

An updated Clinical and Demographic Profile of Acute Myocardial Infarction: The STEMI Blueprint in Sfax

Profil clinico-démographique actualisé de l'infarctus du myocarde aigu

Anis Cheikhrouhou¹, Selma Charfeddine¹, Souha Rabah¹, Yosra Mejdoub², Aïman Ghrab¹, Zied Triki¹, Rania Gargouri¹, Mariam Jabeur¹, Amine Bahloul¹, Souad Mallek¹, Faten Triki¹, Leila Abid¹

1. Cardiology Department, Hedi Chaker University Hospital of Sfax, Sfax, Tunisia

2. Community Medicine and Epidemiology department, Hedi Chaker University Hospital of Sfax, Sfax, Tunisia

SUMMARY

Introduction: ST-segment elevation myocardial infarction (STEMI) remains a major cause of cardiovascular mortality, with a disproportionately high and growing burden in North Africa compared with declining trends in high-income countries. Local, center-specific data remain scarce in Tunisia.

Aim: This study aimed to characterize the clinical profile and ventricular outcomes of patients admitted with STEMI to a tertiary cardiology center in southern Tunisia.

Methods: This retrospective, descriptive study included all patients admitted for STEMI to the Department of Cardiology at Hedi Chaker University Hospital (Sfax, Tunisia) over a three-month period (January–March 2023), diagnosed per 2017 ESC criteria.

Results: Among 156 patients (mean age 60.23 ± 11.9 years, male predominance), smoking (61.5%) and diabetes (33.3%) were the leading risk factors. Anterior STEMI was the most frequent presentation (48.7%). Complications occurred in 55% of patients, most commonly acute heart failure (26%) and cardiogenic shock (5.1%). Coronary angiography showed predominantly single-vessel disease, with the LAD as the most frequent culprit artery (40%).

Conclusion: This contemporary cohort highlights a younger STEMI population with a high burden of smoking and diabetes compared with Western series, alongside substantial rates of in-hospital complications — underscoring the need for strengthened regional prevention and care strategies.

KEYWORDS

ST-segment elevation myocardial infarction; cardiovascular risk factors; clinical profile; left ventricular ejection fraction; coronary angiography; in-hospital complications.

RÉSUMÉ

Introduction : L'infarctus du myocarde avec sus-décalage persistant du segment ST (STEMI) demeure une cause majeure de mortalité cardiovasculaire, avec un fardeau particulièrement élevé et croissant en Afrique du Nord, contrairement à la diminution observée dans les pays à revenu élevé. Les données locales spécifiques aux centres hospitaliers restent limitées en Tunisie.

Objectif : Décrire le profil clinique, démographique et biologique ainsi que le retentissement ventriculaire des patients admis pour STEMI dans un centre tertiaire de cardiologie du sud tunisien.

Méthodes : Il s'agit d'une étude rétrospective descriptive incluant tous les patients admis pour STEMI au service de cardiologie du CHU Hédi Chaker de Sfax (Tunisie) sur une période de trois mois (janvier–mars 2023), selon les critères diagnostiques de la Société Européenne de Cardiologie (ESC) 2017.

Résultats : Cent cinquante-six patients ont été inclus (âge moyen : $60,23 \pm 11,9$ ans ; prédominance masculine). Le tabagisme (61,5 %) et le diabète (33,3 %) constituaient les principaux facteurs de risque cardiovasculaire. L'infarctus antérieur représentait la forme clinique la plus fréquente (48,7 %). Des complications sont survenues chez 55 % des patients, principalement l'insuffisance cardiaque aiguë (26 %) et le choc cardiogénique (5,1 %). La coronarographie retrouvait majoritairement une atteinte monotronculaire, l'IVA étant l'artère coupable la plus fréquemment impliquée (40 %).

Conclusion : Cette cohorte contemporaine met en évidence une population de patients victimes de STEMI plus jeune que celle rapportée dans les séries occidentales, caractérisée par une forte prévalence du tabagisme et du diabète ainsi que par des taux importants de complications hospitalières, soulignant la nécessité de renforcer les stratégies régionales de prévention et de prise en charge.

MOTS-CLÉS

Syndrome coronarien aigu avec sus-décalage du segment ST ; Facteurs de risque cardiovasculaires ; profil clinique ; fraction d'éjection ventriculaire gauche ; coronarographie ; complications hospitalières.

Correspondance

Anis Cheikhrouhou

INTRODUCTION

ST-segment elevation myocardial infarction (STEMI) remains one of the leading causes of cardiovascular mortality worldwide(1), and its management is highly time-dependent: outcomes are directly tied to how quickly patients are identified, diagnosed, and revascularized(2). While the epidemiology of STEMI has been extensively studied in high-income countries, where incidence rates have declined steadily over recent decades thanks to improved prevention and systematized care pathways, the picture in North Africa is markedly different(3). Cardiovascular disease continues to represent a growing burden in this region, driven by a high prevalence of modifiable risk factors such as smoking, diabetes, and hypertension, often occurring in a younger population than in Western cohorts(4).

In Tunisia, national registries such as FAST-MI have provided valuable insight into the clinical and demographic profile of STEMI patients(5), but local, center-specific data remain scarce, despite their importance for tailoring resource allocation and identifying gaps in the care pathway. Hedi Chaker University Hospital in Sfax serves as a major referral center for the southern and central regions of the country, including areas without access to catheterization facilities, making it a particularly relevant setting in which to characterize the contemporary STEMI population.

