A DESCRIPTIVE STUDY ON CHARACTERISTICS OF PATIENTS WITH MYOCARDIAL INFARCTION AND THEIR OUTCOMES: A RURAL PRIMARY HEALTHCARE SETTING IN LUBOK ANTU DISTRICT, SARAWAK

[1,5]Caryn Tsujean Lim MB BCh BAO, [2,5*]Yik Hon Ho MBBS, [3]Stephenie Ann Albart MD, [4]Jie Ping Schee MBBS MRCP AM, [3]Irene Looi MBBS FRCP, [5]Alan Yean Yip Fong MBChB, FRCP

[1]Lubok Antu Health Clinic, Lubok Antu, Sri Aman, Sarawak, Malaysia
[2]Batang Ai Health Clinic, Lubok Antu, Sri Aman, Sarawak, Malaysia
[3]Clinical Research Centre, Seberang Jaya Hospital, Penang, Malaysia
[4]Department of Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia
[5]Department of Cardiology, Sarawak Heart Center, Kota Samarahan, Sarawak, Malaysia

---

*Corresponding Author:
Ho Yik Hon, Department of Cardiology, Sarawak Heart Center, Kota Samarahan, Sarawak, Malaysia.
Tel: +60178998983, Email: richardho920825@gmail.com

ABSTRACT
Introduction*:* Myocardial infarction (MI) is the leading cause of death worldwide. More studies are needed to provide insight of rural MI care in Malaysia.
Objective: This study aims to explore patient and non-patient factors in MI and mortality outcomes.
Methods*:* We conducted an observational study involving secondary data collection through medical records review of whom presented to rural primary healthcare facilities before being referred to regional secondary and/or tertiary centres. We explored their inpatient and 30-day cardiac-related mortality outcomes. All MI patients from the locality were included, excluding those whose final diagnosis were not MI.
Results: Nine patients were included. Eight (88.9%) experienced STEMI. Eight (88.9%) were male. Median age was 53 (Q1:40.5–Q3:64.5) years. Median duration from symptoms onset to presentation was 2 (1.125 – 35.250) hours. Median time from presentation to aspirin delivery was 45 (12.5 – 86.0) minutes. The median door-to-needle time was 190 (163.0 – 212.5) minutes. Five (55.6%) received medical thrombolysis in secondary hospital prior to elective percutaneous coronary intervention (PCI). Inpatient mortality was 11.1% corresponding to 30-day mortality.
Conclusions: Logistic challenges and local healthcare limitations pose difficulties for rural MI care. Better equipped healthcare facilities is essential for prompt diagnosis and interventions for MI patients.

KEYWORDS: Myocardial infarction, rural, primary healthcare, Malaysia

INTRODUCTION

Myocardial infarction (MI) is the leading cause of death worldwide [1]. 17.9 million people died of cardiovascular disease each year, with an estimation of 32% of all deaths worldwide [2]. More than 75% of cardiovascular deaths occurs in low-income and middle-income countries [3]. Acute occlusion of coronary artery causing ST segment elevated myocardial infarction (STEMI) commonly leads to early mortality and myocardial damage [4]. In the UK, between the year of 2013-2014, there were 187,421 hospital visits due to MI.

This is translated into the fact that there was a patient being diagnosed with MI every 3 minutes on average [5]. According to National Cardiovascular Disease, Acute Coronary Syndrome (NCVD-ACS) Registry in Malaysia, there were a total of 17,771 patients diagnosed with acute coronary syndrome (ACS) throughout the country from 2014-2015, with 46.1% being STEMI, 25.2% being NSTEMI, 28.7% being unstable angina [6]. This translates into 0.03% of Malaysian population being diagnosed with ACS per year, considering a population of 32.7 million [7].

According to a study done in a rural hospital in Bangladesh, the in-hospital mortality rate of STEMI is high despite adherence to published guidelines and thrombolysis, highlighting the multifactorial contribution to cardiac mortality, including prolonged pain-to-door time, poor coverage of ambulance service, low community awareness of acute coronary syndrome, and lack of emergency medical services in rural settings [8]. Another study undertaken in north of Scotland looking at the discrepancy between the treatment of STEMI in remote compared to central locations, had identified the potential challenges to this discrepancy to include staffing availability and training, public awareness and inter-hospital communication [9].

