

An evaluation of STEMI in a Tunisian tertiary care hospital: from risk factors to reperfusion

Évaluation de la prise en charge de l'infarctus du myocarde avec sus-décalage du segment ST dans un centre tertiaire tunisien

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SUMMARY

Introduction : ST-segment elevation myocardial infarction (STEMI) remains a leading cause of cardiovascular mortality worldwide. This study aimed to evaluate the early clinical management of STEMI in a Tunisian tertiary care hospital by analyzing patient demographics, clinical presentation, and reperfusion strategies.

Methods: We conducted a retrospective analysis of all consecutive patients presenting within 24 hours of symptom onset with STEMI at the Cardiology Department of Hedi Chaker University Hospital, Sfax, from January 1 to March 31, 2023. Data were extracted from electronic medical records and analyzed using SPSS software.

Results: A total of 156 patients (mean age 60.2 ± 11.8 years; 86.5% male) were included. The most common risk factors were active smoking (61.5%), diabetes (33.3%), and hypertension (25%). The median patient delay was 4 hours (IQR: 2–8 hours). Primary percutaneous coronary intervention (PPCI) was performed in 88% of cases, with a median door-to-balloon time of 60 minutes. Radial access was used in 92.7%, and the left anterior descending artery was the most frequently involved culprit vessel (40%). Drug-eluting stents were used in 85% of interventions. Fibrinolysis was performed in 7% of patients, with a 63.6% success rate; 36.4% required rescue PCI. In-hospital mortality was 7%, mainly due to cardiogenic shock and ventricular arrhythmias. Factors associated with poor in-hospital outcomes included diabetes, dyslipidemia, cardiogenic shock, hypotension, ventricular fibrillation, cardiac arrest, elevated C-reactive protein, and leukocytosis. Patients receiving medical attention within 4 hours had better outcomes.

Conclusions: PPCI remains the primary reperfusion strategy for STEMI in Tunisia. However, pre-hospital delays persist. Improving public awareness, enhancing emergency services, and streamlining hospital workflows are essential to optimize STEMI outcomes.

KEYWORDS

STEMI, Tunisia, myocardial infarction, reperfusion, primary PCI, risk factors, in-hospital outcomes

RÉSUMÉ

Introduction : L'infarctus du myocarde avec sus-décalage du segment ST (STEMI) demeure l'une des principales causes de mortalité cardiovasculaire dans le monde. Cette étude avait pour objectif d'évaluer la prise en charge clinique précoce du STEMI dans un centre hospitalo-universitaire tunisien en analysant les caractéristiques démographiques des patients, leur présentation clinique et les stratégies de reperfusion utilisées.

Méthodes : Nous avons réalisé une étude rétrospective incluant tous les patients consécutifs admis dans les 24 heures suivant le début des symptômes pour un STEMI au service de cardiologie du CHU Hédi Chaker de Sfax entre le 1er janvier et le 31 mars 2023. Les données ont été recueillies à partir des dossiers médicaux électroniques et analysées à l'aide du logiciel SPSS.

Résultats : Au total, 156 patients ont été inclus (âge moyen : $60,2 \pm 11,8$ ans ; 86,5 % d'hommes). Les principaux facteurs de risque cardiovasculaire étaient le tabagisme actif (61,5 %), le diabète (33,3 %) et l'hypertension artérielle (25 %). Le délai médian entre le début des symptômes et le premier contact médical était de 4 heures (intervalle interquartile : 2–8 heures). Une angioplastie coronaire primaire (PCI primaire) a été réalisée chez 88 % des patients, avec un délai médian porte-ballon de 60 minutes. L'abord radial a été utilisé dans 92,7 % des cas, et l'artère interventriculaire antérieure était l'artère coupable la plus fréquemment impliquée (40 %). Des stents actifs ont été implantés dans 85 % des interventions. Une fibrinolyse a été réalisée chez 7 % des patients, avec un taux de succès de 63,6 %, tandis que 36,4 % ont nécessité une angioplastie de sauvetage. La mortalité intrahospitalière était de 7 %, principalement liée au choc cardiogénique et aux arythmies ventriculaires. Les facteurs associés à une évolution défavorable en milieu hospitalier comprenaient le diabète, la dyslipidémie, le choc cardiogénique, l'hypotension artérielle, la fibrillation ventriculaire, l'arrêt cardiaque, l'élévation de la protéine C-réactive et l'hyperleucocytose. Les patients pris en charge dans les quatre premières heures suivant le début des symptômes présentaient de meilleurs résultats cliniques.

Conclusion : L'angioplastie coronaire primaire constitue la principale stratégie de reperfusion du STEMI en Tunisie. Toutefois, les délais préhospitaliers restent importants. L'amélioration de la sensibilisation de la population, le renforcement des services d'urgence et l'optimisation des parcours de soins hospitaliers sont essentiels pour améliorer le pronostic des patients atteints de STEMI.