The aim of this study was therefore to describe the clinical, demographic, and biological profile of patients admitted for STEMI to the cardiology department of Hedi Chaker University Hospital over a three-month period, establishing a contemporary local registry of presentation patterns and ventricular outcomes. These local insights serve to contextualize our regional practices within the framework of current national and international registries.

PATIENTS AND METHODS

This retrospective, descriptive study was conducted in the Department of Cardiology at Hedi Chaker University Hospital, a tertiary referral center in Sfax, Tunisia. All patients admitted for urgent management of acute STEMI over a three-month period, from January 1 to March 31, 2023, were eligible for inclusion.

Patients of either sex and any age were included if they met the 2017 European Society of Cardiology (ESC) criteria for STEMI (1) : acute chest discomfort or other symptoms suggestive of myocardial ischemia, associated with new, persistent ST-segment elevation at the J-point in at least

two contiguous leads. The thresholds applied were ≥ 1 mm (0.1 mV) in all leads other than V2–V3, and in V2–V3, ≥ 2 mm in men aged 40 years or older, ≥ 2.5 mm in men younger than 40 years, and ≥ 1.5 mm in women regardless of age. A 0.5 mm threshold was used in the posterior leads (V7, V8 and V9) and a new or presumably new left bundle branch block in the context of acute myocardial ischemia was also considered diagnostic. Patients presenting more than 24 hours after symptom onset or with incomplete clinical data, were not included from the study.

Data were extracted from digital patient records using the hospital's system "dossier médical informatisé (DMI)", based on a pre-designed collection grid covering general population characteristics (age, sex, length of hospitalization, cardiovascular risk factors, and personal and family history of cardiovascular disease), pre-hospital and clinical data (timing of symptom onset, hemodynamic status at admission, electrocardiographic findings, and in-hospital complications such as cardiogenic shock, conduction disorders, and ventricular arrhythmias), and laboratory parameters (hemoglobin, leukocyte count, C-reactive protein (CRP), cardiac troponin, renal function, glycemia, lipid profile, and Glycated hemoglobin (HbA1c)).

Data were entered and analyzed using SPSS (Statistical Package for the Social Sciences) version 27. Qualitative variables were expressed as absolute frequencies and percentages. Quantitative variables were expressed as means $\pm$ standard deviation when normally distributed, or as medians with interquartile ranges (IQR) otherwise, with normality assessed using the Kolmogorov-Smirnov test.

RESULTS

Population Characteristics and origin

A total of 156 patients with STEMI were included over the three-month study period. The mean age was 60.23 ± 11.9 years, and there was a marked male predominance, with a sex ratio (male/female) of 6.4.

The majority of patients (55.7%, $n = 87$) experienced chest pain while in Sfax city itself (Figure 1). The remaining patients originated from other districts of the Sfax governorate, with the majority residing within 40 km of Sfax Ville (Agareb, El Hencha, Jbeniana, and Mahres), a subset came from more distant regions exceeding 40 km from the center (Bir Ali Ben Khalifa, Ghraïba, Kerkennah and Skhira) or originated from

other regions, including Sidi Bouzid and Tozeur (Table 2). Notably, the island district of Kerkennah presents unique transport challenges requiring specialized aerial or maritime medical evacuation to the mainland.

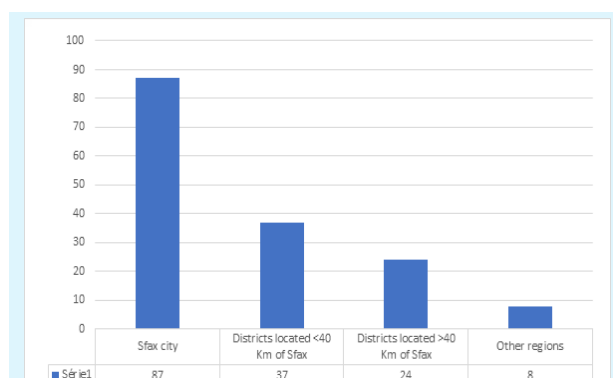


Figure 1. Distribution of patients based on location

Table 2. Hemodynamic parameters of the included patients

	Number of patients	Percentage (%)
Smoking	96	61.5 %
Diabetes	52	33.3 %
Hypertension	39	25 %
Dyslipidemia	12	7.7 %
Family History of Coronary Diseases	7	4.5 %
Chronic Kidney Disease	5	3.2 %

Note : A patient can have more than one risk factor.

Risk factors

Active smoking was the most prevalent risk factor, identified in 96 patients (61.5%), with a mean cumulative exposure of 44.80 ± 11.5 pack-years (Table 1). Diabetes mellitus was present in 33.3% of patients, arterial hypertension in 25%, and dyslipidemia in 7.7%. A family history of coronary artery disease was reported in seven patients, and chronic kidney disease (CKD) was identified in 3.2% of cases.

