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# Clinical and Angiographic Predictors of Prolong Hospital Stay in Young vs Older Myocardical Infarction Patients

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Article

# Clinical and Angiographic Predictors of Prolong Hospital Stay in Young vs Older Myocardial Infarction Patients

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## Abstract

**Background and Objectives:** Although acute myocardial infarction (AMI) is traditionally regarded as a disease of older age, its rising incidence in younger patients challenges age-based assumptions regarding in-hospital management and prognosis. Length of hospital stay is a critical marker of disease complexity and healthcare burden, yet its determinants across age groups remain insufficiently characterized. **Materials and Methods:** We retrospectively analyzed 200 consecutive patients admitted with ST-segment elevation myocardial infarction (STEMI), stratified by age (<45 vs. >45 years). Clinical, biological, echocardiographic, and angiographic parameters were assessed. Prolonged hospitalization was defined as a hospital stay exceeding 7 days. Independent predictors were identified using multivariable logistic regression. **Results:** Despite marked differences in risk profiles and coronary anatomy between age groups, chronological age was not an independent determinant of hospitalization duration. Diabetes mellitus and left anterior descending artery involvement were independently associated with prolonged hospital stay, whereas percutaneous coronary intervention significantly reduced hospitalization duration. **Conclusions:** In STEMI, hospitalization burden is shaped by comorbidity burden and revascularization strategy rather than age itself. These findings challenge age-centered clinical paradigms and support an individualized, mechanism-driven approach to in-hospital management aimed at reducing hospitalization duration and resource utilization.

**Keywords:** myocardial infarction; young people; long stay in hospital

## 1. Introduction

Acute myocardial infarction becomes an important healthcare problem along young patients. [1–4] Age-related differences in cardiovascular risk profiles, coronary anatomy and therapeutic approaches may significantly influence in-hospital outcomes. [5–7]. Previous studies have demonstrated that younger patients with myocardial infarction often exhibit clinical and angiographic phenotypes compared with older individuals, including a higher prevalence of non-traditional risk factors and different patterns of coronary artery involvement. [8–10]

Length of hospital stay represents an important marker of disease severity and prognosis in acute myocardial infarction.[11,12] Long in hospital stay has been associated with more rates of complications, increased costs and longer recovery. [14,15]However, most studies evaluating hospital stay focus on overall cohorts with less attention on age.[16–18]

Beyond its well-established role as a cardiovascular risk factor, diabetes mellitus is associated with complex neurohumoral and microvascular alterations that may aggravate myocardial injury and impair recovery following acute myocardial infarction [11,12,29]. These mechanisms may be particularly relevant in explaining prolonged hospitalization and delayed clinical stabilization in diabetic patients.

The present study aimed to assess clinical and angiographic implications in long stay hospitalisation in patients with acute myocardial infarction, comparing young and older individuals. By comparing this matters, we look to provide insights relevant to risk stratification and optimization of in-hospital management strategies. [19–22]

## 2. Materials and Methods

### 2.1. Study Design and Population

This was a retrospective observational study conducted at the Craiova County Emergency Clinical Hospital, including consecutive patients admitted with acute ST-segment elevation myocardial infarction over two year period.

### 2.2. Definitions and Measurements

STEMI was diagnosed by the current international criteria guideline [1,2,27] patients with NSTEMI were excluded from this study. [1,2] A total of 200 patients with the diagnosis of STEMI were included in this study and were divided into two subgroups: <45 years and >45 years. [3,8]

Clinical and demographic data were collected at admission and during hospitalization: sex, age, smoking status, history of diabetes mellitus and arterial hypertension, lipid profile(LDL-C, HDL-C, total cholesterol), serum creatinine levels, presence of thrombophilia and documented inflammatory disease. [9,10,23]

Left ventricular ejection fraction was estimated using transthoracic echocardiography during hospitalization.

