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Young (<40 Years Old) ST segment Elevation Myocardial Infarction in Brunei Darussalam

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Abstract

Introduction: ST-elevation myocardial infarction (STEMI) in young adults is a serious public health concern. This study assesses the sociodemographic, risk factors and angiographic disease patterns of young adults experiencing STEMI in Brunei Darussalam. **Materials and Methods**: A retrospective review (January 2015 to September 2023) in country's only cardiac catheterisation laboratory performing primary percutaneous coronary intervention. Baseline characteristics, risk factors, and angiographic features were analysed. **Results**: Over a 9-year period, 1,082 patients underwent PPCI, 134 (12.38%) were ≤ 40 years old, predominantly male (90.3%), with a mean age of 35.1 ± 4.0 years old (range: 19-40). Malay ethnicity was prevalent (92.54%). Common STEMI locations were anterior (46.3%), followed by inferior (44.8%). Risk factors included smoking (72.4%), hypertension (23.9%), diabetes mellitus (12.7%), hyperlipidaemia (8.2%), family history of cardiovascular disease (9%), obesity (6.7%), and anabolic steroid use (6%). The left anterior descending (LAD) artery was the primary culprit vessel in 50.7% followed by the right coronary artery (RCA) - 45.5%. Most had single-vessel disease (67.9%), while double-vessel disease (DVD) and triple-vessel disease (TVD) were observed in 22.4% and 9.7%, respectively. Notably, RCA and LAD were the most frequent vessels affected in DVD (53.3%) among those DVD patients. **Conclusion**: Our study showed gender and racial disparities in young adult STEMI in Brunei Darussalam. The most common risk factor is smoking. Single-vessel disease was common with LAD and RCA commonly affected. The study underscores the significance of early interventions and lifestyle modifications to combat young coronary artery disease.

Keywords: Ischaemic heart disease; Coronary artery disease; Acute coronary syndrome; Intervention

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INTRODUCTION

Coronary artery disease (CAD) is a major global health concern and imposes a significant burden on healthcare systems. Globally, between 1990 and 2017, there was an increase in the incidence of CAD from 7 million to 10.6 million, with ischaemic heart disease (IHD) related deaths reaching 8.9 million and a DALY of 170.3 million. IHD is estimated to affect 126 million people, with a prevalence of 1,655 per 100,000 population.[1-3] According the Atherosclerosis Risk in Community (ARIC) study looking at data between 2005 and 2014, the estimated annual incidence of myocardial infarction (MI) was 605,000 new and 200,000 recurrence cases.[4] According to the Global Burden of Disease Report (2019), 49.2% of cardiovascular-related deaths were attributed to IHD.[5] In Brunei Darussalam, CVD is also a leading cause of premature mortality and data showed that CVDs was the leading cause in 2022 with recorded 416 deaths, surpassing deaths attributed to cancer (n=306).[6] Additionally, CAD is associated with an increased risk of recurrent CVD such as stroke and repeated MI in the first year following its occurrence.[7-9]

Several risk factors contribute to CVD and these include age, gender, family history, total cholesterol, high density lipid (HDL) cholesterol, smoking, glucose metabolism disorders, obesity, and hypertension. Diabetes mellitus is common and have been shown to contribute significantly to the progression of CAD.[10] Insulin resistance has strong associations with metabolic syndrome, atherosclerosis formation, and other CVD, and is a significant contributor to CVD.[10]

While the risk increases with older age, its incidence in younger individuals also progressively increases over time. Premature atherosclerosis with plaque rupture is the most common aetiology of MI in the young population (< 45 years of age), accounting for almost about 90% of cases.[11] The remaining 10% of cases are secondary to non-plaque aetiologies including coronary vasospasm, spontaneous coronary artery dissection, hypercoagulability coronary embolism, autoimmune-mediated inflammation, and drug-induced occlusions.[11] Young individuals with CVD are defined by an age cutoff of 40 to 45 years, and they exhibit a unique risk factor profile compared to older counterparts, with a lower prevalence of traditional atherosclerotic cardiovascular risk factors.

To date, data on IHD including among the young population remains limited in our local setting. There has only been on study that assessed thrombolysis for STEMI.[12] This study reports on the socio-epidemiologic characteristics, risk factors and the angiographic features young (< 40 years) STEMI in Brunei Darussalam, a developing Southeast Asia nation.

MATERIALS AND METHODS:

Setting: This research was retrospective study conducted in the tertiary referral cardiac centre (Gleneagles Jerudong Park Medical Centre), the only centre that perform primary percutaneous coronary intervention (PPCI). Patients can be referred directly to the centre though consultation with the oncall cardiologist or from cardiologist or medical team after consultation with oncall cardiologist from respective hospitals.