Table 1. Cardiovascular risk factors of the cohort

Hemodynamic parameter	Result
SBP, mmHg, mean $\pm$ SD	132.75 $\pm$ 24
DBP, mm Hg, mean $\pm$ SD	78, $\pm$ 20
Heart rate, Bpm, median [IQR]	80,[20]
Arterial hypotension, n (%)	13, (8.3)
Tachycardia, n (%)	22, (14)

bpm: Beats per minute; DBP: Diastolic blood pressure; IQR: Interquartile range; SBP: Systolic blood pressure; SD: Standard deviation

Regarding cardiovascular history, 19 patients (12.2%) had a previous myocardial infarction, 15 (9.6%) had undergone prior percutaneous coronary intervention,

10 (6.4%) had a history of stroke, and 5 (3.2%) had peripheral artery disease (Figure 2).

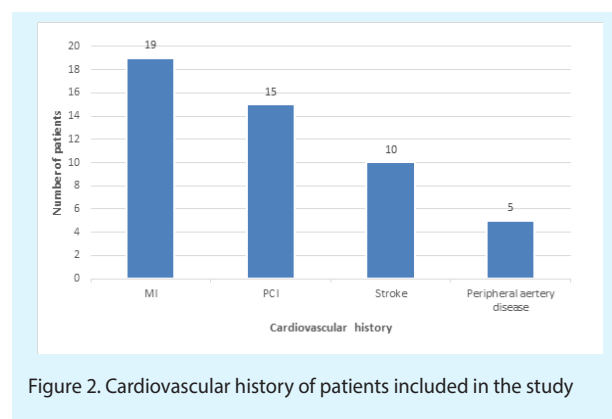


Figure 2. Cardiovascular history of patients included in the study

Clinical presentation

Although symptom onset was most commonly observed during the morning hours (4:00 a.m.–12:00 p.m.), affecting 37.8% of patients, the distribution across the other time periods was relatively homogeneous, with each accounting for nearly 31% of cases (Figure 3).

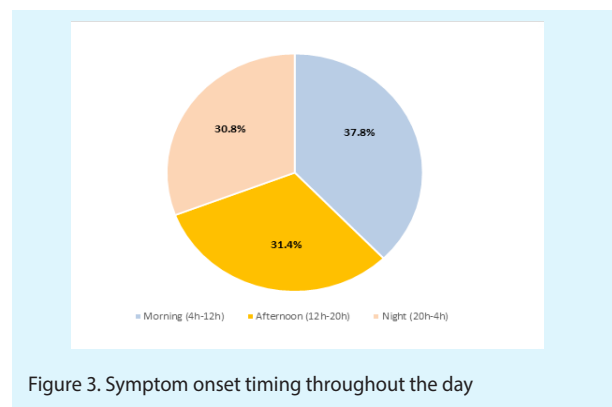


Figure 3. Symptom onset timing throughout the day

Upon admission, baseline hemodynamic parameters were generally within normal ranges, indicating a predominantly stable study population (Table 2). Arterial hypotension was documented in 13 patients (8.3%), while tachycardia (>100 bpm) was observed in 22 patients (14.0%), suggesting possible early hemodynamic compromise in a subset of patients.

Anterior STEMI was the most frequent localization, occurring in 76 patients (48.7%), followed by inferior infarction in 62 patients (40.0%). Lateral and circumferential localizations were less common, affecting 10 (6.4%) and 7 (4.5%) patients, respectively. No cases of isolated posterior STEMI were identified in the study population (Figure 4).

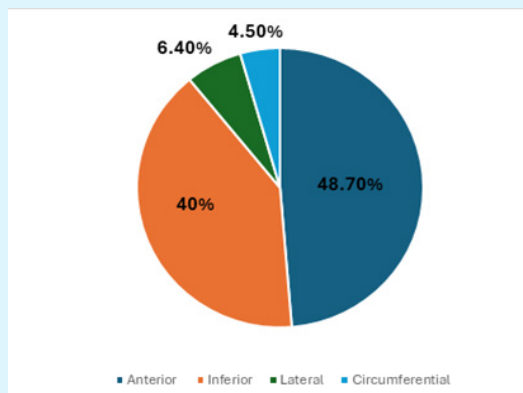


Figure 4. Distribution of the location of ST-segment elevation myocardial infarction

Complications were present at the time of admission in 86 patients (55%) (Table 3). Acute heart failure was observed in 26% of patients, including 8 patients (5.1%) with cardiogenic shock. No patient presented a cardiac arrest aside from the ones who had ventricular fibrillation.

Table 3. Distribution of patients based on complications upon admission

	Number of patients	Percentage (%)
Acute heart failure	40	26
Right ventricle involvement	14	9
Cardiogenic shock	8	5.1%
ventricular septal defect	1	0.6
Supraventricular arrhythmias	9	5.8
Atrial fibrillation	6	3.8
Flutter	3	1.9
Ventricular fibrillation	7	4.5
Conduction disorders	8	5.2
3rd degree Sinoatrial exit block	2	1.2
Complete heart block	4	2.5
2nd Degree Atrioventricular Block (MOBITZ 1)	1	0.6
1st Degree atrioventricular Block	1	0.6

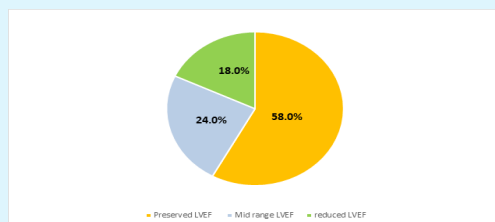


Figure 5. Distribution of the ventricular function in our cohort
LVEF: left ventricle ejection fraction

Biological abnormalities at admission were dominated by leukocytosis (60%) and hyperglycemia (45%), while positive CRP, anemia, and acute kidney injury were observed in 33%, 22.4%, and 15% of patients, respectively (Table 4, Table 5). Of the 70 patients presenting with hyperglycemia, 18 were newly diagnosed with diabetes.

