Addis Ababa University College of Health Sciences,

Tikur Anbessa Specialized Hospital

Assessing the risk factors, clinical and coronary angiographic profile, and hospital mortality of acute coronary syndrome in young people : 5-year retrospective cross-sectional study

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Summary of thesis

Name of principal investigator	Dr. Zelalem Belay (internal medicine resident)
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Full Title of the Project	Assessing the Risk factors, clinical and coronary angiographic profile, and in hospital mortality of Acute Coronary Syndrome in young: A 5 year Retrospective Cross Sectional Study
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APPROVAL SHEET

ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES, SCHOOL OF MEDICINE, DEPARTMENT OF INTERNAL MEDICINE, POSTGRADUATE PROGRAM

I, Dr. Zelalem Belay, hereby declare that this thesis entitled "Assessing the risk factors, clinical and coronary angiographic profile, and in-hospital mortality of acute coronary syndrome in young adults: a 5-year retrospective cross-sectional study" in line with the requirement of graduate studies was fully undertaken by me under the guidance of my advisor, and that I have, to the best of my knowledge and effort, avoided plagiarism or duplication of materials unless and otherwise cited and/or acknowledged, and that it has not been so far submitted for any form of publication or consideration before the final approval.

_____ _____ _____

Principal investigator Signature Date

I hereby certify that I have read and evaluated this research thesis relating to "Assessing the risk factors, clinical and coronary angiographic profile, and hospital mortality of acute coronary syndrome in young people: A 5-year retrospective cross-sectional study" under my guidance from its inception up to its current format and that it can be submitted for final approval in partial fulfillment of the Certificate of Specialty in Internal Medicine.

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Abbreviations / Acronyms

AAU- Addis Ababa University

AHA- American Heart Association

ACC - American College of Cardiology

CHS- College of Health Sciences

CVD- Cardiovascular Disease

DBP- Diastolic Blood Pressure

DM- Diabetes Mellitus

EF- Ejection Fraction

ESC- European Society of Cardiology

HF- Heart Failure

IHD- Ischemic Heart Disease

LVEF- Left Ventricular Ejection Fraction

SBP- Systolic Blood Pressure

TASH- Tikur Anbessa Specialized Hospital

VT-Ventricular tachycardia

VF-Ventricular fibrillation

AV- Atrioventricular

LAD-left anterior descending

TAG-Triglyceride

RBBB- right bundle branch block

CAG- coronary angiography

LAD -left anterior descending

LCMCA-left main coronary artery

PDA-posterior descending artery

LCX-left circumflex

OM1-Obtuse marginal

D1- diagonal branch

IQR- interquartile range

SD-standard deviation

SPHMMC- St Paul's hospital millennium medical college

Abstract

Background: The incidence of coronary disease is positively associated with age. However, in recent years there has been an increased incidence of Acute Coronary Syndromes (ACS) in young adults. The cardiovascular risk profile of these patients appears to be different.

Objective: The objective of this study is to assess risk factors, clinical and coronary angiographic profiles, and hospital mortality of acute coronary syndrome in young adults treated in TASH and Gesund medical and cardiac centers.

Methods: Retrospective cross-sectional descriptive study was conducted from November 2023 to January 2024 at Tikur Anbessa specialized hospital and Gesund Medical Center in Addis Ababa, Ethiopia. All ACS patients younger than 45 years of age who had coronary angiography (CAG) from January 2019 to January 2024 were included in the study. Data was collected by reviewing the patient chart and analyzed by SPSS version 26.

Results: 103 patients were included in the study, and the median age of the study population was 39 (36–42) years. Men made up 93 (90.3%) of the study sample. The most common type of ACS was ST segment elevation (STEMI), diagnosed in 81 (78.6%) and 91 (88.35) patients with elevated troponin levels. Most patients presented with a complaint of chest pain experienced by 100 (97.1%), followed by diaphoresis (63.1%) and generalized fatigue (57.3%). Angiographically, 82 (79.6%) had abnormal coronary arteries. The most commonly involved artery was the LAD, seen at 47 (45.6%). Out of 82 patients with positive CAG, 66 (80.48%) have single-vessel disease, followed by 11 (13.42%) with double-vessel disease and 5 (6.1%) with triple-vessel disease. The most prevalent conventional cardiovascular risk factors were lipid abnormalities (64, 61.2%), followed by hypertension (35%), cigarette smoking (22.3%), and diabetes (22.4%). Heart failure was the commonest complication (34%), followed by post-MI pericarditis. The median (IQR) length of hospital stay was 5 (3–7) days, and the presence of multivessel disease (AOR, 6.01; 95% CI, 1.39–25.92; P = 0.016), and not being a smoker (AOR, 3.18; 95% CI, 1.05–9.62; P = 0.041)

were associated with increased length of hospital stay. The in-hospital mortality rate was low (1%).

Conclusion: The populations of young patients with ACS were predominantly males residing in urban areas. Most of the patients in this age group had one or more identified CVD risk factors. The CVD risk factor profile identified in this age group was similar to that of older patients but with a variable rate of contribution. STEMI and single-vessel disease were the predominant presentations. The short-term prognosis (in-hospital mortality) was excellent in this age group.

Keywords: young adults, acute coronary syndrome, coronary artery disease, risk factors, coronary angiography.

1. Introduction

1.1. Statement of problem

Cardiovascular disease was the leading cause of death globally, accounting for 32% of the total deaths in 2019. Ischemic heart disease is the leading cause, followed by stroke and COPD. Acute coronary syndrome (ACS) is often the first manifestation of cardiovascular disease(1). ACS is a spectrum of conditions where there is suspicion or confirmation of acute myocardial ischemia or infarction. Based on ECG changes and cardiac troponin levels, it can be either unstable angina, NSTEMI, or STEM(2).

ACS is primarily caused by an acute thrombus in an atherosclerotic coronary artery. Atherosclerotic plaque ruptures or splits, exposing thrombogenic material that activates platelets and the coagulation cascade. Even atheromas causing minimal obstruction can rupture, resulting in thrombosis. The resulting thrombus interferes with blood flow to the myocardium, and spontaneous thrombolysis occurs in two-thirds of patients. Other causes include coronary artery embolism, coronary spasm, and spontaneous coronary artery dissection(3).

The risk factors for coronary artery diseases include age, male sex, and a family history of premature coronary artery disease. Modifiable ASCVD risks include blood apolipoprotein-B-containing lipoproteins, high blood pressure, cigarette smoking, and diabetes, with adiposity increasing CVD risk through conventional risk factors and other mechanisms(4).

Although ACS is common in elderly patients, its trend is increasing in young adults. Compared to the older population, younger patients have a different cardiovascular risk profile and clinical presentation. The prevalence of ACS in individuals under 45 years of age is reported to be around 5–10% (5, 6, 7).

