

Characteristics, Treatment and In-hospital Outcomes of Unselected Patients with Non-ST-Elevation Myocardial Infarction in Daily Clinical Practice at An Interventional Centre over a Period of Ten Years: Results from the MIRLU-Registry

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Abstract

Background: Since the definition of Non-ST-Elevation Myocardial Infarction (NSTEMI) in 2000, its in-hospital management is rapidly developing. There is only a few available data, though, to describe the long-term changes in clinical characteristics, treatment patterns and outcomes in “real world” unselected patients and provide a feedback regarding guideline implementation.

Methods and results: We conducted a retrospective data collection of all consecutive patients admitted to our clinic with an acute myocardial infarction (AMI) between 2000 and 2009 (Myocardial Infarction Registry Ludwigshafen- MIRLU). From the overall 6119 patients included, 2976 were diagnosed with NSTEMI (48.6%). The median age was 67.9 ± 11.9 years and 68.5% were men. 93.4% underwent coronary angiography, 60.6% of them received percutaneous coronary intervention (PCI) and 4.8% immediate emergency bypass surgery. The rate of guideline adherent medical therapy was high at admission and at discharge. The most common in-hospital complications were post-infarction angina (4.4%), congestive heart failure (4.0%), cardiogenic shock (2.8%) and blood loss requiring transfusion (2.8%). Average in-hospital mortality was 4.2%.

Over the period of ten years we observed an increase of 4.4 years in mean age (p for trend <0.01) and no changes in gender proportion ($p=0.25$). The rates of coronary angiography, PCI and stent implantation increased, while emergency bypass surgery rate declined ($p<0.01$). The complications' rate remained unchanged ($p=0.13$). In-hospital mortality showed no significant variation ($p=0.71$). In a multivariate analysis cardiogenic shock, moderately and severely impaired left ventricular function and increasing age were independent mortality predictors.

Conclusion: The observation of NSTEMI patients over 10 years showed an increase in mean age, rates of coronary angiography and PCI with stent implantation, while emergency bypass surgery declined. Administration rate of guideline adherent medical therapy was high. However, overall mortality remained unchanged. Cardiogenic shock, significantly reduced left ventricular function and increasing age were the strongest predictors of in-hospital mortality.

Keywords: Non-ST-elevation myocardial infarction; Registry; Percutaneous coronary intervention; Mortality predictors

Introduction

Although significant progress has been made on studying its pathogenesis [1-4] and improving treatment and prevention strategies, coronary artery disease is still a leading cause of death in the industrial world [5-9]. One of its most important clinical manifestations is acute myocardial infarction (AMI). Since the definition of non-ST-elevation myocardial infarction (NSTEMI) and its distinction from ST-elevation myocardial infarction (STEMI) in 2000 [10] numerous randomized clinical trials have contributed to

substantial advances in patient management, which is well defined in practice guidelines [10-13]. However, information about changes in patients' characteristics and outcomes over the years, as well as assessment of guideline implementation in daily clinical practice from a “real world” perspective can be more accurately derived from observational data through large-scale unselected cohorts, due to the minimizing of selection and information bias. Those bias appear in randomized trials due to inclusion and exclusion criteria, potentially excluding high risk patients and underestimating mortality [14,15], as well as in many prospective registries based on voluntarily reported data, where the inclusion of all consecutive patients is not ensured and written consent is required but not always given [16-18]. In other

registries data is collected only over a short period of time [17,19-21] leading to a suboptimal detection of trends.

In the present work we sought to evaluate the development of clinical characteristics, in-hospital treatment patterns and outcomes, as well as to provide feedback regarding guideline adherence and mortality in NSTEMI using “real world” data from a registry of unselected consecutive patients over a long period of time at an interventional center.

Methods

The myocardial infarction registry Ludwigshafen (MIRLU-Registry)

We conducted a retrospective data collection of all consecutive patients admitted to the Heart Centre Ludwigshafen with an AMI (STEMI and NSTEMI) between 06/2000 and 12/2009. All data stems from patients’ records of the emergency department, intensive care unit and catheterization laboratory and was gathered into a pre-specified database, the Myocardial Infarction Registry Ludwigshafen (MIRLU). Data from this registry regarding years 2000-2002 are published in a previous report of Zahn et al. [22].