Table 4. Initial Biological Parameters

	Mean rate	Extremes
Hemoglobin (mg/dL)	14	8.2-18,2
Leukocytes (/mm ³)	12987	1065-147 300
Glycemia (mmol/L)	10,5	2-14.5
Creatinine (micromol/L)	95,40	38-1000
CRP (mg/L)	27,9	0.1-360
HbA1c (%)	7,2	4.8-14.9
LDL (g/L)	1,3	0.4-3.8

CRP: C-reactive protein. HbA1c: glycated hemoglobin. LDL: Low density lipoprotein

Table 5. Main Biological Abnormalities at Admission

Biological results	Number	Percentage (%)
Hyperglycemia	70	45
Anemia	35	22.4
Leukocytosis	93	60
Positive CRP	51	33
Acute kidney injury	23	15

CRP: C-reactive protein.

Echocardiographic Evaluation of Ventricular Function

All patients underwent transthoracic echocardiography during their hospital stay. A preserved left ventricular ejection fraction (LVEF) $\geq 50\%$ was the most frequently observed while reduced LVEF $\leq 40\%$ and mildly reduced (mid-range) LVEF between 40% and 50% were less frequent.

Coronary artery status

Coronarography data was present in 148 patients. A total of 81 patients were identified as having single vessel coronary artery disease (Figure 6) while single and multi-vessel disease were less common.

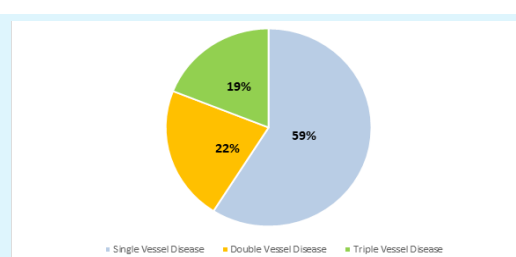


Figure 6. Distribution of patient based on coronary artery disease burden

The left anterior descending artery (LAD) was the most frequently identified culprit vessel, accounting for 40% of cases. The right coronary artery (RCA) was involved in 28% of patients, followed by the left circumflex artery (LCx) in 12% and the obtuse marginal branch in 11%. Less frequently, the culprit lesion was located in the left main coronary artery (LMCA) (5%) or the diagonal coronary artery (4%) (Table 6).

Table 6. Distribution of patients according to the culprit artery

Culprit artery	Percentage (%)
Left anterior descending artery	40
Right coronary artery	28
Left circumflex artery	12
Obtuse marginal branch	11
Left Main Coronary artery	5
Diagonal artery	4

DISCUSSION

STEMI remains a major public health burden worldwide, with declining incidence in high-income countries but a persistently high and growing burden in North Africa and Tunisia(1,6). In our cohort, 156 STEMI cases were admitted over a three-month period, highlighting the substantial burden of STEMI in our region. This volume contrasts sharply with the 215 cases recorded throughout the entire year of 2013 in our department, reflecting both the evolution of our center into a high-volume referral facility and the growing burden of cardiovascular disease in Tunisia (7). The mean patient age was 60.23 years, comparable to that reported in the FAST-MI Tunisia registry (60.8 years) (5), but younger than in major European and American cohorts, where mean ages ranged from 67.9 to 69 years (8,9). A marked male predominance was observed, consistent with Tunisian data (88.5%) and higher than that reported in the United States (64.2%) (8).

Smoking was identified in 61.5% of our patients, similar to the 63.6% reported by FAST-MI Tunisia and considerably higher than the 40% reported in French FAST-MI, reflecting a broader regional trend toward higher tobacco exposure, including a reported rise in female smoking (5). Diabetes was present in one third of our patients, higher than rates reported in North India (24%)

(10), the Polish PCI registry (17.5%) (11), and a Pakistani cohort (24%) (12), but consistent with north African data: 28% in Morocco (13), 32.2% among Tunisian male STEMI patients and around 50% among Tunisian women (14), and 32% in Tunisian FAST-MI. This pattern reflects the disproportionately high burden of diabetes across North Africa (15) and underscores the need for targeted prevention strategies in this population. Hypertension was present in 25% of our cohort, close to the 30% reported by Chamtour et al.(14), but lower than figures reported in Pakistan (56%) (12) and parts of Eastern Europe (16). Such variability likely reflects differences in screening and reporting practices rather than true differences in disease burden. Dyslipidemia (7.7%) and a family history of coronary artery disease (4.5%) were both less frequently reported in our cohort than in comparable series, where dyslipidemia prevalence ranged from 11.8% to 18.2% (5,14) and family history reached 7.4% in a large international registry (17). This discrepancy may reflect underdiagnosis rather than a true lower prevalence. CKD was identified in only 3.2% of our patients, considerably lower than the 10.6% to over 30% reported in Sweden (18), possibly reflecting differences in age distribution.