MOTS-CLÉS

STEMI ; Tunisie ; infarctus du myocarde ; reperfusion ; angioplastie coronaire primaire ; facteurs de risque ; évolution intrahospitalière.

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INTRODUCTION

ST-segment elevation myocardial infarction (STEMI) is a major contributor to cardiovascular morbidity and mortality worldwide, affecting over three million individuals annually (1). Although significant progress has been made in high-income countries through public health strategies and expanded access to care, low- and middle-income nations, including Tunisia, continue to face substantial challenges in managing STEMI due to delayed presentation and limited access to specialized services (2).

In Tunisia, the burden of ischemic heart disease remains high, with an age-adjusted incidence of myocardial infarction estimated at 163 per 100,000 population (3,4). Despite the increasing availability of percutaneous coronary intervention (PCI) services, timely access and early reperfusion remain suboptimal in many settings (3,4). This study aimed to assess the acute management of STEMI in a tertiary care hospital in Sfax, Tunisia, by analyzing patient epidemiological profiles, clinical characteristics, and the reperfusion strategies employed. The study also sought to identify factors associated with adverse in-hospital outcomes to inform improvements in local STEMI care pathways.

METHODS

Study population, type and period of the study

This retrospective descriptive and analytical study included all consecutive patients diagnosed with STEMI who presented within 24 hours of symptom onset to the Cardiology Department of Hedi Chaker University Hospital between January 1 and March 31, 2023. STEMI diagnosis was based on the 2017 European Society of Cardiology criteria (5). Patients with symptom onset beyond 24 hours or incomplete data were excluded.

Data collection

Data Collection Data were extracted from the DMI electronic medical record system using a standardized data extraction form. Collected variables included demographic data, clinical presentation, risk factors, laboratory parameters, management strategies, and in-hospital outcomes. The first medical contact was defined as the duration from the onset of chest pain to the final STEMI diagnosis. We defined Patient delay as the duration from the onset of symptoms to first medical contact. We considered Arterial hypotension as a systolic blood pressure of below 90 mmHg or a diastolic

blood pressure of below 60 mmHg. Tachycardia was defined by a resting heart rate exceeding 100 beats per minute. We defined chronic kidney disease either by the presence of kidney impairment or an eGFR of less than 60 mL/min/1.73 m², which has been present for at least three months, using the MDRD formula. Hyperglycemia was defined as blood glucose in excess of 11 mmol/L on admission. We identified Diabetes mellitus through a fasting plasma glucose concentration of ≥ 7.0 mmol/L or glycated hemoglobin (HbA1c) concentration of $\geq 6.5\%$. Anemia was identified when hemoglobin concentration was below 13 g/dL in male subjects and below 12 g/dL in female subjects. Leukocytosis was defined by a white blood cell count exceeding 11,000 cells/ μ L. The raised C-reactive protein level was considered as ≥ 10 mg/L.

Ethical considerations

Ethical Approval was obtained from the Head of the Cardiology Department. Patient anonymity and data confidentiality were maintained.

Statistical analysis

Statistical Analysis SPSS version 27 was used for data analysis. Qualitative variables were expressed as frequencies and percentages; quantitative variables were expressed as mean \pm standard deviation or median with interquartile range. The Kolmogorov-Smirnov test was used for normality. Univariate analysis was performed to identify factors associated with in-hospital complications. Chi-square or Fisher's exact tests were used; significance was set at $p \leq 0.05$

RESULTS

General characteristics

Among of the 156 STEMI cases, 86.5% were males. The mean age was 60.23 (11.9) years old. Among of the total population, 12.2% of the patients had a history of myocardial infarction with 9.6% having prior PCI. The initial symptom occurred in 37.8% of the cases between 4 a.m. and 12 p.m. The median patient delay time was 4 hours, with an interquartile range (IQR) of 2 hours. Regarding first medical contact location, most of the patients (49%) attended the emergency department of the Habib Bourguiba university hospital and only 4% called the emergency services (UMAS).

Clinical Presentation and Laboratory Findings

The upon admission clinical presentation was characterized by arterial hypotension in 8.3% and tachycardia in 14% of the cases. Anterior STEMI was the most common (48.7%), followed by inferior STEMI (40%). Complications upon admission were reported in 55% of patients, with heart failure (26%) and ventricular fibrillation (4.5%) being the most frequent. Hyperglycemia was noted in 45%, anemia in 22.4%, leukocytosis in 60%, and CRP elevation in 33%.

Table 1. resumes the clinical and paraclinical characteristics of the total population.

