How common are ventricular arrhythmias in patients admitted to CCU with chest pain and a non-ischaemic ECG? A pilot study

Anne-Maree Kelly,[1] Sharon Klim[2]

[1]Joseph Epstein Centre for Emergency Medicine Research at Western Health and The University of Melbourne, Victoria, Australia
[2]Joseph Epstein Centre for Emergency Medicine Research at Western Health, Victoria, Australia

Correspondence to
Professor Anne-Maree Kelly, Joseph Epstein Centre for Emergency Medicine, JECEMR, Sunshine Hospital, St Albans 3021, Australia;
anne-maree.kelly@wh.org.au

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ABSTRACT

Objective The aim of this study was to determine the incidence of serious ventricular arrhythmias in a cohort of patients admitted to coronary care units for investigation and treatment of possible acute coronary syndrome.

Design Secondary analysis of prospective cohort study.

Setting Community teaching hospital.

Patients Adults (>18 years) admitted to coronary care unit with chest pain and non-ischaemic ECG.

Interventions None.

Main outcome measures Rate of serious ventricular arrhythmia during hospital stay.

Results 397 patients were studied; median age 64 years, 65% male; median Thrombolysis in Myocardial Infarction score 3; troponin elevation 43%, final diagnosis myocardial infarction 32%. No patient in the study suffered a serious ventricular arrhythmia (0%, 95% CI 0 to 1.0%).

Conclusion Patients admitted to coronary care units for investigation and treatment of possible acute coronary syndrome with a non-ischaemic ECG have a very low rate of serious ventricular arrhythmia.

INTRODUCTION

Patients admitted to hospital for investigation of potentially ischaemic chest pain are often admitted to coronary care units (CCUs) for continuous cardiac monitoring and close observation. The rationale for this approach appears to follow from the improvement in survival seen with the introduction of this approach to identify and treat arrhythmias (in particular ventricular arrhythmias) in patients with myocardial infarction in the 1960s.[1–3] At that time, myocardial infarction was almost exclusively diagnosed based on ECG findings, in particular ST segment elevation, and the ventricular arrhythmia rate was of the order of 8–10%.[4]

In 2010, ECG-diagnosed myocardial infarctions were in the minority compared with those diagnosed on the basis of biomarkers, in particular troponin. In addition, a proportion of patients admitted for investigation will prove to have non-infarction acute coronary syndrome (ACS) or a non-ACS diagnosis. The cost of the CCU model of care for these patients groups needs to be balanced against the risk of serious arrhythmias. There is also the possibility that lower-risk patients managed in CCU might prevent higher-risk patients from accessing a CCU bed, with similar flowback effects in emergency departments (EDs).

There is some evidence suggesting that the rate of serious arrhythmias in an ED population without ECG changes being investigated for chest pain is very low.[5] However, there are few data exploring the incidence of life-threatening ventricular arrhythmias in the group of patients admitted to CCU for investigation and treatment of possible ACS who do not have ECG evidence of infarction.

The aim of this study was to determine the incidence of serious ventricular arrhythmias in a cohort of patients admitted to CCU for investigation and treatment of possible ACS.

METHODS

This is a secondary analysis of a subset of data from a prospective cohort study of adult patients attending the ED of a community teaching hospital with chest pain of potential cardiac origin as assessed by the treating clinician. The study ED has an annual census of 36 000 patients. Patients were excluded from the parent study if they had clearly ischaemic ECG features identified by the treating clinician, they did not have a troponin assay or ECG performed within 24 h of pain onset, there was a clear non-ACS diagnosis made by the treating clinician at initial assessment, or they had a serious arrhythmia prehospital or at ED presentation. The eligibility criterion for this analysis was admission to CCU for further testing or treatment. The study hospital has a two-tiered chest-pain-management process. Patients falling into the low- or intermediate-risk groups as defined by Heart Foundation (Australia) Guidelines for the Management of Acute Coronary Syndromes (2006)[6] are eligible for an ED-based accelerated chest-pain-assessment pathway. Those defined by the guideline as high risk or with another specific clinical concern are referred to the cardiology team for consideration of CCU admission. The final decision to admit to CCU was made by the duty cardiology team, based on their assessment of the patient and initial investigation findings.