Coronary angiography evaluation was performed in patients with an indication for invasive evaluation. Angiographic assessment included culprit vessel, number of diseased vessel, percutaneous coronary intervention, stent implantation and number of stents were also collected. Significant coronary stenosis was defined as >50% luminal narrowing.[2,24]

Length of hospital stay was defined as the number of days from admission to hospital discharge. Hospitalization duration was analyzed as a continuous variable and dichotomized into long hospital stay >7 days versus <shorter hospital day. [14–16]

### 2.3. Objectives

The primary objective of this study was to evaluate and compare significant cardiovascular risk factors between younger (<45 years) and older (>45 years) patients with STEMI, and to assess age related differences in angiographic findings and left ventricular ejection fraction.

The secondary objective was to identify clinical and angiographic predictors of long stay in hospital and to evaluate difference in hospitalization burden between younger and older patients.

### 2.4. Statistical Analysis

Continuous variables were expressed as medians with interquartile ranges (IQR), and categorical variables as counts and percentages. Group comparisons were performed using the

Mann–Whitney U test for continuous variables and the  $\chi^2$  test or Fisher's exact test for categorical variables, as appropriate.

Prolonged hospital stay was defined according to the predefined threshold and analyzed as a binary outcome. Univariate analyses were performed to identify variables associated with prolonged hospitalization, followed by multivariable logistic regression to determine independent predictors. Results were reported as odds ratios (OR) with 95% confidence intervals (CI).

All analyses were two-sided, and a p value <0.05 was considered statistically significant. A two-sided p value <0.05 was considered statistically significant. Statistical analyses were performed using jamovi (version 2.6.45.0), based on the R statistical computing environment.

### 3. Results

The analysis of demographic and clinical characteristics revealed several significant differences between patients aged <45 years and >45 years. (Table 1) Male sex constituted the majority in both categories, representing 78,1% of patients in younger group and 70,1% in the older group, without a statistically significant difference between groups (p=0.196). Smoking status was similarly distributed across both groups, with no meaningful variation between younger and older individuals (p=0.426) [3,5]

**Table 1.** Baseline clinical, biological and laboratory characteristics of the study population.

		Age group		
		<45 year n= 66 No. (%) Median(IQR)	>45 years n= 134 No. (%) Median(IQR)	p
Gender	Men	52(78,1%)	94(70,1%)	0.196
	Women	14 (21,2%)	40( 29,9%)	
Smoking status	Smoke	48 (35,8%)	86 (64,2%)	0.426
	Non-smoke	20 (30,3%)	48 (35,8%)	
Diabetes mellitus	YES	14 (21,2%)	80 (59,7%)	< 0.001
	NO	52 (78,8%)	54 (40,3%)	
HBP status	YES	43 (65,2%)	121 (90,3%)	< 0.001
	NO	23 (34,8%)	13 (9,7%)	
	LDL Cholesterol	158 (69 – 238)	130 (45 – 302)	0.001
	HDL Cholesterol	39,5 (23 – 76)	40,0 (7 – 100)	0.4071
	Cholesterol	219(109-290)	200(100-394)	0.002
	Serum creatinine (mg/dl)	0,82(0,54-2,10)	1,13(0,66-3,10)	0.008
	Thrombophilia	9	1	<0.001
	Inflammatory disease	26	10	<0.001
Hepatic cytolysis	YES	34(17%)	71(35,5%)	0.881
	NO	32(16%)	63(31,5%)	

In contrast, cardiometabolic comorbidities were markedly more prevalent among patients aged over 45 years. Diabetes mellitus affected nearly two-thirds of older patients (59,7%), compared with only 21,1% of those under 45 years (p<0.001). [7,21] A similar pattern was observed for high blood

pressure which was documented in 90,3% of older patients, significantly exceeding the prevalence observed in the younger cohort (65,2%  $p < 0.001$ ). [8,9]

Analysis of lipid parameters revealed higher atherogenic lipid levels among younger patients. Median LDL-cholesterol levels were significantly elevated in the <45 years group (158 mg/dL), compared with the older patients (130 mg/dL) ( $p = 0.001$ ). Total cholesterol followed the same trend, with higher median values in younger individuals (219 mg/dL vs 200 mg/dL,  $p = 0.002$ ). No significant difference was identified in HDL-cholesterol concentrations between age groups ( $p = 0.407$ ). Renal function differed significantly with higher serum creatinine values observed in patients age >45 years ( $p = 0.008$ ).

