Wien Klin Wochenschr (2010) 122: 220–228
DOI 10.1007/s00508-010-1352-y

Printed in Austria

Wiener klinische Wochenschrift
The Middle European Journal of Medicine

Primary percutaneous intervention of ST-elevation myocardial infarction in Austria: Results from the Austrian acute PCI registry 2005–2007

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Received August 20, 2009, accepted after revision February 8, 2010

Primäre perkutane Koronarintervention bei ST-Hebungsinfarkt in Österreich: Ergebnisse des österreichischen Akut-PCI Registers 2005 – 2007

Zusammenfassung. *Hintergrund:* Die primäre perkutane Koronarintervention (PPCI) ist die Therapie der Wahl zur Behandlung des akuten ST-Hebungsinfarktes (STEMI). Die Implementierung von Therapienetzwerken und Registern, welche Rückschlüsse auf die aktuelle Qualität der Infarkttherapie erlauben, sind Schlüsselelemente für eine optimierte Therapie im akuten ST-Hebungsinfarkt.

Ziel: Ziel war es, die angiographische und intrahospitale Erfolgs- sowie Komplikationsrate der interventionellen Infarkttherapie bei ST-Hebungsinfarkt in Österreich zu analysieren.

Methodik: Für die Analyse wurden 4016 Patienten, welche in einem Zeitraum von 3 Jahren seit Implementierung des österreichischen Akut-PCI Registers im Januar 2005 konsekutiv erfasst wurden, berücksichtigt.

Ergebnisse: Die Rate der PPCI als Indikation für akute Koronarintervention ist von 83,5 % im Jahr 2005 auf 92,4 % im Jahr 2007 angestiegen ($P<0{,}0001$). Die mediane Zeit von Spitalseintritt zur Reperfusion (="door-to-balloon time") konnte von 60,0 Minuten (40,0 – 90,0) im Jahr 2005 auf 53,0 (30,0 – 80,0) Minuten im Jahr 2007 reduziert werden ($P=0{,}012$). Darüber hinaus ist der Anteil der Patienten, welche eine adäquate antithrombotische Therapie mit ASS/Heparin und Clopidogrel erhielten, 2007 signifikant größer gewesen als 2005 (78,8 % *vs.* 85,1 % und 67,8 % *vs.* 90,3 %; $P<0{,}001$). Die intrahospitale Mortalität betrug 9,6 % bei Intervention nach erfolgloser Lyse, 6,4 % bei Lyse- oder GpIIbIIIa Inhibitor-Therapie gefolgt von PCI (=„facilitated PCI") und 5,1 % bei PPCI. Mittels multivariater Analyse konnte gezeigt werden, dass kardiogener Schock (OR: 20,21; 95 % CI: 12,21 – 33,44; $P<0{,}001$), Reanimation (OR: 2,62; 95 % CI: 1,47 – 4,69; $P=0{,}01$), Alter (OR: 1,04; 95 % CI: 1,02 – 1,06; $P<0{,}001$) und die angiographische Erfolgsrate (OR: 5,93; 95 % CI: 3,33 – 10,57; $P<0{,}001$) unabhängige Prädiktoren der intrahospitalen Mortalität waren.

Konklusion: Fortwährende Bestrebungen zur Etablierung lokaler Netzwerke, um das Management des akuten ST-Hebungsinfarktes zu optimieren, haben im Beobachtungszeitraum von 2005 bis 2007 zu einer Verkürzung der „door-to-balloon time" sowie einer verbesserten antithrombotischen Therapie geführt und waren mit einer intrahospitalen Mortalität von 5 % assoziiert. Diese Ergebnisse entsprechen den internationalen Erfolgsraten und stehen im Einklang mit rezenten Richtlinien und vergleichbaren Registern.

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Summary. *Background:* Primary percutaneous coronary intervention (PPCI) has become the preferred reperfusion strategy in ST-elevation myocardial infarction (STEMI).

Implementation of networks of care and registries providing continuous quality assessment are key components for optimal management in patients with STEMI.

Aim: To analyze procedural success and in-hospital outcome of interventional therapy of STEMI in Austria.

Methods: We evaluated a total number of 4016 consecutive STEMI patients registered in the first three years after implementation of the Austrian acute PCI registry in January 2005.