Malaysia is a middle-income country with limited resources, especially in rural settings [10]. In rural areas of Malaysia, most patients with STEMI have limited or delayed access to thrombolysis or primary cutaneous intervention. Cardiac catheterisation laboratories are not readily available in rural hospitals. Moreover, long distances to the nearest hospitals limiting accessibility to thrombolysis, causes a delay in treatment. Great efforts are needed to overcome these challenges in rural settings in order to provide better care and outcome for patients with MI. There remain significant opportunities to improve STEMI care in rural setting of Malaysia.

Limited studies are available to provide insight of cardiovascular disease and MI care in rural settings in Malaysia. This study aims to explore patient and non-patient related factors among myocardial infarction patient population and their in-hospital and 30-day cardiac mortalities.

METHODS
Study type and design
This is a descriptive study involving retrospective data collection. We included patients who presented to primary healthcare facilities in a rural setting and subsequently referred to secondary or tertiary healthcare centers for further investigation and management.

Through a review of medical records from 7 primary healthcare facilities in Lubok Antu District, all consecutive study subjects who were diagnosed with myocardial infarction from 1 January to 30 June 2021 were included, subsequently being followed up on their status of in-patient cardiac mortality and 30-day cardiac mortality. Data collected from primary healthcare centers included patients' demographics, risk factors for cardiovascular disease, prior history of ischaemic heart disease, vital signs upon presentation, duration of symptoms prior to presentation, distance from place of onset to nearest clinics, treatment received in primary healthcare centers, and transportation journey from primary healthcare centers to secondary or tertiary healthcare facilities. Data on the level of cardiac enzymes and duration of hospital stay were obtained from secondary hospital, namely Sri Aman Hospital. Subsequently, in-hospital cardiac mortality and 30-day cardiac mortality post-MI were recorded for each patient through review of their inpatient records and medical records during their follow-ups in primary healthcare clinics after discharge. Patients who failed to present to primary healthcare clinics after discharge were contacted via phone calls to assess their post-discharge mortality status. No subject was lost to follow-up.

Study population, inclusion, and exclusion criteria
All consecutive patients diagnosed with myocardial infarction from 1 January 2021 till 30 June 2021 in primary healthcare clinics within Lubok Antu District, Sri Aman Division, were included; namely Lubok Antu Health Clinic, Engkelili Health Clinic, Batang Ai Health Clinic, Merindun Health Clinic, Nanga Kesit Health

Clinic, Nanga Stamang Health Clinic, Nanga Delok Health Clinic, and Nanga Patoh Health Clinic, were included. Patients who did not have a final diagnosis of a myocardial infarction were excluded.

Primary and secondary outcomes
The primary outcome of this study was in-hospital cardiac mortality. The secondary outcome was 30-day post MI cardiac mortality.

Ethics consent
This study was approved by Medical Review and Ethics Committee (MREC), Ministry of Health Malaysia (MOH) in 2021 (Approval Code: NMRR-21-285-58514). MREC waived informed consent for this study.

Statistical analysis
The data analysis was done using the SPSS version 22. Continuous variables were expressed as median with inter-quartile range as these data were skewed. Categorical variables were described as frequency and percentages.

RESULTS
Table 1: Characteristics of Patients with Myocardial Infarction and Their Outcomes

