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Variations in the quality of care of patients with acute myocardial infarction among Swiss university hospitals

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Abstract

Objectives. The objective of our study was to assess hospital variations in the quality of care delivered to acute myocardial infarction (AMI) patients among three Swiss academic medical centres.

Design. Cross-sectional study.

Setting. Three Swiss university hospitals.

Study participants. We selected 1129 eligible patients discharged from these hospitals from 1 January to 31 December 1999, with a primary or secondary diagnosis code [International Classification of Diseases, 10th revision (ICD-10)] of AMI. We abstracted medical records for information on demographic characteristics, risk factors, symptoms, and findings at admission. We also recorded the main ECG and laboratory findings, as well as hospital and discharge management and treatment. We excluded patients transferred to another hospital and who did not meet the clinical definition of AMI.

Main outcome measures. Percentage of patients receiving appropriate intervention as defined by six quality of care indicators derived from clinical practical guidelines.

Results. Among 577 eligible patients with AMI in this study, the mean (SD) age was 68.2 (13.9), and 65% were male. In the assessment of the quality indicators we excluded patients who were not eligible for the procedure. Among cohorts of 'ideal candidates' for specific interventions, 64% in hospital A and 73% in hospital C had reperfusion within 12 hours either with thrombolytics or percutaneous transluminal coronary angioplasty ($P = 0.367$). Further, in hospitals A, B, and C, respectively 97, 94, and 84% were prescribed aspirin during the initial hospitalization ($P = 0.0002$), and respectively 68, 91, and 75% received angiotensin converting enzyme inhibitors at discharge in the case of left ventricular systolic dysfunction ($P = 0.003$).

Conclusions. Our results showed important hospital-to-hospital variations in the quality of care provided to patients with AMI between these three university hospitals.

Keywords: acute myocardial infarction, clinical performance measurements, quality indicators, quality of health care, variations

Cardiovascular diseases, among which coronary artery diseases are the most common, are the main cause of death in middle-aged and older adults in most European countries [1]. Due to its frequency and severity, acute myocardial infarction (AMI) has been a topic of intense scientific and clinical interest. A series of randomized clinical trials confirmed the efficacy of various therapies, e.g. thrombolysis, beta-blockers, angiotensin converting enzyme inhibitors [2–5]. From this evidence, clinical practice guidelines for the management of patients with AMI have been published [6]. Despite publication of these guidelines, optimal treatment of patients with AMI is often not prescribed. In the USA, the Health Care Financing Administration has implemented, since 1992, a continuous quality improvement approach to ensure quality of care for Medicare beneficiaries [7]. Quality indicators (QIs) were developed from the aforementioned clinical practice guidelines and several studies were implemented to highlight differences in patterns of care provided between hospitals [8,9].

During the same period, several studies have pointed out geographical variations in the distribution of health care [10,11]. Some studies have shown geographical variations among hospitals in the USA regarding the use of cardiac procedures for AMI patients [12,13]. A recent study showed that

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substantial geographical variations existed in the treatment of AMI patients across all states in the USA, demonstrating a gap between knowledge and practice and that therapies of proven benefit for AMI were underused [13]. In Europe, although few studies have shown geographical variations [14], a few have compared process of care in AMI patients within or across countries [15,16]. Similarly, in Switzerland, some studies have shown the existing patterns of pharmacological treatment among AMI patients [17–20]. The objective of our study was to assess hospital-to-hospital variations in the quality of care of AMI patients between three Swiss university hospitals.

Methods

Setting and patients

We conducted a cross-sectional study including adult patients hospitalized for AMI in three Swiss academic medical centres. These three hospitals were all urban public university hospitals, the major tertiary care centres for their respective areas, and participated voluntarily in the study. Patients included in the study were discharged from these hospitals from 1 January to 31 December 1999, with a primary or a secondary diagnosis of AMI [International Classification of Disease, 10th Revision (ICD-10) codes I21.0–I21.9, I22.0–I22.9, and I23.0–I23.8]. Cases were identified by means of the mandatory standardized discharge summary routinely transmitted to the Swiss Federal Statistical Office.

