

Evaluating the role of a triage electrocardiogram protocol at an urban emergency department

在一所市區急症室內評估分流心電圖方案的角色

BL Lim 林明良, A Vasu, GH Lim 林義賢

Objective: Our emergency department (ED) performs triage ECG for a variety of complaints to identify patients in need of treatment escalation. The aim of this study was to evaluate the existing triage ECG protocol as a means of treatment decision making. **Methods:** This prospective observational study was conducted in an urban ED over one week. We recruited all patients aged 18 years and above with an undiagnosed complaint requiring a triage ECG based on the existing departmental protocol. As part of the protocol, an experienced emergency doctor then reviewed the ECG to determine the need for treatment escalation. Explicit data collection was performed using our electronic database. The outcome measures were proportions of triage treatment escalations, reasons for escalation and disposition status. Analysis was by descriptive statistics. **Results:** 739 patients were recruited from a total attendance of 3228. The rate of triage ECG was 23%. There were 22 (3%) triage escalations. Usually each escalation resulted from a combination of reasons. These included important ECG changes (77%), abnormal vital signs (5%) and ongoing symptoms (95%). **Conclusions:** The triage ECG protocol resulted in important escalations in a small proportion of presentations. Future research is needed to refine guidelines on the use of triage ECG for different ED complaints. (*Hong Kong j.emerg.med.* 2010;17:149-153)

目的：本急症室對多種申訴進行分流心電圖檢查，以識明需要增強治療的病人。本研究旨在評估目前的分流心電圖方案作為決定治療的方法。**方法：**這前瞻性觀察研究在一所市區急症室進行一星期。招募所有18歲或以上，申訴未得到診斷而需要根據目前部門方案進行分流心電圖檢查的病人。作為方案的一部份，一名資深的急症科醫生其後審核心電圖以決定增強治療的需要。使用我們的電子數據庫進行明確的數據收集。量度結果為分流增強治療的比例，增強的原因及處置的情況。以描述性統計學分析。**結果：**從合計3228就診病人中，招募了739名。分流心電圖率為23%，有22名（3%）分流增強治療。每次增強治療通常由多個原因引致，包括心電圖重要的轉變（77%）、不正常的生命表徵（5%）及持續的症狀（95%）。**結論：**分流心電圖方案引致一小部份的就診者重要的治療增強。今後需要科研以改善急症室在不同申訴下，使用分流心電圖檢查的指引。

Keywords: Electrocardiography, triage

關鍵詞：心電圖檢查、分流

Correspondence to:

Lim Beng Leong, MBBS, MRCS(A&E)

Tan Tock Seng Hospital, Emergency Department, 11 Jalan Tan Tock Seng, Singapore 308433

Email: Beng_Leong_Lim@tsh.com.sg

Alicia Vasu, BSc(Biomedical), MPH

Lim Ghee Hian, FRCSEd(A&E), MMed(Public Health Medicine), FAMS

Introduction

One of the most important objectives of an emergency department (ED) is to identify the group of patients with a life-threatening condition from a cohort who present with undifferentiated complaints. Triage at presentation, usually performed by a nurse, is an

important part of that process. Triage assessment usually comprises collection of clinical data and limited examination (e.g. vital signs, oxygen saturation, general appearance) resulting in the assignment of an urgency group.

The 12-lead electrocardiogram (ECG) is a tool that can identify potentially serious or time critical conditions like ST elevation myocardial infarction (STEMI) and hyperkalaemia.¹ In our ED, we implemented a protocol for ECG at triage for a number of pre-determined complaints. The ECG and clinical data are reviewed by a senior doctor to decide on the need for treatment escalation. The aim of this study was to evaluate our ED triage ECG protocol and its impact on treatment decision-making.

Methods

This prospective observational study was conducted from 1st to 7th January 2009 at the ED of a 1,000-bed tertiary public adult hospital. The study centre is an urban ED with an annual census averaging 150,000 attendances and receives patients from all regions of the country.

Patients aged 18 years and above who presented to the study ED were included if an ECG was indicated based on the existing departmental protocol. Those who already had a definitive diagnosis by a referring physician were excluded. Our departmental practice mandated a triage ECG to be done for all patients with complaints as listed in Table 1. Recruited patients underwent triage ECG performed by a nurse within 10 minutes of arrival and had their ECG reviewed by a doctor from an authorised pool of senior medical officers (screening doctors). In addition to the ECG, screening doctors had access to information on presenting complaints, vital signs and a partial assessment of the patient. Based on this information, the screening doctor decided whether to escalate the management of a patient to the resuscitation room or place him/her in the consultation queue based on the triage acuity status.