Characteristic	Total (n=9)	(Q1 ; Q3)	(min ; max)
Median age (IQR) – yr	53 (24)	(40.5;64.5)	37;79
Age < 55 yrs - no. (%)	5(55.6)		
Age > 55 yrs - no. (%)	4(44.4)		
Sex – no. (%)			
Male	8(88.9)		
Female	1(11.1)		
Race or ethnic groups - no. (%)			
Iban	8(88.9)		
Chinese	1(11.1)		
Types of MI – no. (%)			
STEMI	8 (88.9)		
NSTEMI	1 (11.1)		
Risk factors – no. (%)			
Hypertension	6(66.7)		
Diabetes mellitus	2(22.2)		
Dyslipidaemia	5(55.6)		
Family history of premature CVD	4(44.4)		
Smoking	6(66.7)		
Ex-smoker	1(11.1)		
Alcoholic	5(55.6)		
Ex-alcoholic	1(11.1)		
Past history of coronary revascularization	0		
Anti-platelet usage	2(22.2)		
Other variables – median (IQR)		Q1 : Q3	Min ; Max
Onset of symptoms to presentation – hour	2(34.13)	1.125;35.25	0.75;144
Duration from place of onset to primary healthcare facility – minutes	10(12.5)	5.0;17.5	2;20
Time from presentation to aspirin given – minutes	45(73.5)	12.5;86.0	10;102

Time from departure to arrival – minutes	80 (25)	75.0;100	70;105
Systolic BP – mmHg	114(39)	101;140	85;144
Diastolic BP – mmHg	78(15.5)	70.5;86	64;94
Heart rate – bpm	95(71.5)	83;154.5	74;240
SpO2 - %	97(9)	89.5;98.5	80;100
Respiratory rate – breath per minute	20 (4)	18;22	18;28
Random capillary blood sugar – mmol/L	10.4(4.27)	7.3;11.58	6.5;11.6
TIMI score	4 (4)	3;7	1;13
Treatment – no. (%)			
Medical thrombolysis	5(55.6)		
PCI	7(77.8)		
Hospitalization duration (days) - median (IQR)	4(3)	4;7.25	3;8
Door to needle time (min) - median (IQR)	190(49.5)	163;212.5	146;225
Total ischaemic time (min) - median (IQR)	270(92)	243;335	231;340
Outcomes (in-hospital) – no. (%)			
Alive	8(88.9)		
Death	1(11.1)		

IQR = Interquartile range
Q1= Lower quartile or First quartile
Q3= Upper quartile or Third quartile

Nine adult patients were included (refer Table 1). Eight (88.9%) patients experienced STEMI. Eight (88.9%) were male, and 8 (88.9%) were Iban. Median age was 53 (Q1: 40.5 – Q3: 64.5) years, the youngest being 37 years old. Median duration from onset of symptoms to presentation was 2 (1.125 – 35.250) hours. Median time from presentation to aspirin delivery was 45 (12.5 – 86.0) minutes. Median duration of the journey from place of onset to primary healthcare facilities was 10 (5.0 – 17.5) minutes. Median duration of the journey from primary healthcare to secondary hospital was 80 (75 – 100) minutes, the longest being 6 days. Median door-to-needle time was 190 (163.0 – 212.5) minutes. Median total ischaemic time was 270 (243 – 335) minutes. Five (55.6%) received medical thrombolysis in secondary hospital prior to elective percutaneous coronary intervention (PCI). In-patient mortality was 11.1% while 30-day mortality was correspondingly 11.1% as well.

DISCUSSION

Lubok Antu District in Sarawak consists of a population of 27,984 people, with the majority being Iban (indigenous group)/Malay (90.4%). Chinese occupied 5.8% of the population while Indian and others occupied 0.4% [11]. Hence, 88.9% of our study population consisted of Iban. National statistics show 1.4% incidence of ACS among Iban [6]. It is however, unable to conclude that Iban has higher prevalence of myocardial infarction from this study as the cohort population comes from an Iban predominant area.

Majority of the patients who experienced MI in this setting were relatively young compared to national data (median age groups of this study and national data were 53 and 58.6 years respectively). They were male predominant which was consistent with the national data from NCVD-ACS Registry (79.3% male) [6]. Eight (88.9%) of the study patients experienced STEMI. The alarming proportion of study population with STEMI is an area of concern, which deserves further exploration as to factors which might be

associated with the higher incidence of STEMI compared to 46.1% from national data [6]. However, there is also the possibility of under-reporting of NSTEMI due to non-presentation to healthcare facility, or death at home due to MI; which render further exploration in future study. Logistic challenge is also an issue in most rural settings in Malaysia which might affect the true reflection of incidence and prevalence of MI in rural.

