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# Acute management of ST-elevation myocardial infarction in a tertiary hospital in Kenya: are we complying with practice guidelines?

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ORIGINAL RESEARCH

# Acute management of ST-elevation myocardial infarction in a tertiary hospital in Kenya: Are we complying with practice guidelines?

## *Phase active de prise en charge des infarctus du myocarde avec élévation du segment ST dans un hôpital tertiaire au Kenya. Les directives pratiques sont-elles respectées?*

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**Introduction:** Current practice guidelines emphasize the importance of rapid reperfusion of patients with ST-elevation myocardial infarction (STEMI). The aim of this study was to evaluate the current rate of compliance with evidence-based practice guidelines for the management of STEMI patients at a tertiary hospital in Kenya.
**Methods:** This was a retrospective chart review. Data on patient characteristics, emergency treatment, and outcomes were collected on adults admitted with a diagnosis of STEMI from January 2012 to February 2013.
**Results:** Data were collected for 45 patient presentations. There were 37 male patients (82%). The mean age was 59.7 ± 3.8 years. Of the 45 patients, 23 were Asian (51%), 18 were Black (40%) and four were Caucasian (9%). Thirty-five patients (78%) presented within 12 h of symptom onset. Within 10 min of arrival to the hospital, 40 patients (89%) had electrocardiographs performed and 39 patients (87%) were reviewed by a doctor. Medications given on presentation were aspirin (98%), clopidogrel (91%) and anticoagulants (73%). All patients received reperfusion therapy. Twenty-eight patients (62%) received fibrinolytic therapy and 17 patients (38%) had primary percutaneous coronary intervention. Door-to-needle time of <30 min was achieved in 43% of the cases. Door-to- balloon time was <90 min in 29% of the cases. All the patients survived to hospital discharge. The average length of stay was 5.3 ± 1.0 days. In-hospital complications occurred in six patients (13.3%). These included bleeding (three patients), stroke (one patient) and cardiogenic shock requiring intra- aortic balloon pump support (two patients).
**Conclusion:** Whereas the majority of STEMI patients are evaluated within 10 min of presentation, less than 50% receive reperfusion therapy within the recommended time frame. While there are attempts to comply with evidence based guidelines in resource-limited settings, there is a need to improve acute care systems to target early reperfusion of STEMI patients.

**Introduction:** Les directives pratiques actuelles mettent l'accent sur la reperfusion rapide des patients victimes d'un infarctus du myocarde avec élévation du segment ST (STEMI). L'objectif de cette étude était d'évaluer le taux de conformité actuel aux directives pratiques scientifiquement fondées pour la prise en charge des patients victimes de STEMI dans un hôpital tertiaire au Kenya.
**Méthodes:** Cette étude a consisté en un examen rétrospectif des dossiers. Les données relatives aux caractéristiques des patients, au traitement d'urgence et aux résultats ont été recueillies pour des adultes admis avec un diagnostic de STEMI entre janvier 2012 et février 2013.
**Résultats:** Des données ont été recueillies pour 45 cas. Trente-sept étaient des hommes (82%). L'âge moyen était de 59,7 ± 3,8 ans. Sur les 45 patients, 23 étaient asiatiques (51%), 18 étaient noirs (40%) et quatre caucasiens (9 %). Trente-cinq patients (78%) s'étaient présentés dans les 12 heures suivant l'apparition des symptômes. Dans les dix minutes suivant leur arrivée à l'hôpital, 40 patients (89%) passaient un électrocardiogramme et 39 patients (87%) étaient examinés par un médecin. Les médicaments administrés à l'arrivée étaient les suivants : aspirine (98%), clopidogrel (91%) et anticoagulants (73%). Tous les patients ont bénéficié d'un traitement de reperfusion. Vingt-huit patients (62%) s'étaient vu administrer une thérapie fibrinolytique et 17 patients (38%) avaient subi une angioplastie coronarienne percutanée primaire. Un délai d'attente inférieur à 30 min était enregistré dans 43% des cas. Un délai de traitement inférieur à 90 min était enregistré dans 29% des cas. Tous les patients survivaient jusqu'à leur sortie de l'hôpital. La durée moyenne du séjour était de 5,3 ± 1 jour. Six patients (13,3%) ont souffert de complications pendant leur séjour. Ces complications étaient les suivantes : saignements (trois patients), attaque (un patient) et collapsus cardiaque nécessitant une assistance par pompe à ballonnet intra-aortique (deux patients).
**Conclusion:** Alors que la majorité des patients souffrant de STEMI étaient examinés dans les dix minutes suivant leur arrivée, moins de 50% bénéficiaient d'une thérapie de reperfusion dans le délai recommandé. Si l'on peut constater des tentatives de se conformer aux directives scientifiquement fondées dans des milieux caractérisés par une insuffisance de ressources, il est nécessaire d'améliorer les systèmes de prise en charge active afin de cibler la reperfusion précoce des patients victimes de STEMI.