We found, respectively 553, 380, and 196 eligible patients in these three hospitals. All 1129 cases were eligible patients registered in the administrative data system with a primary or secondary diagnosis of AMI. We excluded 236 patients transferred to another acute care facility, three patients who left the hospital against medical advice, four with inconsistent date of discharge, 97 not hospitalized for an AMI but actually coded so, and 70 patients with an incomplete or missing chart. We further excluded 142 cases because the considered episode did not match the clinical definition of AMI, using the definition described in the consensus document of the Joint European Society of Cardiology/American College of Cardiology Committee for the Redefinition of Myocardial Infarction. This definition includes typical rises or gradual falls (troponin) or more rapid rises or falls (CK-MB) of biochemical markers of myocardial necrosis with at least one of the following: (i) ischaemic symptoms; (ii) development of pathologic Q-waves on the ECG; (iii) ECG changes as indicative of ischaemia (ST-segment elevation or depression) [21]. The final sample size was 577.

Data

Data abstraction was conducted by trained medical doctors or medical record specialists. In two hospitals, the entire medical charts were available for data abstraction. In the third, only the electronic medical records, which included the discharge letter, laboratory results, and all cardiological procedures, were obtained. Variables abstracted from the charts included age, sex, smoking status, hypertension, diabetes, hyperlipidaemia, history of heart failure, stroke, angina pectoris, or myocardial infarction. Clinical information included measurement of chest pain, syncope, dyspnoea, and cardiogenic shock. We also recorded ECG findings and laboratory values, as well as, if available, the ejection fraction or a narrative description of the ejection fraction on an echocardiography, angiography, or ventriculography. We also abstracted medication at admission (including thrombolysis), during hospitalization, and at discharge as well as specific procedures such as percutaneous transluminal coronary angioplasty and coronary artery bypass surgery. The Charlson co-morbidity index, a weighted average of selected comorbidities, was computed at index hospitalization for each patient as measurement of severity of illness, using the Deyo modification [22].

QIs

QIs were developed from evidence-based guidelines. They were derived from the US Cooperative Cardiovascular Project [8,9] and used in many studies. The development of these performance measurements for AMI was based on the reliability and validity of the indicator and on the evidence of a process–outcome link [23]. They were adapted locally with key clinicians. Table 1 summarizes these QIs with the respective exclusion criteria.

The first QI was the measurement of timely reperfusion within 12 hours of admission by use of thrombolytics or percutaneous transluminal coronary angioplasty. Patients who were treated only with thrombolytics (no percutaneous transluminal coronary angioplasty) were excluded if they had a contraindication to thrombolytics. We abstracted the time in minutes between the admission and the procedure. The second and third QIs were the prescription of aspirin, respectively within 24 hours after admission, and at discharge. We excluded patients with contraindications to aspirin. For all QIs related to a prescription or counselling at discharge, we excluded patients who died at the hospital. The fourth QI was the prescription of β-blockers at discharge. All β-blockers prescribed at discharge were recorded and patients with contraindication were excluded. The fifth QI was prescription of angiotensin converting enzyme inhibitors at discharge in patients with left ventricular systolic dysfunction, which was defined as a value of the ejection fraction of ≤40% documented in the chart from the current hospitalization. If no quantified information was found in the chart, a patient was classified as having left ventricular systolic dysfunction based on narrative terms describing the ejection fraction. Angiotensin converting enzyme inhibitors were identified in the medical charts through generic or trade name. We excluded from the study patients who experienced any of the listed contraindications to angiotensin converting enzyme inhibitors. We assessed smoking cessation counselling with the information available in the medical record.

Analysis

Firstly, descriptive univariate measures were implemented. Then, bivariate analyses were conducted using when appropriate χ^2 tests, Fisher's exact tests, and analysis of variance

Table I Quality indicators for the diagnosis and management of acute myocardial infarction