Patient data was included in the registry if the diagnosis of an AMI was documented in the coronary angiography report and/or a troponin-T test was positive. All other patients who did not receive a coronary angiography (contraindications, death shortly after admission etc.) were identified through a list of discharge diagnoses of the electronic patient archive. Patients could be either primarily admitted to our clinic or secondarily transferred from another hospital. Cases in which positive troponin-T was related to medical conditions other than AMI were excluded through a study of patients’ files in order to confirm the diagnosis and perform data collection. The MIRLU-Registry consists of ACCESS2000 Databases, which include various questionnaires. In the present work we present and analyze data regarding only patients diagnosed with NSTEMI.

Definitions

NSTEMI was diagnosed in the presence of the following criteria: a) Prolonged (>20 min) anginal pain or angina equivalents at rest, b) Absence of persistent (>20 min) ST segment elevation in resting 12-lead ECG and c) Elevated troponin-T serum concentration with acute significant rise or fall. Raised levels were considered those exceeding the upper normal level at the clinic laboratory. Pre-hospital delay was defined as the time between symptom onset and primary hospital admission. In-hospital delay was defined as the time between hospital admission and coronary angiography. For patients transferred to our clinic from other hospitals without capability of invasive diagnostic, in-hospital delay was calculated as the sum of in-hospital delay-1 (admission at primary hospital until beginning of transportation), transportation delay and in-hospital delay-2 (admission at Heart Centre Ludwigshafen until coronary angiography).

An in-stent restenosis is the detection of a new stenosis >50% in a coronary artery segment previously treated with PCI and stent implantation. Post-procedural reinfarction was diagnosed if patients had clinical symptoms and/or electrocardiographic signs of recurrent ischemia and an additional relevant increase of cardiac biomarkers. Stroke was defined as the occurrence of persistent specific neurological deficits.

Statistical methods

Mainly descriptive analyses were performed. For categorical variables percentage and absolute patient numbers are presented and for continuous variables means with standard deviations are computed as appropriate. For not normally distributed variables medians with quartiles are computed as well.

For the calculation of trends Cochran-Armitage Trend Test and Jonckheere-Terpstra Test were performed. P-values below 5% ($p < 0.05$) were considered significant. P-values are results of two-sided tests. All analyses were performed using the SAS[®]-Statistic-Software Version 9.3 (SAS Institute, Inc., Cary, NC, USA) on a personal computer.

A multivariate regression analysis for independent predictors of in-hospital mortality was performed including 11 variables whose values were calculated from the available cases. These are: cardiogenic shock, moderately to severely reduced left ventricular function, age per 10 year increase, female gender, coronary angiography, diabetes mellitus, creatinine >2.0 mg/dl, chronic obstructive lung disease (COLD), body mass index (BMI) >35, intrahospital infarction and left bundle branch block in ECG. Odds ratios (OR) with 95% confidence intervals (CI) were calculated.

Results

From the overall 6119 patients with AMI enrolled in the MIRLU registry, 2976 were diagnosed with NSTEMI (48.6%). The patients’ distribution in each year (2000- 2009) is given in Figure 1. The median age was 67.9 ± 11.9 years and 68.5% were men. Further basic characteristics, as well as risk factors and comorbidities are presented in Table 1.

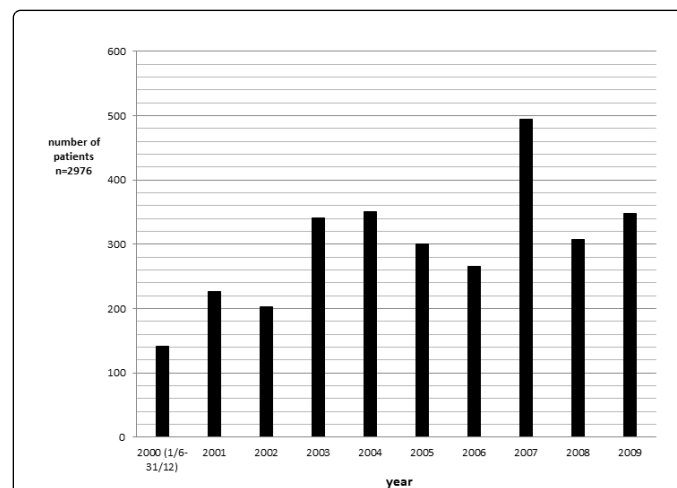


Figure 1: Number of patients with NSTEMI over the period 2000-2009.