Results: The rate of PPCI as an indication for acute coronary intervention increased from 83.5% in 2005 to 92.4% in 2007 ($P<0.0001$). During this period the median door-to-balloon time decreased from 60.0 (40.0–90.0) min to 53.0 (30.0–80.0) min ($P=0.012$). The percentage of patients receiving adequate adjunctive antithrombotic therapy with ASA/heparin and clopidogrel significantly increased (78.8–85.1% and 67.8–90.3%, respectively; $P<0.001$). Overall in-hospital mortality was 9.6% in rescue PCI, 6.4% in facilitated PCI and 5.1% in PPCI. On multivariate analysis, cardiogenic shock (OR: 20.21, 95% CI: 12.21–33.44, $P<0.001$), resuscitation (OR: 2.62, 95% CI: 1.47–4.69, $P=0.01$), age (OR: 1.04, 95% CI: 1.02–1.06, $P<0.001$) and angiographic success (OR: 5.93, 95% CI: 3.33–10.57, $P<0.001$) were independent predictors of in-hospital death.

Conclusion: Continuous nationwide efforts to establish regional networks for STEMI treatment in the years 2005–2007 led to a decrease in door-to-balloon time, improved adjunctive antithrombotic therapy and an in-hospital mortality of 5%. Results of interventional STEMI treatment in Austria are in accordance with current guidelines and with other contemporary registries.

Key words: Primary PCI, ST-elevation myocardial infarction, registry.

Introduction

Early reperfusion therapy is associated with decreased mortality after ST-elevation myocardial infarction (STEMI) [1]. Primary percutaneous coronary intervention (PPCI) has been shown to be more effective than fibrinolysis in reducing short-term mortality, reinfarction and stroke [2], and thus has become the preferred therapeutic option if performed expeditiously by an experienced team. Given these widely accepted advantages of early mechanical reperfusion, current guidelines have emphasized the importance of establishing systems of care as key components for successful STEMI treatment [3, 4]. The implementation of guidelines has significantly improved the outcome of patients, as shown recently in regional and national registries [4–8]. The Austrian acute PCI registry was designed to evaluate interventional therapy and determine predictors of successful treatment and in-hospital outcome in patients receiving coronary intervention in a real-world setting of myocardial infarction (MI) in Austria. The current report summarizes the results of therapeutic management of more than 4000 patients with STEMI enrolled in the registry during the first three years after its implementation.

Methods

The Austrian acute PCI registry is a nationwide, prospective, multicenter, observational registry of interventional reperfusion therapy in MI in Austria. Between 2005 and 2007, 4016 consecutive patients with STEMI who were considered for interventional reperfusion were recorded. At the time of analysis, 19 of 25 PCI centers with experience in acute PCI (at least 50 cases per year) participated in the registry. Central data management, data protection and analyses were performed at the Department of Medical Statistics, Informatics and Health Economics of Innsbruck Medical University.

The registry was instituted according to the Declaration of Helsinki and the study protocol was approved by the ethics committee of Innsbruck Medical University (UN2467).

Data collection

Data of patients with acute MI admitted to the participating centers within 24 h of symptom onset were recorded using an internet-based questionnaire. Patient characteristics included age, sex, diabetes, smoking status, previous coronary intervention and previous MI. The following data items were collected: the mode of admission (self-admission, in-hospital admission, primary or secondary transport by ambulance or helicopter) and several key time points (symptom onset, first medical contact, time of admission at the primary hospital and the PCI center, arrival at the catheter laboratory, balloon time), from which corresponding time delays were calculated. The indications for acute PCI were defined as PPCI, facilitated PCI (lytic therapy with or without concomitant glycoprotein IIb/IIIa inhibitor or glycoprotein IIb/IIIa inhibitor alone followed by immediate PCI) and rescue PCI (after lytic failure). The antithrombotic pretreatment before arrival at the catheter laboratory was defined as standard therapy with heparin and aspirin; administration of clopidogrel and/or the use of GpIIb/IIIa antagonists, and the application of thrombolytic therapy (optional full or half dose) were recorded, as well as the time of treatment relative to hospital admission (prehospital or intrahospital). Periprocedural data included: target vessel, treatment of the target lesion with balloon angioplasty alone or with either drug-eluting (DES) or bare-metal stent (BMS); the degree of stenosis and thrombolysis in MI (TIMI) flow were documented before and after intervention, and angiographic success was defined as post-procedural TIMI flow 2 + 3; adjunctive therapy with GpIIb/IIIa antagonists, bivalirudin or additional devices (distal protection, intra-aortic balloon pump [IABP]). Stratification of peri-interventional risk included the occurrence of cardiogenic shock, pre-hospital resuscitation or resuscitation until end of procedure and the number of leads with ST-elevation. In-hospital outcome variables were recorded at discharge from the PCI hospital and included mortality, periprocedural bleeding complication, persistent neurological deficit after peri-interventional ischemic stroke, re-infarction and staged PCI.

