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Outcomes / Predictions

The impact of delayed rapid response call activation on patient outcomes

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ABSTRACT

Purpose: To investigate the impact of delay in rapid response call (RRC) activation on Hospital mortality.
Materials and methods: This study was conducted in a university affiliated hospital providing medical, surgical, mental health, maternity, and pediatric services. RRCs were considered delayed if RRC activation was delayed by ≥15 min. The primary outcome measure was in-hospital mortality. Secondary outcomes included hospital length of stay (LOS), requirement of ICU admission, as well as requirement of mechanical ventilation and ICU LOS for patients requiring ICU admission.
Results: A total of 826 RRCs occurred in 629 patient admissions. A quarter of all RRCs were delayed by ≥15 min, with a median delay of 1 h and 20 min. Patients with a delayed RRC had significantly higher in-hospital mortality (34.7% vs. 21.2%; p = 0.001,) and significantly longer hospitalizations (11.6 vs. 8.4 days; p = 0.036). After adjusting for confounders, RRC activation was independently associated with increased in-hospital mortality (*OR = 1.79; 95% CI = 1.17–2.72*: p = *0.007*).
Conclusions: A delay of ≥15 min was associated with significantly increased in-hospital mortality and longer hospitalization. The factors contributing to the observed increase in mortality with delayed RRCs require further exploration.

1. Introduction

Rapid response systems (RRS) are designed to identify deteriorating patients and provide appropriate and timely care at the bedside for deteriorating patients in the ward setting. Such systems broadly constitute two arms: 1) detection of deteriorating patients and timely activation of rapid response calls (RRCs) (the "afferent limb"); and 2) appropriate and timely response by adequately trained and well equipped Rapid Response team (RRT) (the "efferent limb").

Timely activation of a RRC is vital for preventing further patient deterioration by allowing the RRT to respond appropriately. Despite this, afferent limb failure (ALF) remains a major limitation of well-established RRS, with evidence to suggest that failure to appropriately monitor and recognize signs of physiological deterioration, and to appropriately activate RRCs is common [1-3]. There is also evidence to suggest that ALF resulting in delay in RRC activation is associated with an increase in adverse patient outcomes such as higher mortality, unplanned Intensive Care Unit (ICU) admissions and longer hospitalization [4-6]. A recent review of data from the MERIT study, a 23-hospital cluster randomized trial, revealed an association between delay in RRC activation of 15 min or more and higher risk of death and unplanned ICU admission [5]. More recently, another single center study from a tertiary care institution found that delay in activation of RRC of 1 h or more was associated with increased hospital mortality and length of stay (LOS) [6].

Characteristics of specific healthcare services or facilities may influence both the afferent and efferent limbs of a RRS. Patient demographics, case mix, and staffing levels and training can vary between tertiary and non-tertiary institutions and have the potential to influence ALF, as well as the outcomes of patients with delayed RRC activation. Previous studies investigating the impact of delay in RRC activation on patient outcomes have been conducted exclusively at tertiary institutions [4,6], or utilizing data collected from multiple sites with heterogeneous resources and patient populations, and with immature RRS [5]. This study aimed to investigate the incidence of delay in RRC activation and whether delay in RRC activation of 15 min or more is associated with worse patient outcomes (including in-hospital mortality, longer

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hospitalization, and ICU admission) in a metropolitan Australian hospital with a well-established RRS.

2. Methods

2.1. Design

This study was a single centre retrospective observational study, investigating the impact of delay in RRC activation on patient outcomes including ICU admission, hospital LOS, and in-hospital mortality.

2.2. Ethical approval

This project was reviewed and approved as audit activity by Research Governance of Peninsula Health (ref. QA/14/PH/26). Informed consent was not required as this study was a retrospective chart review that required no patient contact.

2.3. Study setting

This study was conducted in a metropolitan hospital located in metropolitan Melbourne (Victoria, Australia). At the time of this study (2013) this hospital had approximately 500 in-patient beds, providing medical, surgical (excluding cardiac and neurosurgery), mental health, maternity, and pediatric services.

