



Clinical paper

In-hospital cardiac arrest after a rapid response team review: A matched case–control study[☆]Joonas Tirkkonen^{a,*}, Heini Huhtala^b, Sanna Hoppu^c^a Department of Intensive Care Medicine, Tampere University Hospital and Department of Anaesthesiology and Intensive Care Medicine, Seinäjoki Central Hospital, PO Box 2000, FI-33521 Tampere, Finland^b Faculty of Social Sciences, University of Tampere, FI-33014, Finland^c Department of Intensive Care Medicine, Tampere University Hospital, PO Box 2000, FI-33521 Tampere, Finland

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ABSTRACT

Aim: Study the incidence and reasons behind in-hospital cardiac arrests (IHCAs) after rapid response team (RRT) reviews.

Methods: We conducted a matched case–control study at Tampere University Hospital, Finland. Data on adult patients who were triaged to remain on general ward after first (index) RRT review without treatment limitations but who suffered an IHCA within the following 48 h were prospectively collected for 5.3 years. These cases were matched (age \pm 3 years, sex, surgical/medical ward, admission year) at a 1:4 ratio to controls (no ICHA after RRT review).

Results: Of 2653 index RRT reviews, 17 patients suffered an IHCA on general ward within the 48 h after review. Their 30-day mortality rate was 88%. The incidence was 6.3/1000 index RRT reviews or 4.6/100,000 hospital admissions. Patients who suffered an IHCA within 48 h after RRT review were more likely to have a preceding ICU admission, and their median national early warning scores (NEWSs) at the end of the index RRT reviews (=last NEWSs) were higher than those of the controls. Higher last NEWS was the only factor associated with ICHA after RRT review (OR 1.22, 95% CI 1.00–1.49, $p = 0.048$) in a conditional multivariable regression model.

Conclusions: IHCA within 48 h after an index RRT review on general ward is a rare event with poor prognosis. It is independently associated with higher NEWS at the end of the index RRT review. Careful consideration is stressed, when patients with high NEWS are left on ward after RRT reviews.

Introduction

The incidence of adult in-hospital cardiac arrest (IHCA) is approximately 1.6 cases per 1000 hospital admissions [1]. Most IHCAs are preceded by derangements in vital signs, and the probability of survival to hospital discharge decreases as the number and severity of vital dysfunctions before the event increase [2,3].

If vital dysfunctions occur, rapid response teams (RRTs) review general ward patients to prevent IHCAs via minor interventions and timely transfers to intensive care [4]. Most RRT patients are triaged to remain on general ward without do not attempt resuscitation (DNAR) –orders [5,6]. One study that investigated the short-term outcomes among this RRT population found that 0.4% of no-DNAR patients triaged to remain on ward died during the following 24 h [6].

Is IHCA after an RRT review truly such a rare event, and is there something that the RRT misses during these reviews? In this matched

case–control study, we aimed 1) to report the incidence and prognosis of an IHCA occurring within 48 h after RRT triages a patient to remain on ward without a DNAR order and 2) to investigate thoroughly whether these cases (IHCA after RRT review) differed from controls (no IHCA after RRT review) at the time of their index RRT review.

Methods

Ethics

The Ethics Committee of the Tampere University Hospital (Tays) approved the study protocol (Approval no: R10111, 2010). Patient consent was waived, as this was an observational study.

[☆] A Spanish translated version of the abstract of this article appears as Appendix in the final online version at <https://doi.org/10.1016/j.resuscitation.2018.03.007>.