Patients with NSTEMI (n=2976)		
Basic characteristics		
Age (years)*	67.9 ± 11.9	
females	31.5%	938/2976

BMI (kg/m ²)*	27.8 ± 4.5	
Comorbidities		
prior AMI	24.3%	714/2944
prior PCI	17.9%	527/2944
prior aortocoronary bypass operation	11.6%	341/2944
heart failure more than NYHA I	11.4%	336/2944
prior stroke	9.3%	274/2944
chronic obstructive lung disease	9.2%	272/2944
Risk factors		
arterial hypertension	82.7%	2435/2944
hyperlipidaemia	61.9%	1823/2944
diabetes mellitus	36.5%	1075/2944
smoking	32.8%	965/2944
serum creatinin >2.0 mg/dl	15.6%	458/2944
ECG at admission:		
heart rate (beats per min)*	79.1 ± 15.3	
left bundle branch block (LBBB)	3.0%	88/2939
atrial fibrillation	12.7%	364/2859
* means with standard deviations		

Table 1: Patient characteristics, risk factors and comorbidities.

93.4% of the patients underwent coronary angiography, 60.6% of them received percutaneous coronary intervention (PCI) and 4.8% immediate emergency bypass surgery. The median in-hospital delay for patients directly admitted to our clinic was, as expected, shorter than in patients transferred from other hospitals. Intrahospital AMI was rare. Detailed data about cardiac catheterization, reperfusion therapy and time delay is given in Table 2. Most common culprit vessel was the left anterior descending artery. An in-stent restenosis was observed in 8.5% of coronary lesions. A coronary stent was implanted in 82.6% of PCI procedures and bare-metal stents were mainly used (82.6%). Other catheter-supported interventions (intraaortic balloon pump, thrombectomy, protect-device) were very rarely performed. Angiographic findings and data about PCI are given in Table 3. The rate of guideline adherent medical therapy was high both at admission and at discharge. In 2009 a new platelet aggregation inhibitor, prasugrel, makes its first appearance and was used in 39 cases (Table 4). The most common in-hospital complications were post-infarction angina (4.4%), congestive heart failure (4.0%), cardiogenic shock (2.8%) and blood loss requiring transfusion (2.8%). In-hospital mortality was 4.2%. The average length of stay was 8.5 days. For about one third of patients a cardiac rehabilitation was arranged after hospital discharge.

Patients with NSTEMI (n=2976)		
Coronary angiography & reperfusion:		
Patients who received coronary angiography	93.4%	2779/2976

Reperfusion with PCI	56.6%	1683/2976
Immediate emergency aortocoronary bypass operation	4.8%	142/2951
Patients who received thrombolysis	0.2%	06/2976.

Table 2: Coronary angiography, reperfusion therapy, time intervals.

Changes over the years

Over the period of ten years we observed an increase of 4.4 years in median age (65.4 years in 2000 to 69.8 years in 2009, p for trend <0.01) and no changes in gender proportion (p=0.25). The prevalence of arterial hypertension (75.9% in 2000, 86.6% in 2009), renal failure (6.6% in 2000, 21.5% in 2009) and atrial fibrillation (10% in 2000, 16.8% in 2009) grew significantly (p<0.01), whereas hyperlipidaemia decreased (66.4% in 2000, 57% in 2009, p<0.01). The rate of diabetes mellitus did not significantly change (p=0.43). Rates of AMI or stroke in the past medical history also remained stable (p=0.29 and 0.70 respectively), whereas the rate of previous PCI increased (10.9% in 2000, 21.8% in 2009, p<0.01).