Symptom onset occurred most frequently in the morning, between 4 a.m. and noon, in 37.82% of our patients. This is consistent with the well-documented circadian peak in cardiovascular events between 6 a.m. and noon, attributed to surges in autonomic and hormonal activity around the time of waking (19). The mean admission systolic blood pressure in our cohort and heart rate closely matched the Tunisian FAST-MI registry (5) and a large Chinese primary PCI registry (79.2 bpm) (20), in which an admission systolic pressure of 121–150 mmHg was associated with the lowest mortality. Anterior STEMI was the most frequent presentation in our series (48.7%), in line with FAST-MI Tunisia (52.1%) and a 20-year Tunisian cohort (49.3%) (14); anterior STEMI is recognized to carry a less favorable prognosis given the larger myocardial territory at risk (21). Inferior (40%) and lateral STEMI (6.4%) were likewise consistent with previously reported ranges, with inferior myocardial infarction generally associated with a more favorable in-hospital course, with possible right ventricular involvement (22,23).

Complications were frequent in our cohort, present in 55% of patients at admission. Acute heart failure (26%) was more

common than in FAST-MI Tunisia (11.4%) but comparable to an Argentinian cohort (22.3%) (5,24); heart failure at presentation is a strong independent predictor of in-hospital mortality(24). Cardiogenic shock (5.1%) was slightly lower than the 6.2–7.1% reported in the Ruti-STEMI-Shock registry and the 10% reported in a Pakistani cohort, possibly reflecting the lower proportion of women in our series, female sex being a recognized risk factor for cardiogenic shock (25). Right ventricular involvement (9%) closely matched a Tunisian series (9.7%) (14) and is associated with an increased risk of biventricular failure, cardiogenic shock, and arrhythmia, requiring careful hemodynamic management (26). Ventricular fibrillation occurred in 4.5% of our patients, higher than the 2.5% reported in the FAST-MI program (5); recognized contributors include younger age, diabetes, alcohol use, elevated admission heart rate, and inferior infarct localization (27). Ventricular septal defect (0.6%) and complete atrioventricular block (2.5%) were both within the ranges reported in the contemporary reperfusion era, with hypertension, anterior infarction, female sex, and diabetes among the recognized predisposing factors (28,29).

Hyperglycemia at admission was observed in 45% of our patients, of whom 33.3% had known diabetes, consistent with reports that up to half of STEMI patients present with elevated glucose irrespective of diabetic status (30). Admission hyperglycemia is an independent predictor of in-hospital and long-term mortality and has been linked to larger infarct size and impaired microvascular function (30). Anemia was present in 22.4% of patients, slightly above the 17.9% reported in a large STEMI cohort (31), and is independently associated with worse short and long-term outcomes, including higher mortality and heart failure rates (32). Acute kidney injury occurred in 15% of patients, lower than the 27% reported by Tan et al, but remains strongly associated with the development of heart failure and increased mortality, particularly in the setting of cardiorenal syndrome (33). Inflammatory markers were frequently abnormal, with leukocytosis in 60% and elevated CRP in 33% of patients; both have established prognostic value for short- and long-term mortality after STEMI(34,35).

A non preserved LVEF (<50%) was observed in 42% of our patients, slightly lower than the 44.5% reported in a large cohort of 3,033 STEMI patients (36). Recognized contributors to reduced LVEF include advanced age, hypertension, diabetes, prior cardiac events, and elevated body mass index, fasting glucose, and leukocyte counts(37).

Reduction in LVEF is in turn associated with a higher rate of in-hospital complications, including pulmonary edema, cardiogenic shock, and ventricular tachycardia (38).

Coronary angiography in this series showed a single-vessel pattern in the majority of cases. This distribution places multivessel disease at the lower end of what is generally reported in STEMI populations. Multivessel disease in STEMI has been reported to represent between 40% and 65% of cases, a range largely derived from Western interventional registries(39,40). Our patients' relatively higher proportion of single-vessel disease could reflect a comparatively younger population or simply the smaller sample size. Regarding the culprit lesion, LAD was the most frequent culprit, followed by RCA then LCx. This hierarchy mirrors what has been consistently described in a Danish STEMI cohort. This pattern is generally attributed to the left anterior descending's larger plaque burden, more frequent eccentric and rupture-prone lesions, and its anatomically more proximal, high-shear-stress segments compared with the circumflex(41).

CONCLUSION

This study provides an updated overview of STEMI patients managed at a major referral center in southern Tunisia. Patients were notably younger than those reported in Western cohorts and exhibited a high prevalence of smoking and diabetes, consistent with national registry findings and suggesting an earlier onset of coronary artery disease in our population. The marked increase in case volume compared with previous local data further reflects the growing burden of STEMI on regional cardiology departments.

Rates of heart failure, cardiogenic shock, and ventricular arrhythmias at presentation remained substantial, emphasizing the severity of STEMI cases encountered in daily practice. In addition, the frequent occurrence of hyperglycemia and anemia highlights the importance of comprehensive risk assessment during hospitalization.