Males are more likely to be affected by ACS than females in all age groups. Young patients with ACS are more likely to have a smoking history, a family history of premature CAD, cocaine use, and obesity. Diabetes and hypertension are less common in young patients with ACS than in

elderly patients. Normal and non-significant coronary lesions are more common in young patients with ACS (6).

STEMI is the most common manifestation of ACS in young as evidenced by most studies (6, 8, 9, 10, 11, 12). Single-vessel disease is more common in young populations compared to older ones, and LAD commonly affects coronary arteries

The symptomatology of ACS presentation in young adults also differs from that of the older population. A higher proportion of young patients do not experience angina, but they have a shorter ischemic time (13). It is important to be aware of the risk factors and clinical presentation of ACS in young patients so that early diagnosis and treatment can be initiated.

1.2 .Significance of the study

Understanding clinical presentation, risk factors, coronary angiographic profiles, and in-hospital complications specific to this age group can aid in the development of targeted prevention and early treatment strategies. By shedding light on the unique characteristics of ACS in young patients, this study has the potential to inform clinical practice, public health initiatives, and future research efforts aimed at mitigating the burden of ACS in this population.

2. Literature review

Coronary artery disease (CAD) is a leading cause of death and disability worldwide. It is primarily a disease of the elderly, but it can also affect younger individuals. The cutoff for young people varies in different studies but is generally considered to be 40–45 years old(14).

The proportion of patients with acute coronary syndrome (ACS) who are under 45 years old varies from 5.8% to 8%. A study published in the Journal of the American Heart Association found that 8% of patients with ACS enrolled in the International Survey of Acute Coronary Syndromes in Transitional Countries registry were less than 45 years old. In contrast, a study from Thailand found that only 5.8% of patients with ACS in the Thai ACS registry were less than 45 years old. The youngest patient in the study was 22.8 years old (6).

Males are more likely to be affected by ACS than females in all age groups. Young patients with ACS are more likely to have a smoking history and a family history of premature CAD. Diabetes and hypertension are less common in young patients with ACS than in elderly patients. The incidence of ST-segment elevation myocardial infarction (STEMI) is also lower in younger patients. Normal and non-significant coronary lesions are more common in young patients with ACS (6).

Ewa M. Maroszyńska-Dmoch et al. conducted a study in Poland from 2001–2008 to evaluate the clinical and angiographic characteristics of young adults with acute coronary syndromes (ACS). The study involved 239 patients, aged 40 or younger, who underwent coronary angiography. The most common presentation was ST segment elevation myocardial infarction (52.8%). Angiographically normal coronary arteries were found in 37.2% of CAD patients and 16.9% of ACS patients. Conventional cardiovascular risk factors were lipid abnormalities, cigarette smoking, increased body mass index, CAD family history, and hypertension(15)

A study from the University of California San Diego Medical Center on 2643 patients with ACS found that most young patients (age < 45 years) were male (92%) and had a family history of premature CAD (41%). This was more common in middle-aged patients (28%) and elderly patients (12%). More young patients were current smokers (82%) than middle-aged patients (56%) and elderly patients (24%)(16).

C. Arantes et al. determined cardiovascular risk factors, clinical presentation, angiographic findings, and prognosis of young patients out of 1367 consecutively admitted ACS patients in a coronary unit over a 3-year period in Braga Hospital, Portugal. 8.12% of subjects were aged <45 years (group 1) and 91.88% ≥45 years (group 2). Male gender ($p<0.001$) and smoking ($p<0.001$) were more prevalent in group 1, whereas diabetes mellitus ($p<0.001$), arterial hypertension ($p<0.001$), stable angina ($p=0.002$), and prior acute myocardial infarction (AMI) ($p=0.026$) were higher in group 2, but there were no significant differences observed regarding the previous diagnosis of dyslipidemia (48.6% of group 1 and 55.3% of group 2). Group 1 had higher levels of LDL cholesterol ($p<0.001$), total cholesterol ($p<0.001$), and triglycerides ($p<0.001$), and lower levels of HDL cholesterol ($p = 0.001$). Myocardial infarction with ST segment elevation

occurred in 62.2% of subjects in group 1 and 50.2% in group 2. Multivessel disease was more common in group 2 ($p = 0.001$), while single-vessel disease was more common in group 1 ($p<0.001$). Group 2 had a worse prognosis, with a greater occurrence of heart failure ($p<0.001$) and death ($p = 0.047$) during hospitalization(17).

A study done in Switzerland found that there was a high prevalence of modifiable cardiovascular risk factors such as smoking, dyslipidemia, hypertension, obesity, and diabetes in young patients with ACS. Obesity and smoking were more common in young than in elderly patients with ACS(18). A study done in Spain found a 36% of cocaine user among young ACS patients (11).

A study conducted at the Universitat Autonoma de Barcelona found a significant increase in the link between cocaine use and coronary artery disease (ACS) among patients admitted to a coronary care unit from January 2001 to December 2008. In this study of 2752 ACS patients, of whom 479 were under the age of 50, 11.7% had a history of cocaine use, a rise from 6.8% in 2001 to 21.7% in 2008. Patients under 30 were more likely to admit to cocaine use, with 25% admitting to being users compared to 5.5% of those aged 45–50 Acute coronary syndrome linked to cocaine consumption in 24 patients showed larger myocardial infarcts, a lower left ventricular ejection fraction, and increased in-hospital mortality. Patients with a positive urine test for cocaine or admitting to being users upon admission had a lower left ventricular ejection fraction(19).

A study by Stoykova et al. evaluated 210 patients with acute coronary syndrome (ACS) in Sofia, Bulgaria, including 36 young patients aged under 40 (men) and 50 (female) A thorough family history and laboratory testing for common gene variants, such as those affecti ng thrombophilia factor V Leiden, prothrombin G20210A, PAI-1 4G/5G, MTHFR-CC677T, MTHFR A 1287C, MTHFR A 1298C, and glycoprotein IIb/IIIa, were conducted for ea ch patient in the study. A study found that 32 individuals had thrombophilia-related genetic variations and that 85% had a family history of ischemic heart disease. The most common diseased artery was the left anterior descending artery (LAD). The genetic evaluation revealed 20% homozygotes of pathogenic factor V of Leiden, 7% heterozygotes of pathogenic form, 25% PAI 1 4G/5G homozygotes, 11% PAI 1 4G/5G heterozygotes, 13% prothrombin G20210A

homozygotes, and 2% prothrombin G20210A heterozygote. 28% experienced repeated ACS, and 4% had a previous ischemic stroke.(20)

STEMI is the most common manifestation of ACS in young as evidenced by most studies (6, 8, 9, 10, 11, 12). Murugan et al.'s study revealed that 44% of patients had STEMI, with single vessel disease being the most common (48%), followed by double and triple vessel disease (22% and 17%), with the left anterior descending artery being the most affected (12). similarly, Tungsubutra W et al. reported in young ACS patients ST segment elevation myocardial infarction (STEMI) in 67%, non-ST segment elevation myocardial infarction (NSTEMI) in 20%, and unstable angina in 14% (6).

