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6.1.3.1 Biochemical Markers for Myocardial Infarction Used in Combination with Clinical Decision Limits. Influence of S-Myoglobin on the Predictive Values

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ABSTRACT

To predict the development of an acute myocardial infarction (AMI) in a patient with chest pain or other symptoms compatible with myocardial infarction is a difficult clinical problem. In this study of 927 consecutive patients with a suspected AMI symptoms selected by the Multicenter Chest Pain Study Group were tested. An equation was constructed based on five of the most significant variables found. In a subgroup of 305 patients the additional value of S-Myoglobin was tested and found to be valuable for the decision of further handling of the patient with suspected AMI.

INTRODUCTION

Acute myocardial infarction (AMI) is a common disease with a high initial mortality. Observation in a hospital is considered a standard procedure during the initial phase. Many patients are admitted with quite a low probability of AMI because of the legal and publicity consequences of a diagnostic error in the emergency room. The symptomatology of AMI can be very variable which adds to the diagnostic difficulties (1). Thus it is not unexpected that the percentage of certified AMI in a material of patients with a suspected myocardial infarction seldom is above 25-30% (2). In Sundsvall Hospital during 1991 non-AMI patients admitted for a suspected myocardial infarction occupied the same number of beds as patients with verified AMI.

A patient with a suspected AMI in our hospital is admitted to the coronary care unit. The responsible physician is confronted with the following options:

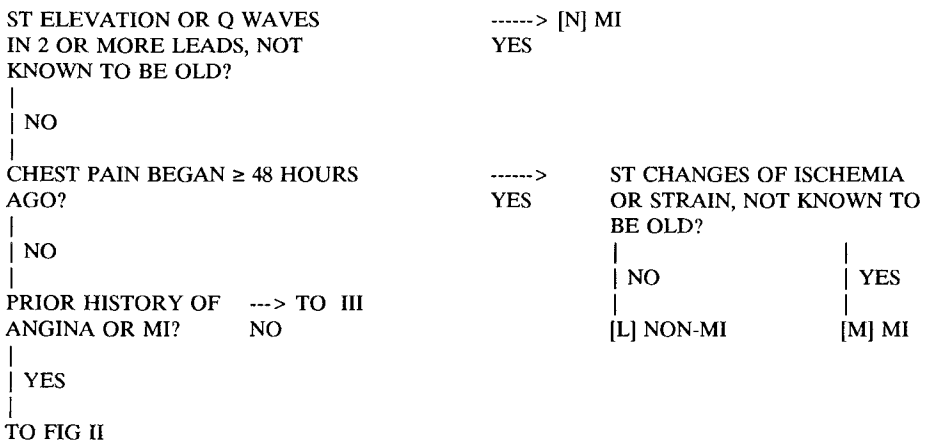
1) keep the patient for further observation in the coronary care unit

2) send the patient to an ordinary ward for further treatment

3) send the patient back home

Clinical decision rules have been developed to minimize the risk of diagnostic errors and to optimize the use of hospital resources. During the last 10 years the Multicenter Chest Pain Study Group (MCPSG) in Boston has made extensive efforts to find clinical symptoms which can predict patient groups with various probabilities of AMI and an algorithm for this evaluation has been suggested (3).

I.



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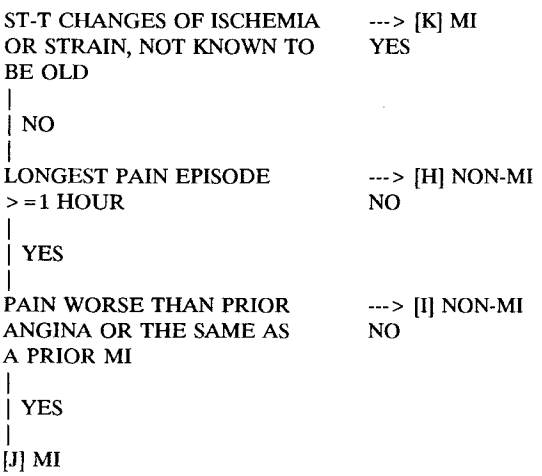

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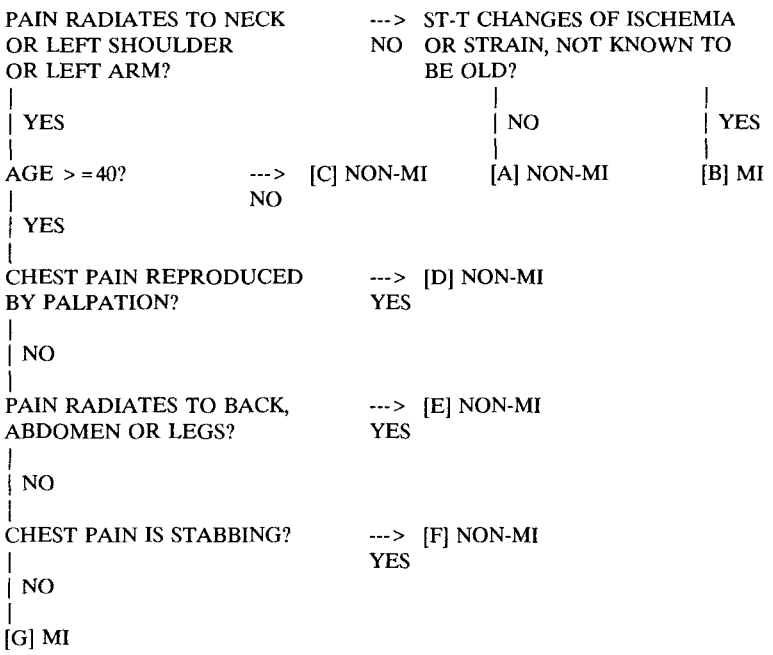