Patient populations: All patients treated between January 2015 and September 2023 in the tertiary centre and had undergone coronary angiogram were identified for the study. Inclusion Criteria was young adults (< 40 years) diagnosed with STEMI during the defined study period. Exclusion Criteria: Patients who did not meet the age criteria or those with incomplete or missing medical records were excluded from the analysis.

Definition followed the standardised definition and NSTEMI was defined as ST-segment elevation in at least two contiguous leads that displayed the following criteria: a minimum of 2.5 mm elevation in men under the age of 40 years, 2 mm elevation in men aged 40 years and above, or 1.5 mm elevation in women in leads V2–V3. In other leads, 1mm of elevation meets this criterion, provided there are no signs of left ventricular hypertrophy or left bundle branch block. To identify posterior MI, we look for ST-segment elevation of at least 0.5mm in leads V7–V9.[13]

Data collection: Patient data were retrospectively retrieved from the hospital's electronic medical records system. The collected information included baseline sociodemographic data and angiographic findings. Data are collected through medical records, and angiographic reports. Diagnostic criteria are employed for risk factors, and angiographic features are documented through medical records.

Baseline Characteristics: This category covers demographic information, such as age, ethnicity and gender. Comorbidities such as hypertension, dyslipidaemia, diabetes mellitus, and, chronic kidney injury were collected. A family history of premature CAD was identified when any blood relative (parents and/or siblings) experienced angina, MI, or sudden cardiac death before the age of 55 years in males and 65 years in females. For adults, the World Health Organisation (WHO)

categories individuals as 'overweight' when their Body Mass Index (BMI) in kg/m^2 falls within the range of 25.0 to 29.9, and 'obese' when their BMI is equal to or exceeds 30.0.

Angiographic Features: Coronary angiography and PPCI were performed using the standard radial or femoral artery approach, with the femoral approach used when radial access was not feasible. The subsequent management of patients was determined based on the complexity of atherosclerotic lesions found during the PPCI. Certified interventional cardiologists were responsible for interpreting the angiograms, classifying vessel stenosis as a reduction in diameter of at least 50%. CAD was further categorised into three groups: mild (less than 50% stenosis), moderate (51% to 69% stenosis), and severe (70% or more stenosis). Patients were categorised based on the number of vessels affected, leading to classifications such as single-vessel disease (SVD), double-vessel disease (DVD), triple-vessel disease (TVD), and left main coronary artery disease. To minimise bias, the study strictly adhered to inclusion criteria for patient recruitment

Statistical Analysis: Descriptive data were collected to summarise baseline characteristics and risk factors. Categorical variables were presented as frequencies and percentages, while continuous variables were described using means and standard deviations. The chi-square test or Fisher's exact test, as appropriate, was employed to assess associations between risk factors and STEMI. A p-value of < 0.05 was considered statistically significant. All statistical analyses were conducted using SPSS version 25 (IBM, New York)

Ethical Considerations: The study was conducted in accordance with the Declaration of Helsinki. Patient privacy and confidentiality were rigorously maintained throughout the data collection and analysis process. Patients were assigned unique identification reference and identifying details such as name and hospital registrations numbers were removed. All data was anonymised for analyses.

RESULTS

Over a 9-year period, a total of 1,082 patients underwent PPCI with 134 (12.4%) being ≤ 40 years old, giving an overall period incidence of 120 cases per year and 14.9 cases per year for young STEMI.

Among the young STEMI patients, majority was male (90.3%) with an average age of 35.08 years old, with an age range spanning from 19 to 40 years. The majority were of Malay descent (92.5%) with the remaining being Indian (4.48%) and Chinese (2.99%) **(Table I)**. The most common risk factor was smoking (72.4%) followed by hypertension, diabetes mellitus and hyperlipidaemia. A positive family history of CVD was on recorded in 9%.

Table I. Baseline Characteristics of young STEMI (n=134).

Variables	n (%)
Gender	
Male	121 (90.3)
Female	13 (9.7)
Ethnicity	
Malay	124 (92.5)
Indian	6 (4.5)
Chinese	4 (3.0)
Risk Factors	
Smoker	97 (72.4)
Hypertension	32 (23.9)
Diabetes Mellitus	17 (12.7)
Hyperlipidaemia	11 (8.2)
Family History	12 (9)
Obesity	9 (6.7)
Anabolic Steroid	8 (6)

The distributions of MIs were almost equal proportion - 46.3% anterior STEMI, 44.8% inferior STEMI and smaller proportions affecting the other territories (**Table II**).