Single vessel disease was the most frequently identified finding during coronary angiography in studies conducted by Sharma et al, Esteban MR et al and Iragavarapu et al.,(10, 11, 21). Esteban et al. found that_myocardial infarction with an abnormal Q wave (48%) and single-vessel involvement (44.7%) predominated. Intrahospital mortality was 1.6% (11). But Studies done by Hoo et al. and Iragavarapu et al. showed that NSTEMI and UA were more common than STEMI (21, 22). At presentation most patients had Killip 1 ACS and it is consistent in all studies (10, 11). Study conducted by Iragavarapu showed that younger ACS patients had moderate LV dysfunction (35.83%). Similar result also found by Esteban MR et al.

Based on American Heart Association (AHA) data, roughly 18% of men and 23% of women over 40 who experience an initial heart attack (MI) will die within a year, with a third of STEMI (severe heart attack) patients dying within the first 24 hours. While less serious, unstable angina (UA) and non-ST-segment elevation myocardial infarction (NSTEMI) cases still carry a risk, with 15% of patients dying or experiencing a reinfection within 30 days of diagnosis(23). A study by Che-Muzaini CM et al. in Iran found that the in-hospital complication of ACS was 36.1. Heart failure was the most common complication (35.4%), followed by arrhythmia (18.4%), cardiogenic shock (14.9%), pulmonary edema (9.6%), and death (7.8%)(24).

The principal mechanism of ACS in young patients was atherosclerosis (86.5%), followed by coronary artery embolism (CAE)(9%), and spontaneous coronary artery dissection (SCAD) (4.5%)(25).

Symptomatology of ACS presentation in young adults differs from older population. A higher proportion of young patients do not experience angina (5) On the contrary, a Polish registry compared ACS presentations in 7481 women (1834 ≤45 years and 5647 aged 63–64 years) between 2007 and 2014. While chest pain was the leading symptom for both groups, younger women experienced it more frequently (90.4% vs. 88.5%, P = 0.025). Pre-hospital cardiac arrest was more common in younger women (2.1% vs. 0.8%, P<0.001), and they received faster balloon angioplasty (8.9 vs. 15.2 hours, P<0.0001). Additionally, younger women presented with less severe symptoms upon admission (Killip class I: 92.7% vs. 86.2%, P<0.001)(26).Similarly, the Tamil Nadu STEMI Program also showed total ischemic time was shorter for younger patients (235 vs. 255 minutes; p = 0.03)(13).

In a sub-Saharan study conducted by Sarr et al., the incidence of young ACS was 6.8%, which is in the same range as in western countries. It showed a strong male predominance, and the median age was 34 years. Smoking was the most common risk factor identified. 85.7% of patients presented with STEMI, and echocardiography revealed a reduced ejection fraction in 37.5% of patients, and hospital mortality was 14.3%(7).

In Ethiopia, a meta-analysis done by Kebede et al. found that most ACS were STEMI (59%) at diagnosis, and hypertension (54.8%) was the most common risk factor identified. The pooled proportion of in-hospital mortality for ACS was 14.82%(27). Another study conducted by Mulugeta et al. found that the median age for diagnosis of ACS was 55.65 years, and 72% of patients were diagnosed with STEMI. Hypertension (45.6%) was the most common identified risk factor. The majority of the patients were having killip class I symptoms. The incidence of reduced EF was 60%. Mortality at the ED was reported at 6.8%. Heart failure and arrhythmia were the most common identified complications (20.4% and 16.5%, respectively)(28).But studies specifically addressing young ACS have not been done so far.

3. Objectives

3.1 General objective

- To assess the risk factors, clinical and angiographic characteristics, in-hospital complications, and mortality of young ACS patients

3.2 Specific objectives

- To determine the risk factors of young ACS patients
- To determine the clinical and angiographic characteristics of young ACS patients
- To determine in-hospital complications
- To determine the inpatient mortality of young ACS
- To determine the length of the hospital stay

4 .Methods and Materials

4.1. Study setting

The study was conducted at Tikur Anbessa Specialized Hospital and Gesund Cardiac and Medical Center, both located in Addis Ababa, Ethiopia. Tikur Anbessa is the largest referral and teaching hospital in Ethiopia, established in 1972 and transferred to Addis Ababa University in 1998. It is the main teaching center for clinical and preclinical training, offering specialty and subspecialty training and clinical services. Gesund Cardiac and Medical Center is a private cardiac facility in Addis Ababa, providing various cardiac services to the people of the Horn of Africa.

4.2 Study design

Hospital based retrospective cross sectional descriptive study was employed.

4.3 Source population

All ACS patients who were treated in TASH and Gesund medical and cardiac center from January 2019 to January 2024.

4.4 Study population

The study population for the study are all young ACS patients (age less than or equals to 45 years) who were treated in study centers from January 2019 to January 2024.

4.5 Inclusion and exclusion criteria

4.5.1 Inclusion criteria

- All young ACS patients who had CAG

4.5.2 Exclusion criteria

- Age above 45 years
- incomplete documentation
    - missing results (troponin, lipid profile)
    - missing discharge summery
    - lost echocardiography or CAG results
- lost chart

4.6 Sample size determination

All ACS patients aged less than or equal to 45 years of age who had CAG from January 2019 to January 2024 were included in the study. 103 patients who fulfilled inclusion and exclusion criteria were found in the CAG registration books and were included in the study.

4.7 Variables

- Age
- Sex
- ACS type

- Echocardiographic (ejection fraction, LV thrombus)
- Coronary angiographic findings
- In-hospital complications of ACS (heart failure, electrical, mechanical, and pericarditis)
- Risk factors of ACS
- Length of hospital stay
- In hospital mortality

4.8 Operational definition

- ACS includes the diagnosis of NSTEMI, STEMI, and unstable angina.

- Young ACS means a patient with ACS who is less than or equal to 45 years old.
- A family history of premature CAD was defined as having a primary relative who had been diagnosed with CAD prior to the age of 55 years in a male relative or 65 years in a female relative.
- Dyslipidemia is defined by the ATP III panel classification.
    - High total cholesterol; total cholesterol >240 mg/dl
    - High LDL, LDL level 160–189 mg/dl
    - Low HDL cholesterol, HDL level <40 mg/dl
    - High TAG, TAG level >200 mg/dl
    - Or the patient has had previously documented dyslipidemia.
- Pre diabetes has HbA1c levels ranging from 5.7 to 6.4%.