These findings encourage the continued efforts to strengthen cardiovascular prevention, particularly targeting smoking and diabetes, while ensuring the development of efficient STEMI care pathways. Regular evaluation of STEMI patient profiles may also help monitor the effectiveness of prevention strategies and guide future healthcare planning in Tunisia.

REFERENCES

- Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2018 Jan 7;39(2):119–77. doi:10.1093/eurheartj/ehx393
- Neumann FJ, Sousa-Uva M, Ahlsson A, Alfonso F, Banning AP, Benedetto U, et al. 2018 ESC/EACTS Guidelines on myocardial revascularization. *Eur Heart J*. 2019 Jan 7;40(2):87–165. doi:10.1093/eurheartj/ehy394 PubMed PMID: 30165437.
- Puymirat E, Aissaoui N, Cayla G, Lafont A, Riant E, Mennuni M, et al. Changes in One-Year Mortality in Elderly Patients Admitted with Acute Myocardial Infarction in Relation with Early Management. *Am J Med*. 2017 May;130(5):555–63. doi:10.1016/j.amjmed.2016.12.005 PubMed PMID: 28065766.
- Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019: Update From the GBD 2019 Study. *J Am Coll Cardiol*. 2020 Dec 22;76(25):2982–3021. doi:10.1016/j.jacc.2020.11.010 PubMed PMID: 33309175; PubMed Central PMCID: PMC7755038.
- Addad F, Mahdhaoui A, Gouider J, Boughzela E, Kamoun S, Boujnah MR, et al. Management of patients with acute ST-elevation myocardial infarction: Results of the FAST-MI Tunisia Registry. *PloS One*. 2019;14(2):e0207979. doi:10.1371/journal.pone.0207979 PubMed PMID: 30794566; PubMed Central PMCID: PMC6386252.
- Yao H, Ekou A, Niamkey T, Hounhoui Gan S, Kouamé I, Afassinou Y, et al. Acute Coronary Syndromes in Sub-Saharan Africa: A 10-Year Systematic Review. *J Am Heart Assoc*. 2022 Jan 4;11(1):e021107. doi:10.1161/JAHA.120.021107
- Charfeddine S, Ellouze T, Abid L, Hammami R, Hamza C, Maalej A, et al. Prise en charge de l'infarctus du myocarde avec sus-décalage persistant du segment ST : étude prospective à propos de 215 patients Management of acute myocardial infarction in patients presenting with ST-segment elevation in a Tunisian tertiary cardiac care center. 2017.
- Uddin M, Mir T, Khalil A, Mehar A, Gomez-Pineiro E, Babu MA, et al. ST-Elevation Myocardial Infarction Outcomes: A United States Nationwide Emergency Departments Cohort Study. *J Emerg Med*. 2022 Mar;62(3):306–15. doi:10.1016/j.jemermed.2021.10.028 PubMed PMID: 35058097.
- Bhatty A, Wilkinson C, Batra G, Alfredsson J, Erlinge D, Ferreira J, et al. Cohort profile: the European Unified Registries On Heart Care Evaluation and Randomized Trials (EuroHeart)-acute coronary syndrome and percutaneous coronary intervention. *Eur Heart J Qual Care Clin Outcomes*. 2024 Aug 8;10(5):386–90. doi:10.1093/ehjqcc/qcae025 PubMed PMID: 38609345.
- Ostrominski JW, Vaduganathan M, Girish MP, Gupta P, Hendrickson MJ, Qamar A, et al. Missed Opportunities for Screening and Management of Dysglycemia among Patients Presenting with Acute Myocardial Infarction in North India: The Prospective NORIN STEMI Registry. *Glob Heart*. 2022;17(1):54. doi:10.5334/gh.1140 PubMed PMID: 36051328; PubMed Central PMCID: PMC9374010.