The hospital RRS was established in 1999. At the time of this study, RRCs were activated as "Code Blue" for cardiorespiratory arrest, or "MET" (Medical Emergency Team) calls for patients meeting any other criteria listed in Table 1. MET calls were responded to by a Critical Care Liaison Nurse (CCLN) (between 8:30 and 17:00) or ICU nurse (between 17:00 and 08:30), an ICU senior registrar, and a medical registrar. "Code Blue" calls were attended by a coronary-care trained nurse in addition to the MET team. An anesthetist attended the RRC if assistance was required to manage the patient's airway. This RRS operated seven days per week, all year-round.

A report was made at the time of each RRC using a standardized template, which was filed in patient case notes. This information was also entered into an electronic database maintained by the CCLN team.

2.4. Patients

All admissions to Frankston Hospital during the calendar year of 2013 that had a RRC were identified from CCLN databases. RRCs for visitors, staff, and outpatients were excluded due to a lack of documented physiological observations prior to the RRC, which were necessary to determine if the RRC activation was delayed.

Further RRCs were excluded if there was insufficient documentation to allow researchers to determine whether the RRC was delayed. Pediatric patients (<16 years) were also excluded from analysis (Fig. 1).

Table 1
Criteria for activation of a MET call at the study hospital. Cardiorespiratory arrests trigger a 'Code Blue' rapid response call. Upper and lower limits are provided for criteria with specified thresholds.

System	Criteria	Lower limit	Upper limit
Airway	Airway threatened		
	Airway obstructed		
Breathing	Respiratory rate (breaths per minute)	8	36
	SaO_2 (on supplemental oxygen)	90%	
	Respiratory distress		
Circulation	Systolic blood pressure (mm Hg)	90	180
	Heart rate (beats per minute)	40	130
	Arrhythmia		
	Urine output	50 mL/4 h	
Neurological	Altered conscious state		
	Seizures		
Other	Staff concern		

2.5. Data collection and variables

Patient demographics were retrieved from their medical records. The trigger for RRC activation (Table 1), and date and time of each RRC was retrieved from CCLN databases and confirmed against patient case notes.

RRCs between the hours of 8:30 and 17:00 were defined as 'in-hours' based on the working hours of the CCLN team during the study period. RRCs occurring outside of this time period were considered 'out-of-hours'.

For each RRC, an experienced intensivist reviewed the patient's case notes and determined if the RRC activation had been delayed or not. A RRC was considered to be delayed if:

- There were documented observations meeting criteria for RRC activation (Table 1);
- These observations were documented ≥15 min prior to the time of RRC activation, as documented in the RRC database and confirmed using patient case notes; *and*
- These abnormal observations were not documented to return to within normal limits prior to the RRC activation

If there were no abnormal observations recorded prior to the RRC activation it was considered that the RRC was not delayed, regardless of the time between the last documented observations and the RRC activation. This threshold of 15 min was used by previous Australian studies investigating the impact of delay in RRC activation on patient outcomes [5].

The outcomes for patient admissions with one or more delayed RRC during the hospital admission were then compared to admissions with no delayed RRCs.

2.6. Outcomes

The primary outcome for this study was in-hospital mortality. Secondary outcomes included need for ICU admission and hospital LOS.

Proportion of patients and total length of mechanical ventilation and renal replacement therapy, total number of ICU admissions within the same hospital admission, and total length of ICU stay during the hospital admission were recorded for patients admitted to ICU. Non-invasive ventilation (NIV) that was commenced or recommenced during a RRC was recorded for each patient.

2.7. Statistical analysis

Chi-squared tests for proportions were used to compare the distribution of categorical variables between groups. Mann-Whitney *U* tests were used to compare continuous variables (such as hospital LOS) between groups, as these variables were not normally distributed. Multivariable analysis was performed to assess the independent effect of delayed RRC on hospital mortality. Variables that were found to be statistically significantly different between groups, and those judged to be clinical significant were included as covariates in multivariable analysis. These variables included age; age-adjusted Charlson Comorbidity Score (CCI); whether the patient was classified as a medical or surgical admission; and whether the patient had any RRCs that occurred out-of-hours, on weekends, on surgical wards, or due to low oxygen saturation. Statistical significance was set at a two-tailed p-value of <0.05. All statistical analysis was conducted using SPSS (IBM, v.20) statistical package.

3. Results

3.1. Patient demographics

Patient admission demographics are summarised in Table 2. During the study period there were 826 RRCs occurring across 629 admissions.