Data collected included demographics, risk factor profiles, Thrombolysis in Myocardial Infarction and Global Registry of Acute Coronary Events score data, ECG and biomarker assay (troponin I, TnI) results, ED disposition and in-hospital adverse events (death, new infarction, serious arrhythmia, cardiogenic shock, pulmonary oedema). The assay used by the laboratory was TnI-Ultra by Siemens Diagnostics, formerly Bayer Diagnostics performed on an Advia Centaur analyser. The test has a reported range of 0.006 to 50 ng/ml. The coefficient of variation is 10% at TnI 0.03 ng/ml, 5.3% at 0.08 ng/ml and 4.1% at 0.18 ng/ml. The 99th centile is 0.04 ng/ml (95% CI 0.03 to 0.05 ng/ml;

information provided by manufacturer). All treatment, including duration of monitoring, was at the discretion of the treating cardiologist.

The primary outcome of interest was the rate of serious ventricular arrhythmia during the CCU stay. Secondary outcomes of interest were subgroup analysis for the groups with a final diagnosis of myocardial infarction, those with a TnI level >99th centile of the normal population for the test (0.04 ng/ml) and those with a TnI level more than five times the 99th centile. The latter was chosen, as some authors suggest that with the increased sensitivity of troponin assays, this is the level where specificity for myocardial necrosis becomes more acceptable.[7] For this study, serious ventricular arrhythmias were defined as ventricular fibrillation or sustained ventricular tachycardia (>10 beats) requiring treatment.

Analysis was by descriptive statistics. CIs (95%) were calculated using the Wilson procedure.[8 9] No sample-size calculation was undertaken. The study was approved by the low-risk ethics panel of the administering organisation. Patient consent was not required.

RESULTS

Three hundred and ninety-seven eligible patients were identified. Characteristics of the sample are shown in table 1. Clinical features and final diagnosis are shown in table 2. Two hundred and twenty-five (56.7%) patients had neither an initial nor peak troponin >99th centile of the test. One hundred and sixty-two patients (43.3%) had a troponin assay >99th centile of the test, and 122 (30.7%) had a troponin assay more than five times the 99th centile of the test.

No patient in the study suffered a serious ventricular arrhythmia (0%, 95% CI 0 to 1.0%). Regarding the subgroups, the CIs were: myocardial infarction 0 to 3.0%, TnI >99th centile of the test 0 to 2.3% and TnI more than five times 99th centile 0 to 3.1%.

Table 1 Characteristics of the study sample

Variable	Data	
Age	Median 64, IQR 56–76, range 21–96	
Gender	Male=259, 65%	
Mode of arrival	Ambulance 265, 67% Self 128, 32% Transfer 2, 0.5% Missing data 2	
Risk factors	Hypertension	283, 71%
	Diabetes	138, 35% (2 missing data)
	Smoker	212, 53%
	Renal impairment	41, 10%
	Family history	99, 25%
	Hypercholesterolaemia	254, 64%
Comorbidities	PVD	25, 6%
	CHF	58, 15%
	Prior AMI	121, 31%
	Known coronary stenosis	170, 43%
	Prior atrial fibrillation	54, 14%
	LVEF <0.4	6, 1.5%
	PCI <6 months	14, 3.5%
	CABG	50, 14%
Medications	Aspirin	205, 52%
	Warfarin	34, 8.6% (one missing data)
	Statin	218, 55% (one missing data)
Thrombolysis in Myocardial Infarction score	Median 3, IQR 2–4, range 0–7	
Global Registry of Acute Coronary Events score	Median 112, IQR 88–140, range 21–228	

Table 2 Clinical features and outcome

Variable	Data	
Clinical features	Pulse rate	Median 76, IQR 65–91, range 30–199
	Systolic blood pressure	Median 136, IQR 121–153, range 60–220
	Creatinine	Median 90, IQR 80–120, range 50–540
	Syncope	16, 4%
	Killip class	I 288, 73% II 108, 27% III, 1, 0.3%
Troponin I (initial)	Median 0.02, IQR 0.02–0.09, range 0.02–50	
Troponin I (peak <24 h)	Median 0.02, IQR 0.02–0.26, range 0.02–50	
Final diagnosis	Myocardial infarction	126, 32%
	Non-AMI ACS	117, 29%
	Non-ACS	46, 12%
	Chest pain without diagnosis	108, 27%

ACS, acute coronary syndrome; AMI, acute myocardial infarction.

