Peer reviewed article

Impact of clinical practice guidelines on prioritisation for allocation of intensive care beds in high-risk acute coronary syndrome patients: does age play a role?[1]

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Summary

Question under study: To assess which high-risk acute coronary syndrome (ACS) patient characteristics played a role in prioritising access to intensive care unit (ICU), and whether introducing clinical practice guidelines (CPG) explicitly stating ICU admission criteria altered this practice.

Patients and methods: All consecutive patients with ACS admitted to our medical emergency centre over 3 months before and after CPG implementation were prospectively assessed. The impact of demographic and clinical characteristics (age, gender, cardiovascular risk factors, and clinical parameters upon admission) on ICU hospitalisation of high-risk patients (defined as retrosternal pain of prolonged duration with ECG changes and/or positive troponin blood level) was studied by logistic regression.

Results: Before and after CPG implementation, 328 and 364 patients, respectively, were assessed for suspicion of ACS. Before CPG implementation, 36 of the 81 high-risk patients (44.4%) were admitted to ICU. After CPG implementation, 35 of the 90 high-risk patients (38.9%) were admitted to ICU. Male patients were more frequently admitted to ICU before CPG implementation (OR = 7.45, 95% CI 2.10–26.44), but not after (OR = 0.73, 95% CI 0.20–2.66). Age played a significant role in both periods (OR = 1.57, 95% CI 1.24–1.99), both young and advanced ages significantly reducing ICU admission, but to a lesser extent after CPG implementation.

Conclusion: Prioritisation of access to ICU for high-risk ACS patients was age-dependent, but focused on the cardiovascular risk factor profile. CPG implementation explicitly stating ICU admission criteria decreased discrimination against women, but other factors are likely to play a role in bed allocation.

Key words: acute coronary syndrome; risk stratification; intensive care; bed allocation; admission criteria; rationing

1 Abstracts were presented at the 5th International Conference on Priorities in Health Care, Wellington, 2004, and the 73rd Annual Meeting of the Swiss Society of Internal Medicine, Basel, 2005.

Funding: no external resources, no institutional affiliations.

Introduction

Acute chest pain is a frequent complaint leading to emergency room visits. Fifteen percent of these patients suffer from acute coronary syndrome with persistent ST segment elevation on the electrocardiogram (ECG), also called persistent ST elevation myocardial infarction (STEMI). Another 35% of them suffer from acute coronary syndrome without persistent ST segment elevation (ACS), also called non-ST elevation NSTEMI and unstable angina [1]. Mortality before hospital discharge is about 5% [2]. ACS is characterised by the rupture of an atheromatous plaque in a coronary artery, leading to thrombus formation, occlusion of the artery or distal embolisation [3, 4]. Aggressive treatment is able to stop this process and consequently save some viable cardiac muscle tissue. Diagnosis is based on clinical history, physical examination, troponin blood level determination, and ECG, which together allow the correct identification of 90% of these patients [5]. Stratification into different risk categories [6, 7] gives prognostic and subsequent therapeutic information [8].

Clinical practice guidelines (CPG) dedicated to the assessment of patients with ACS have been published in the United States in 1994 [9], and revised recently [10]. European CPG have also been recently published [11]. These CPG recommend that patients identified as high-risk ACS should be admitted to intensive care units (ICU), but bed shortage and limited resources impose implicit rationing in every day practice. We wanted to assess which patients' characteristics played a role in explaining access of patients identified as high-risk ACS to our medical ICU, and whether introducing CPG explicitly stating ICU admission criteria changed this practice.

Patients and methods

CPG development in our institution was published previously [12]. In short, risk stratification was divided into 4 categories:

1. Low-risk patients: acute chest pain without ECG modification, or cardiac enzyme elevation (troponin I blood level <0.1 µg/ml).
2. Intermediate-risk patients: acute chest pain with transient modifications of the ECG (down-sloped ST segment <1 mm or negative T-wave), and negative troponin I blood level (<0.1 µg/ml).
3. High-risk patients: prolonged chest pain (>20 minutes), or modification of the ECG (down-sloped ST segment >1 mm), or at least one positive troponin I blood level.
4. Very high-risk patients: acute, recurrent, or refractory chest pain, or haemodynamic instability (heart failure or cardiogenic shock), or rhythmic instability, and transient ST segment elevation.

The high-risk group described in the European [11] and American [10] CPG was split into high-risk and very high-risk groups, because different treatment strategies, which are not available in all hospitals, are used in our institution to treat these specific conditions.