Statistical analysis

The frequency of categorical variables was expressed in percent and differences were assessed using chi-squared or Fisher's exact tests as appropriate. Results of normally distributed continuous variables were expressed as the mean value ± standard deviation (SD), and continuous variables with non-normal distribution were presented as median values and interquartile intervals. The distribution of continuous variables was tested using the Kolmogorov–Smirnov test of normality. Accordingly, for normally distributed variables, differences between and within groups were calculated using *t*-tests. Time delays were calculated using

the corresponding time points and expressed as median and interquartile range. In the present analysis, only PPCI data were considered in the calculation of time delays, thus excluding rescue and facilitated PCI. Differences in delays were assessed using Kaplan–Meier analysis and a log-rank test. In addition, predictors of in-hospital mortality were identified in multivariate analysis. Logistic regression analysis was performed to assess the significance of factors generally thought to be related to in-hospital mortality and to quantify their relative importance in STEMI patients undergoing interventional reperfusion. Candidate variables were: occurrence of cardiogenic shock, resuscitation, age, diabetes, previous MI and angiographic success. A two-sided *P*-value <0.05 was considered statistically significant. SPSS® statistical software (version 16.0) was used for all analyses.

Results

Between January 2005 and December 2007, data on 4016 patients who received interventional therapy for STEMI were recorded in the Austrian acute PCI registry by 19 of 25 centers performing PCI for acute coronary syndromes in Austria (at least 50 cases per year). Indications for acute PCI were PPCI in 88.7%, rescue PCI in 7.0% and facilitated PCI in 4.3%. PPCI as an indication for acute coronary intervention increased from 83.5% in 2005 to 92.4% in 2007 ($P<0.001$), whereas during this period the rates of facilitated PCI (6.7 *vs.* 2.1%, $P<0.001$) and rescue PCI (9.9 *vs.* 5.6%, $P<0.001$) decreased reflecting a relative increase in PPCI among patients undergoing interventional treatment for STEMI. Patients were 62.0 (52.0–73.0) years old and 72.8% of the patients were men. Table 1 summarizes the patient characteristics at hospital admission. Neither indication for PCI nor patient characteristics showed significant differences when comparing 2005 with 2007 (Table 1).

Mode of admission

The majority of patients were admitted directly by ground ambulance service (47.7%) or helicopter transport (6.1%); total number of primary admissions 53.8%. A total of 33.2% of patients were initially admitted to a hospital without PCI capability and subsequently transferred on the ground (26.1%) or by helicopter (7.1%) to the PCI center. Overall, 4.1% of the patients suffered an MI during hospitalization (in-hospital admission) and 8.8% directly contacted the emergency department of a PCI hospital. Comparing 2005 with 2007, there was no change in the rates of primary transport (52.7 *vs.* 53.8%; $P=0.56$) or secondary transport (32.7 *vs.* 34.6%; $P=0.31$). There was no difference in the frequency of in-hospital admission (4.9 *vs.* 3.6%; $P=0.1$) or the number of patients who directly contacted the emergency department themselves (9.7 *vs.* 7.9%; $P=0.1$).

Time delays in primary PCI

The overall time delays in primary PCI are shown in Fig. 1. Comparing 2005 and 2007, the door-to-balloon (d2b) time decreased from 60.0 (40.0–90.0) min to 53.0 (30.0–80.0) min