- Dziewierz A, Zdzierak B, Malinowski KP, Siudak Z, Zasada W, Tokarek T, et al. Diabetes Mellitus Is Still a Strong Predictor of Periprocedural Outcomes of Primary Percutaneous Coronary Interventions in Patients Presenting with ST-Segment Elevation Myocardial Infarction (from the ORPKI Polish National Registry). *J Clin Med*. 2022 Oct 25;11(21):6284. doi:10.3390/jcm11216284 PubMed PMID: 36362512; PubMed Central PMCID: PMC9657628.
- Khan ZU, Ullah W, Shams S, Saleem S, Afsar R, Shah SU. Prevalence of Hypertension and Diabetes Mellitus in Patients Thrombolysed for STEMI. *Pak J Med Health Sci*. 2023 Jun 2;17(04):462–462. doi:10.53350/pjmhs2023174462
- Chang YJ, Chang SL, Chong E, Suenari K, Michalopoulos A. Cardiovascular Emergencies. *BioMed Res Int*. 2017;2017:7210261. doi:10.1155/2017/7210261 PubMed PMID: 28752094; PubMed Central PMCID: PMC5511652.
- Chamtouri I, Souissi R, Amdouni N, Jomaa W, Abdallah W, Hamda KB, et al. ST-segment Elevation Myocardial Infarction in North African Women: Results From a Twenty-year Experience. *J Saudi Heart Assoc*. 2022;34(3):166–74. doi:10.37616/2212-5043.1316 PubMed PMID: 36447603; PubMed Central PMCID: PMC9671144.
- Agarwal MA, Garg L, Lavie CJ, Reed GL, Khouzam RN. Impact of family history of coronary artery disease on in-hospital clinical outcomes in ST-segment myocardial infarction. *Ann Transl Med*. 2018 Jan;6(1):3. doi:10.21037/atm.2017.09.27 PubMed PMID: 29404349; PubMed Central PMCID: PMC5787715.
- Blöndal M, Ainla T, Eha J, Löiveke P, Marandi T, Saar A, et al. Comparison of management and outcomes of ST-segment elevation myocardial infarction patients in Estonia, Hungary, Norway, and Sweden according to national ongoing registries. *Eur Heart J Qual Care Clin Outcomes*. 2022 May 5;8(3):307–14. doi:10.1093/ehjqcc/qcaa098 PubMed PMID: 33710273.
- Marx N, Federici M, Schütt K, Müller-Wieland D, Ajan RA, Antunes MJ, et al. 2023 ESC Guidelines for the management of cardiovascular disease in patients with diabetes. *Eur Heart J*. 2023 Oct 14;44(39):4043–140. doi:10.1093/eurheartj/ehad192 PubMed PMID: 37622663.
- Sederholm Lawesson S, Alfredsson J, Szummer K, Fredrikson M, Swahn E. Prevalence and prognostic impact of chronic kidney disease in STEMI from a gender perspective: data from the SWEDEHEART register, a large Swedish prospective cohort. *BMJ Open*. 2015 Jun 23;5(6):e008188. doi:10.1136/bmjopen-2015-008188 PubMed PMID: 26105033; PubMed Central PMCID: PMC4480024.
- Morris CJ, Yang JN, Scheer FAJL. The impact of the circadian timing system on cardiovascular and metabolic function. *Prog Brain Res*. 2012;199:337–58. doi:10.1016/B978-0-444-59427-3.00019-8 PubMed PMID: 22877674; PubMed Central PMCID: PMC3704149.
- Hu Z, Luo XD, Zhou WJ, Xu CW, Chen XZ, Zhang BF, et al. Association between admission blood pressure and spontaneous reperfusion and long-term prognosis in STEMI patients: an observational and multicenter study. *BMC Cardiovasc Disord*. 2024 Sep 18;24(1):500. doi:10.1186/s12872-024-04168-4 PubMed PMID: 39294617; PubMed Central PMCID: PMC11409803.
- Ferrante G, Barbieri L, Sponzilli C, Lucreziotti S, Salerno Uriarte D, Centola M, et al. Predictors of Mortality and Long-Term Outcome in Patients with Anterior STEMI: Results from a Single Center Study. *J Clin Med*. 2021 Nov