	Number of patients	Percentage (%)
Smoking	96	61.5
Arterial Hypertension	52	33.3
Dyslipidemia	12	7.7
Family History of coronary Diseases	7	4.5
Chronic Kidney Disease	5	3.2
Clinical presentation upon admission		
Arterial hypotension	13	8.3
Tachycardia	22	14
Heart failure	40	25.6
Killip II	29	18.5
Killip III	3	2
Killip IV	8	5.1
Clinical and electrical extension to the right ventricle		
Resuscitated cardiac arrest	7	4.5
ventricular septal defect	1	0.6
Supraventricular rhythm disorders	9	5.8
Ventricular fibrillation	7	4.5
Conduction disorders	8	5.2
Location of STEMI		
Anterior	76	48.7
Inferior	63	40
Lateral	10	6.4
Circumferential	7	4.5
Biological parameters		
Hyperglycemia	70	45
Anemia	35	22.4
Leukocytosis	93	60
Positive CRP	51	33
Renal failure	23	15

Therapeutic strategies

Primary percutaneous coronary intervention (PPCI) was the most used reperfusion strategy in 88% of patients with a median door-to-balloon time of 60 minutes (IQR: 1). Radial access was used in 92.7%. The most common culprit vessel was the left anterior descending artery (40%), followed

by the right coronary artery (28%) and circumflex artery (12%). Drug-eluting stents were used in 85% of cases. Thromboaspiration was performed in 2.2% of patients, and glycoprotein IIb/IIIa inhibitors were administered in 19%. Due to delayed PPCI access, Fibrinolysis was performed in 7%, with 63.6% success; 36.4% required rescue PCI (median delay: 3.5 hours). Conservative treatment was used in 5.1% due to contraindications. All patients received dual antiplatelet therapy, heparin, and statins. Beta-blockers and ACE inhibitors were prescribed in 54% and 81% of patients, respectively.

In-Hospital outcomes (Table II)

The in-hospital mortality rate was 7%. Cardiogenic shock and electrical complications were the leading causes. Non-fatal in-hospital complications rate occurred in 7.7% (4.4% heart failure, 2% re-infarction, 0.6% stroke, 0.6% pericarditis).

Factors significantly associated with poor outcomes included diabetes (OR 2.26; $p=0.047$), dyslipidemia (OR 3.5; $p=0.049$), hypotension (OR 4; $p=0.006$), cardiogenic shock (OR 7.2; $p=0.014$), cardiac arrest (OR 62; $p<0.001$), ventricular fibrillation (OR 9.6; $p=0.008$), elevated CRP (OR 4.6; $p=0.001$), and leukocytosis (OR 3.8; $p=0.041$). Early medical attention (<4 hours) was associated with better outcomes (OR 0.39; $p=0.050$).

Table 1. resumes the clinical and paraclinical characteristics of the total population.

Risk factor	p-value	Odds Ratio (OR)
Diabetes	0,047*	2,26
Dyslipidemia	0,049*	3,5
Patient delay < 4 h	0,050	0,39
Systolic blood pressure < 100 mmHg	0,006	4
High C-reactive protein	0,001	4,6
leukocytosis	0,041*	3,8
Upon admission cardiogenic shock	0,014*	7,2
Recovered cardiac arrest	0,000*	62
Ventricular fibrillation	0,008*	9,6

* Statistically significant values

DISCUSSION

This study demonstrates a substantial improvement in STEMI care at our center compared to previous years, with increased use of PPCI and reduced door-to-balloon times. However, EMS activation remains low, highlighting the need for public education. The in-hospital mortality rate shows progress from past rates, likely due to better access to PPCI and faster treatment.

Despite advancements, challenges remain. The underuse of EMS and prolonged patient delays suggest areas for systemic improvement. Increasing public awareness, training EMS teams, and developing STEMI networks could further reduce mortality.

Patients' characteristics

We observed that the mean age of STEMI patients was lower than that observed in developed countries: estimated at 60.8 years in the 2019 Tunisian FAST-MI (4), and 60.23 in our study VS mean age of 67.9 years in multiple European countries based on the Euro Heart Study (7). Gender-wise, males are more frequently affected by STEMI, a trend consistently observed across studies and confirmed also by ours. Among cardiovascular risk factors smoking, diabetes and hypertension are the leading factors for STEMI (4,3). In our study, 4% of our patients were initially transported directly to our cardiology department by UMAS of Sfax. This rate is notably lower than that reported in the Tunisian FAST-MI 2019 registry (18.5%) and lower than other international findings (for example: Portugal 23%), (4,8). The low EMS utilization rate observed in our study may be attributed to a lack of public awareness regarding the critical importance of activating EMS during acute cardiac events (8,9). In fact, the European Society of Cardiology recommends EMS as the preferred first medical contact location for STEMI patients (9). These findings emphasize the urgent need to enhance public education efforts to encourage our population to call emergency services (190) when experiencing chest pain lasting more than 15 minutes. Patient delay is a critical determinant of outcomes in STEMI patients, as it directly contributes to the total ischemic time, which significantly impacts morbidity and mortality (9). In Tunisia, this delay remains alarmingly high. A study published in 2024 reported an average delay of 4.27 hours before first medical contact, a finding that closely aligns with our study, where the median patient delay was 4 hours (11). These consistent results highlight the major challenge of reducing patient delay in the management of STEMI and the need for targeted interventions to address this problem. In our study, 88% of patients underwent PPCI compared to 7% who received fibrinolysis. This rate significantly exceeds the Tunisian FAST-MI registry data, where 30% of STEMI patients received PPCI (4). Door to balloon time is a key element in the management of STEMI, enabling rapid determination of the need for primary percutaneous coronary intervention (9). In our study, this median time was 1 hour, which aligns highly