Demographics, clinical summaries, radiological and laboratory results were collected using a real-time

electronic medical records system. Outcomes of interest included proportions of triage escalations together with their final ED disposition and inpatient diagnoses. A search within our hospital records system was then carried out a week later to capture re-attendances or re-hospitalisation data. The ECGs collected were reviewed by two independent emergency physicians to validate findings. They were aware of the clinical information of the patients. Analysis was by descriptive statistics. Proportions of triage escalations were calculated together with their reasons for escalation. This study was approved by the National Healthcare Group Research Ethics Committee.

Results

Out of 3228 patients, 739 (22.9%) underwent triage ECG; of which 432 (58.5%) were males. The median age of the study group was 54.5 years. The racial

Table 1. Emergency department complaints that mandate a triage ECG

Cardiorespiratory complaint
Chest pain
Exclusion of acute coronary syndrome
Dyspnoea
Syncopal or presyncopal episode
Abdominal symptom
Epigastric pain
Neurological complaint
Altered mental status
Glasgow Coma Scale score <15
Disorientation
Confusion
Dizziness
Focal symptoms including vertigo, dysarthria, unsteady gait, weakness
Suspected overdose except alcohol
Chest trauma
Abnormal vital sign
Systolic blood pressure <90 mmHg
Pulse rate <60/min or >100/min
Oxygen saturation <92% on room air
Electrolyte abnormality
Known or suspected hypokalaemia or hyperkalaemia

distribution consisted of 500 (67.7%) Chinese, 98 (13.3%) Indians, 81 (11.0%) Malays and 60 (8.1%) others (Bangladeshi, Filipino and Caucasian). The distribution of indications for a triage ECG is illustrated in Figure 1.

There were 22 (3%) escalations from triage. Figure 2 demonstrates the number of escalations of each complaint. The triage ECG, abnormal vital signs and ongoing symptoms accounted for 17 (77%), 1 (5%), and 21 (95%) escalations respectively. Of note, each

escalation resulted from a combination of these factors. There were no escalation in patients with initial complaints of epigastric pain, syncope, overdose, non-cardiac tachycardia, chest trauma, abnormal vital signs and suspected abnormal electrolytes. Table 2 is a summary of the ECG patterns seen amongst these escalated patients. In half of the escalations (n=11), the ECG was the important determinant of triage escalation, including 8 patients with STEMI and 3 patients with ECG pattern suggestive of left main artery disease with diffuse ST depression and ST

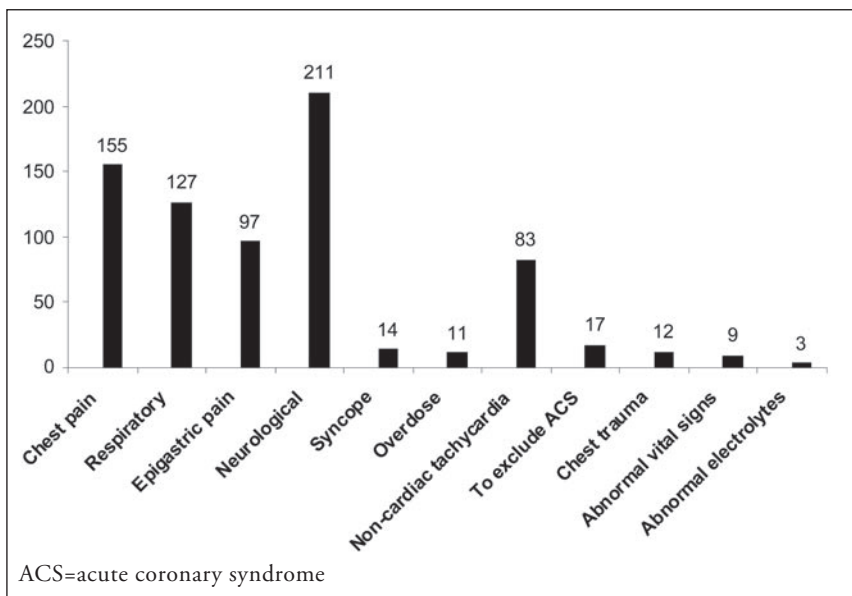


Figure 1. Distribution of indications for triage ECG (n=739).