- 29;10(23):5634. doi:10.3390/jcm10235634 PubMed PMID: 34884341; PubMed Central PMCID: PMC8658372.
22. Hattab FZE, Radi FZ, Hara L, Hafidi EM, Zarzur J, Cherti M. Infarctus du myocarde inférieur: première série marocaine, à propos de 103 cas. *Pan Afr Med J*. 2019 May 31;33(74). doi:10.11604/pamj.2019.33.74.16047
 23. Mirhosseini SA, Azami P, Hosseini M, Akbari M, Khorshidi S, Sadeghi F, et al. Clinical Profile, Angiographic Findings, and Outcome of Isolated High Lateral ST-Elevation Myocardial Infarction; A Gender-Specific Longitudinal Study of A Rare Subtype of Myocardial Infarction [Internet]. 2024 [cited 2026 Jun 19]. Available from: <https://www.researchsquare.com/article/rs-4974274/v1> doi:10.21203/rs.3.rs-4974274/v1
 24. Zoni CR, D'Imperio H, Zapata G, Charask A, Macín SM, Castillo Costa Y, et al. Heart Failure at Admission Complicating ST-Elevation Myocardial Infarction in a Middle-Income Country. Experience of the ARGENT-AMI-ST Registry. *Curr Probl Cardiol*. 2024 Jan;49(1 Pt B):102076. doi:10.1016/j.cpcardiol.2023.102076 PubMed PMID: 37716540.
 25. Kolte D, Khera S, Aronow WS, Mujib M, Palaniswamy C, Sule S, et al. Trends in incidence, management, and outcomes of cardiogenic shock complicating ST-elevation myocardial infarction in the United States. *J Am Heart Assoc*. 2014 Jan 13;3(1):e000590. doi:10.1161/JAHA.113.000590 PubMed PMID: 24419737; PubMed Central PMCID: PMC3959706.
 26. Inohara T, Kohsaka S, Fukuda K, Menon V. The challenges in the management of right ventricular infarction. *Eur Heart J Acute Cardiovasc Care*. 2013 Sep;2(3):226–34. doi:10.1177/2048872613490122 PubMed PMID: 24222834; PubMed Central PMCID: PMC3821821.
 27. Incidence, Characteristics, and Outcomes of Ventricular Fibrillation Complicating Acute Myocardial Infarction in Women Admitted Alive in the Hospital | Journal of the American Heart Association [Internet]. [cited 2026 Jun 19]. Available from: <https://www.ahajournals.org/doi/10.1161/JAHA.122.025959>
 28. Campion BC, Harrison CE, Giuliani ER, Schattenberg TT, Ellis FH. Ventricular septal defect after myocardial infarction. *Ann Intern Med*. 1969 Feb;70(2):251–61. doi:10.7326/0003-4819-70-2-251 PubMed PMID: 5764501.
 29. Aguiar Rosa S, Timóteo AT, Ferreira L, Carvalho R, Oliveira M, Cunha P, et al. Complete atrioventricular block in acute coronary syndrome: prevalence, characterisation and implication on outcome. *Eur Heart J Acute Cardiovasc Care*. 2018 Apr;7(3):218–23. doi:10.1177/2048872617716387 PubMed PMID: 28617040.
 30. Acute Hyperglycemia-Induced Injury in Myocardial Infarction - PubMed [Internet]. [cited 2026 Jun 19]. Available from: <https://pubmed.ncbi.nlm.nih.gov/39126075/>
 31. Akbar KMA, Dharma S, Andriantoro H, Sukmawan R, Mangkuanom AS, Rejeki VG. Relationship between Hemoglobin Concentration at Admission with the Incidence of No-Reflow Phenomenon and In-Hospital Mortality in Acute Myocardial Infarction with Elevation of ST Segments in Patients who underwent Primary Percutaneous Coronary Intervention. *Int J Angiol Off Publ Int Coll Angiol Inc*. 2023 Jun;32(2):106–12. doi:10.1055/s-0042-1742308 PubMed PMID: 37207009; PubMed Central PMCID: PMC10191690.
 32. Wang S, Zhang Y, Qi D, Wang X, Zhu Z, Yang W, et al. Age and gender mediated the association between anemia and 30-day outcomes in patients with ST-segment elevated myocardial infarction. *Int J Cardiol Heart Vasc*. 2024 Apr;51:101377. doi:10.1016/j.ijcha.2024.101377 PubMed PMID: 38464962; PubMed Central PMCID: PMC10920728.
 33. TAN J, ZHANG YH, SI J, XIAO KL, HUA Q, LI J. Incidence, predictors and prognosis of acute kidney injury in acute ST-segment elevation myocardial infarction patients undergoing emergent coronary angiography/primary percutaneous coronary intervention. *J Geriatr Cardiol JGC*. 2023 Feb 28;20(2):139–49. doi:10.26599/1671-5411.2023.02.004 PubMed PMID: 36910244; PubMed Central PMCID: PMC9992945.
 34. Early Detection of Inflammation-Prone STEMI Patients Using the CRP Troponin Test (CTT) - PubMed [Internet]. [cited 2026 Jun 19]. Available from: <https://pubmed.ncbi.nlm.nih.gov/35566579/>
 35. Klein A, Wiberg S, Hassager C, Winther-Jensen M, Frikk-Schmidt R, Bang LE, et al. Admission Leukocyte Count is Associated with Late Cardiogenic Shock Development and All-Cause 30-Day Mortality in Patients with ST-Elevation Myocardial Infarction. *Shock*. 2020 Mar;53(3):299–306. doi:10.1097/SHK.0000000000001369 PubMed PMID: 31058719.
 36. Savic L, Mrdovic I, Asanin M, Stankovic S, Lasica R, Matic D, et al. Prognostic Impact of Non-Cardiac Comorbidities on Long-Term Prognosis in Patients with Reduced and Preserved Ejection Fraction following Acute Myocardial Infarction. *J Pers Med*. 2023 Jul 8;13(7):1110. doi:10.3390/jpm13071110 PubMed PMID: 37511723; PubMed Central PMCID: PMC10381839.
 37. Mahdavi-Roshan M, Ghorbani Z, Gholipour M, Salari A, Savar Rakhsh A, Kheirkhah J. Evaluation of cardiometabolic risk markers linked to reduced left ventricular ejection fraction (LVEF) in patients with ST-elevation myocardial infarction (STEMI). *BMC Cardiovasc Disord*. 2022 May 14;22(1):224. doi:10.1186/s12872-022-02660-3 PubMed PMID: 35568801; PubMed Central PMCID: PMC9107768.
 38. Vakili H, Sadeghi R, Rezapoor P, Gachkar L. In-hospital outcomes after primary percutaneous coronary intervention according to left ventricular ejection fraction. *ARYA Atheroscler*. 2014 Jul;10(4):211–7. PubMed PMID: 25258637; PubMed Central PMCID: PMC4173312.
 39. Gul F, Parekh A. Multivessel Disease. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 [cited 2026 Jun 19]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK557895/> PubMed PMID: 32491818.
 40. Baine KR, Mehta SR, Lai T, Welsh RC. Complete vs culprit-only revascularization for patients with multivessel disease undergoing primary percutaneous coronary intervention for ST-segment elevation myocardial infarction: a systematic review and meta-analysis. *Am Heart J*. 2014 Jan;167(1):1-14.e2. doi:10.1016/j.ahj.2013.09.018 PubMed PMID: 24332136.
 41. Waziri H, Jørgensen E, Kelbæk H, Fosbøl EL, Pedersen F, Mogensen UM, et al. Acute myocardial infarction and lesion location in the left circumflex artery: importance of coronary artery dominance. *EuroIntervention J Eur Collab Work Group Interv Cardiol Eur Soc Cardiol*. 2016 Jul 20;12(4):441–8. doi:10.4244/EIJY15M09_04 PubMed PMID: 26348675.