All consecutive patients with ACS evaluated in our emergency ward over the 3-month periods before and after CPG implementation were prospectively assessed. A research assistant (DG) reviewed medical charts and collected medical history, clinical characteristics, laboratory tests results, ECG interpretation, and treatment modalities (including ICU admission) on the day following admission.

Two reviewers separately carried out independent risk assessments based on laboratory tests results and independent ECG interpretation for all patients. Details of this study methodology have been recently published [13]. The study showed that significantly more patients were classified as suffering from atypical chest pain (39.6% vs. 47.0%, p = 0.006) after CPG implementation. CPG availability was associated with significantly more formal diagnoses (79.9% vs. 92.9%, p <0.0001), and risk stratification (53.7% vs. 65.4%, p <0.0001) at the end of initial patient assessment. The present study focused on high-risk and very high-risk patients, who should have been admitted to the ICU.

Comparisons between the two groups were carried out with Student's t-test for normally distributed variables, Mann-Whitney U-test for non-normally distributed variables, and Chi-sqared test for qualitative variables. Impact of patient's characteristics on ICU bed allocation in high-risk and very high-risk patients was carried out with logistic regression. The study period was added as a covariate, and interaction terms with all statistically significant variables of the first model were carried out successively, to compute a log-likelihood ratio test and show a potential association between ICU admission and the patients' characteristics variable. Age was first treated as a linear, and then quadratic variable. To assess the impact of the squared term, a plot of the predicted probability of admission by age with and without the squared term was carried out. Our analyses were carried out with Stata 8.0 for Windows. Statistical significance was assumed at p <0.05.

Results

During the two study periods, before and after CPG implementation, 3284 and 3260 patients respectively, were assessed at the Medical Emergency Centre of our institution. Among them, 497 patients (15.1%) and 498 patients (15.3%), respectively, were evaluated for chest pain. Pain of non-cardiac origin was diagnosed in 143 patients (28.8%) before and 109 patients (21.9%) after CPG implementation. STEMI was diagnosed in 26 patients (5.2%) and 25 patients (5.0%) in the two groups, respectively. These two categories were excluded from the study.

The remaining 328 patients (10.0% of all admissions during the first study period) and 364 patients (11.2% of all admissions during the second study period) were included in this study. Their main characteristics were similar and have been previously published [13].

Before CPG implementation, 81 patients (24.7%) were classified as high-risk or very high-risk patients, but only 36 of them (44.4%) were admitted to ICU. After CPG implementation, 90 patients (24.7%) were classified as high-risk or very high-risk patients, but only 35 of them (38.9%) were admitted to ICU. Their characteristics are displayed in table 1. Apart from different rates in positive family history, history of hypertension, and events linked with their cardiovascular history, both groups of patients were similar in the 2 study periods. Fewer had seen a physician before presenting to the emergency room in the second period.

Table 2 displays the odds ratios, 95% confidence intervals, and statistical significance of the different patient's characteristics leading to admission into ICU in the best model. CPG implementation did not change these characteristics, except for gender, after which women were as likely to be admitted as men.

Age did not play a significant role in either period when treated as a linear variable. However, after adding a quadratic term (age squared) to the regression, the coefficients "age" and "age squared" were both statistically significant in both periods. Plotting the probability of ICU admission on age and age squared revealed an inverse U-shape pattern. This implies that the probability of ICU admission was lower for both young and old ages.

Discussion

This study showed that explicitly stating ICU admission criteria for high-risk and very high-risk ACS patients did not markedly change ICU bed allocation, except for suppressing gender discrimination. Prioritisation focused on cardiovascular risk factor profile, with age playing a significant role along a quadratic function curve. This means that the link between age and probability of admission to ICU is not linear, with both extremes of age being less likely to be admitted to ICU (based on the age distribution curve).

These results are to be related to another study [14] carried out in the United States, which showed that CPG for treating unstable angina were incompletely applied in elderly patients, and that performance as assessed by quality measures varied widely among hospitals. In our study, this variability was obvious and other factors than those available for inclusion in the regression played a role in prioritising access to ICU beds.