Table 1. Patient characteristics

	Total ($n=4016$)	2005 ($n=1156$)	2006 ($n=1275$)	2007 ($n=1585$)	*P*-value		
					2005 *vs.* 2006	2006 *vs.* 2007	2005 *vs.* 2007
Age (years)	62.0 (52.0–73.0)	62.0 (52.0–72.0)	63.0 (54.0–74.0)	62.0 (52.0–72.5)	<0.01	0.01	0.46
Age men	60.0 (51.0–69.0)	59.0 (50.0–69.0)	61.0 (51.0–70.0)	60.0 (51.0–70.0)	0.01	0.13	0.25
Age women	69.0 (58.0–77.0)	69.0 (58.0–77.0)	71.0 (57.8–78.0)	68.0 (58.0–77.0)	0.16	0.07	0.73
Men	72.8 (2922/4016)	73.9 (854/1156)	70.7 (901/1275)	73.6 (1167/1585)	0.09	0.09	0.90
Diabetes	17.9 (598/3350)	18.3 (166/908)	17.8 (189/1059)	17.6 (243/1383)	0.81	0.87	0.70
Oral therapy	12.8 (413/3228)	13.6 (116/854)	12.2 (125/1026)	12.8 (172/1348)	0.37	0.71	0.60
Insulin therapy	6.0 (200/3311)	6.2 (55/894)	6.7 (70/1043)	5.5 (75/1374)	0.64	0.23	0.52
Current smoker	48.9 (1540/3096)	50.3 (414/823)	43.8 (422/963)	51.8 (678/1310)	0.01	<0.01	0.53
Previous MI	12.5 (425/3388)	12.0 (108/898)	12.5 (142/1132)	12.9 (175/1358)	0.73	0.81	0.56
Previous PCI	12.6 (436/3469)	13.0 (119/918)	12.7 (146/1146)	12.2 (171/1405)	0.90	0.67	0.61
Cardiogenic shock	10.8 (435/4016)	10.0 (116/1156)	12.1 (154/1275)	10.4 (165/1585)	0.12	0.17	0.80
Resuscitation	9.1 (365/4016)	8.7 (100/1156)	8.9 (113/1162)	9.6 (152/1585)	0.89	0.52	0.42

Age presented as median (interquartiles); categorical variables presented as percent with corresponding numbers in parentheses. *P*-values were calculated with Mann–Witney *U*-test or Fisher exact test as appropriate.

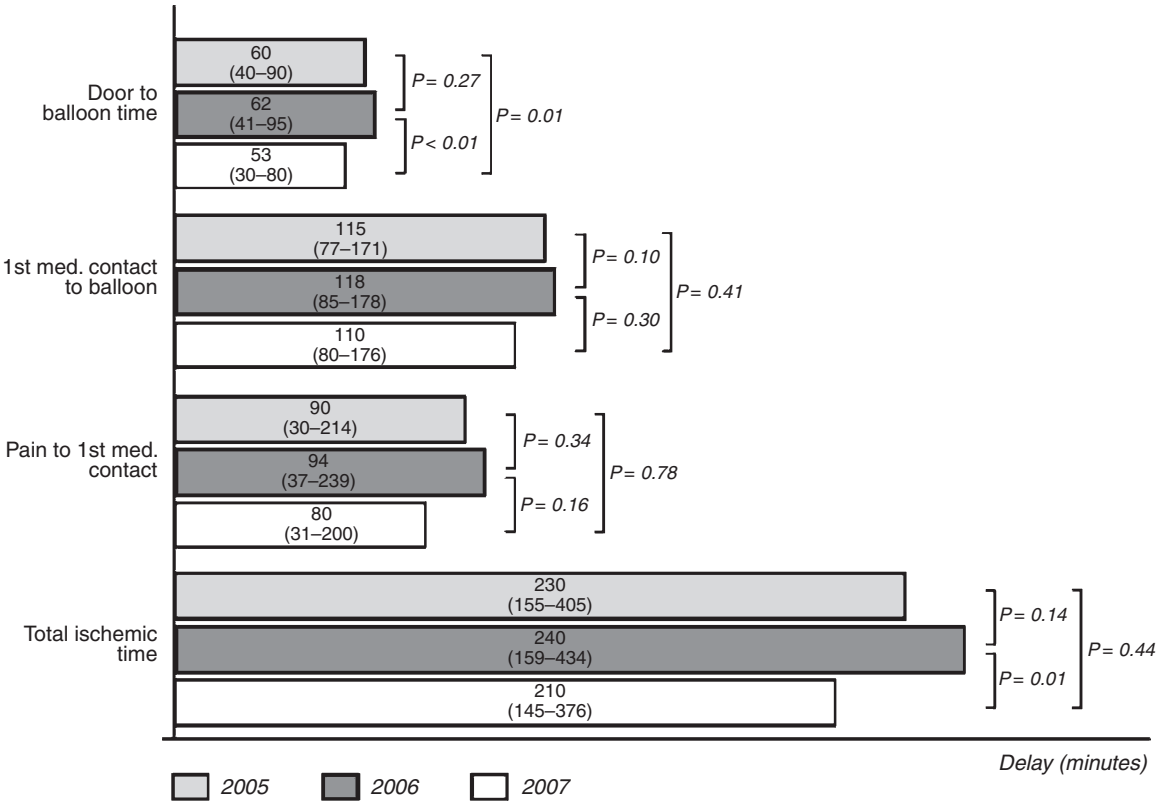

Fig. 1. Median and interquartile time delays (min) in primary PCI. Delays in 2005 (light-grey bars), 2006 (dark-grey bars) and 2007 (white bars) were compared using the log rank test