Thrombophilia and inflammatory diseases were more frequently identified in younger patients, being present in 9 and 26 cases, respectively compared with only 1 and 10 cases in the older cohort (both  $p < 0.001$ ). [9,18,23]

Hepatic cytolysis was observed in a comparable proportion of patients in both groups, with no statistically significant difference between them ( $p = 0.881$ ), suggesting that liver enzyme elevation was not associated with the studied clinical phenotype.

With respect to infarction characteristics, a significant difference in infarction type was observed between the two age groups ( $p = 0.002$ ). Anterior and antero-lateral infarction were more common in patients <45 years, whereas inferior and infero-posterior infarction predominates in older patients. Unstable angina was rarely observed and occurred exclusively in the younger group.

Coronary angiography was performed significantly more often in patients younger than 45 years (95,5% vs 46,3%  $p < 0.001$ ). Accordingly, percutaneous coronary intervention with stent implantation was more frequently performed in this group (87,5% vs 45,3%  $p < 0.001$ ). Younger patients predominantly presented with single-vessel diseases, most commonly involving the left anterior descending artery, while multivessel coronary artery disease was more prevalent in patients age >45 years ( $p < 0.001$ ) [5,8,24]

Consistent with these findings, patients <45 years more frequently required at least one coronary stent, whereas absence of stent implantation was more frequent in the older age ( $p < 0.001$ ) [24–26]. Thrombolytic therapy rates did not differ significantly between age groups. Left ventricular ejection was comparable overall, but showed a significant difference between the groups ( $p = 0.006$ ). (Table 2)

**Table 2.** Infarction characteristics and angiographic findings.

	Age group		p
	<45 year n= 66	>45 years n= 134	
Anterior 67(33,5%)	16(8%)	51(25,5%)	0.002
Anterolateral 19(9,5%)	9(4,5%)	10(5%)	
Inferior 41(20,5%)	11(5,5%)	30(15%)	
Inferolateral 3(1,5%)	2(1%)	1(0,5%)	
Inferoposterior 54(27%)	15(7,5%)	39(19,5%)	
Inferoposterolateral 5(2,5%)	4(2%)	1(0,5%)	
Posterior 2(1%)	1(0,5%)	1(0,5%)	
Posterolateral 2(1%)	1(0,5%)	1(0,5%)	

	Inferoposterior with RV 3(1,5%)	3(1,5%)	0(0%)	
	Inferoposterolateral with RV 1(0,5%)	1(0,5%)	0(0%)	
	Lateral 2(1%)	2(1%)	0(0%)	
	Unstable angina 1(0,5%)	1(0,5%)	0(0%)	
Angiographically evaluated	YES 124(62%)	63(95,5%)	6145,5%)	<0.001
	No 76(38%)	3(4,5%)	73(54,5%)	<0.001
PCI with stent implantation	YES 104(52%)	58 (87,9%)	46(34,3%)	<0.001
	NO 96(48%)	8(12,1%)	88 (65,7%)	< 0.001
Coronary artery involvement	None 6(3%)	4 (6,1%)	2 (1,5%)	
	LAD 32(16,0%)	22(34,3%)	10(7,5%)	
	LCX 10(5,0%)	6(9,1%)	4(3%)	
	RCA 32(16,0%)	13(19,7%)	19(14,2%)	< 0.001
	Two vessel disease 19(9,5%)	10(14,1%)	9(7,4%)	
	Three vessel disease 25(12,5%)	8(12,5%)	17(12,5%)	
	No angiographically evaluated 76(38%)	3(4,7%)	73(53,7%)	
Number of stents	0 stents 99(49,5%)	11(16,7%)	88(65,7%)	
	1 stent 71(35,5%)	46(69,7%)	25(18,7%)	
	2 stents 18(9%)	6(9,1%)	12(9%)	<0.001
	3 stents 9(4,5%)	2(3%)	7(5,2%)	
	4 stents 3(1,5%)	1(1,5%)	2(1,5%)	
Thrombolysis	YES 53(26,1%)	20(29,2%)	33(24,6%)	0.496
	NO 146(73,9%)	46(70,8%)	101(75,4%)	
EF%		45±6,95	45±7,73	0.006
Hospital stay		4,32(1-10, 2.00)	6,78(1-20,3.00)	<0.001