4.9 Data collection and materials

Data was collected by principal investigator from study population using structured data collection questioner assessing patients´ demographic data, risk factors, presenting symptoms, type of ACS, CAG finding, in hospital complications, length of hospital stay and in hospital mortality. It was collected by review of patient's medical records (charts and iCare registry)

4.10 Data analysis procedure

The collected data was verified, cleaned, and checked for quality before the analysis. The IBM SPSS Statistics software package version 26 was used for the entry of statistical data and analysis. Descriptive statistics was used as a statistical data analysis method and was expressed as frequencies and numbers (percentages %) for categorical variables. The results were summarized by using tables, and figures. Continuous variables were represented as means, standard deviations, median and interquartile range. Univariant binary regression analysis was performed to determine the association of each variable with length of hospital stay and multivessel disease. Furthermore, a multivariable logistic regression model was done to identify predictors increased length of hospital stay and multivessel disease. P-values less than 0.05 are considered to determine the statistical significance of the association and adjusted odds ratio with a 95% confidence interval is used to determine the presence association.

4.11. Ethical consideration

The ethical clearance of the study was obtained from the institutional review board department of internal medicine, AAU, CHS. Since data was collected from chart (secondary data) patient consent was not taken. All the information obtained was held with confidentiality and used only for the intended purpose.

4.12 Dissemination of the results

The result of this study will be presented to the department of internal medicine and public health department, as part of the internal medicine specialty thesis at AAU, CHS. Attempts will be made to present the result at scientific conferences and to publish the result of the study in local and/ or international journals.

5. Results

5.1 Socio-demographic characteristics of patients

The study included total of 103 patients. Out this, most were men 93(90.3%), and median (IQR) age was 39(36-42). The youngest age in study was 20 years old. Majority of patients (72.8%) were from Addis Ababa and 94(91.3%) lived in an urban setup. 83(80.6%) of the patients were obtained from Gesund Cardiac and Medical Center, while the rest were from TASH. (table1, Figure1).

Figure 1: Pie chart demonstrating place of residence of patients

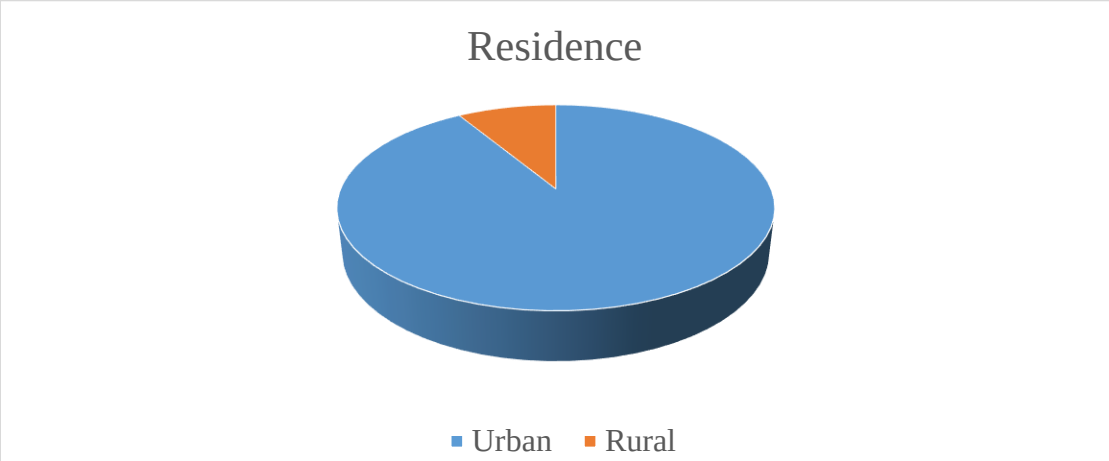

Table 1 Socio-demographic characteristics of patients

Characteristics		N	%	Median (IQR)
Sex	Female	10	9.7	
	Male	93	90.3	
Age				39 (36-42)
Region	Adis Abeba	75	72.8	
	Afar	1	1.0	
	Amhara	8	7.8	
	Benshangul Gumuz	1	1.0	
	Dire Dawa	3	2.9	
	Oromia	6	5.8	
	SNNP	8	7.8	
	Somalia	1	1.0	
Hospital	Gesund	83	80.6	
	TASH	20	19.4	

5.2 Clinical presentation and risk factors

The commonest presenting complaint was chest pain experienced by 100(97.1%) patients followed by diaphoresis (63.1%), and generalized fatigue (57.3%). The characteristic pattern chest pain was expressed as squeezing in type in 55(64.7%) patients and heaviness in 22(25.9%)

patients. 18(27.7%) and 17(26.2%) patients reported radiation of the chest pain to both arms and the left arm only, respectively. The chest pain was exacerbated with exertion in 32(56.1%) patients, and relieved with rest in 27(47.4%) patients while 26(45.6%) patients experienced the pain at rest (Table 1).

Most patients 94(91.3) had risk factors and more than half of study population 57(55.3%) had more than risk one risk factors. The commonest risk factor identified was dyslipidemia occurring

in 64(61.2%) of patients. This was followed by hypertension 35(34%), cigarette smoking 23(22.3%), and diabetes 22(21.4%). Risk factor was identified in 9(8.7%) patients. The commonest pattern of dyslipidemia was isolated low HDL 38(63.3%) followed by high TAG 10(16.7%) (Table 3). The mean (SD) total cholesterol, LDL cholesterol, and HDL cholesterol at presentation were 170(50), 102(38), and 36(12), respectively, while the median (IQR) TAG level was 134(86-191) (Table 5 and Figure 2). None of study population had cocaine use and Covid 19

Infection as risk factor.

5.3 Diagnosis of patients

The commonest type of ACS encountered was STEMI found 81(78.6%) patients, and 69(67.0%) had Killip I disease. Majority of patients had elevated troponin level 91 (88.35) at presentation. The median (IQR) time from disease onset to hospital visit was 48(13-72) hours. Upon echocardiographic evolution, 54(52.4%) had an ejection fraction of ≥50%, and 19(18.4%) had LV thrombus. Upon ECG evaluation, 23(22.3%) patients had inferior lead involvement marking the commonest pattern of ECG abnormality. This was followed by anterolateral (17.5%) and anteroseptal (16.5%) leads. 6(6.8%) patients had a normal ECG (Table 4).