(P=0.012). However, the time from symptom onset to first medical contact, the contact-to-balloon time and the total ischemic time did not significantly improve during this period. Overall, 61.2% of patients presented within the first 2 h after symptom onset. Assuming an acceptable transport time of <120 min from first medical contact to balloon and a d2b time <60 min, 55.2% achieved reperfusion within this contact-to-balloon time and 53.7% within the demanded d2b time. The percentage of patients with a d2b time <60 min increased from 50.4% in 2005 to 59.2% in 2007 (P<0.001). The number of patients with a contact-to-balloon time <120 min remained unchanged (P=0.33).

Adjunctive therapy and periprocedural angiographic characteristics in PPCI

Antithrombotic pretreatment in PPCI and periprocedural characteristics are shown in Table 2. ASA and heparin were given in 82.5% of the patients before arrival at the catheter laboratory. In total, 81.8% of the patients received clopidogrel pretreatment, which was started in the prehospital phase in 20.9% of patients. Comparing 2005 with 2007, clopidogrel treatment was started earlier and the proportion of patients who received clopidogrel in addition to ASA/heparin increased. In contrast, the frequency of pretreatment with GpIIb/IIIa antagonists decreased. The stent rate remained constant, whereas the rate of drug-eluting stent implantation decreased.

In 11.7% (n=418) of patients with an initial "intention-to-treat" with PPCI, intervention was not performed. Regarding this subgroup, medical treatment was decided in 51.0%, acute CABG was needed in 21.0% and in the remaining 27% of patients PCI was not feasible. In the catheter laboratory, 54.9% received GPIIb/IIIa antagonists and 4.4% received bivalirudin. Treatment with bivalirudin increased significantly in 2007, whereas the rate of GPIIb/IIIa antagonists remained unchanged over time. Thrombectomy was done in 6.8% and in 3.3% an intra-aortic balloon pump was inserted. Table 2 summarizes adjunctive medical treatment, peri-interventional characteristics and changes comparing 2005 with 2007.

In-hospital outcome

The overall mortality in acute PCI was 5.5%. Comparing different indications for acute PCI, the mortality was highest in rescue PCI (9.6%) and lowest in PPCI (5.1%; P<0.01). Patients receiving facilitated PCI had a mortality of 6.4%. In-hospital complication rates were low in general and similar for different acute PCI indications, except for a trend toward higher bleeding rates in facilitated PCI (P=0.15; Table 3).

Subgroup analyses showed highest rates of in-hospital mortality in patients with cardiogenic shock and patients with resuscitation (resuscitation *vs.* no resuscitation, 23.1% *vs.* 3.5%; P<0.001, Fig. 2). Women and men had similar in-hospital mortality (5.9% *vs.* 4.8%; P=0.13), but elderly