Figure 1. The diagnostic algorithm outlined by Goldman et al (3).

After evaluation of the symptoms of the patients they were placed in 14 different categories (A to N) by following the branches of the "diagnostic tree". This algorithm was computerized and its result in predicting a final diagnosis of AMI was tested by determining the percentages of AMI in the various categories. The percentages varied from 1 to 77% (4).

A comparison between the physician s judgement and the computerized predictions in deciding whether to admit the patient to the coronary care unit or not showed the same sensitivity but the algorithm gave a higher specificity.

GOAL OF THE STUDY

The goal of this study was to test if a selected portion of the clinical variables used by the MCPSG in combination with S-Myoglobin on a new higher quality level could improve the prediction of AMI in the emergency room situation.

METHODS

A questionnaire record was kept for every patient admitted to the department of internal medicine with a history of a suspected AMI during a 6-month period 1990-91 (N=927).

S-Myoglobin concentration was assayed with a fast quantitative immunological turbidometric method (Turbiquant Myoglobin Reagents, Behring Diagnostic Inc.) CV %=8.01 in a subgroup of 305 patients. The Goldman algorithm (3) for classification of the clinical symptoms was used. The final diagnosis was established according to Gillum et al and Hamfelt et al (5, 6).

The statistical analysis was performed with Epi Info version 5.01 (7). Differences in proportions were evaluated by Chi-square analysis.

MATERIAL

The variables used by the MCPSG were recorded in 927 patients, 550 males and 377 females with a mean age of 66.2 and 71.9, with a suspected AMI. 230 patients got a confirmed diagnosis of AMI and 697 were considered as non AMI patients. The risk groups A to N given by the MCPSG have been identified in this material (table 1).

RESULTS

The risk groups in the MCPSG study were compared with the corresponding groups in this study. The prevalence of AMI in this material is 25% compared to 12% in the MCPSG study. In the groups D, I, K, L there is a significantly higher AMI prevalence in this study. In the group N with earlier not known ST elevation or Q wave the AMI prevalence was significantly lower.

Table 1.

Patients with a suspected AMI, diagnostic group, % of verified AMI

Group	MCPSG	%	Sundsvall	%	chi-2	p-value
A	24/1218	2	3/73	4	0.67	0.22
B	39/150	26	6/42	14	2.51	0.11
C	3/124	2	0/4	0		1.00
D	1/79	1	2/10	20		F 0.03 +
E	5/65	8	2/11	18		F 0.27
F	1/57	2	0/2	0		F 1.00
G *	51/294	17	13/46	35	3.10	0.08
H	16/404	4	5/77	7		F 0.36
I	2/194	1	9/91	9		F 0.001 +
J *	34/304	11	16/134	12	0.05	0.82
K *	89/343	26	42/111	38	5.78	0.02 +
L	17/1039	2	8/94	9		F 0.0006 +
M *	32/149	21	9/44	21	0.02	0.88
N *	262/350	75	115/180	64	6.96	0.008 +
Total	**576/4770**	**12**	**230/927**	**25**	**103.65**	**< 0.0005**

* = rec.CCU by MCPSG + = Stat.sign. F = Fischer - exact prob.test

A multiple regression analysis with the 11 clinical symptoms as independent variables and the diagnosis of AMI as the dependant variable was performed. The symptom variables were reduced from 11 to the 5 most significant:

1) ST elevation or Q wave in the ECG not known to be old

2) Chest pain began more than 48 hours ago

3) Ischemia on ECG or strain

4) Radiation of pain to the shoulder

5) Chest pain duration of more than 1 hour

Table 2.

Variable	Mean	Beta coefficient	95% confidence Lower	Upper	Std Err	Partial F-test
ST ELEVAT.	0.19	0.41	0.3494	0.4726	0.0314	170.95
CH.PAIN>48HR	0.18	- 0.09	- 0.1470	- 0.0253	0.0311	7.69
ISCH/STRAIN	0.36	0.21	0.1579	0.2593	0.0259	64.97
PAIN RAD.	0.51	0.13	0.0793	0.1759	0.0246	26.82
PAIN >1 HR	0.76	0.11	0.0482	0.1615	0.0289	13.15
Y-Intercept		-.04				

From these variables an equation for infarct risk score was constructed:
Infarct risk score =[ST-elevation] x 0.41 - [chest pain >48 hr] x 0.09 + [ischemic ECG] x 0.21 + [pain radiat. to shoulder] x 0.13 + [chest pain dur. >1 hr] x 0.11 - 0.04. The material was then reclassified according to the calculated infarct risk score. The percentages of AMI varied from 5 to 94% in the different score intervals (Figure 2). A score limit of > =0.2 gave a sensitivity of 90.9% and a specificity of 46.3%, a positive predictive value of 35.9% and a negative predictive value of 93.9%. When a score limit of > =0.2 was used in the subgroup of 305 patients in which S-Myoglobin determinations were available, the sensitivity was 73.0% and the specificity 74.5%.