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### African relevance

- Cardiovascular disease is the second commonest cause of death in Africa.
- African clinicians are able to comply with evidence-based practice guidelines.
- African clinicians can strengthen cardiovascular services in acute care systems.


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## Introduction

Evidence-based practice guidelines specify a maximum delay of 30 min for fibrinolysis and 90 min for primary percutaneous coronary intervention (PCI) for patients with ST-elevation myocardial infarction (STEMI).[1] These guidelines derive almost exclusively from the developed world populations, and whether these guidelines are applicable to population groups outside the developed world is unknown.[2–5]

The observed delays for primary PCI in STEMI registries mainly from the developed world often largely exceed those realised in clinical trials.[6–8] A significant number of patients do not receive either fibrinolysis or primary PCI within these recommended maximum delays. The ACCESS (Acute Coronary Events – a Multinational Survey of Current Management Strategies) registry is the only registry that has tried to gain insights into the epidemiology, practice patterns, and outcomes of STEMI patients among different population groups in underdeveloped nations.[9] The study was conducted in countries in Africa, Latin America, and the Middle East. ACCESS data from South Africa showed that the use of evidence-based interventions was in-line with practices in the developed world though there was still room for improvement.[10] A prospective study done here in Kenya at the Aga Khan University Hospital, Nairobi (AKUH,N) in 2010, showed that no reperfusion therapy was given to one-third of all STEMI patients due to late presentation to the hospital.[11] There were low rates of primary PCI and door-to-balloon times were prolonged, with the majority of the eligible patients receiving fibrinolysis.

The aim of this study was to evaluate the current rate of compliance with evidence-based practice guidelines for the management of STEMI patients at AKUH,N. The results of the study will hopefully demonstrate the progress in the management of STEMI at AKUH,N and inform any future local developments aimed at ensuring maximal compliance with evidence-based practice guidelines. This will hopefully translate into improved management and outcomes for STEMI patients in Kenya.

## Methods

The Republic of Kenya is located on the equator in eastern Africa, and borders Ethiopia, Somalia, Tanzania, Uganda and Sudan; the country's east coast is along the Indian Ocean. The country has a population of over 38 million people; Nairobi, the capital, is the largest city of Kenya, with a population of more than three million people.[12]

The Aga Khan University Hospital, Nairobi (AKUH,N), established in 1958, is a regional tertiary referral university hospital that provides secondary and tertiary level health care services in Nairobi, Kenya.[13] It has a 24-h Emergency Centre (EC) and primary PCI capabilities with an interventional cardiologist on-call 24-h a day.

A retrospective chart review was conducted at AKUH,N between 1 January 2012 and 28 February 2013 of all patients aged $\geqslant$21 years admitted with a diagnosis of acute coronary syndrome (ACS). All patients with a final discharge diagnosis of STEMI were included in the study.

Patients were excluded if their symptoms were precipitated by a secondary co-morbidity (e.g., anaemia, heart failure, and non-cardiac trauma), they were transferred in from other hospitals having already been initially managed for STEMI and if their emergency records were incomplete or not found.