Table 2. Adjunctive therapy and periprocedural characteristics

	Total (*n*=3563)	2005 (*n*=965)	2006 (*n*=1134)	2007 (*n*=1464)	*P*-value		
					2005 *vs.* 2006	2006 *vs.* 2007	2005 *vs.* 2007
Medical pretreatment							
ASA/heparin	82.5 (2940/3563)	78.8 (760/965)	82.4 (934/1134)	85.1 (1246/1464)	0.04	0.06	<0.001
Clopidogrel total	81.8 (2793/3416)	65.5 (573/875)	82.5 (902/1093)	91.0 (1318/1448)	<0.001	<0.001	<0.001
Prehospital	20.9 (701/3354)	11.5 (94/818)	19.3 (210/1089)	27.4 (397/1447)	<0.001	<0.001	<0.001
Intrahospital	62.0 (2092/3373)	56.3 (479/851)	64.1 (692/1080)	63.9 (921/1447)	0.001	0.933	<0.001
GpIIb/IIIa inhibitor	19.0 (596/3131)	31.6 (260/824)	17.5 (169/964)	12.4 (167/1343)	<0.001	0.001	<0.001
Interventional data							
TIMI flow							
Before procedure 0-I	72.0 (2361/3280)	69.1 (610/883)	68.7 (714/1039)	76.4 (1037/1358)	0.93	<0.001	<0.001
II	18.2 (598/3280)	20.5 (181/883)	20.0 (208/1039)	15.4 (209/1358)	0.82	<0.01	0.004
III	9.8 (321/3280)	10.4 (92/883)	11.3 (117/1039)	8.2 (112/1358)	0.56	0.02	0.12
Post procedure 0-I	5.5 (174/3190)	5.9 (50/847)	6.1 (62/1029)	4.7 (62/1324)	0.85	0.16	0.28
II	6.2 (199/3190)	5.8 (49/847)	6.9 (70/1019)	6.0 (80/1324)	0.3	0.45	0.71
III	87.1 (2777/3190)	87.0 (737/847)	85.4 (870/1019)	88.4 (1170/1324)	0.88	0.05	0.04
No reflow	1.3 (40/3190)	1.3 (11/847)	1.7 (17/1019)	0.9 (12/1324)	0.57	0.13	0.52
Angiographic success	93.3 (2976/3190)	92.8 (786/847)	92.2 (940/1019)	94.4 (1250/1324)	0.66	0.04	0.15
Intervention							
BMS	57.2 (2037/2563)	58.3 (563/965)	50.3 (570/1134)	61.7 (904/1464)	<0.001	<0.001	0.10
DES	24.8 (885/3563)	25.3 (244/965)	30.3 (344/1134)	20.3 (297/1464)	0.01	<0.001	0.004
Without stent	6.3 (223/2363)	5.4 (52/965)	5.7 (65/1134)	7.2 (106/1464)	0.78	0.13	0.08
Multivessel PCI	9.2 (299/3266)	7.6 (73/965)	11.0 (112/1015)	8.9 (114/1286)	0.01	0.09	0.28
No intervention	11.7 (418/3563)	11.0 (106/965)	13.7 (155/1134)	10.7 (157/1464)	0.73	0.02	0.84
Medical treatment	51.0 (177/347)	54.5 (55/101)	45.0 (58/129)	54.7 (64/117)			
CABG	21.0 (73/347)	21.8 (22/101)	19.4 (25/129)	22.2 (26/117)	0.15	0.10	0.99
PCI not feasible	27.0 (97/347)	23.8 (24/101)	35.7 (46/129)	23.1 (27/117)			
Co-therapy							
GpIIb/IIIa inhibitor	54.9 (1896/3451)	57.3 (490/855)	50.5 (572/1132)	57.0 (834/1464)	0.03	0.001	0.90
Bivalirudin	4.4 (149/3366)	1.7 (13/777)	5.7 (64/1125)	4.9 (72/1464)	<0.001	0.42	<0.001
Thrombectomy	6.8 (230/3380)	6.8 (53/785)	5.7 (65/1131)	7.7 (112/1464)	0.39	0.06	0.50
Distal protection	0.7 (22/3360)	0.9 (7/768)	0.6 (7/1128)	0.5 (8/1464)	0.59	0.81	0.41
IABP	3.3 (111/3401)	3.7 (30/807)	3.9 (44/1130)	2.5 (37/1464)	0.91	0.05	0.12

Data presented as percent with corresponding numbers in parentheses; *P*-values calculated using Chi-squared and Fisher exact tests.

Table 3. In-hospital outcome in ST-elevation myocardial infarction

Outcome	Total (*n* = 4016)	Primary PCI (*n* = 3563)	Rescue PCI (*n* = 281)	Facilitated PCI (*n* = 172)	*P*-value
Mortality	5.5 (220/4016)	5.1 (182/3563)	9.6 (27/281)	6.4 (11/172)	<0.01
Re-infarction	1.5 (58/3974)	1.4 (49/3526)	2.2 (6/277)	1.7 (3/171)	0.58
Major bleeding	0.9 (37/3975)	0.9 (32/3527)	1.4 (4/277)	0.6 (1/171)	0.60
2nd revascularization	4.4 (165/3777)	4.4 (148/3372)	5.2 (13/251)	2.6 (4/154)	0.46
Neurologic deficit	1.4 (57/3972)	1.3 (46/3525)	2.5 (7/277)	2.3 (4/170)	0.15

Data are presented as percent with corresponding numbers in parentheses; *P*-values calculated using the Chi-squared test.