Quality indicator	Description
1 Receipt of reperfusion (within 12 hours) either with thrombolytics or primary percutaneous transluminal coronary angioplasty (PTCA)	Proportion of patients receiving thrombolytics or undergoing primary PTCA during the first 12 hours of their arrival at hospital. Exclusions: patients who had only thrombolysis (no PTCA) were excluded if they had one of the following contraindications to thrombolysis: bleeding, chronic hepatic disease, coagulopathy, gastric ulcer, recent stroke, recent surgery or trauma, resuscitation within 6 hours.
2 Aspirin within 24 hours	Frequency of patients receiving aspirin during the first 24 hours. Exclusions: patients with recent bleeding, chronic hepatic disease, coagulopathy, gastric ulcer, anticoagulants at admission, metastatic or terminal cancer, allergy to aspirin.
3 Aspirin at discharge	Frequency of use of aspirin at discharge in patients discharged alive. Exclusions: patients with recent bleeding, chronic hepatic disease, coagulopathy, gastric ulcer, anticoagulants at admission, metastatic or terminal cancer, allergy to aspirin.
4 β-blockers at discharge	Frequency of use of β-blockers at discharge in patients discharged alive. Exclusions: patients with hypotension or shock, or systolic blood pressure < 100 mmHg, asthma, chronic obstructive pulmonary disease, bradycardia, dementia, bi-fascicular or tri-fascicular block, severe heart failure with pulmonary oedema, or New York Heart Association Class IV.
5 Angiotensin converting enzyme inhibitors (ACEIs) at discharge if left ventricular systolic dysfunction	Frequency of use of ACEIs at discharge in patients with reduced left ventricular function (ejection fraction ≤ 40%). Exclusions: patients with cough, renal insufficiency, skin rash, hyperkalaemia, angio-oedema, neutropenia, and hypotension related to ACEI use.
6 Smoking cessation counselling	Frequency of smoking cessation counselling in cigarette smokers during hospitalization.

(ANOVA) methods. No adjusted analyses are reported since all eligible patients should be considered for the procedures examined. All analyses were conducted with SAS software, version 8.02 (SAS institute Inc., Cary, NC, USA).

Results

Of the 577 eligible patients, 216 (37.4%) were hospitalized in hospital A, 270 (46.8%) in hospital B, and 91 (15.8%) in hospital C. The mean (SD) age of the entire sample was 68.2 (13.9) years, 65.2% were male, 12.6% had a previous history of heart failure, 35.5% a previous AMI or history of angina, 6.5% a previous stroke, 55.2% hypertension, 67.8% hyperlipidaemia, 22.8% diabetes, and 31.5% were current smokers.

Patient characteristics by hospital

Patient characteristics at admission are reported in Table 2 for each hospital. The mean age was slightly higher in hospital B compared with the other providers. More males were hospitalized in hospital C compared with hospitals A and B. Similarly, more patients were hospitalized in hospital C with a previous AMI or angina, compared with hospitals A and B. We also observed that more patients were hospitalized with hyperlipidaemia in hospital B, compared with other providers. We noted that in hospital C chest pain was less frequent but a cardiogenic choc occurred more often. In hospital C, 20.9% of the patients had coronary artery bypass surgery during hospitalization, compared with 12.2% in hospital B, and 7.4% in hospital A.

QIs across hospitals

A review of QIs is reported in Table 3. Reperfusion within 12 hours with thrombolytics or primary percutaneous transluminal coronary angioplasty was performed in 66.2% of AMI patients, and, respectively, 64.3% and 72.7% in hospitals A and C (information not available in hospital B). Large variations were observed between hospitals for the prescription of aspirin within 24 hours after admission in patients with no contraindication to aspirin. In hospital B, 97.2% of eligible patients received aspirin within 24 hours of admission, compared with 94.4% in hospital B, and 84.6% in hospital C. At discharge, 91.0% of the patients with no contraindication received aspirin, and 80.5% β-blockers. Less variation between hospitals was observed for these two QIs. However, large variation was observed for the prescription of angiotensin converting enzyme inhibitors at discharge for patients with left ventricular systolic dysfunction and no contraindication to angiotensin converting enzyme inhibitors. In hospital

Table 2 Demographic characteristics, risk factors, symptoms, and findings at admission in patients with AMI, by hospital, $n = 577$