Table 2: Characterization of symptoms at presentation

Presenting symptoms	N	%
Chest pain	100	97.1

Dyspnea	38	36.9
Nausea and vomiting	38	36.9
Diaphoresis	65	63.1
Generalized Fatigue	59	57.3
Syncope	2	1.9
Epigastric pain	6	5.8
Body swelling	1	1.0
Orthopnea	11	10.7
PND	4	3.9
Palpitation	19	18.4
Nausea	11	10.7
Type of chest pain (n=86)		
Squeezing	55	64.7
Heaviness	22	25.9
Stabbing	7	8.2
Dull aching	2	2.4
Radiation of chest pain (n=76)		
Left arm	17	26.2

Right arm	4	6.2
Both arms	18	27.7
Right shoulder	3	4.6
Left shoulder	7	10.8
Both shoulders	3	4.6
Back	5	7.7
Jaw	4	6.2
Root of neck	2	3.1
Non radiating	13	20.0
Association of chest pain with exertion (n=85)		
Worsening with exertion	32	56.1
Relieved with rest	27	47.4
Chest pain at rest	26	45.6

5.4 Coronary angiographic findings

The most commonly involved artery on coronary angiography was the LAD seen in 47(45.6%) patients followed by the RCA (11.6%). Multivessel involvement was seen in 16(15.5%) patients while 21 (20.4%) had a normal coronary angiography. Out of 21 patients with normal coronary angiography 8(38.1%) had STEMI, 7(33.3%) UA, 6(28.6%) NSTEMI and 20(95.2%) were men. Out of 82 patients with CAG abnormality 66(80.48%) has single vessel disease followed by 11(13.42%) double vessel and 5(6.1%) triple vessel disease. Only 1(.98%) patient had LMCA

disease.79 (98%) of patients had significant coronary artery stenosis (LMCA >50%, other coronary artery vessels >70 % stenosis) (fig 3).Coronary artery atherosclerosis, which was observed in 68(82.9%) patients was the commonest mechanism of ACS, followed by coronary artery embolism in 12(14.6%) of patients. (Table 6).

5.4.1 Factors associated with multivessel disease

Upon binary regression, older age, cigarette smoking, diabetes, prediabetes, higher LDL levels and Killip class II-IV were associated with multivessel disease a -value of 0.30 as a cutoff. These variables were then taken to multivariate logistic regression, after which older age (AOR, 1.37; 95% CI, 1.10-1.71, P=0.006), cigarette smoking (AOR, 5.52; 95% CI, 1.26-24.19; P=0.0230), and prediabetes (AOR, 10.63; 95% CI, 1.83-61.75; P=0.008) were found to have a statistically significant association with multivessel disease. (Table 9).

5.5 Inpatient complications of ACS and hospital out come

Heart failure was commonest complication which occurred in 34(33 %) of patients, followed by post MI pericarditis which was seen in 16(15.5%) patients. In total, 14(13.6%) patients experienced electrical complications, and the commonest one was ventricular tachycardia seen in 6(5.8%) patients, of which 4 were sustained. The median (IQR) length of hospital stay was 5(3-7) days, and only 1(1%) patient with cardiogenic shock died in hospital (Table 7).

5.5.1 Factors associated with prolonged hospital stay

Upon binary regression, abnormal troponin levels, longer time to presentation, not being a smoker, EV of ≤50%, presence of LV thrombus, presence of multivessel disease, Killip class II or more, and presence of electrical complications were associated with prolonged length of hospital stay using a -value of 0.25 as a cutoff. These variables were then taken to multivariate logistic regression, after which only 2 variables were found to have a statistically significant association with prolonged length of hospital stay. These variables were the presence of multivessel disease (AOR, 6.01; 95% CI, 1.39-25.92; P= 0 .016), and not being a smoker (AOR, 3.18; 95% CI, 1.05-9.62; P=0.041) (Table 7).

Table 3: Identified risk factors of patients

Risk factors	N	%
Dyslipidemia	64	61.2
HTN	35	34
Smoking cigarette	23	22.3
Diabetes	22	21.4
Prediabetes	17	16.5
Alcohol use disorder	5	4.
Other risk factors*	9	8.7
APS	1	1
No risk factor identified	9	8.7
Type of diabetes (n=22)		
Type 1	2	9.1
Type 2	20	90.1
Patterns of dyslipidemia (n=60)		
HDL only	38	63.3
HDL and TAG	10	16.7
LDL and HDL	2	3.3

Total Chole and TAG	3	5
Total Chole and HDL	2	3.3
Total Chole, LDL and HDL	1	1.7
TAG only	2	3.3
Total chole, HDL and TAG	1	1.7
LDL and TAG	1	1.7
* Are obesity (4), psoriasis (1), khat chewing (2), colorectal cancer (1) Factor V Leiden mutation (1)		

Table 4: Patterns of ECG abnormalities

Patterns of ECG lead involvement	N	%
Inferior only	23	22.3
Anterolateral	18	17.5
Anteroseptal	17	16.5
Anterior only	11	10.7
Anteroseptal with lateral	6	5.8
Lateral only	5	4.9
Inferior with lateral	5	4.9
Anteroseptal with inferior	3	2.9
Septal only	2	1.9
Normal ECG	6	5.8
Other ECG abnormalities	7	6.8
*Other ECG abnormalities include: inferior with posterior (1), inferior with anterior (1), right side (1), anterolateral with inferior (1), anteroseptal with ST segment depression (1), non-specific ST segment changes (1), anterior with ST segment depression (1)		

