ST segment elevation myocardial infarction : Prognosis contribution of the shock index in patients admitted to the emergency department.

Syndrome coronarien aigu avec sus décalage du segment ST: Apport pronostique du shock index chez les patients admis au service d'accueil des urgences vitales

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Résumé

Introduction : Les maladies cardiovasculaires sont aujourd'hui la principale cause de décès dans les pays industrialisés. L'urgentiste est de plus en plus confronté à la prise en charge du syndrome coronarien aigu avec sus-décalage du segment ST (STEMI). Il paraît donc important d'avoir des outils simples de stratification du risque pour ces patients. Le shock index (SI), rapport de la fréquence cardiaque et la pression artérielle systolique, a prouvé son efficacité dans l'évaluation initiale et l'estimation du pronostic à court terme chez les patients admis en situation critique dans la salle d'accueil des urgences vitales (SAUV). L'objectif de cette étude était d'évaluer la valeur pronostique du SI à court terme chez les patients admis en SAUV pour un STEMI.

Méthodes : Etude prospective, observationnelle et monocentrique menée sur une période de 6 mois au service d'accueil des urgences de l'hôpital Monji Slim, incluant de façon consécutive des patients admis pour STEMI.

Résultats : Nous avons inclus 50 patients dont l'âge moyen était de 60±11 ans avec un genre ratio (H/F) = 3,2. La douleur thoracique était le motif de consultation le plus fréquent (84%).

Les évènements cardiovasculaires majeurs qui ont été rapportés dans cette étude étaient l'œdème aigu du poumon, les troubles du rythme et de la conduction et l'état de choc cardiogénique respectivement chez 26%, 14%, 8% and 8% de la population. La mortalité intra-hospitalière a été estimée à 10% et celle à 1 mois à 26%. En analyse multivariée, un SI≥ 0,73 apparait comme facteur prédictif indépendant de mortalité hospitalière (p=0,05 ;OR ajusté =11; IC95%:1-136) et à 1 mois (p=0,021; OR ajusté=11; IC95%: 1,3-23)

Conclusion : Le shock index est ressorti comme facteur prédictif indépendant de la mortalité intra hospitalière et à un mois et il a été corrélé au pronostic.

Mots-clés

Shock index, syndrome coronarien aigu, infarctus du myocarde avec sus décalage du segment S, pronostic, service d'accueil des urgences vitales

Summary

Background: Cardiovascular disease is now the leading cause of death in industralized countries. The emergency doctor is increasingly confronted with the management of acute coronary syndrome with ST segment elevation myocardial infarction (STEMI). Therefore it seems important to have simple risk stratification tools in patients admitted for STEMI. The shock index (SI), heart rate and systolic blood pressure ratio, proved its effectiveness in the initial assessment and estimation of the short-term prognosis in critically ill patients admitted to the Emergency department (ED). The aim of this study was to assess the short term prognostic value of SI in patients admitted to ED for STEMI.

Methods : It's a prospective, single center study, conducted over a period of 6 months, including patients admitted at the emergency department of hospital Mongi Slim for STEMI.

Results: 50 patients were included. The mean age was 60±11 years and gender ratio (M/F) was 3,2. Chest pain was the main motivation for consultation (84%). The major cardiovacular events that were reported in our study were acute heart failure, rhythm disorders, conduction disorders and cardiogenic shock respectively in 26%, 14%, 8% and 8% of the population. Intra-hospital mortality is estimated at 10% and 22% after 1 month. In multivariate analysis, a SI ≥ 0.73 appears as an independent predictor of hospital mortality (p=0,05 ; adjusted OR=11; CI95%:1-136) and at 1 month (p=0,021; adjusted OR=11; CI95%: 1,3-23)

Conclusion: The shock index appears as a simple clinical tool for the initial assessment of the clinical severity of patients admitted in emergency department for STEMI. It also represents a predictor of intra-hospital and 1 month mortality when it initially exceeds 0.7 on admission.

Keywords

Shock index, acute coronary syndrome, ST segment elevation myocardial infarction, prognosis, emergency medical service

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BACKGROUND

ST segment elevation myocardial infarction (STEMI) is a vital emergency. The prognosis of this entity during the first month remains reserved with a mortality of up to 30-50% [1].

Early risk stratification can help identify patients who are at high ischemic risk requiring appropriate treatment with close monitoring [2]. It is therefore important to have simple assessment tools to predict the severity and mortality of patients admitted to the emergency department (ED) for STEMI.

Shock index (SI), ratio of heart rate to systolic blood pressure calculated at the admission, has a physiological value that varies between 0,5 and 0,7 in healthy adults [3].

The prognostic value of SI was initially evaluated in severe patients admitted to the Emergency department for different acute pathologies. However, few studies have addressed the prognostic value of SI, in patients admitted for STEMI with heterogeneity in cut-off values to predict the occurrence of major cardiovascular events.

The aim of this study was to assess the short-term prognostic value of SI in patients admitted to the ED for STEMI.

METHODS

Study design

This study was a prospective, single center study, performed in the Emergency department of Mongi Slim hospital, over a period extending from January 1st, 2019 to July 1st, 2019.