The study was approved by the Aga Khan University Faculty of Health Sciences East Africa research ethics committee (2013/REC-44). Patient confidentiality was maintained by secure storage of data sheets, use of an anonymous coding system and restricted access to the database.

Data sheets were used to record the information directly from the patients' records. Data collected on each patient included: age, sex and ethnicity; presenting complaint; duration of symptoms; systolic blood pressure on admission; time to initial electrocardiograph (ECG) from first medical contact; time to initial doctor review; medication on arrival; door-to-needle (fibrinolysis) time; door-to-balloon inflation (primary PCI) time; in-hospital complications; medications on discharge, length of stay and discharge condition. Data were entered and analysed using Microsoft Excel 2010 software.

## Results

Data were collected for 45 patient presentations, 37 of which were male patients (82%). The mean age was 59.7 $\pm$ 3.8 years. The age distribution of the patients is shown in Table 1. Of the 45 patients, 23 were Asian (51%), 18 were Black (40%) and four were Caucasian (9%).

Thirty-five patients (78%) presented within 12 h of onset of symptoms, while 19 patients (42%) presented within the first 2 h. The median (Q1, Q3) delay from symptom onset to hospital admission for patients who presented within 12 h was 2.0 (1.0, 5.0) h. All the patients had a history of chest pain on presentation. Nine patients had concurrent shortness of breath and four had other symptoms e.g. epigastric pain, nausea, and vomiting. Three patients were in cardiac arrest at presentation. Six patients had no risk factors for ACS. Figure 1 shows the risk factors present in the study population. The rate of compliance with practice guidelines is shown in Table 2.

Medications given on presentation were aspirin (98%), clopidogrel (91%), anticoagulation (73%), nitroglycerine spray (31%) and morphine (26%). All patients received reperfusion therapy. Twenty-eight patients (62%) received fibrinolysis with bolus tenecteplase while 17 patients (38%) had primary PCI done. All the patients survived to hospital discharge. The average length of stay in the hospital was 5.3 $\pm$ 1.0 days. The in-hospital complication rate was 13.3% ($n$ = 6). These included bleeding (three patients), stroke (one patient) and cardiogenic shock requiring intra-aortic balloon pump support (two patients).

**Table 1** Age distribution of patients.

| Age | Number of patients ($n$ = 45) |
|---|---|
| < 55 years | 16 |
| 55–64 years | 14 |
| 65–74 years | 8 |
| $\geqslant$75 years | 7 |

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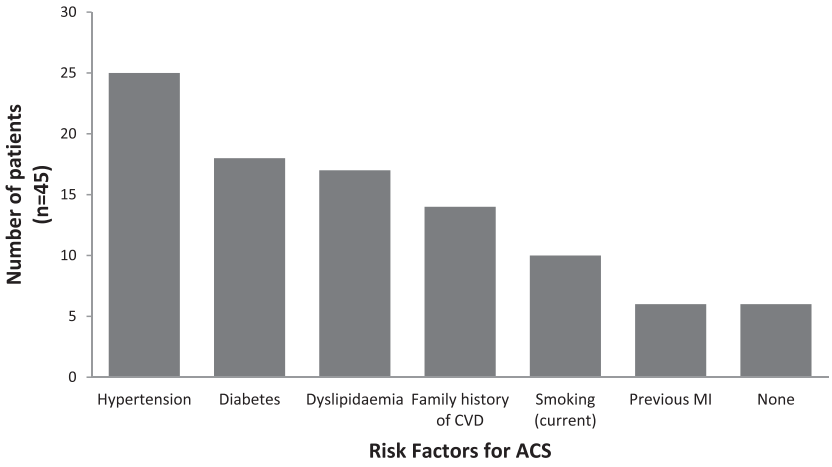


CVD, cerebrovascular disease; MI, myocardial infarction; ACS, acute coronary syndrome

**Figure 1** Risk factors for acute coronary syndrome.

**Table 2** Rate of compliance with practice guidelines.

| Guideline | Compliance rate, % (n) |
|---|---|
| Initial ECG done within 10 min of first medical contact | 89 (40) |
| Initial doctor review within 10 min of arrival | 87 (39) |
| Door-to-needle (fibrinolysis) goal of 30 min | 43 (12) |
| Door-to-balloon inflation (primary PCI) goal of 90 min | 29 (5) |