DISCUSSION

This study suggests that patients with potentially ischaemic chest pain but without ECG changes of infarction admitted to CCU have a very low risk (<1%) of serious ventricular arrhythmia. This challenges the practice of recommending continuous cardiac monitoring for all patients undergoing assessment of potential ACS. Such a low arrhythmia rate could prompt consideration of other models of care, reserving continuous monitoring/CCU care for higher-risk patients.

Although numbers of patients with myocardial infarction and elevated TnI were small, resulting in CIs for ventricular arrhythmia up to 3.1%, no patient in either group experienced a serious ventricular arrhythmia. This raises the possibility that elevation of TnI in the absence of ECG changes is not associated with significant risk of serious ventricular arrhythmia. This question is worthy of further research. Our finding might appear to be at odds with the findings of Avezum *et al*,[10] who reported a 3.5% rate of ventricular arrhythmia or cardiac arrest in the non-ST-elevation myocardial infarction cohort of their registry based study and with those of Al-Khatib *et al*,[11] who reported a rate of 2.1% in a pooled analysis of randomised trials of platelet IIb/IIIa inhibitors for unstable angina. The reasons for the discrepancy are likely due to different selection criteria. For the Global Registry of Acute Coronary Events registry study,[10] patients were required to have a clinical history consistent with ACS accompanied by either ECG changes consistent with ACS, serial increases in biochemical markers of cardiac necrosis or documented coronary artery disease. They also included patients in cardiac arrest at ED arrival. For the pooled analysis,[11] patients required transient ST segment elevation or transient or persistent ST depression or T wave inversion. This patient population is clearly different from the subject of our study. Most of the patients included in those studies would have been excluded from our study based on clear ECG evidence of ischaemia.

Balancing cost and risk in healthcare has long been a challenge. CCUs are an expensive model of care, with high staff ratios and technology costs. Strong evidence supporting the model is scarce. In fact, two randomised trials failed to show any benefit for this model of care.[12 13] It should be noted, however, that both include low-risk patients and were underpowered to

address some of the issues. Other authors in non-randomised studies demonstrated reductions in mortality.[1–3]

Desmond Julian, one of the pioneers of CCU, has stated that 'Coronary care …. can only be justified if it is restricted to those patients likely to benefit from it.'[4] He has further stated that patient selection is the key to appropriate and cost-effective care.[14] ECG findings are one element of this selection, as are cardiac biomarkers and careful clinical assessment. Our findings suggest this is an area worthy of further study. If our findings were replicated, they would seriously challenge the current model of care for patients with chest pain and non-ischaemic ECG, potentially allowing innovative and more cost-effective management processes.

This study has some limitations that should be considered when interpreting the results. It is a single-site study, so generalisability to other sites cannot be assumed. Patients with a clearly ischaemic ECG were excluded. This was based on the treating clinician's interpretation of the ECG. A number of conditions such as hypertension, previous myocardial infarction and drug effects may result in ECG changes similar to ACS. This may have led to some selection bias, but does represent the 'real world' of ED practice where management decisions are driven in part by ECG interpretation. A large proportion of the cases (68%) did not have a final diagnosis of myocardial infarction, and most did not have biomarker evidence of myocardial damage. CIs around the subgroup analysis results are larger than expected owing to the high proportion of patients with normal TnI levels. This was not anticipated. A larger, preferably multisite sample, would provide narrower CIs. We were unable to collect accurate data on the duration of monitoring for patients. It is possible that episodes of asymptomatic non-sustained VT were not detected.

CONCLUSION

Patients admitted to CCU for investigation and treatment of possible acute coronary syndrome with a non-ischaemic ECG have a very low rate of serious ventricular arrhythmia. If confirmed, this could open the way for innovative and more cost-effective management processes for selected patients.

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Competing interests None.

Ethics approval Ethics approval was provided by the Western Health Low Risk Ethics Panel.

Contributors AMK had the concept for the study; AMK and SK designed the study; SK collected data; AMK analysed data; AMK and SK interpreted data; AMK drafted the manuscript; SK offered comments/refinements.

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