The overall number of NSTEMI patients grew over the years (227 in 2001, 348 in 2009). The rates of coronary angiography (92.5% in 2001, 99.3% in 2008 and 96% in 2009, p<0.01), PCI (minimum of 49.9% in 2003, maximum of 75.2% in 2008, p<0.01) and stent implantation (79.6% in 2000, 88.1% in 2009, p<0.01) increased, while immediate emergency bypass surgery rate declined (14.4% in 2000, 1.1% in 2009, p<0.01). Average in-hospital delay was reduced (694 min in 2000, 222 min in 2009, p<0.01).

First vessel to receive PCI (culprit lesion) localization	Patients with NSTEMI (n=2976)	
Right coronary artery	28.70%	433/1508
Left main	1.90%	28/1508
Ramus interventricularis anterior	34.70%	523/1508
Ramus circumflexus	32.00%	483/1508
Arterial bypass graft	0.20%	3/1508
Venous bypass graft	2.50%	38/1508
In-stent restenosis	8.50%	120/1412
TIMI-flow after PCI		
0	4.10%	45/1089
1	1.10%	12/1089
2	1.70%	19/1089
3	93.00%	1013/1089
Severity of stenosis (percentage)		
Before PCI *	92 ± 8 %	
After PCI *	10.5 ± 25.9 %	
Stent implantation performed	82.60%	1290/1561
Number of stents per lesion*	1.1 ± 0.3	

Stent type		
Bare-metal stent	82.60%	1046/1267
Drug-eluting stent	17.50%	221/1267
Additional catheter assisted interventions		
Intraaortic balloon pump	0.60%	18/2779
Thrombectomy device	1.10%	27/2426
protect-device	0.40%	9/2 423
duration of cardiac catheterization procedure (min)**	30	20-45
fluoroscopy time (min:sec)**	6:24	4:06-10:24
amount of contrast medium (ml) *	138.5 ±79.7	
* mean with standard deviation		
** median and quartiles		

Table 3: Angiographic findings, PCI and other catheter-assisted interventions.

The use of drug-eluting stents was initiated mainly in 2003 (13.6%), grew in 2004 (28.1%), then decreased until 2007 (10.5%) and finally increased again until 2009 (30.9%).

We observed a significant reduction in the amount of contrast medium and fluoroscopy time (227.9 ml and 8:57 min in 2000, 107.9 ml and 5:21 min in 2009, $p < 0.01$). The use of aspirin as well as clopidogrel increased over time (87.4% in 2000 to 92.8% in 2009 for aspirin, 53.6% in 2000 to 92.4% in 2008 for clopidogrel). In 2009 we documented a lower administration of clopidogrel (67.1% at admission, 61.9% at discharge) in favour of prasugrel (13.3% at admission, 22.2% at discharge). Administration of glycoprotein IIb/IIIa inhibitors was high until 2006 (between 31.8% and 58.2%) and then declined (12.9% in 2009). The use of statins, betablockers and ACE-inhibitors remained unchanged ($p = 0.85$, $p = 0.69$, $p = 0.64$ respectively). The practice of echocardiography for assessing left ventricular function increased significantly (75% in 2000, 97.7% in 2009, $p < 0.01$).

The overall rate of complications did not change ($p = 0.13$). Length of stay declined only after 2005 (10.1 days in 2005 to 8.2 days in 2009, $p < 0.01$). In-hospital mortality showed no significant variation over time ($p = 0.71$).

Eleven variables were included in a multivariate analysis for predictors of in-hospital mortality. These are shown in Figure 2. Cardiogenic shock (OR 8.3, 95%CI 4.6-15.0), moderately and severely reduced left ventricular function (OR 4.9, 95%CI 2.9-8.2) as well as increasing age (OR 1.5, 95%CI 1.1-1.9) were independent predictors of mortality.