On the other hand, practice did not markedly change after guideline implementation, as only a minority of high-risk and very high-risk patients were oriented to ICU. These results can be interpreted in two ways:

First, the fact that CPG have limited impact on actual practice has already been shown in different domains, including ACS [15–17]. In our hospital, CPG implementation was shown to increase the rate of formal diagnosis and risk stratification [13]. The impact of CPG on the later stages of patient care is likely to be limited if structural conditions do not allow their implementation. ICU bed availability is obviously a major limiting factor for admission of ACS patients, independently of their risk stratification.

Second, implicit rationing is current practice in our country despite official denial by public health care authority. Clinicians are used to it, and CPG do not change this reality. In a national questionnaire survey of intensive care specialists about factors influencing their decision to admit a pa-

Table 1

ACS high and very high risk patients' characteristics.

Patient characteristics	Before guidelines (n = 81)	After guidelines (n = 90)
ICU admission, n (%)	36 (44)	35 (39)
Age, mean (SD)	69 (16)	68 (17)
Male gender, n (%)	49 (60)	64 (71)
Risk factors		
Diabetes mellitus, n (%)	17 (21)	12 (13)
Hypertension, n (%)	54 (67)	45 (50)
Family history, n (%)	29 (36)	12 (13)
Hypercholesterolaemia, n (%)	44 (54)	47 (52)
Cardiac history, n (%)	14 (17)	39 (43)
Infarction history, n (%)	33 (31)	20 (22)
Angiography history, n (%)	32 (40)	20 (22)
Angioplasty history, n (%)	24 (30)	14 (16)
Surgery history, n (%)	14 (17)	10 (11)
Non medical provenance, n (%)	68 (84)	55 (61)
Systolic blood pressure, mean (SD)	144 (25)	146 (25)
Diastolic blood pressure, mean (SD)	85 (17)	88 (16)
Heart rate, mean (SD)	85 (25)	86 (23)

Table 2

Impact of patients' characteristics and study period on probability of ICU admission (logistic regression).

Patient characteristics	Odds ratio	95% CI	P value
Age	1.57	1.24–1.99	<0.001
Age squared	1.00	0.99–1.00	<0.001
Male gender period 1	7.45	2.10–26.44	0.002
Male gender period 2	0.73	0.20–2.66	0.630
Diabetes mellitus	0.58	0.19–1.76	0.338
Hypertension	0.31	0.12–0.81	0.017
Family history	2.17	0.82–5.76	0.120
Hypercholesterolaemia	4.84	1.93–12.18	0.001
Cardiac history	2.08	0.80–5.44	0.136
Infarction history	0.40	0.11–1.38	0.146
Angiography history	1.75	0.58–5.29	0.323
Cardiac surgery history	0.82	0.22–2.97	0.759
Non medical provenance	3.13	1.23–7.95	0.017
Systolic blood pressure	1.01	1.00–1.03	0.093
Heart rate	1.02	1.00–1.04	0.051
Period	2.66	0.63–11.13	0.181
Log likelihood	–80.8		
McFadden pseudo R2	0.30		

tient, 82% mentioned the prognosis of the disease, 81% the acuity of the illness, and 71% patient's preferences [18]. Until now, in our setting, available resources allowed physicians to prioritise ICU bed allocation on the basis of patient's cardiovascular risk profile, and CPG supported this practice. However, this stratification for ICU admission could change as resources are getting increasingly limited. It might reach a point beyond which cardiovascular risk profile will not be restrictive enough to ensure patient's selection to ICU available beds, necessitating additional criteria, which might be of dubious validity. As physicians' practise in ACS has been shown to differ by specialty [19] and regions [20], explicit rationing should be preferable to subjective selection of patients.

This study has obvious limitations: it involved only one centre, did not extend to assessing impact on treatment or patient outcome, and the impact of CPG was assessed shortly after their implementation and not repeated later. In addition, ICU bed availability at the time of allocation was not recorded. Furthermore, patient assessment could be refined by including signs of heart failure, and using a risk score to add one criterion for patient orientation to ICU. Finally, the emergency room teams at the time of two study periods were different, which might also influence patient's orientation after emergency room evaluation.

However, this study has also important policy implications. It showed that obstacles to CPG implementation [21], such as bed availability or compliance with CPG, should be more actively communicated to hospital managers or of the emergency and intensive care services, in order to suppress them. Otherwise, CPG tend to be only partly implemented, carrying potential to harm patients, as well as to expose both physicians and hospitals to litigation in the event of a patient suffering adverse consequences of not having been treated according to the CPG. In our setting, a proposal for implementing an acute coronary care unit and a specific pathway for ACS patients is currently under study and should solve the present ICU bed shortage to accommodate high-risk and very high-risk patients with ACS.