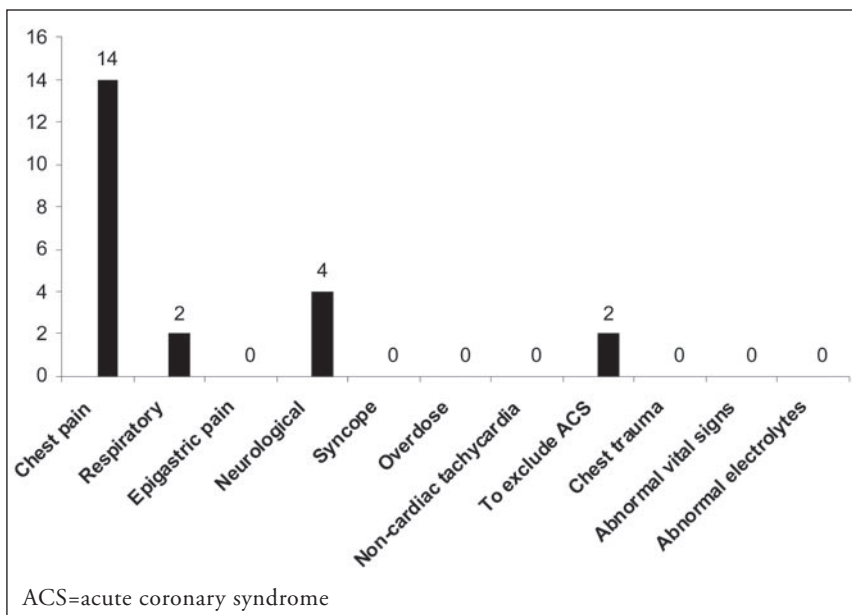


Figure 2. Distribution of triage escalations with complaints (n=22).

elevation in lead aVR. Six (27.3%) patients with symptomatic atrial fibrillation (AF) and rapid ventricular rate (>120/min) were escalated from triage. Their symptoms included palpitations, breathlessness and chest pain. They were given intravenous medications to control their ventricular rate and/or treated for their underlying precipitating causes.

The final ED disposition status of the 22 triage escalations were: 1 died in the ED, 7 were admitted to the coronary care unit, 3 were admitted to the general ward with telemetry service, 10 were admitted to the general ward and 1 was transferred to another hospital for immediate percutaneous coronary intervention (PCI) due to temporary unavailability of local PCI service.

Notably, 64 patients were subsequently escalated to resuscitation treatment post-triage. The reasons for these post-triage escalations included abnormal physical signs or change in vital signs, abnormal laboratory or radiological results, ongoing symptoms

or consultation with other subspecialties. However, none resulted from an abnormal triage ECG. Among those patients (653 or 88% of the study group) who received no escalation in the ED, their final dispositions are shown in Table 3. Of note, none were admitted to the coronary care or intensive care units. No re-attendances or re-admissions were identified.

Discussion

Our study showed that the triage ECG played an important role in treatment escalation of patients presenting with chest pain and symptomatic patients with AF and a rapid ventricular rate of >120/min. Of note, we had correctly escalated 3 patients with ECG pattern of diffuse ST depression and ST elevation in lead aVR suggestive of left main coronary occlusion.^{2,3} Our study agrees with Lee⁴ that the ECG is a valuable tool for diagnosis of the STEMI patient. However, we did not design our study to investigate the treatment

Table 2. Distribution of ECG patterns of triage escalations

ECG pattern	Number of triage escalations (n=22)
ST elevation	8 (36.4%)
ST elevation and depression*	3 (13.6%)
ST depression	9 (40.9%)
Right bundle branch block	2 (9.1%)
Left bundle branch block	1 (4.5%)
Sinus tachycardia	1 (4.5%)
Fast atrial fibrillation (>120/min)	6 (27.3%)

* ST elevation in aVR and diffuse ST depression

Table 3. Final emergency department dispositions of non-escalated patients

Emergency department disposition	Number of non-escalated patients (n=653)
Treated & discharged	291 (44.6%)
Referred to other hospitals	5 (0.8%)
Admitted to EDTC	13 (2.0%)
Admitted to general ward	305 (46.7%)
Admitted to CCU	–
Admitted ICU/HDU	–
Died	–
AMA/Absconded	39 (6.0%)

AMA=discharged against medical advice; CCU=coronary care unit; EDTC=Emergency Diagnostic and Treatment Centre (short stay ward); HDU=high dependency unit; ICU=intensive care unit

options of the subgroup of patients with AF and rapid ventricular rate.