	Patients with NSTEMI (n=2976)	
Initial medical therapy (<48 h after admission)		
Aspirin	94.40%	2704/2863
Clopidogrel	79.70%	2236/2807
Prasugrel	1.30%	39/2976

Vitamin K antagonist	6.00%	161/2691
Betablocker	92.40%	2638/2854
Statin	94.50%	2691/2847
ACE-inhibitor	90.70%	2579/2845
GP IIb/IIIa-antagonist	31.50%	869/2755
Medication at discharge		
Aspirin	89.80%	2503/2787
Clopidogrel	73.40%	2022/2753
Prasugrel	1.30%	38/2976
Vitamin K antagonist	12.50%	333/2673
Betablocker	91.60%	2552/2786
Statin	93.90%	2607/2776
ACE-inhibitor	88.20%	2441/2767

Table 4: Concomitant medical therapy.

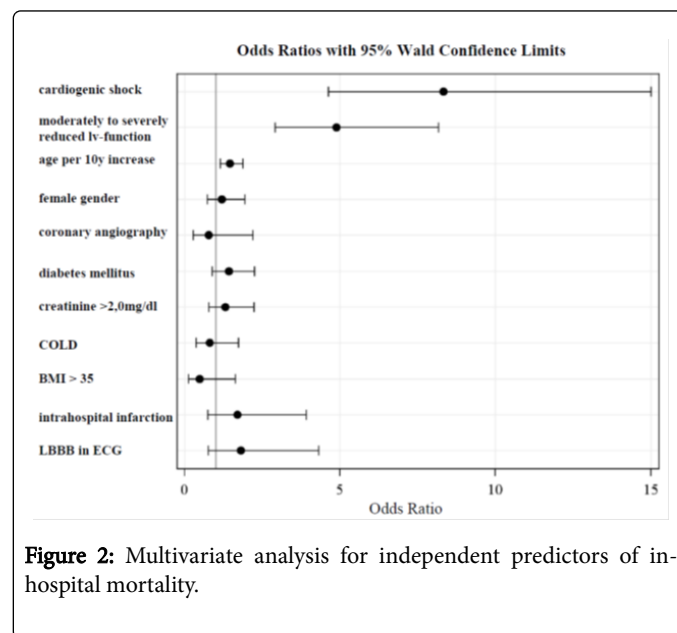


Figure 2: Multivariate analysis for independent predictors of in-hospital mortality.

Discussion

In the present study we observed, over a period of ten years, a growing use of guideline adherent medical and interventional therapy in a continuously ageing NSTEMI population with significant comorbidity. In-hospital mortality remained low and did not change over time.

Basic characteristics: We documented a high proportion of elderly patients with a rising mean age over time. This is consistent with findings from the second Euro-Heart-Survey [21] a prospective study including hospitals from 32 European countries, as well as a large French registry from Donataggio et al. [18] reporting a mean age of 66.1 and 67 years for NSTEMI respectively. A national AMI registry from Rogers et al. [23] involving 2157 US hospitals also showed an

increasing mean age between 1990 and 2006 for NSTEMI. This is probably due to the growing population of elderly people [24,25] and improvements in primary AMI prevention, as well as the growing acceptance to treat elderly patients invasively. An increasing rate of arterial hypertension, renal failure and atrial fibrillation is possibly explained through the ageing NSTEMI population and a better primary prevention of cardiovascular disease in recent years with an earlier detection of risk factors and comorbidities. Similar observations were made by the studies mentioned above. Diabetes mellitus was reported in approximately one third of NSTEMI cases and its rate remained stable over time, supporting data from a substudy of the Euro-Heart Survey [39] reporting a prevalence of 37.1% for NSTEMI. The only cardiovascular risk factor declining was hyperlipidaemia, an observation made by the second Euro-Heart Survey as well.