Analysis of hospitalization duration (Table 3) revealed significant age-related differences when stratified according age-related differences when stratified according to clinical, angiographic, and procedural characteristics. A hospital stay longer than 7 days was significantly more frequent among those younger than 45 years. [11,14,16]

Table 3. Hospitalization duration.

Long hospital stay	Parameter	Age group		p
		<45 days n= 66 No. (%) Median(IQR)	>45 days n= 134 No. (%) Median(IQR)	
>7 days	Diabetes mellitus YES	2(2,8%)	43(60,6%)	0.002
	Diabetes mellitus NO	8(11,3%)	18(25,4%)	
<7 days	Diabetes mellitus YES	12 ( 9,3%)	37 (28,7%)	<0.001
	Diabetes mellitus NO	44 (34,1%)	36 (27,9%)	
>7 days	PCI with stent implantation YES	7(9,9%)	12(16,9%)	<0.001
	PCI with stent implantation NO	3(4,2%)	49(69%)	
<7 days	PCI with stent implantation YES	51(39,5%)	34(26,4%)	<0.001
	PCI with stent implantation NO	5(3,9%)	39(30,2%)	
>7 days	LAD culprit YES	5(7%)	3(4,2%)	<0.001
	LAD culprit NO	5(7%)	58(8,1%)	
<7 days	LAD culprit YES	17(13,2%)	7(5,4%)	0.003
	LAD culprit NO	39(30,2%)	66(51,2%)	
>7 days	EF<40%	4(5,6%)	35(49,3%)	0.306
	EF>40%	6(8,5%)	26(36,6%)	
<7 days	EF<40%	16(12,4%)	30(23,3%)	0.141
	EF>40%	40(31,0%)	43(33,3%)	

Diabetes mellitus showed a strong association with prolonged hospitalization. Among patients hospitalized for more than 7 days, diabetes was significantly more prevalent in the >45 years group than in the younger group (60,6% vs 2,8% p=0.002). Conversely, among patients with hospital stays shorter than 7 days, diabetes remained significantly more frequent in older patients (28,7% vs 9,3% p<0.001).

Percutaneous coronary intervention with stent implantation also differentiated significantly according to age and hospitalization duration. In patients with hospital stays exceeding 7 days, PCI with stent implantation was more frequently performed in older age (16,9% vs 9,9%), while the absence of PCI was markedly more common in the >45 years (69% vs 4,2% p<0.001). Similarly, among

patients hospitalized for less than 7 days, PCI with stent implantation was more frequent in patients younger than 45 years (39,5% vs 26,4%), where lack of PCI predominated in older group.

Left anterior descending artery involvement demonstrated a significant association with hospitalization duration. For long hospital stay, LAD culprit lesions were more frequent in younger ages, while the absence of LAD involvement predominated in the older ages ( $p < 0.001$ ).

Left ventricular ejection fraction did not differ significantly between age group in relation with hospitalization duration. No significant differences were observed for EF  $< 40\%$  and  $> 40\%$  in either prolonged or shorter hospital stay ( $p = 0.141$ ).