We also found the ECG to be effective in identifying patients with a cardiac condition requiring treatment escalation. Our protocol of performing a triage ECG within 10 minutes of arrival of a STEMI patient was acceptable according to the American Heart Association guidelines.⁵ Equally important, no patients with an ECG indicative of STEMI or diffuse coronary artery disease were identified post-triage.

It is important to appreciate that there were no patients with potentially fatal arrhythmias like ventricular tachycardia or higher grades of heart blocks in our study. These patients can have minimal symptoms⁶ and successful outcomes depend on their early recognition. The potential benefits of the triage ECG on this subgroup of patients require further validation.

Our study also suggested a redundant use of triage ECGs with 97% not resulting in escalation. Apart from groups with complaints of chest pain, neurological or respiratory symptoms or referrals for exclusion of acute coronary syndrome, no patient had treatment escalation despite the ECG. Clearly the performance of triage ECG plus screening doctor interpretation and assessment takes time that will be diverted from other patient care activities. However, ECG has also been reported to be useful in treatment escalation and risk stratification of patients without cardiorespiratory complaints; particularly in tricyclic overdose.⁷⁻⁹ Refinement of patient selection to maintain sensitivity but increase specificity would result in better resource utilisation.

Our protocol relies not only on the triage ECG but also on the partial assessment by the triage nurse and screening doctor for critical decision making. Our study was not designed to identify the impact made by each component. This is an area worthy of further research.

Our study has some other limitations that should be considered when interpreting the results. Firstly, the study period was short (one week) and the number of triage escalations was small. We are unable to conclude that had we studied a larger sample, escalations based

on ECG would not have been needed in the complaint groups for which we found none in this sample. The study only involved one hospital and hence generalisability to other settings cannot be assumed. We did not collect data on the cost of the protocol (in terms of staff time/resources) so are unable to comment on cost-effectiveness.

Conclusions

We conclude that our triage ECG protocol resulted in important treatment escalations for a small proportion of patients. Future research is needed to refine guidelines for its use to minimise redundancy.

References

1. Webster A, Brady W, Morris F. Recognising signs of danger: ECG changes resulting from an abnormal serum potassium concentration. *Emerg Med J* 2002;19(1):74-7.
2. Nikus K, Eskola MJ. Electrocardiogram patterns in acute left main coronary artery occlusion. *J Electrocardiol* 2008; 41(6):626-9.
3. Nikus KC, Eskola MJ. The ECG in a mechanical obstruction of the ostium of the left main coronary artery. *Int J Cardio* 2002; 86(2-3):327-9.
4. Lee TH. Chest pain in the emergency department: uncertainty and the test of time. *Mayo Clin Proc* 1991;66 (9):963-5.
5. Krumholz HM, Anderson JL, Brooks NH, Fesmire FM, Lambrew CT, Landrum MB, et al. ACC/AHA clinical performance measures for adults with ST-elevation and non-ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Performance Measures on ST-Elevation and Non-ST-Elevation Myocardial Infarction). *J Am Coll Cardiol* 2006;47(1):236-65. Erratum in: *J Am Coll Cardiol* 2006;47(10):2140.
6. Hebbar AK, Hueston WJ. Management of common arrhythmias: Part II. Ventricular arrhythmias and arrhythmias in special populations. *Am Fam Physician* 2002;6(12):2491-6.
7. Thorstrand C. Clinical features in poisonings by tricyclic antidepressants with special reference to the ECG. *Acta Medica Scand* 1976;199(5):337-44.
8. Niemann JT, Bessen HA, Rothstein RJ, Laks MM. Electrocardiographic criteria for tricyclic antidepressant cardiotoxicity. *Am J Cardiol* 1986;57(13):1154-9.
9. Boehnert MT, Lovejoy FH Jr. Value of the QRS duration versus the serum drug level in predicting seizures and ventricular arrhythmias after an acute overdose of tricyclic antidepressants. *N Eng J Med* 1985;313(8):474-9.