## Discussion

This is a study describing the profile, management and outcomes of 45 STEMI patients at AKUH,N in Kenya and the compliance with evidence-based practice guidelines. The majority (82%) of our patients were males which was similar to other international registries, namely, ACCESS (81%).[9] The patients in our study had a mean age of 59.7 ± 3.8 years which may be attributed to the increasing incidence of risk factors for ACS (diabetes, hypertension, and hyperlipidaemia) in a much younger population in our society.[14]

The three most common risk factors for STEMI in our patients were hypertension, diabetes and dyslipidaemia. These risk factors were among others, including abdominal obesity, psychosocial factors, lack of daily consumption of fruits and vegetables, regular alcohol consumption, and lack of regular physical activity; also identified by the worldwide INTERHEART study accounting for more than 90% of the population-attributable risk of a first myocardial infarction.[15] More programmes targeting the prevention and control of these three risk factors in our population should be implemented to reduce the incidence of ACS. Patients with one or more of the risk factors for ACS should also be educated on their increased risk and identification of early warning symptoms for ACS.

Majority of our patients (78%) presented within 12 h of symptoms onset with 42% presenting within 2 h. Increased educational initiatives on the importance of early presentation for chest pain symptoms instituted by the hospital may have contributed to this increase in patients presenting early.

Many patients with STEMI present late after the development of symptoms. The time from symptom onset to hospital presentation in different registries of patients has been ⩾ 4 h in almost 50%,[16] more than 6 h in 40%,[17] and more than 12 h in 9–31%.[2,18] The absence of an established public prehospital care system means the majority of our patients arrive by private vehicle.[19] Out-of-hospital transport time constitutes only 5% of the delay to treatment time.[20] The decision to use an ambulance is an important variable that can reduce out-of-hospital delay.

The interval from the onset of symptoms to the patient's recognition of them constitutes the majority (60–70%) of the delay to definitive therapy.[21] Public education programs have had only transient effects.[22] Education of patients with known coronary artery disease appears to be the only effective primary intervention to reduce denial or misinterpretation of symptoms.

Almost 90% of the patients had an ECG done and were seen by a doctor within 10 min of arrival to the hospital. This success is probably due to standing orders for nurses in the hospital to obtain a 12-lead ECG on any patient with chest pain suspected of having myocardial ischemia or acute myocardial infarction. This was one of the strategies recommended by the National Heart Attack Alert Program Coordinating Committee to reduce some of the delays in treatment times for acute myocardial infarction patients.[23]

There was a striking consistency in the hospital use of antiplatelets with almost all patients (98%) receiving aspirin upon presentation to the hospital. This is consistent with the rates reported in other registries (⩾95%)[24,25] and in keeping with current medical practice, where the majority of patients presenting with ACS are given aspirin.

There was a higher rate of fibrinolysis (62%) in our study compared with North American and European registries (< 50%).[3,9] The rate of primary PCI in our study was 38% compared to 40% in ACCESS[9] and 58–64% in the second Euro Heart Survey (EHS-ACS-II)[24] and the Global Registry of Acute Coronary Events (GRACE) study.[2] This is probably due to a combination of factors. Primary PCI has only been

established in our institution in the last three years compared to other regions that have been doing it for a longer time and therefore have well-established systems that ensure efficiency and minimize delays. After-hours primary PCI is also a challenge due to staffing availability in the catheterization laboratory. Patients who presented shortly after symptom onset (within 2 h) and where the delay to primary PCI was estimated to be more than 90 min from initial hospital presentation, preferentially received fibrinolysis. This practice is based on recent studies that compared primary PCI to fibrinolysis in patients who present within 3 h of symptom onset. In the STREAM study which randomly assigned 1892 patients who presented within 3 h to undergo either fibrinolytic therapy with bolus tenecteplase or primary PCI, there was no difference in the primary composite end point (death, shock, congestive heart failure, or reinfarction up to 30 days) between the two groups (12.4% versus 14.3%, respectively; relative risk 0.86, 95% CI 0.68–1.09).[26] Fibrinolysis was also chosen after hours when primary PCI was not readily available.