Characteristics	*n* (%) or mean (SD)	Hospital A, *n* (%) or mean (SD), *n* = 216	Hospital B, *n* (%) or mean (SD), *n* = 270	Hospital C, *n* (%) or mean (SD), *n* = 91	*P* value
Age					
Mean (SD)	68.2 (13.9)	68.0 (14.1)	69.5 (13.6)	64.8 (13.9)	0.018
16–60 years	171 (29.6)	67 (31.0)	74 (27.4)	30 (33.0)	0.059
61–70 years	140 (24.3)	50 (23.2)	58 (21.5)	32 (35.2)	
71–80 years	137 (23.7)	49 (22.7)	72 (26.7)	16 (17.6)	
>80 years	129 (22.4)	50 (23.2)	66 (24.4)	13 (14.3)	
Sex					
Male	376 (65.2)	132 (61.1)	175 (64.8)	69 (75.8)	0.047
Female	201 (34.8)	84 (38.9)	95 (35.2)	22 (24.2)	
Previous history HF (*n* = 538)	68 (12.6)	23 (11.1)	32 (13.3)	13 (14.29)	0.682
Previous AMI or angina (*n* = 564)	200 (35.5)	68 (32.2)	82 (31.3)	50 (55.0)	0.0001
Previous stroke (*n* = 570)	37 (6.5)	15 (7.0)	16 (6.0)	6 (6.6)	0.911
Hypertension (*n* = 569)	314 (55.2)	125 (59.0)	143 (53.6)	46 (51.1)	0.348
Hyperlipidaemia (*n* = 503)	341 (67.8)	145 (69.1)	150 (72.5)	46 (53.5)	0.006
Diabetes (*n* = 570)	130 (22.8)	40 (18.8)	65 (24.3)	25 (28.1)	0.158
Current smoker (*n* = 569)	179 (31.5)	70 (32.7)	74 (27.8)	35 (39.3)	0.114
Symptoms and findings					
Chest pain (*n* = 564)	468 (83.0)	189 (89.6)	222 (84.7)	57 (62.6)	<0.0001
Syncope (*n* = 570)	58 (10.2)	17 (7.9)	27 (10.2)	14 (15.4)	0.141
Dyspnoea (*n* = 564)	189 (33.5)	75 (34.9)	75 (29.1)	39 (42.9)	0.049
Cardiogenic shock (*n* = 568)	67 (11.8)	23 (10.8)	21 (7.8)	23 (26.4)	<0.0001
Mean (SD) Charlson comorbidity index (*n* = 577)	1.6 (1.4)	1.9 (1.2)	1.9 (1.4)	0.1 (0.3)	<0.0001
Mean (SD) length of stay (*n* = 577)	12.9 (12.7)	12.6 (10.2)	14.5 (14.9)	8.5 (9.2)	0.0004
Median length of stay	10.0	10.5	9.0	6.0	

SD, standard deviation; HF, heart failure; AMI, acute myocardial infarction.

Table 3 Quality Indicators in patients with acute myocardial infarction by hospital, $n = 577$

Indicators	Total (*n* = 577), *n* (%)	Hospital A (*n* = 216), *n* (%)	Hospital B (*n* = 270), *n* (%)	Hospital C (*n* = 91), *n* (%)	*P* value
Quality indicators					
Receipt of reperfusion (within 12 hours) either with thrombolytics or primary PTCA (*n* = 145)	96 (66.2)	72 (64.3) (*n* = 112)	NA	24 (72.7) (*n* = 33)	0.367
Aspirin within 24 hours (*n* = 532)	499 (93.8)	205 (97.2) (*n* = 211)	217 (94.4) (*n* = 230)	77 (84.6) (*n* = 91)	0.0002
Aspirin at discharge (*n* = 478)	435 (91.0)	168 (94.4) (*n* = 178)	207 (89.6) (*n* = 231)	60 (87.0) (*n* = 69)	0.110
β-Blockers at discharge (*n* = 400)	322 (80.5)	113 (78.5) (*n* = 144)	154 (79.4) (*n* = 194)	55 (88.7) (*n* = 62)	0.203
ACEIs at discharge if LVSD (*n* = 154)	122 (79.2)	46 (67.6) (*n* = 68)	67 (90.5) (*n* = 74)	9 (75.0) (*n* = 12)	0.003
Smoking cessation advice (*n* = 158)	68 (43.0)	32 (50.8) (*n* = 63)	31 (50.8) (*n* = 61)	5 (14.7) (*n* = 34)	0.0008

PTCA, percutaneous transluminal coronary angioplasty; ACEIs, angiotensin converting enzyme inhibitors; LVSD, left ventricular systolic dysfunction; NA, not applicable because the information about the exact time in minutes of PTCA was not available.