Figure 2: Bar graph demonstrating Killip class of patients

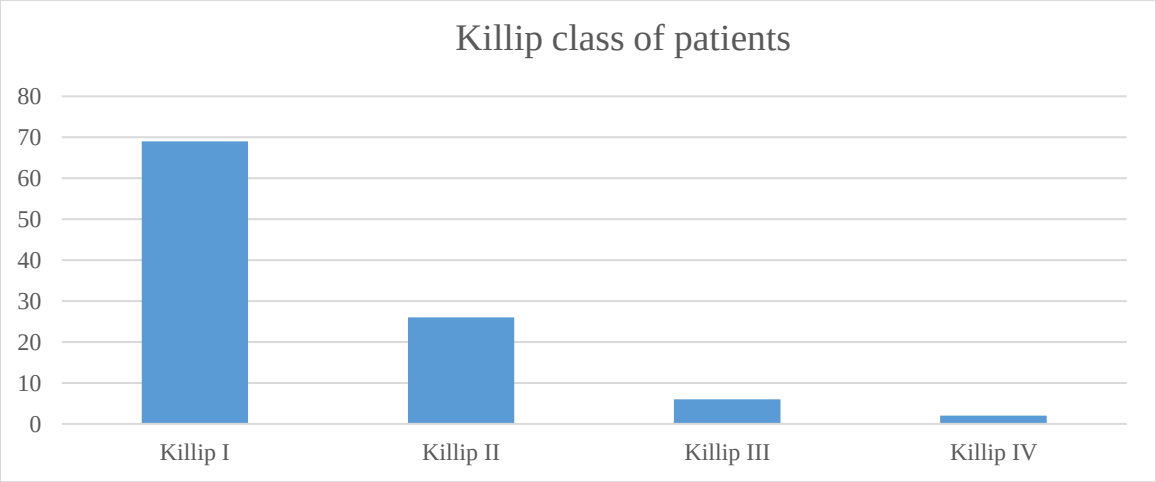

Figure 3: Coronary angiography finding

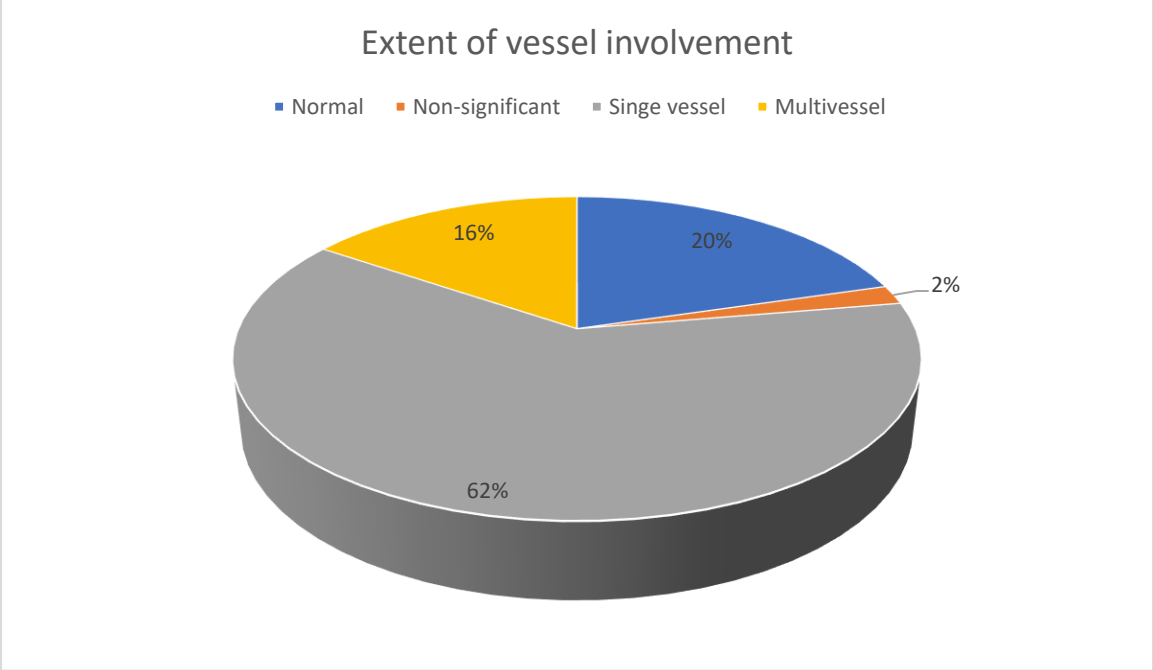

Table 5:ACS profile of patients at presentation

Characteristics		N	%	Mean (±SD)	Median (IQR)
Type of ACS	STEMI	81	78.6		
	NSTEMI	11	10.7		
	Unstable angina	11	10.7		
Serum troponin level in ng/L					28 (4-691)
Time to presentation in hours					48 (13-72)
Ejection fraction	< 30%	10	9.7		
	30% – 40%	18	17.5		
	40% – 50%	21	20.4		
	> 50%	54	52.4		
LV thrombus	No	84	81.6		
	Yes	19	18.4		
Killip classification	I	69	67.0		
	II	26	25.2		
	III	6	5.8		
	IV	2	1.9		
Lipid profile at	Total cholesterol			170±50	

presentation (mg/dL)	LDL cholesterol			102±38	
	HDL Cholesterol			36±12	
	TAG				134 (86-191)

Table 6: CAG profile of patients at presentation

Involved vessels on CAG	N	%
LAD	47	45.6
RCA	12	11.6
Lcx	4	3.9
Multivessel	16	15.5
Normal	21	20.4
OM1	2	1.9
PDA	1	1.0
Findings on CAG (n=82)		
Atherosclerosis	68	82.9

Embolism	12	14.6
Bridging	1	1.2
Ectasia	1	1.2

Table 7: Complications of ACS

Electrical complications (n=14)	N	%	Median (IQR)
VF	3	21.4	
VT	6	42.9	
RBBB	2	14.3	
AV block	2	14.3	
Atrial flutter	1	7.1	
Mechanical complications (n=16)			
Post MI Pericarditis	16	15.5	
Inpatient death (n=103)	1	1	
Length of hospital stay			5 (3-7)

Table 8: Factors associated with increased length of hospital stay (>5 days)

Variables		LOS > 5 Days		COR (95% CI)	P value	AOR (95% CI)	P value
		Yes	No				
Troponin	Normal	4	8	1.00		1.00	
	Increased	53	38	2.79 (0.78 - 9.94)	0.114	1.72 (0.37-8.00)	0.487
Time to presentation (hrs) - M (IQR)		48 (12-72)	48 (16-96)	0.997 (0.99-1.00)	0.174	0.997 (0.99-1.00)	0.369
Smoking	No	48	32	2.33 (0.90-6.03)	0.080	3.18 (1.05-9.62)	0.041*
	Yes	9	14	1.00		1.00	
EF	≥50%	23	31	1.00		1.00	
	<50%	34	15	3.06 (1.36-6.88)	0.007	2.16 (0.78-6.03)	0.140
LV thrombus	No	43	41	1.00		1.00	
	Yes	14	5	2.67 (0.88-8.08)	0.082	1.42 (0.38-5.25)	0.604
Multivessel disease	No	44	43	1.00		1.00	
	Yes	13	3	4.24	0.033	6.01	0.016*

				(1.13-15.91)		(1.39-25.92)	
Killip class	I	33	36	1.00		1.00	
	II-IV	24	10	2.62 (1.09-6.29	0.031	1.40 (0.49-3.97)	0.525
Electrical complications	No	49	43	1.00		1.00	
	Yes	8	3	2.34 (0.58-9.38)	0.230	1.46 (0.29-7.27)	0.644
* Variables that showed significant association with prolonged hospital stay upon multivariate logistic regression							

Table 9: Factors associated with multivessel disease

Variables		Multivessel disease		COR (95% CI)	P-value	AOR (95% CI)	P-value
		No	Yes				
Age (year) – median (IQR)		38 (34-41)	42 (40-45)	1.36 (1.12-1.64)	0.002	1.37 (1.10-1.71)	0.006*
Cigarette smoking	No	70	10	1.00			
	Yes	17	6	2.47(0.79-7.74)	0.121	5.52 (1.26-24.19)	0.023*

Diabetes	No	70	11				
	Yes	17	5	1.87(0.57-6.11)	0.299	3.47(0.67-17.98)	0.139
Prediabetes	No	76	10	1.00			
	Yes	11	6	4.15(1.26-13.67)	0.020	10.63(1.83-61.75)	0.008*
LDL (mg/dl) – mean (SD)		100 (37)	115 (43)	1.01(0.996-1.025)	0.141	1.01 (0.99-1.03)	0.270
Killip Class	I	61	8				
	II-IV	26	8	2.35(0.80-6.92)	0.122	1.06(0.26-4.38)	0.936
* Variables that showed significant association with multivessel disease upon multivariate logistic regression.							