Study shows that patient delay accounts for the time taken from onset of symptoms to first medical contact (FMC). FMC is defined as the time of first assessment by a healthcare professional who has the knowledge of obtaining and interpreting a 12-lead electrocardiogram (ECG) and administer initial treatment [12]. The longest duration from symptom onset to FMC in our study population was 144 hours which shows much room of improvement for early presentation. Early presentation and early initiation of treatment are the central goal in AMI management which have influence on the outcome of AMI [13]. Although exact factors which causes late presentation have yet to be established, patients who stayed in impoverished area are more likely to present late after symptoms onset [14]. Hence, further study is needed to investigate the factors which contribute to late presentation which might include patient's awareness, education level and socioeconomic background for subsequent measure to be taken to address the issue.

Another point that worth highlighting is the median time from presentation to aspirin delivery, which took 45 minutes, with the longest received aspirin only after more than 1 hour of presentation. The reason of delay in delivery of initial treatment needs to be explored in future study, which might include prompt recognition of the diagnosis by healthcare workers. This is important as it could potentially influence the cardiac-related outcome of MI patients and quality of MI care in rural settings.

Among the 8 (88.9%) patients presented with STEMI, only 5 (55.6%) received fibrinolytic therapy, as compared to national data of 69.2%. None of the patients in the study received primary PCI. The median door-to-needle time of 190 minutes in the study was longer compared to 45 minutes in the national data [6]. Late presentation

had resulted in patients missing the thrombolysis window. Logistic challenges, particularly long distance and journey time to the nearest hospitals, had also resulted in long door-to-needle time in our setting. There was no Cardiac catherisation laboratories available in the vicinity hospital for primary PCI even if patients presented within the appropriate thrombolysis window.

The overall in-patient and 30-day mortality rates from our study were 11.1% and 11.1% respectively. National data from NCVD-ACS Registry shows figures of 7.4% and 9.2% for in-patient and 30-day mortality respectively [6]. However, direct comparison of the statistics of our study's primary and secondary outcomes might not be valid due to the low power of study which is the main limitation of this study. The single mortality of this study was a gentleman of Chinese ethnicity with multiple cardiovascular risk factors of hypertension, dyslipidaemia and active smoker while taking aspirin for the past 7 days. Although he presented within 2 hours from symptoms onset and initial treatment was given within 15 minutes of FMC, he eventually succumbed with the diagnosis of STEMI. He had symptoms of severe angina which is defined as more than 2 angina episodes within 24 hours prior to presentation. Further study on the association between ethnicity or severe angina, and mortality outcome need to be carried out to ascertain the relationship between the factors and outcomes. Due to the low number of recruits of study population, analysis on association between different factors and the in-patient and 30-day mortality outcomes cannot be performed. However, it can be postulated that the mortality outcomes among patients in rural setting may be multifactorial, including long journey time from primary to secondary healthcare settings, delay in the delivery of antiplatelet therapy, non-availability of primary PCI, and lower thrombolysis rate. Measures should be undertaken to address logistic challenges and rural primary healthcare limitations in order to improve the standard of care for MI patients. Short duration of study is another limitation of this study. If a longer duration study is conducted, a larger sample size can be recruited to increase the power of the study and to explore the mortality outcome at longer interval.

More studies are needed to explore the regional epidemiology as the demography of the local population might be different from the national data for focus effort to be instituted to overcome local healthcare limitations. Larger power study will be useful to investigate factors which are associated with cardiac-related outcome.