In multivariable logistic regression analysis (Table 4) assessing predictors of hospitalization duration, diabetes mellitus emerged as an independent determinant of prolonged hospital stay with a more than twofold increase in risk (OR 2.450, 95% CI 1.22-4.97,  $p = 0.011$ ). Likewise, involvement of the left anterior descending artery was significantly associated with longer hospitalization (OR 2.014, 95%CI 1.67-6.01,  $p = 0.021$ ).

**Table 4.** Predictors of hospitalization duration.

Predictor	OR	CI	p
Age <45 years vs >45 years	0.531	0.20-1.35	0.187
<b>Diabetes mellitus(yes vs no)</b>	<b>2.450</b>	<b>1.22-4.97</b>	<b>0.011</b>
Gender(man vs woman)	0.689	0.33-1.42	0.316
PCI(yes vs no)	0.186	0.08=0.43	<0.001
Multivesse disease	1.338	0.53-3.32	0.532
<b>LAD involvement</b>	<b>2.014</b>	<b>1.67-6.01</b>	<b>0.021</b>

Conversely, the performanve of percutaneous coronary intervention was independently associated with significantly reduced likelihood of prolonged hospitalization, indicating a strong predictive effect (OR 0.186, 95%CI 0.08-0.43,  $p < 0.001$ ).

No significant associations were observed for age <45 years, sex, or the presence of multivessel disease, all of which failed to predict hospitalization duration in the adjusted model.

#### 4. Discussion

In this retrospective observational study, we evaluated age-related differences in clinical, biological, and angiographic characteristics of patients presenting with ST-segment elevation myocardial infarction (STEMI), with a particular focus on predictors of prolonged hospitalization. The main findings of our analysis indicate that diabetes mellitus and left anterior descending (LAD) artery involvement were independent predictors of longer hospital stay, while percutaneous coronary intervention (PCI) was associated with a significantly shorter hospitalization duration, irrespective of age.

Consistent with previous reports, younger patients (<45 years) [3,8,18] exhibited a distinct cardiovascular risk profile compared with older individuals. Traditional cardiometabolic risk factors, such as diabetes mellitus and arterial hypertension, were significantly more prevalent in patients over 45 years, whereas younger patients more frequently presented with thrombophilia, inflammatory diseases, and a more atherogenic lipid profile. These findings support the concept that myocardial infarction in younger individuals is often driven by non-traditional or emerging risk factors, rather than by long-standing metabolic comorbidities alone.

Angiographic characteristics also differed markedly between age groups. Younger patients were more frequently evaluated invasively and were more likely to undergo PCI with stent implantation, predominantly for single-vessel disease, most commonly involving the LAD artery. In contrast, older patients more often exhibited multivessel coronary artery disease and were less frequently treated with PCI, reflecting both more complex coronary anatomy and a higher burden of comorbidities that may limit invasive strategies. These differences likely contribute to the observed variations in hospitalization duration between age groups. [24–28]

With regard to hospitalization burden, prolonged hospital stay (>7 days) was more strongly associated with clinical and procedural factors than with age itself. Diabetes mellitus emerged as a robust predictor of longer hospitalization, a finding that aligns with previous evidence linking diabetes to increased in-hospital complications, delayed recovery, and higher resource utilization following acute myocardial infarction. Recent data have shown that SGLT2 inhibition with dapagliflozin can ameliorate neural damage in both cardiac and renal tissues in diabetic models, suggesting potential mechanisms through which optimized metabolic control may influence post-infarction recovery and hospitalization burden [30]. Similarly, LAD involvement was independently associated with prolonged hospitalization, likely reflecting the larger myocardial territory at risk, increased infarct size, and higher likelihood of complications such as left ventricular dysfunction. [24–27] In contrast, PCI demonstrated a strong protective effect against prolonged hospitalization. Early and successful revascularization may facilitate faster clinical stabilization, earlier mobilization, and reduced complication rates, ultimately translating into shorter hospital stays. Notably, left ventricular ejection fraction did not independently predict hospitalization duration in our cohort, suggesting that anatomical and procedural factors may play a more prominent role in determining in-hospital recovery than systolic function alone in the acute phase.