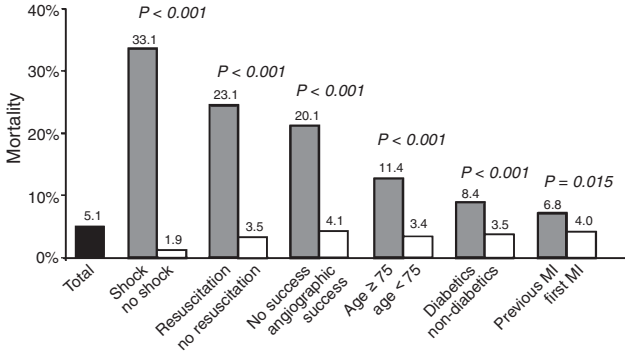

Fig. 2. Mortality in primary PCI subgroups. *P*-values calculated using Chi-squared tests

Table 4. Independent predictors of in-hospital mortality in primary PCI (multivariate analysis)

	Odds ratio	95% CI	*P*-value
Age	1.04	1.02–1.06	<0.001
Cardiogenic shock	20.21	12.21–33.44	<0.001
Angiographic success	5.93	3.33–10.57	<0.001
Previous MI	0.92	0.51–1.77	0.88
Diabetes	1.66	0.98–2.82	0.06
Resuscitation	2.62	1.47–4.69	0.01

patients (≤75 *vs.* <75 years), patients with prior MI, diabetes, and patients with no angiographic success had higher in-hospital mortality rates (Fig. 2). In multivariate analysis including the mentioned subgroups, cardiogenic shock was the strongest independent predictor of in-hospital mortality, followed by resuscitation, angiographic success and age (Table 4). There was no significant difference in in-hospital outcome comparing 2005 and 2007 (data not shown).

Discussion

The Austrian acute PCI registry is a prospective ongoing activity of the Working Group of Interventional Cardiology to evaluate secular trends in invasive therapy of acute coronary syndromes in Austria with regard to continuous changes of guidelines and treatment recommendations. Based on 4016 patients with STEMI treated with PCI in the majority of hospitals offering 24 h/7 day acute PCI service in Austria, the present report gives a representative overview of contemporary interventional treatment of MI in an alpine country. Major achievements since implementation of the registry include continuous increase of the PPCI rate over time, improvement of early antithrombotic therapy, reduction in d2b times leading to higher rates of patients treated within the recommended time-window, and a tendency toward lower in-hospital mortality in acute PCI.

Implementation of PPCI in the treatment of acute STEMI has led to significant reduction of in-hospital mortality and has improved long-term outcome [2, 5]. In the current ESC and AHA/ACC guidelines, PPCI is recommended as the preferred reperfusion strategy, if provided in an accurate time window by an experienced team [4, 8]. To ensure high quality of treatment and shorten delays, treatment networks adapted to local conditions are recommended [3, 4]. Registries such as ours may help to document the effect of and adherence to guidelines in clinical practice. The implementation of guidelines can lead to measurable improvement in patient outcome. For example, the Vienna STEMI network was established in 2003 and, as demonstrated by Kalla et al., the in-hospital mortality after STEMI in Vienna was reduced from 16% in 2002 to 9.5% in the following two years [5]. Several treatment networks in different regions of Austria were developed during the same time period, resulting in an overall increase in the primary PCI rate in Austria. Our acute PCI registry was initiated during this period and has enabled continuous documentation of the quality of care in interventional therapy in acute coronary syndromes. Registry data also show the response of clinical practice to recent trials. The recently published FINESSE trial did not show an advantage for facilitation of PCI by half-dose reteplase plus abciximab or by abciximab alone [9]. In the ASSENT-4 trial, lytic therapy with tenecteplase followed by immediate PCI was associated with higher in-hospital mortality than PPCI alone [10]. The significant decrease of facili-

tated PCI in Austria from 2005 to 2007 reflects an adequate response to these trial results. The recent ESC guidelines recommend early pretreatment with clopidogrel in addition to ASA [4], although evidence from large randomized trials showing a benefit of prehospital clopidogrel in PPCI is still lacking. Since 2005 the proportion of patients receiving antithrombotic pretreatment has continuously increased. In 2007, almost every patient received ASA and clopidogrel before PCI. Moreover, in the present cohort, 21% of patients had received clopidogrel before arrival at the PCI center. In contrast, in the German PREMIR registry, prehospital clopidogrel treatment was documented in only 2% of patients undergoing PPCI [11]. The high numbers of secondary transfers in the present registry may be a possible explanation for this difference.