A door-to-needle time within the recommended 30 min was achieved in only 43% of the patients who received thrombolysis. In the GUSTO trial which evaluated in-hospital delays as part of the GUSTO Time to Treatment Substudy, less than 5% of patients were treated within 30 min of arrival.[27] Established protocols in our EC that identify and prioritize patients presenting with STEMI may have contributed to the reduced delay in the door-to-needle time rates in our study. Further improvement in the compliance with the guidelines can be achieved through regular education and training of the EC doctors who are responsible for initial evaluation and management of the patient.[24] The EC doctors should be proficient in the determination of eligibility of fibrinolytic therapy and be responsible for the initiation of the therapy. Determination of fibrinolytic therapy eligibility by EC doctors reduces the delay in fibrinolytic therapy initiation by approximately 50%.[28] For patients who have typical and uncomplicated presentations of STEMI, requiring communication with the internist or cardiologist before initiating fibrinolytic therapy is inappropriate and may result in unnecessary delays trying to locate these consultants.

Thirty-eight percent of our patients had primary PCI compared to 13% in the previous study.[11] Only 29% of these cases achieved a door-to-balloon time (DTBT) of less than 90 min. Similar rates have been observed in other studies. The DTBT in the United States has been decreasing slowly. In large surveys, the median DTBT fell from 120 min from 1994 to 1995 to 108 min from 1999 to 2002;[29,30] however, between 1999 and 2002, only 35% of patients met the recommended goal of less than 90 min.[30] Evidence for a detrimental effect of longer DTBTs on outcomes comes from both observational studies and randomized trials. In a report of 29,222 STEMI patients in the NRMI-3 and 4 registries (1999–2002) who were treated with PCI within 6 h of presentation, longer DTBTs were significantly associated with increased in-hospital mortality (3.0, 4.2, 5.7, and 7.4% for DTBT of $\leqslant$90 min, 91–120 min, 121–150 min, and $>$150 min, respectively).[31] Patients with DTBTs more than 90 min had a higher mortality compared to those with DTBTs $\leqslant$90 min (odds ratio 1.42, after adjusting for patient characteristics). In a multivariate analysis of 365 hospitals, seven strategies that reduced DTBT were identified: activation of the catheterization laboratory by the EC physician (mean reduction in DTBT, 8.2 min), single call activation of the catheterization laboratory (13.8 min), staff arrival in the catheterization laboratory within 20 min compared to more than 30 min after being paged (19.3 min), having a cardiologist always on site (14.6 min), having EC and the catheterization laboratory staff use real-time feedback (8.6 min), EC activation of the catheterization laboratory while the patient is en-route (15.4 min), regular audits of performance times and standard and simple algorithms.[32] Regular audits of performance times and standard and simple algorithms have already been implemented in the hospital in a bid to reduce the DTBT.

An earlier time to presentation of our STEMI patients and potentially the presence of a well-established system for their management may have contributed to our 0% mortality rate.

Although our study sought to provide a representative sample of patients with STEMI from everyday practice, it was a retrospective chart review that was subject to limitations and biases, including incomplete information; collection of nonrandomized data; as this was one hospital, the population may not be representative of the whole country. Eligible patients were those who were alive at hospital admission, meaning that the highest risk patients (i.e., those who died before reaching the hospital) were excluded.

## Conclusion

This study highlights a number of important features in the acute management of STEMI patients in our setting that has implications for the development of acute care systems in Kenya. Whereas the majority of STEMI patients are evaluated within 10 min of presentation, less than 50% receive reperfusion therapy within the recommended time frame. While there are attempts to comply with evidence-based guidelines in resource-limited settings, there is a need to strengthen acute care systems to target early reperfusion of STEMI patients.

## Conflict of interest statement

The authors declare no conflict of interest.

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