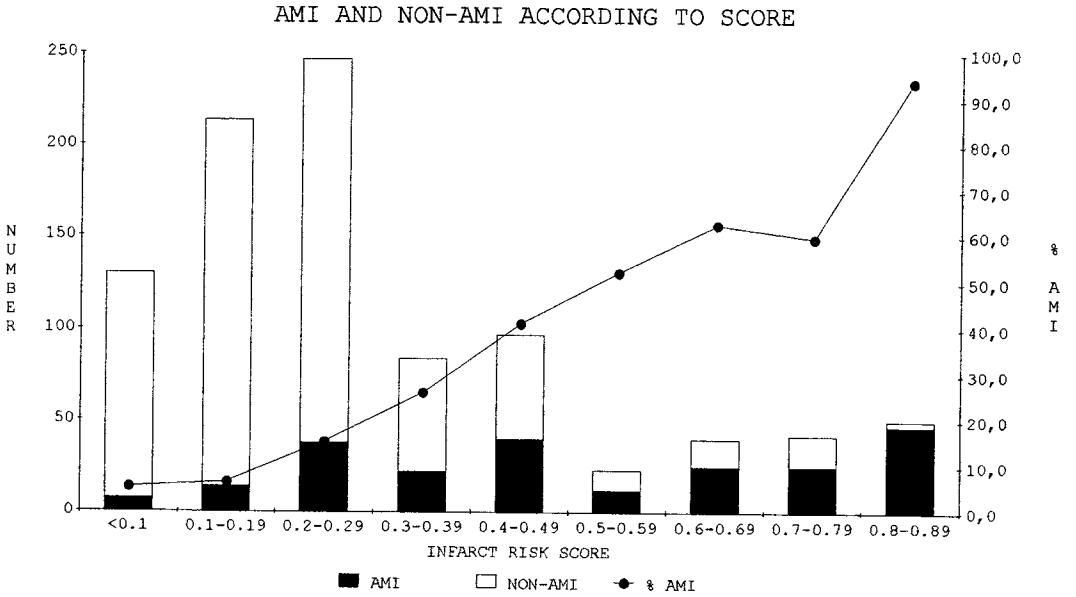

Figure 2. The distribution of AMI and non-AMI according to infarct risk score. The prevalence of AMI (%) in the different score groups is shown by the line (chi-sq=285.6, DF=8, p<0.0005).

If the primary selection of AMI is done according to the principles outlined by Ohman et al (8) with an ST elevation in the ECG as the primary criterion and S-Myoglobin > = 100 ug/l as the second criterion the sensitivity of this method is 74.3%, specificity 84.9%, positive predictive value 61.1% and the negative predictive value 91.2%.

If infarct risk score > =0.2 or S-Myoglobin > =100 ug/l was the criterion for AMI we found a significant increase in sensitivity to 89.2% (p=0.02), a significant decrease in specificity to 70.1% (p=0.0002), and a non-significant decrease in the positive predictive value to 48.9% (p=0.07) and a non-significant increase in the negative predictive value to 95.3% (p=0.11) compared with a "ST elevation or a new Q wave in ECG not known to be old" as the primary criterion.

DISCUSSION

This study shows that the clinical variables used by the MCPSG can be adapted to a Swedish patient material in a county hospital with a higher AMI prevalence and a higher mean age of the patients. The 11 variables according to Goldman et al (3) were reduced to the five most significant variables by a multivariate regression analysis.

Ohman et al have shown that more diagnostic information becomes available by assaying S-Myoglobin in patients with no ST elevation on the ECG. By using a RIA method with high precision the predictive values were higher then by using the semiquantitative latex agglutination method chosen because of its advantage in giving a result in a few minutes. With this algorithm Ohman et al found a sensitivity of 82.2% and a negative predictive value of 72.4%. This is in agreement with an earlier study by us (6) when we also used a semiquantitative rapid agglutination method for assaying S-Myoglobin. In this study a fast high precision quantitative immune-turbidimetric method was used together with a score equation based on five clinical variables. It was possible to increase the sensitivity from 73 to 89.2% and the negative predictive value from 89.5 to 95.3% in our group of 305 patients with this technique compared with the method of Ohman et al applied on our group of patients.

CONCLUSION

Adding the result of S-Myoglobin assayed by a fast high precision method to an infarct risk score calculated by multivariate regression analysis from five clinical variables in the emergency room situation is valuable for the decision of further handling of the patient with suspected AMI.

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