6. Discussion

Although the incidence of acute myocardial syndrome among young adults is low (5-10 %), young patients require special attention, and developing an approach to the early diagnosis and identification of high-risk patients (5, 6, 7).

In our study, the majority of patients treated during the study period were men 93(90.3%), which is consistent with most studies that looked at this age group across the literature review. Our patients visited medical care centers with a median (IQR) time of 48 (13–72) hours after symptom onset, which is much delayed compared to studies done in Dakar, Senegal, with an

average time of 14.5 hours and in the ENACT study, a pan-European survey of ACS, 65% of patients presented within 12 hours of the onset of pain(29). Compared to studies conducted on older patients in our country, our study population had a similar time delay. In a study done by Mulugeta R, Zewdie A. in 2023 which looked in to pattern of ACS presentation at emergency in SPHMMC, the average time from symptom onset to emergency visit was 2 days, but the average age in this study was 55.65 ± 13.96 years. On the contrary, the Polish Registry of ACS and Tamil Nadu STEMI Program showed shorter ischemic time in younger patients (13, 26, 28). This great delay in medical care-seeking behavior may be due to less awareness or knowledge about the signs and symptoms of ACS as well as the benefit of early treatment. In a study done in Adis Abeba, University, from 2019 to 2020, which assessed the knowledge,, attitude, and belief of 330 ACS patients with a mean age of 57.9 ± 14.1 years, 44.6% had adequate knowledge and 46% had an unfavorable attitude about ACS symptoms(30) .

Chest pain remains the most common presenting symptom of ACS in all age groups of patients across the world. In our study, 100 (97.1%) patients presented with chest pain followed by diaphoresis (63.1%) and generalized fatigue (57.3%). Compared to older age groups, younger patients presented with more chest pain symptoms. The Polish Registry of ACS, which compared the presenting symptoms of 7481 women with ACS *from* between 2007 and 2014 (1834 women aged ≤45 years and 5647 women aged 63–64 years), found that the incidence of chest pain was higher in younger women (90.4% vs 88.5%, $P = 0.025$). Similarly, in a study from Saudi Arabia in 2021 by Al-Shahrani et al., which included a total of 652 ACS patients with a mean age of less than 45 years with a mean age of 38 ± 7 vs 60 ± 11 years old, chest pain was more common in younger age groups 97 (89%) vs 444 (81.8%). Similarly, in our setup, older adults with a mean age of 56.3 (SD ± 13.65) years had lower chest pain 66 (53.2%) on study done in TASH, 2019 by Bogale et al. compared to this study (5, 31).

A literature review clearly associates conventional risk factors for ACS and its complications in young subjects, but at different rates compared to older patients. The commonest risk factor identified in our study was dyslipidemia, which was identified in 64 (61.2%) of patients, followed by hypertension (34.3%), cigarette smoking (22.3%), and diabetes (22.4%). Similarly, dyslipidemia was also the most common risk factor identified in older age groups, with a median

age of 56 years, according to a study in Adis cardiac hospital, Ethiopia.(32). This finding was consistent with study from Poand(15).Compared to a study in sub-Saharan Africa by Sarr M. et al. on young patients with ACS, the cigarette smoking risk was lower in our study (23% vs. 52.4%) (7). In comparison to older patients with ACS from SPHMMC, HTN (45.6%, DM 30%), and Adis cardiac hospital (HTN 44% and DM 30%), our study found reduced levels of diabetes and hypertension as risk factors (28, 32, 33).

The most common type of ACS in our study was STEMI, affecting 81 (78.6%) patients. This finding aligns with most studies on ACS in young adults (6, 8, 10). The majority of patients had an elevated troponin level of 91 (88.35%) at presentation, which is comparable with the yield from the study in TASH 2019, which was seen in 88.1% of patients.

On echocardiographic evolution, most of our study population had a preserved ejection fraction (EF ≥50%) (52.4%), and a severely reduced ejection fraction was observed in 10 (9.7%).Compared to the study from TASH in 2019 on older patients with severely reduced ejection seen in 29.2% of patients and from SPHMMC in 2023 with reduced ejection fraction seen in 60.2% of patients, our study population had preserved ejection fraction (28, 31). The prevalence of LV thrombus was 19 (18.4%), which is much higher in the coronary artery intervention era. This may be because of the delayed presentation of patients, median 48 (13–72) hours.

Heart failure was the most common complication, which occurred in 34 (33%) of patients, followed by post-MI pericarditis in 16 (15.5%) patients. A total of 14 (13.6%) patients experienced electrical complications, and the commonest one was ventricular tachycardia, seen in 6 (5.8%) patients. Cardiogenic pulmonary edema and cardiogenic shock were seen in 6 (5.8%) and 2 (1.9%), respectively. The prevalence of complications was lower in our study compared to TASH's 2019 study with Killip class III and IV patients, which accounted for 54.2%, and SPHMMC's 2023 killip class III and IV 22% and 10%, respectively.

Most of our study population, 82 (79.6%) had abnormal CAG findings, and 79 (98%) with positive CAG had significant stenosis (LMCA >50 % and other coronary arteries >70%

stenosis). The pathomechanisms of ACS in subjects with abnormal coronary arteries by CAG in our study group were coronary artery atherosclerosis (68, 82.9%), followed by coronary artery embolism (12, 14.6%). Among patients with an abnormal coronary angiogram in our study population, single-vessel disease was most prevalent (47.5%) with the lesion located in the LAD, followed by RCA (11.6%), which is consistent with most previously published studies in younger age groups(8, 10, 34, 35). A study conducted by C. Arantes et al. looked into cardiovascular risk factors, clinical presentation, angiographic findings, and prognosis of young patients out of 1367 consecutively admitted ACS patients in a coronary unit over a 3-year period in Braga Hospital, Portugal. 8.12% of subjects were aged <45 years (group 1) and 91.88% ≥45 years (group 2). In this study, multivessel disease was more common in group 2 (p = 0.001), while single-vessel disease was more common in group 1 (p<0.001) (17). Multivessel disease was observed in 16 (15.5%) of the patients in our analysis, which is less than the 40.5% of older patients with a median age of 56 years in the Ads Cardiac Hospital study(32). Coronary angiographic findings in our study group showed normal coronary arteries in 21(20.4%) of patients, higher compared to study from pland 16.4%(15).but comparable to a study in the Adis cardiac hospital in older patients with normal angiographic(32).