Cardiac catheterization, angiographic findings and reperfusion therapy: Early coronary angiography and revascularization is strongly recommended from current guidelines in the setting of NSTEMI [13]. The increasing rate of coronary angiography and PCI documented in our study is consistent with findings from the GRACE registry [26], showing a rise in both angiography and intervention numbers between 2001 and 2007. We recorded only a 6.6% of patients not receiving invasive diagnosis. These were mainly symptom-free very old patients with severe comorbidities. Emergency bypass surgery as the initial revascularization strategy appeared to become less popular over the years, most likely due to the increasing number of percutaneous interventions and especially the use of drug-eluting stents. O'Brien et al. [27] in a study of 30986 AMI patients in the USA between 1987 and 2008 reported a 3% per year decrease in bypass surgery rates and a parallel rise of PCI in the subgroup of NSTEMI. However, the overall rate of bypass surgery (emergency and elective), remains high in our population (13.4%), despite a slightly falling trend, supporting the results of Gogo et al. [28] and Parikh et al. [29], who showed a relatively stable overall bypass rate of 11.9-12.5% and 11%-13% in the years 2002-2005 and 2002-2008 in US-hospitals respectively. This can be explained through the more frequent use of coronary angiography with consequent increase in detection of severe multi-vessel disease requiring surgical therapy, as well as through the high rate of diabetics among NSTEMI patients which remains relatively unchanged over time.

The use of coronary stents grows and exceeds 88% in the latest years of our study period. Many randomized trials have shown a lower mortality and rate of restenosis with the use of stents in contrast to balloon-dilation alone [30]. Since 2003 drug-eluting stents (DES) were constantly gaining popularity, reaching a maximum application rate of 31%. Similar rates observed Donataccio et al. [18] with 38% between 2004 and 2008 in France. In the USA higher rates are documented with Gogo et al. [28] and Roe et al. [31] showing DES implantation in up to 80% and 60% of NSTEMI respectively. A slight transient decrease is reported from Roe et al. in the years 2006 and 2007, in accordance with our findings, maybe due to a temporary skepticism towards DES because of studies presenting high rates of in-stent thrombosis at that time [32].

Concomitant medical therapy: Administration of aspirin and clopidogrel significantly increased above 90%, showing an improvement of guideline adherence in our study population. This trend is also presented in the multinational GRACE registry [26] and the second Euro-Heart Survey [21] with lower Clopidogrel administration though, reaching 60-75%. The use of glycoprotein-IIb/IIIa (GP-IIb/IIIa) inhibitors was initially high (up to 58.2%), following

the 2002 and 2007 european guidelines recommending a routine "upstream" application in intermediate- to high-risk patients [10,11]. Stone et al. [33] presented data from the ACUITY-Timing-Study showing that routine "upstream" use of GP-IIb/IIIa inhibitors can have worse outcomes and suggesting a selective administration in higher risk cases. Giugliano et al. supported these findings [34]. These results, as well as the introduction of the direct thrombin inhibitor bivalirudin in 2006-2007 with better outcomes regarding major bleeding than GP-IIb/IIIa inhibitors [33], may have led to a reduction in their administration after 2006, observed both in our study and in the GRACE registry. The guideline adherent therapy with statins, ACE-inhibitors and β -blockers is in our population very frequent and slightly higher than in other registries cited above [21,35,36].

Complications and mortality: About one quarter of our patients had major or minor complications during their hospital stay. Cardiogenic shock, one of the most severe complications, associated with about 40-60% mortality [37-39], was reported in 2.8% of the cases. Similar rates (2.5%) were described from the GUSTO-IIb study including 7986 patients in US hospitals [40]. Anderson et al. presented a slightly higher rate of 4.3% in a large NSTEMI population in the USA [41]. We also observed an increasing rate of bleeding complications requiring transfusion over the years with a mean of 2.8%. This can be possibly explained through the continuously growing use of antithrombotic therapy. Eikelboom et al. [42] and Fox et al. [43] could document similar rates of major bleeding complications in large NSTEMI-ACS registries. A stroke complicating ACS leads to a significant increase in mortality [44]. We documented a very low stroke rate of 0.7%, supporting findings from the Euro-Heart survey [45]. In our data we pointed out a substantially higher rate of cardiogenic shock, re-infarction and major bleeding in the years 2006 and 2008. This could be mainly due to the significantly higher proportion of diabetic patients in these years. Bauer et al. presenting data from the PCI registry of the Euro-Heart survey [46] showed that diabetics present more often with cardiogenic shock than non-diabetics. The PLATO trial [47] comparing clopidogrel and ticagrelor in ACS reported a 53% higher re-infarction and 41% higher major bleeding rates for diabetic patients.