The greatest benefit of reperfusion is achieved in the first hours after symptom onset [12], thus reducing delays in pre- and intrahospital treatment is one of the main goals for STEMI networks. The mean transport delay in Austria of 110 min from first medical contact to balloon inflation seems relatively short, considering the difficult transport logistics in an alpine region. Kalla et al. reported a mean transport delay of 52 ± 44 min and a mean delay from symptom onset to hospital admission of 180 min for the urban region of Vienna [5]. In the MITRA plus registry the mean prehospital delay from symptom onset to hospital admission was 155 min during on-hours, and the German PREMIR registry reported a median delay of 91 min from first medical contact until PPCI [11, 13]. The prehospital delay, however, is only partially influenced by the emergency medical system and is in large part due to inadequate patient awareness. This is shown by the fact that only 61% of patients presented within the first 2 h of symptom onset, reflecting delayed response among patients. However, efforts focusing on reduction of patient-related delays [14, 15] usually do not show persisting effects [16]. Current guidelines recommend a d2b time <60 min in patients arriving through the emergency medical system and <90 min for self-admitted patients [4, 8]. The Viennese STEMI registry reported a mean d2b time of 83 ± 51 min between 2004 and 2006 [5]. In the current analysis the median d2b time in Austria was reduced from 60 min in 2005 to 53 min in 2007, reflecting a continuous improvement in time management in PPCI in Austria. Moreover, the present delays are in accordance with registries from other parts of the world. In the NCDR ACTION registry conducted in 2007 the median d2b time was 75 (55.0–91.0) min, and the GRACE registry reported a median d2b time of 75–80 min between 2000 and 2006 [17, 18]. Longer d2b times were associated with higher mortality rates in NRMI 3 and 4, as well as in the GRACE registry [19, 20]. In the latter, a mortality increase of 0.18% was reported for every 10 min delay in d2b time between 90 min and 150 min for patients undergoing PPCI. In contrast, our observation and a recent study by De Luca et al. could not confirm such an association of d2b time with short-term outcome [21]. Possible explanations may include the relatively short delays in the present cohort. More than 50% of patients in the NRMI registry, but only 25% in the present registry, had a d2b time >90 min, probably reducing the sensitivity of the relation between d2b time and short-term outcome. Moreover, it has been shown that prolonged d2b times were associated with higher in-hospital mortality only in high-risk patients and patients presenting early [22, 23]. Other predictors of short-term outcome were comparable with previously published data. Patients treated with PPCI had an overall mortality of 5.1%, which is well in line with other recent registry data [11, 20, 24, 25]. The strongest independent patient-related predictor of mortality was the presence of cardiogenic shock. Interestingly, diabetes was not associated with mortality in multivariate analysis, which is not in accordance with some previous studies [17, 26–28]. Although the prevalence of diabetes in our study is comparable with the large NRMI-2 cohort of 27,080 patients, the low absolute number of patients with diabetes may explain this discrepancy [28]. A recently published analysis of patients enrolled in 2005 in the Austrian acute PCI registry has reported higher in-hospital mortality in female patients on univariate but not multivariate analysis [29]. In the present report, female sex was no longer a predictor of mortality even on univariate analysis, probably because of the much larger sample size resulting in less selection bias.

Limitations

Only 19 of 25 centers performing acute PCI in different regions of Austria have acquired data for the present registry. However, given the geographic distribution of centers and their individual high volume, this report of more than 4000 patients still reflects the majority of interventional reperfusion therapy in Austria. Instead of site visits, the registered data were checked by the central data management group and centers were contacted for clarification in cases of ambiguity. Data on 30-day and long-term mortality were not collected, hence we may have missed later events in differing subgroups. Furthermore, as this is an acute PCI registry we cannot provide data on patients treated with thrombolysis or receiving no reperfusion therapy at all. Consequently, this registry does not include all treatment strategies in STEMI.

Conclusion

The present data show that since implementation of the Austrian acute PCI registry in 2005 interventional therapy for STEMI has improved and is currently associated with an in-hospital mortality of 5%. Continuous efforts optimizing the quality of therapy have led to significant reduction in d2b time and improvement in adjunctive antithrombotic therapy, both of which are known to be associated with better outcome after MI. Further analysis should evaluate whether the improvement in therapeutic management also results in better long-time survival.

Conflict of interest

The authors declare no conflict of interest.

Appendix

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