with the European Society of Cardiology guidelines, which demonstrates adherence to the recommended 120 minutes timeframe. This result represents an improvement over the department's 2014 report of 135 minutes (6). Chakraborty et al. reported that the left anterior descending artery was the predominant culprit in approximately 73% of cases (12), a much higher proportion than the 42% observed in our study, where the LAD was also identified as the leading culprit. This discrepancy could be explained by differences in patient demographics, particularly age and gender (13). For fibrinolysis cases, The FAST-MI Tunisia Registry indicates that 31.8% of STEMI patients received fibrinolysis (4), compared to 7% in our study. This discrepancy likely reflects differences in care settings: the FAST-MI Registry includes many patients from non-PCI-capable facilities where PPCI is not feasible within the recommended timeframe (4). In contrast, most patients in our study were directly transferred and treated in our department within 120 minutes, where PPCI is readily available and serves as the preferred reperfusion strategy.

Adverse outcomes (In-hospital complications and mortality)

Our study showed a reduction in in-hospital mortality (from 9.3% in 2013 to 7% in 2023), which represents a 24.7% relative reduction over the past 10 years (6). This decrease in mortality may be linked to a significant decrease in treatment delays (door-to balloon time: from 135 minutes in 2013 to 60 minutes in 2023) and a higher use of PPCI (from 74% in 2013 to 88% in 2023) (6). The mortality rate in our study was lower than the 8.5% reported in a 20-year study (2001–2021) from the Cardiology B Department of Monastir and the 9.9% observed in a study conducted in Slovenia between 2018 and 2019 (3,14). For complications, we observed a complication rate of approximately 8% among patients hospitalized for STEMI. This figure is significantly lower than the findings reported by our department a decade ago, when the complication rate was 32% (6). This difference may be attributed to variations in total, ischemic time and the proportion of patients who underwent primary percutaneous coronary intervention (6,9). For poor in-hospital outcomes factors, history of diabetes (OR = 2.26; $p = 0.047$) and dyslipidemia (OR = 3.5; $p = 0.049$) were found to be highly associated in our study, which aligns highly with multiple studies (15). We also found that systolic blood hypotension (<100 mmHg) emerged as an important clinical marker of severity

(OR = 4; $p = 0.006$). In fact, a multicenter observational study published in 2024, involving 3,809 STEMI patients from the Chinese STEMI PPCI Registry, demonstrated that individuals admitted with an SBP range of 121–150 mmHg had the lowest mortality rates (16). Among studies, ventricular fibrillation upon admission was found to be also a severe complication associated with significantly increased short-term mortality, which aligns with our findings (17). It is important to highlight that cardiogenic shock was a severe complication associated with significantly increased short-term mortality in our study (OR = 7.2; $p = 0.014$). Evidence from previous studies indicates that the in-hospital mortality rate for STEMI patients with cardiogenic shock can reach 30.6%, compared to 2.9% in those without shock (18). Furthermore, based on the literature, elevated CRP and leukocyte levels, particularly when measured early after STEMI, are strongly associated with increased short- and long-term mortality (19,20). Notably, patients with CRP levels above the 90th percentile (>33 mg/L) experience significantly higher 30 day and all-cause mortality rates, independent of troponin levels (19). Also, leukocytosis has been linked to an increased risk of developing late cardiogenic shock and elevated 30-day mortality (19). These results highly align with our study findings.

CONCLUSIONS

This study highlights the increasing utilization of PPCI as the dominant reperfusion strategy for STEMI in a Tunisian tertiary care center. While door-to-balloon times have improved and adherence to guideline-recommended therapies is high, pre-hospital delays and low emergency medical services (EMS) utilization remain significant barriers. In-hospital mortality and complications are strongly associated with hemodynamic instability and inflammatory markers on admission. Targeted interventions to raise public awareness, strengthen EMS infrastructure, and reduce time to first medical contact are essential for improving STEMI outcomes in Tunisia.

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