patients were identified using the Maritime Heart Center (MHC) registry. The MHC registry is a prospectively collected, detailed clinical database containing pertinent pre-, intra- and postoperative data on all cardiac surgical cases performed at the QEII HSC from March 1995 until the present. The registry is based on the framework and data definitions used by The Society of Thoracic Surgeons (STS), and has >20,000 patients and >500 different variables.

After surgery, all patients were managed in a dedicated Cardiac Surgery Intensive Care Unit with standardized pre-printed orders. Post-operative sedation was accomplished by using propofol infusion, unless contraindicated, to achieve a Richmond Agitation–Sedation Scale (RASS) between −2 and 0. Post-operative pain control for intubated patients consisted of Acetaminophen (with or without Codeine) through the feeding tube and intravenous opioids (mainly Fentanyl, but sometime morphine or hydromorphone) and was tailored for each patient by the intensive care team. Once extubated, opioids were switched to a suitable alternative oral form (mainly hydromorphone, but sometime morphine) and non-opioid analgesics (Acetaminophen with or without Codeine, Tramadol, or NSAIDs).

Delirium is defined as short-lived mental disturbance marked by illusions, confusion, or cerebral excitement, requiring temporary medical/physical intervention, a consult, or extends the patient's hospital stay, as per the STS definition [27]. This definition will only include patients with agitated delirium, which represents the smaller portion of patients who develop post-operative delirium compared to the mixed and hypoactive types [19,20,28,29]. Delirium is captured via manual chart abstraction, which is done by trained chart abstracters. Delirium is considered present if it is documented in the patient chart by the primary medical team (intensive care or cardiac surgery) and/or a neurology, geriatrics, or psychiatry consult was obtained and confirmed the diagnosis of delirium.

Full ethics approval was obtained from the Capital Health Research Ethics Board, in keeping with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans. Informed consent was waved by the ethics board as the study did not involve therapeutic interventions or potential risks to the involved subjects.

2.2. Defining delirium

Delirium is a disturbance of consciousness, attention, cognition, and perception. The disturbance develops over a short period of time (usually from hours to days) and tends to fluctuate during the course of the day [17]. The medical community has always been aware of delirium's wide range of presentations, from extremely dangerous agitation to depression-like isolation. Nonetheless, the latest updates of the DSM-5 and Geriatric Psychiatry, Fifth Edition were the first place to formally establish 3 distinct subclasses based on presentation: hyperactive, hypoactive, and mixed [12].

Following the STS definition, this dataset defines delirium as mental disturbance marked by illness, confusion, and cerebral excitement, with a comparatively short course [27]. This definition will only include patients with agitated delirium, which represents the smaller portion of patients who develop post-operative delirium compared to the mixed and hypoactive types [19,20,28,29]. Delirium in the maritime heart center database is coded as a binary outcome (Yes/No) and is defined as short-lived mental disturbance marked by illusions, confusion, or cerebral excitement, requiring temporary medical and/or physical intervention, a consult, or extends the patient's hospital stay. This is captured via manual chart abstraction, which is done by trained chart abstracters. The chart abstracters look for any subjective documentation of delirium by the medical team in the chart.

Unfortunately, this definition will only include patients with hyperactive delirium, which usually represent the smaller portion of delirium. In reality, hypoactive delirium is more common in elderly (>65 years) and has been linked to worse outcomes including prolonged ventilation, prolonged hospital stay, and even death [6,9,11,16,20,28,30].

2.3. Identifying agitated delirium

The initial diagnosis of agitated delirium was clinically suspected based on an acute fluctuating temporary agitation, a disturbance in attention or awareness, accompanied with periods of normal mental status in-between episodes, that is not better accounted for by a pre-existing neurocognitive pathology.

In the Intensive Care Unit (ICU), The Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) was used to trigger further investigations if delirium was suspected, although this was not consistent throughout the study period. If delirium was suspected in the general ward (after discharge from the ICU), the diagnosis was confirmed by the consulted service (neurology, geriatrics, or psychiatry) using different diagnostic criteria & screening tools (e.g.: mini-mental test, confusion assessment method, etc.).

2.4. Intraoperative management

Anesthetic management varied depending on the anesthetist preferences. Although, most patients were anesthetized in a systematic approach involving oral premedication with midazolam, induction with intravenous propofol and fentanyl or remifentanil, muscle relaxation with a non-depolarizing muscle relaxant (pancuronium or cisatracurium). The anesthesia was sustained with combined intravenous (midazolam, propofol, or fentanyl) and inhalational anesthesia (sevoflurane or isoflurane). Hemodynamics monitoring was continuous using an invasive blood pressure arterial line, central venous line (with or without a Swan-Ganz pulmonary catheter), electrocardiography using pericardial leads and a folly catheter to monitor urine output. First generation cephalosporin was used for antibiotic prophylaxis of. In case of a documented penicillin allergy, vancomycin was used. A median sternotomy was the most common approach. Some patients had a minimally invasive right thoracotomy for isolated mitral valve repair. Most cases were done On-pump (using cardiopulmonary bypass (CPB)). Anticoagulation during On-pump cases required the administration of low molecular weight heparin at a dose of 4 mg/kg to accomplish an activated clotting time (ACT) of ≥480 s before initiation of CPB. In the off-pump group, low molecular weight heparin at a dose of 2 mg/kg was given before manipulating the heart to achieve an ACT of at least 300 s. At the end of the case, protamine sulfate was given to reverse the effect of heparin. Blood and blood products were administered based on the clinical situation, status of the bleeding, and laboratory coagulation profile after the reversal of heparin effect. Almost all patients were transferred to the ICU intubated and sedated with a propofol infusion. Patients were monitored in the ICU for at