CONCLUSION
The standard of MI care in rural setting still below the par of national standard due to logistic challenges and local healthcare limitations. These imply that more resources eg. laboratory cardiac enzyme markers need to be more readily available and widely accessible for prompt diagnosis of MI while enabling early intervention. Infrastructure in rural areas needs to be improved in order the overcome the logistic challenges faced by the remote community to present to healthcare to seek medical attention in the event of potentially life-threatening diagnosis. Furthermore, the high mortality rate of MI among young patients translates into a worrying fact that we are losing these productive individuals who could otherwise significantly contribute to the economy and growth of our country. It is a healthcare issue that should not be overlooked or undermined as it carries a significant impact to the community and the country. Therefore, concerted efforts are needed in raising awareness among the community on importance of early presentation to healthcare centres once developing symptoms suggestive of MI. In addition, facilities to bridge the gap in logistic challenges can be life-saving for the community, especially those from more remote area. More local secondary hospitals and cardiac catherisation laboratoreis are needed to support the large population in rural settings. If patients in rural settings were able to get to the nearest, adequately-equipped hospitals in a timelier manner with prompt and accurate diagnosis of acute MI was made, this potentially enables their outcomes to be comparable to those in urban and suburban settings in Malaysia. With the improvement of MI care in rural setting, the benefit will translate into greater quality of life among the community, potentially longer life-span and undeniably a considerable growth of the country's economy from the contribution of the productive group of individuals who enjoy better health while reducing the healthcare burden of dealing with morbidities and mortalities in long run.

CONFLICTS OF INTEREST
All authors of the study have no conflicts of interest to declare.

REFERENCES

1. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study. *Lancet.* 2010; 380: 2095-2128.
2. World Health Organization, Cardiovascular Diseases. Available at: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds). Accessed June 2021.
3. Chan MY, Du X, Eccleston D et al. Acute coronary syndrome in the Asia-Pacific region. *Int. J. Cardiol*. 202;861–869, (201).
4. Piérard LA. ST elevation after myocardial infarction: what does it mean? *Heart*. 2007 Nov;93(11):1329-30. doi: 10.1136/hrt.2007.119131. PMID: 17933986; PMCID: PMC2016926.
5. Townsend N, Bhatnagar P, Wilkins E, et al. *Cardiovascular disease statistics.* 2015. London: British Heart Foundation.
6. Annual Report of the NCVD-ACS Registry 2014-2015. Retrieved from: http://www.crc.gov.my/wp-content/uploads/documents/report/report_NCVD_2014_2015.pdf. Accessed June 2021.
7. Department of Statistics Malaysia (2020). Available at: https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=155&bul_id=OVByWjg5YkQ3MWFZRTN5bDJiaEVhZz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09. Accessed June 2021.
8. Kim DY, Wala Z, Islam S, et al. Clinical characteristics and outcomes of ST-segment elevation myocardial infarction in a low income setting in rural Bangladesh. *Int J Cardiol Heart Vasc*. 2019 May 17; 23:100376. doi: 10.1016/j.ijcha.2019.100376. PMID: 31193421; PMCID: PMC6527896.
9. Kamona A, Cunningham S, Addison B, et al. Comparing ST-segment elevation myocardial infarction care between patients residing in central and remote locations: a retrospective case series. Rural and Remote Health 2018; 18: 4618. https://doi.org/10.22605/RRH4618
10. Perkins DH. Malaysia: the challenge of avoiding the middle income trap. Available at: https://www.ehm.my/publications/articles/malaysia-the-challenge-of-avoiding-the-middle-income-trap. Accessed February 2021.
11. City Population: Lubok Antu District, Malaysia (2010). Available at: https://www.citypopulation.de/en/malaysia/admin/sarawak/1308__lubok_antu/. Accessed June 2021.
12. Somaratne JB, Stewart JT, Ruygrok PN, Webster MW. ST-Elevation Myocardial Infarction Networks and Logistics: Rural and Urban. 2018 Jul 14. In: Watson TJ, Ong PJL, Tcheng JE, editors. Primary Angioplasty: A Practical Guide [Internet]. Singapore: Springer; 2018. Chapter 4. PMID: 31314433.
13. Weaver WD. Time to thrombolytic therapy: factors affecting delay and their influence on outcome. *J Am Coll Cardiol*. 1995;25(suppl):3S–9S.
14. Sheifer SE, Rathore SS, Gersh BJ, Weinfurt KP, Oetgen WJ, Breall JA, Schulman KA. Time to Presentation With Acute Myocardial Infarction in the Elderly: Associations With Race, Sex, and Socioeconomic Characteristics. Ciculation. 2000; 102: 1651-1656. Available at: https://doi.org/10.1161/01.CIR.102.14.1651.