Among the young STEMI, the left anterior descending (LAD) artery was the most affected vessels, followed by the right coronary artery (RCA). This is shown in **Table III**. Single-vessel disease (SVD) was the most common accounting for a third of cases (67.9%), followed by DVD. Within the double-vessel disease category, various combinations of affected vessels were noted, with RCA and LAD being the most common (53.3%) among DVD patients. TVD was present in 9.7% of cases. This category highlighted the culprit lesion involved, with 69.2% being the LAD and 30.8% being the RCA.

DISCUSSION

Our study, based on coronary angiography showed that young STEMI is common, accounting for 12.4% of all STEMI over a nine years period. There was a male predominance, and Malay ethnicity, and with a mean age

of 35.1 ± 4.0 years old. Among the location of MIs, anterior wall STEMI was the most common (46.3%), followed closely by inferior (44.8%). Smoking was the predominant risk factor with other risk factors affecting smaller proportion of between 6% for anabolic steroid use to hypertension recorded in 23.9%. LAD artery was the primary culprit vessel in 50.7% followed by the RCA (45.5%). SVD predominated (67.9%) followed by DVD (22.4%), and TVD only seen in 9.7%. Not unexpectedly, LAD and RCA were the most frequent vessels affected (53.3%) among those with DVD. This is the first such study in the country to assess coronary artery disease looking young NSTEMI. There was one previous study that had looked at thrombolysis at two time points, and had shown that age of diagnosis was younger in the later time.

Generally, one in eight of STEMI patients in our study was categorised as young (<40 years) MI. Comparisons with other studies are slightly difficult due to age designations - some categorised young MI as ≤45 or <50 years. Comparing to study in Singapore where young MIs were categorised as <50 years old, young MI was seen in 25.6% (n=465) among 1,818 consecutive patients with STEMI who underwent PPCI. The mean age of young STEMI was 43 ± 4.9 years old.[14] A retrospective study in China (N=701) with STEMI who underwent PPCI between 2019-2021 found 15.4% (n=108) patients were aged ≤45 years.[15] Despite the differences in age categorisation, these findings are comparable to our study, albeit slightly lower. Our definition was younger and therefore, the actual figure likely would be similar if we had used similar definition.

Our young STEMI population was predominantly male (90.3%), and this gender distribution result is in line with trends seen globally, not just for young MI but also overall MI. CVD, including MI, tend to affect men more frequently than women.[16,17] Among the ethnicities, Malay predominate (92.5%) and was more than the national population breakdown, followed by Indian and smaller proportion of Chinese. This difference likely correlates with risk factors, especially smoking which is more common among Malay men in Brunei.[18]

Table II. Locations of STEMI.

STEMI Diagnosis	n (%)
Anterior	62 (46.3)
Inferior	60 (44.8)
Antero-lateral	2 (1.5)
Infero-lateral	2 (1.5)
Infero-posterior	6 (4.5)
Lateral	2 (1.5)

Table III. Angiographic Features of young STEMI patients (n=134).

Culprit Vessel	n (%)
Left Anterior Descending (LAD)	68 (50.7)
Right Coronary Artery (RCA)	61 (45.5)
Left Circumflex Artery (LCX)	5 (3.7)
Single Vessel Disease (SVD)	91 (67.9)
Double Vessel Disease (DVD) [1]	30 (22.4)
RCA and LAD	16 (53.3)
RCA and LCx	1 (3.3)
LAD and RCA	8 (26. 7)
LCx and LAD	2 (6.7)
LAD and LCx	3 (1)
Triple Vessel Disease (TVD) [2]	13 (9.7)
LAD	9 (69.2)
RCA	4 (30.)

Apart from smoking, our study population exhibited relatively lower incidence rates of certain risk factors in comparisons to the older MI patients. Tobacco use was a major risk factor (72.4%) in our study. This observation shows smoking is a significant contributor to MI in our young adults. A systematic review by Wu *et al.* (2022) stated that quitting smoking at the time of diagnosis is associated with approximately a 33% reduction in the risk of experiencing another cardiovascular event.[19] Therefore, public health strategies should and continue to prioritise anti-smoking campaigns and support for smoking cessation, particularly among young individuals. Other risk factors were less common. Diabetes was seen in 12.7%, and hypertension in 23.9% of our young MI population. These figures show similarity with prior research, which has reported a less common prevalence of risk factors in very young Western Indian adults experiencing MI.[16] Overall, these findings provide important insights into the characteristics of the study population and their potential contribution to cardiovascular health.