Importantly, age itself was not an independent predictor of hospitalization duration in the multivariable model. This finding underscores the concept that hospitalization burden in STEMI patients is primarily driven by comorbidities, infarct characteristics, and treatment strategies rather than chronological age per se. These results highlight the importance of individualized risk stratification and emphasize the potential benefits of timely invasive management, even in older patients, when clinically appropriate.

#### 4.1. Limitation

Several limitations of this study should be acknowledged. First, the retrospective, single-center design inherently limits causal inference and may affect the generalizability of the results to other populations or healthcare settings. In addition, the relatively small sample size may have reduced the statistical power to detect more subtle associations, particularly in subgroup and interaction analyses.

Second, hospitalization duration was dichotomized using a predefined threshold (>7 days), which, although clinically relevant, may oversimplify the complex and continuous nature of in-hospital recovery following acute myocardial infarction.

Third, an important limitation relates to potential differences in symptom-to-door time between age groups. Older patients are more likely to present later after symptom onset due to atypical clinical presentation, delayed symptom recognition, or limited access to emergency medical services. This delayed presentation may have contributed to greater myocardial injury, more complex clinical courses, and longer hospitalization, independently of angiographic or procedural characteristics.

Furthermore, although multivariable logistic regression was used to adjust for confounding factors, residual confounding cannot be excluded. Variables such as infarct size assessed by cardiac biomarkers, procedural complexity, in-hospital complications, frailty status, and post-procedural care pathways were not systematically captured and may have influenced hospitalization duration.

Finally, the exclusion of patients with non-ST-segment elevation myocardial infarction limits the applicability of the findings to STEMI populations only and does not allow extrapolation to the broader spectrum of acute coronary syndromes.

## 5. Conclusions

This study highlights important age-related differences in clinical profiles, angiographic characteristics, and hospitalization burden among patients presenting with STEMI. While younger patients more frequently exhibited non-traditional risk factors and were more often treated with invasive strategies, older patients had a higher prevalence of cardiometabolic comorbidities and more complex coronary artery disease.

Importantly, hospitalization duration was primarily influenced by clinical and procedural factors rather than chronological age alone. Diabetes mellitus and left anterior descending artery involvement were identified as independent predictors of prolonged hospital stay, whereas percutaneous coronary intervention was associated with a significantly shorter hospitalization duration.

These findings underscore the importance of early risk stratification and timely revascularization strategies in patients with acute myocardial infarction, irrespective of age. Targeted management of high-risk subgroups, particularly patients with diabetes mellitus and extensive coronary involvement, may contribute to reduced hospitalization burden and improved in-hospital outcomes.

Future prospective, multicenter studies with larger patient populations are warranted to confirm these findings and to further explore age-specific strategies aimed at optimizing in-hospital management and resource utilization in acute myocardial infarction.

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**Data: Availability Statement** The data presented in this study are available on request from the corresponding author due to (Data are not publicly available due to privacy and ethical restrictions.).

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## Abbreviations

The following abbreviations are used in this manuscript:

AMI	Acute Myocardial Infarction
ACS	Acute Coronary Syndrome
CI	Confidence Interval
EF	Ejection Fraction
HDL-C	High-Density Lipoprotein Cholesterol
HBP	High Blood Pressure
IQR	Interquartile Range
LAD	Left Anterior Descending (artery)
LCX	Left Circumflex (artery)
LDL-C	Low-Density Lipoprotein Cholesterol
LV	Left Ventricle
OR	Odds Ratio
PCI	Percutaneous Coronary Intervention
RCA	Right Coronary Artery
STEMI	ST-Segment Elevation Myocardial infarction

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