In-hospital mortality was in average 4.2% and did not change over the studied period, despite the growing rates of coronary angiography, PCI and administration of guideline adherent medical therapy. This is mainly due to the risk-profile of NSTEMI patients, which includes older age and significant comorbidities. Furman et al. documented a stagnating mortality of 12% for non-Q-wave AMI between 1975 and 1997, whereas mortality of Q-wave AMI was reduced from 24% to 14% [48]. In the registry of Rogers et al. already cited above [23] mortality for NSTEMI fell from 7.1% to 5.2% between 1994 and 2006, while decrease in STEMI-mortality was significantly higher. This difference between STEMI and NSTEMI could be probably due to a more aggressive therapeutic strategy in the first one. This was depicted in the results of Roe et al. who compared administration of guideline adherent therapy between the two groups in the period 2000-2002 [49]. The second Euro-Heart survey [21] and the GRACE registry [26] report a slightly lower mortality (2.9%). The first one reflects mortality for a very short period of only 8 months and does not describe long term variations. In GRACE we notice a selection bias, as AMIs in the setting of surgery, bleeding and trauma were excluded and according to the authors patients who died very early after admission were less likely to be enrolled. This probably explains the lower mortality rates compared to our results.

We also conducted a multivariate analysis to identify predictors of in-hospital mortality. Cardiogenic shock reduced left ventricular function and increasing age were independent mortality predictors with cardiogenic shock being the strongest one. Those factors have already been identified by previous studies in the era of percutaneous coronary intervention mainly for STEMI or AMI/ACS in general [50-55], but separate data for NSTEMI are sparse. The acute mortality of cardiogenic shock complicating AMI is in several studies reported to be between 40% and 60% [37-39,56], while Holmes et al. [40] documented even higher rates in patients with NSTEMI (73% vs. 63% for STEMI). Granger et al. [57] studied 11389 patients with ACS enrolled in the GRACE registry between 1999 and 2001 and found that killip class was the strongest independent predictor of in-hospital mortality with an OR of 2.0 per one class increase. In the same analysis age per 10 year increase was also an independent predictor with an OR of 1.7, which is in line with our results. Bosch et al. also showed that age and ejection fraction <48% are powerful predictors of in-hospital mortality in a registry of NSTEMI patients [58]. Those findings are also consistent with our observations. Other traditional risk factors such as diabetes mellitus, renal insufficiency and COLD are well characterized in numerous studies as predictors of long term mortality for AMI [59-62] but we could not find any significant correlation between these characteristics and in-hospital mortality. Similar results presented Ishihara et al. [62] showing that diabetes mellitus increased significantly long- but not short-term mortality after AMI treated with PCI and the study of Lazzeri et al. [61] where the presence of COLD was not associated with early but only with long-term mortality in a collective of AMI patients.

Limitations

As always in observational studies no causality between correlated parameters can be verified, as no randomization took place. Another limitation regards incomplete or missing clinical data retrieved from old patient records, a common drawback of retrospective data collection. This mainly affects patients transferred to our centre from other hospitals to receive angiography/PCI and were transported back shortly after acute management. In some cases with mild troponin increase not receiving coronary angiography (due to old age, severe comorbidity etc.) we cannot be definitively sure about the diagnosis of NSTEMI, as other conditions can lead to positive troponin tests as well. Moreover, our observations were made in the setting of an interventional heart centre with 24h available PCI facility and we cannot extrapolate our findings for non-interventional clinics.

Conclusion

The observation of NSTEMI patients over a period of 10 years in an interventional centre showed a relevant increase in invasive diagnostic, coronary interventions and administration of guideline adherent medical therapy, while emergency surgical revascularization declined. Implementation of guideline recommendations was achieved in a high population of patients. Although overall in-hospital mortality was low, it did not decline over time, apparently as a result of a continuously ageing NSTEMI population with significant comorbidity.

Conflict of Interest

The Authors declare that they have no competing interests.

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