Another interesting observation was the use of anabolic steroids (6%). Steroid usage is associated with an increased risk of coronary disease. Prolonged use of anabolic steroids is linked to the worsening of coronary

disease.[20] Apart from increasing risk for coronary artery disease, use of anabolic steroids also increases the risk for venous thromboembolism, arrhythmias, cardiomyopathy and heart failure.[20] Anabolic steroids can increase the blood pressure, elevate LDL and lower HDL cholesterols which are risk factors for atherosclerosis.[20,21] Fortunately, only one in 20 of the young MI reported anabolic steroids use.

The lower incidence of DVD and TVD among young MI in our study is similar to previous studies which explained that MI in young adults is more likely to have significant underlying SVD with the most common aetiology being plaque rupture (seen in almost 88% to 90% cases). This suggests that in this age group, the pathophysiological mechanisms may involve less severe atherosclerosis, with SVD being predominant.[16,22] Therefore, public health efforts should focus on the prevention, addressing risk factors like hyperlipidaemia, diabetes mellitus and hypertension. All the conditions mentioned above are part of the non-communicable diseases (NCDs) which is strongly associated with obesity. The association of obesity with accelerated atherosclerosis have been shown in the findings of the Pathobiological Determinants of Atherosclerosis in Youth study. The study examined the coronary arteries of 3,000 individuals aged between 15 and 34 revealed a significant correlation between obesity and early atherosclerotic changes, particularly in young men. These changes included the presence of fatty streaks in the coronary artery. These findings emphasise the need for early intervention and lifestyle modifications to mitigate the impact of obesity on cardiovascular health.[21,23] Therefore, promoting awareness of the importance of a heart-healthy lifestyle, including a balanced diet and regular physical activity to reduce obesity should be a central component of public health campaigns.

Despite the valuable insights provided by our study, there are certain limitations that should be acknowledged. The absence of a detailed follow-up of the study cohort represents a limitation, as such follow-up could have offered valuable insights into the post-medical management and procedural outcomes of these patients. Furthermore, the overall low prevalence of some risk factors in our study cohort may dilute the magnitude of their impact on the observed outcomes. Conducting the study with a larger cohort exhibiting greater or comparable prevalence of these risk factors may yield more insightful results. However, our study cohort represented all the patients in the country as our centre is the only referral cardiac centre with coronary angiographic intervention. Hence our study is a national cohort and provide accurate national data.

The main strength of this study is that there is only one tertiary referral centre for cardiac intervention and the data presented are of the whole nation. The only limitation is the retrospective nature of the study. Despite this, data of patients and procedures were captured in electronic records which minimise missing data. Overall, these findings underscore the urgency of implementing targeted public health interventions to address this issue. It is evident that ACS in younger populations warrants increased attention and the development of preventive strategies to reduce both its prevalence and impact.

CONCLUSION

Our study provides crucial insights into the clinical characteristics and angiographic features of young adults STEMI in Brunei Darussalam. One in eight of all NSTEMI was categorised as young MIs and majority were male and Malay ethnicity predominance. Smoking was the main risk factors, and the LAD and RCA were equally affected. Future research with larger cohorts and extended follow-up periods can provide deeper insights into these factors and their implications for the young population in Brunei Darussalam. Our study encourages a multi-faceted approach, combining early intervention, lifestyle modification, and targeted smoking cessation efforts to address the growing challenge of STEMI in young Bruneians and enhance cardiovascular health in the region.

Take Home Message

- Young STEMI (≤ 40 years old) is not uncommon, accounting for 12.4% of STEMI in Brunei Darussalam.
- Anterior and inferior were the most common location with the LAD and RCA most commonly affected vessels
- SVD and DVD accounted for 67.9% and 22.4% respectively
- Smoking is the most common risk factors—72.4% were smokers, followed by hypertension 23.9%
- Public education is important to tackle risk factors

Abbreviations

CVST	cerebral venous sinus thrombosis
GCS	Glasgow Coma Scale
CRP	C-reactive protein
ESR	Erythrocyte sedimentation rate
INR	International normalised ratio
PCR	Polymerase chain reaction
NCCT	Non-contrast computed tomography
ICH	Intracerebral haematoma
MIP	Maximum intensity projection
CTV	CT venogram
LMWH	Low-molecular-weight0heparin
VKA	Vitamin K antagonist
DOAC	Direct oral anticoagulant

Declarations

Ethical Declaration

This was a retrospective study which was conducted following the standard as set in the Declaration of Helsinki.

Disclosure and Conflict of Interest

The authors declare that they have no conflicts of interest and no financial disclosures relevant to this case report.

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