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References

1 Fox KA, Goodman SG, Klein W, Brieger D, Steg PG, Dabbous O, et al. Management of acute coronary syndromes. Variations in practice and outcome. Findings from the Global Registry of Acute Coronary Events (GRACE). Eur Heart J. 2002;23: 1177–89.
2 Bhatt DL, Roe MT, Peterson ED, Li Y, Chen AY, Harrington RA, et al. Utilization of early invasive management strategies for high-risk patients with non-ST-segment elevation acute coronary syndromes: results from the CRUSADE Quality Improvement Initiative. JAMA. 2004;292:2096–104.
3 Ross R. Atherosclerosis: an inflammatory disease. N Engl J Med 1999;340:115–25.
4 Libby P. Current concept of the pathogenesis of the acute coronary syndromes. Circulation. 2001;104:365–72.
5 Topol EJ. Acute coronary syndromes. In Topol EJ, ed, Textbook of Cardiovascular Medicine, Philadelphia, PA: Lippincott-Raven, 1998.
6 Braunwald E. Unstable angina: a classification. Circulation. 1989;80:410–4.
7 Rizig DG, Healy S, Margulis A, Vandam D, Bakalyar D, Timmis G, et al. A new clinical classification for hospital prognosis of unstable angina pectoris. Am J Cardiol. 1995;75:993–7.
8 Calvin JE, Klein LW, Van den Berg BJ. Risk stratification in unstable angina. Prospective validation of Braunwald classification. JAMA. 1995;273:136–41.
9 Braunwald E, Jones R, Mark DB. Diagnosing and managing unstable angina. Circulation. 1994;90:613–22.
10 A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. ACC/AHA Guidelines for the management of patients with unstable angina and non-ST-segment elevation myocardial infarction. J Am Coll Cardiol. 2000;36:970–1062.
11 Management of acute coronary syndromes in patients presenting without persistent ST segment elevation. Eur Heart J. 2002;23:1809–40.
12 Berger A, Eckert P, Stauffer JC, Wasserfallen JB. Le syndrome coronarien aigu. Recommandations pour la pratique clinique (in French). Genève: Editions Médecine & Hygiène, 2002.
13 Wasserfallen JB, Berger A, Eckert P, Stauffer JC, Schlaepfer J, Gillis D, et al. Impact of medical practice guidelines on the assessment of patients with acute coronary syndrome without persistent ST segment elevation. Int J Qual Health Care. 2004; 16:383–9.
14 Shahi CN, Rathore SS, Wang Y, Thakur R, Wu WC, Lewis JM, et al. Quality of care among elderly patients hospitalized with unstable angina. Am Heart J. 2001;142:263–70.
15 Krumholz HM, Philbin DM Jr, Wang Y, Vaccarino V, Murillo JE, Therrien ML, et al. Trends in the quality of care for Medicare beneficiaries admitted to the hospital with unstable angina. J Am Coll Cardiol. 1998;31:957–63.
16 Iliadis EA, Klein LW, Vandenberg BJ, Spokas D, Hursey T, Parrillo JE, et al. CPG in unstable angina improve clinical outcomes by assuring early intensive medical treatment. J Am Coll Cardiol. 1999;34:1689–95.
17 Heller RF, D'Este C, Lim LLY, O'Connell RL, Powel H. Randomised controlled trial to change hospital management of unstable angina. Med J Austr. 2001;174:217–21.
18 Escher M, Perneger TV, Chevrolet JC. National questionnaire survey on what influences doctors' decision about admission to intensive care. BMJ. 2004;329:425–9.
19 Reis SE, Holubkov R, Zell KA, Edmundowicz D, Shapiro AH, Feldman AM. Unstable angina: specialty-related disparities in implementation of practice guidelines. Clin Cardiol. 1998;21: 207–10.
20 Hasdai D, Behar S, Wallentin L, Danchin N, Gitt AK, Boersma E, et al. A prospective survey of the characteristics, treatments and outcomes of patients with acute coronary syndromes in Europe and the Mediterranean basin: the Euro Heart Survey of Acute Coronary Syndromes. Eur Heart J. 2002;23:1190–201.
21 Katz DA. Barriers between guidelines and improved patient care: an analysis of AHCPR's unstable angina clinical practice guideline. Health Serv Res. 1999;34:377–89.