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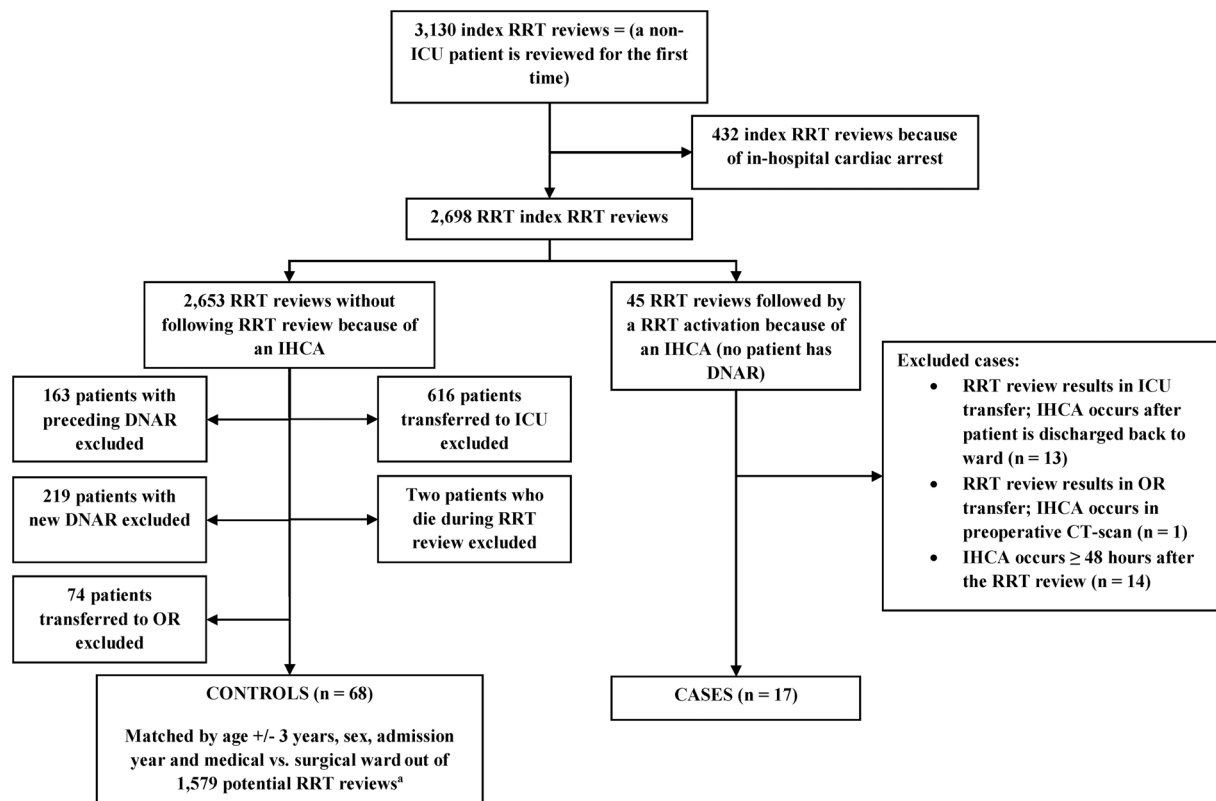


Fig. 1. Study cohort. RRT, rapid response team; IHCA, in-hospital cardiac arrest; DNAR, do not attempt resuscitation; ICU, intensive care unit; OR, operation room; CT, computed tomography.

^aOne medical patient under 50 years of age could not be matched for admission year (only six patients with similar age, sex and ward among the cohort of 1579 potential control patients).

Hospital

Tays is one of five tertiary referral centres in Finland, with approximately 70,000 somatic admissions annually. The hospital provides the most advanced care for a catchment population of 1.1 million citizens. The intensive care unit (ICU) currently has 21 beds, with approximately 2100 admissions per year. There is a separate ICU with seven beds for surgical cardiothoracic patients.

Rapid response team

The hospital’s rapid response system was implemented in January 2009. The ICU-operated RRT is physician led and the general ward staff utilise dichotomised RRT trigger criteria (heart rate < 40/min or > 140/min, systolic blood pressure < 90 mmHg, peripheral arteriolar oxygen saturation < 90%, respiratory rate < 5/min or > 24/min, decrease in state of consciousness and the ‘worried’ criterion). The RRT attends both medical emergencies and cardiac arrests 24/7. Although the RRT is physician-led, the RRT nurses may attend a patient by themselves (in collaboration with the parent unit physician) and only consult with the RRT physician by phone.

Definitions

‘Index RRT review’ refers to a patient’s first RRT review during his/her hospitalisation. ‘Delayed RRT activation’ refers to a RRT activation that is preceded by recorded objective RRT activation criteria 20–360 min before the RRT review is triggered. Patients’ cumulative comorbidity was assessed with the Charlson comorbidity index (CCI) [7]. National early warning score (NEWS) is an early warning scoring system that has been implemented in all public hospitals in the United Kingdom [8]. NEWS provides a standardized method for the assessment and response to acute illness [8]. Each of the seven included vital signs

(heart rate, systolic blood pressure, respiratory rate, peripheral blood oxygen saturation, body temperature, level of consciousness and the need for supplementary oxygen) is scored from 0 to 3 depending on how abnormal the measured value is. The total score is added up, and a score of ≥ 7 is considered a status that requires immediate RRT review [8].

Exclusion criteria

RRT activations for paediatric patients (< 18 years) and index RRT reviews including an IHCA were excluded. RRT reviews for operating rooms, ICUs and the emergency room were further excluded, as were RRT reviews for outpatients. Finally, RRT reviews of patients with pre-existing or new DNAR orders and RRT reviews resulting in ICU/operating room transfer were excluded.

Data collection

Prospective data collection began in 1 January 2010 as a part of an ongoing project involving RRT data gathering per the Utstein Style [9]. No previous study had documented the incidence of IHCA reviews, so data for precise sample size calculations were not available. We aimed to collect data within a six-year period, as a longer study period would inevitably have affected the internal validity of the results. However, data collection was terminated eight months ahead of time, on 31 April 2015. Because only one case had occurred in the previous 12 months, our research resources were directed to another study.

The initial data collection consisted of Utstein-style RRT templates [9], which were completed by the RRT nurses at scene. The RRT nurses recorded patient’s name and social security number, event location, RRT review reason with a short verbal comment on the preceding events, vital signs (which were measured multiple times during the reviews), all conducted examinations and interventions, possible

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