B, 90.5% of the patients received angiotensin converting enzyme inhibitors, compared with 75.0% in hospital C, and 67.7% in hospital A.

Discussion

This study indicates that substantial variations existed between these three Swiss academic medical centres regarding the management and treatment of AMI patients. Furthermore, our results indicate that most patients received appropriate care, based on European or US standards. Our finding that reperfusion within 12 hours with thrombolytics or primary percutaneous transluminal coronary angioplasty was performed in 66.2% of patients, was similar to the results of a study among Medicare patients including all acute care hospitals in the USA. In that study, conducted in 1995, 68.7% of the patients hospitalized with AMI had reperfusion within 12 hours [8]. Another publication from the Medicare Healthcare Improvement Program showed a slight increase in reperfusion therapy in all US hospitals, from 59.2% in 1994–1995 to 60.6% for the period 1998–1999 [24]. This study showed that the management of AMI patients in the acute phase has improved over the years in the USA, especially regarding early reperfusion.

However, aspirin prescription rates, within 24 hours of admission and at discharge, showed higher figures in our study compared with published US rates, which were 85% and 86% for the years 1998–1999 and 2000–2001, respectively [9,24]. During the same period, 79% of the patients received aspirin at discharge in one Swiss academic medical centre [18].

Concerning the prescription of β-blockers at discharge, our results are comparable with those described in the USA in 2000–2001 (79%) [9], but we implemented our study in 1999. Our results are higher than those found in a study conducted in one Swiss university hospital in 1996, where 70% of the patients with no contraindication received β-blockers [18]. For the prescription of angiotensin converting enzyme inhibitors at discharge in case of left ventricular systolic dysfunction, our results are also similar to those observed in the USA for the years 2000 and 2001 [9].

Over the past few decades, the importance of variation in modern medicine has been demonstrated. In particular, differences have been observed in the way similar patients are treated in one health care setting compared with another [25]. John Wennberg was a pioneer in this field and his research findings about small area variations in New England are reported [11,26].

Variations in health care management and delivery have been demonstrated previously for the use of cardiac procedures after AMI [12,13]. One study focused on whether or not geographical variations in the use of health services were due to inappropriate care. They studied the appropriateness of the use of coronary angiography and carotid endarterectomy. They found only small differences in the levels of appropriateness for these procedures between geographical areas of high, average, and low use. They concluded that differences in appropriateness could not explain geographical variations in the use of these procedures [27].

Several limitations may have biased our results. Firstly, in Switzerland administrative discharge data have been mandatory since 1998. The quality of data has improved but is still very heterogeneous across providers. In particular, only 196 eligible AMI patients were identified through ICD-10 codes in one hospital, which is about the same size as the two others included in the study, from where twice the number of patients was recorded. A selection bias may have occurred because of this lower figure in the identification of AMI patients in one hospital. Another limitation is related to the chart abstraction process, which was conducted in each hospital by different people, with various educational backgrounds, although their training, and reporting procedures were similar. Furthermore, in two of the hospitals, the entire medical chart was obtained by the abstractors, whereas in the third, only the electronic discharge letter, laboratory findings and reports from cardiology testing were available. In addition, the quality of medical records and completeness of information may also vary within and between centres. Incorrect information may have brought some misclassification bias. Another limitation was the fact that hospital participation in this study was voluntary. Representation could differ considerably between these voluntary hospitals and other hospitals, making the generalization of results questionable.

In conclusion, we found significant hospital-to-hospital variation in the quality of care delivered to AMI patients between three Swiss academic medical centres. We believe that these variations are unlikely to be fully explained by systematic errors and are therefore at least partially real. Our findings indicate that, according to the published evidence of effectiveness, the management and treatment of AMI patients could be improved, although it was comparable to the observed quality of care delivered in other European or US hospitals.

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