The median (IQR) length of hospital stay was 5 (3–7) days, and only 1 (1%) patient with cardiogenic shock died in the hospital (Table 7). In our study, mortality is lower compared to older patients from the TASH 2019 study with a mortality rate of 27.4% and SPHMMC with a mortality rate of 6.8%.Similary, compared to previous studies done in TASH in 2019, with a length of hospital stay of 9.77±6.42 days, our study showed a shorter duration of hospital stay(28, 31) The presence of multivessel disease (AOR, 6.01; 95% CI, 1.39–25.92; P = 0.016) and not being a smoker (AOR, 3.18; 95% CI, 1.05–9.62; P = 0.041) were predictive of an increased length of hospital stay. Most studies show smoking increases mortality and hospital stay length but historically lowers mortality rates, known as "Smoker's Paradox." Most findings from this paradox were from pre-thrombolytic or thrombolytic eras, according to a 2011 systematic review(36). But recent data from the ACUITY trial, which included 13,819 patients, found that smoking was an independent predictor of higher 1-year mortality, affecting 29% of the patients. But in this study, patients were more than 65 years old (37). from this study It is

difficult to conclude that smoking shortens the length of hospital stay in this study as the sample size is small; further study is needed.

7. Conclusion

The populations of young patients with ACS were predominantly males residing in urban areas. Most of patients in this age group had one or more identified CVD risk factors. The CVD risk factor profile identified in this age group was similar to older patients but with variable rate of contribution. STEMI and single vessel disease were predominate presentations. Short term prognosis (in-hospital mortality was excellent in this age group

8. Recommendation

1. Investigate reasons behind delayed presentation and develop interventions to encourage young adults to seek timely medical attention upon experiencing ACS symptoms.
2. ACS should not be over looked in young adults especially those with risk factors.
3. Screening and primary CVD prevention according to Major guidelines and encourage healthy life style.
4. Conduct further research to understand the association between smoking and length of hospital stay in young ACS patients in the context of current treatment strategies

9. Strength and Limitation of study

Strength

1. This study is the first to explore the characteristics of ACS in young adults in Ethiopia, offering valuable insights.

2. The study utilized comprehensive data on risk factors, clinical presentations; angiographic findings, complications, and hospital stay length to gain a comprehensive understanding of ACS in young adults.
3. The study identifies common risk factors such as dyslipidemia, hypertension, and diabetes, suggesting potential areas for intervention and prevention strategies.

Limitation

1. Cross-sectional study, capturing a single time frame and unable to establish causal relationships between factors.
2. Limited sample size, the study's generalizability may be limited due to its small sample size of 103 participants and most patients are male residing in urban areas.
3. The retrospective data revealed insufficient documentation for symptom characterization and risk factor assessment (BMI was only measured for a few patients).

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12. Annex

Assessing the Risk factors, clinical and coronary angiographic profile, and in hospital mortality of Acute Coronary Syndrome in young adults: A 5 year Retrospective Cross Sectional Study

After taking IRB ethical approval data was retrieved by reviewing patient's charts and medical record

Patient I care ----------

1. Demographic data
    a) Age----------
    b) Sex ☐Male ☐Female
    c) 1. Region /Major city -------
    d) Residency
        1. Urban
        2. Rural

2 Diagnoses

a) STEMI
b) NSTMI
c) Unstable angina

3. EKG involved leads

a) Inferior
b) Anterior

c) Laterals
d) Posterior
e) Right
f) Inferior
g) Anteroseptal
h) Anterolateral
i) Normal
j) Others

4. Troponin level in ngm/L

5. Risk factors

a) Smoking 1.cigarette 2. Marijuana
b) Cocaine use
c) Hypertension
d) Diabetes mellitus 1. T1DM 2. T2DM
e) Obesity
f) Prior dyslipidemia on treatment
g) Dyslipidemia /lipid profile
    1. Total cholesterol level
    2. LDL cholesterol level
    3. HDL cholesterols level
    4. Triglycerides level
h) OCP use
i) Family history premature CAD
j) Sedentary Life
k) Covid 19
l) CKD
m) Others

5. Presenting symptoms

a) Chest pain
b) Epigastric pain
c) dyspnea
d) nausea or vomiting,
e) diaphoresis
f) generalized fatigue
g) body swelling
h) fever
i) syncope
j) palpitation
k) cardiac arrest
l) characteristics of chest pain (type)
    a. Squeezing
    b. Heaviness
    c. Stabbing
    d. Dull aching
    e. Tearing
    f. Burning
    g. tightness

m) radiation of chest pain
    a. Left arm
    b. Right arm
    c. Bilateral arms
    d. Right shoulder
    e. Left shoulder
    f. Bilateral shoulders
    g. Back
    h. Jaw

i. Root of neck
j. Non radiating

n) Association of chest pain with exertion)
a. Worsening with exertion
b. Relieved with rest
c. Chest pain at rest

6. Duration of symptoms in hours
7. Echocardiography
a) Left ventricular ejection fraction (%)
1. >50
2. 40-50
3. 30-40
4. <30

b. LV thrombus

8. Coronary angiography involved artery
a. Left Anterior descending artery
b. Right coronary artery
c. Circumflex artery
d. Left main coronary artery
e. Multivessel disease
f. Non obstructive
g. Coronary artery occlusion in percent (%)
h. Pathomecanism of ACs
a) Atherosclerosis
b) Coronary artery embolism
c) Coronary artery dissection
d) Coronary artery Bridging

9. Number of vessels involved
a. 1.--- 2. --- 3. ----

10. . Hospital course

a) Killip classification 1 .i 2. ii 3 ii 4, iv

b) Arrhythmia

1. Atrial fibrillation
2. Atrial flutter
3. VF
4. VT
5. Brady arrhythmia
    i. 1st degree AV block
    ii. Mobitz type 1 AV block
    iii. Mobitze type 2 AV block
    iv. High degree AV block
    v. 3rd degree AV block
    vi. Sinus bradycardia

c) Mechanical complication

1. Ventricular sepal rupture
2. Ventricular wall rupture
3. Papillary muscle rupture

d) Post MI pericarditis

e) In-hospital death

11. Duration of hospital stay in days