Study population

The enrolment involved randomly selected patients hospitalized for STEMI, aged over eighteen years. Only patients, in whom the diagnosis of STEMI was documented, were included [4]. Non-inclusion criteria were patients admitted in cardiac arrest and those with transient STEMI. We excluded patients in whom the diagnosis of acute myocarditis was finally retained and those whose follow-up was incomplete.

All patients included in this study were informed orally about the objectives and the course of the study. All of them provided informed consent to the study.

Data collection

Data related to demographic (age/gender), clinical characteristics (hypertension, diabetes, hyperlipemia, smoking) and symptoms on admission were recorded for each patient. All patients were subjected to clinical examination with an evaluation of the hemodynamic state including measurement of systolic and diastolic blood pressure, heart rate and SI.

The SI is defined as the ratio of heart rate (HR) to systolic blood pressure (SBP) collected at admission. It has been used since 1967 as a simple and sensitive hemodynamic indicator for the evaluation of patients with hypovolaemia even in the absence of modification of other clinical parameters such as HR or SBP [5]. The normal value varies between 0.5 and 0.7 in healthy adults [3]. A higher value is observed in hypovolaemia [6] and in states of mainly septic shock [7]

We noted also in-hospital treatments, reperfusion procedures and the following possible major cardiovascular events (MACE : death, acute heart failure, re-infarction, arrhythmias and conduction disturbance) within the hospital and one month after discharge from the cardiology department.

Statistical analysis

The data were analyzed using SPSS statistical software (version 23.0)

Percentages were calculated to assess qualitative variables. Mean values and standard deviations, median and interval quartile range (IQR) were determined for the quantitative variables. The differences between surviving and deceased patients during the intrahospital stay and at one month after discharge were assessed by the independent sample t test for continuous variables and the chi-square test or Fischer's exact test as deemed appropriate for categorical variables.

The search for mortality predictive factors in a univariate study, was carried out by calculating the Odds ratio. For the Odds ratio calculation, we transformed the quantitative variables into qualitative variables with two modalities. To determine the threshold at which the quantitative variable must be "cut", we established ROC (Receiver Operating Characteristics) curves particularly for SI. After verifying that the area under the curve was significantly greater than 0.5, we chose as a threshold the value of the variable which corresponds to the best "sensitivity-specificity" pair. In order to identify the risk factors independently related to the event, a stepwise

multivariate logistic regression analysis was conducted. Multivariate analysis allows to calculate adjusted Odds ratios, measuring the proper role of each factor.

In all statistical tests, the significance level was set at 0.05.

5. Ethical approval

The study was conducted after free and informed consent of the participants. All participants were informed of the anonymity and confidentiality of their responses at the time of the investigation.

RESULTS

Characteristics of the study population

A total of 50 patients met the inclusion criteria with a mean age of 60±11 years with extremes ranging from 39 to 86 years. There was a clear male predominance with a 3,2 gender ratio. Hypertension, smoking and diabetes were the most common cardiovascular risk factors reported respectively in 46%, 44% and 18% of the poulation study. The three most common reasons for consultation were : chest pain (42%), dyspnea (11%) followed by palpitations (9%). An elevation of the ST segment in the anterior terrritory was seen in 25 patients (50%), in the inferior territory in 17 patients (34%) and in the lateral leads in 6 patients (12%), the mirror sign was present in 62% of patients. The SI was on average at 0,58 ± 0,16. Patients with SI ≥ 0,7 represented 24% of the population. Regarding the reperfusion therapy, 52% of patients had primary angioplasty and 48% had pharmacological thrombolysis.

Intra-hospital mortality in our study was 10% and was estimated at 26% after one month. The MACE that were reported in our study were acute heart failure, rhythm disorders, conduction disorders and cardiogenic shock respectively in 26%, 14%, 8% and 8% of the population.

Predictors of intra-hospital and one-month mortality

A comparative study was conducted between the two groups of patients who died in the intrahospital period and the survivors. Both groups were comparable in terms of demographic characteristics, cardiovascular risk factors, comorbidities and functional signs. The group of deceased patients had a systolic blood pressure lower. Cardiogenic shock, right heart failure and conduction disorders were more commonly encountered in patients who died in the intrahospital phase. The SI at admission was significantly higher in the deceased group (0,72 ± 0,11 versus 0,56 ± 0,16 ; p= 0,02). We objected from the ROC curve that a SI ≥ 0.73 was significantly associated with in-hospital mortality after STEMI (p <0.001; $CI_{95\%}$: 0.6 - 1) with a sensitivity of 80% and a specificity of 97%.

The one-month comparative study concluded that the two groups were comparable in terms of demographic data, cardiovascular risk factors and functional signs. deceased patients had higher heart rate compared to the survivors. Age>65 years, cardiogenic shock and SI≥ 0,73 were significantly associated with one-month mortality.

In multivariate analysis, only SI ≥ 0,73 appears as an independent predictive factor of hospital mortality (p=0,05; adjusted OR=11; $CI_{95\%}$:1-136) and after 1 month (p=0,021; adjusted OR=11; $CI_{95\%}$: 1,3-23) among patients admitted to ED for STEMI.

DISCUSSION

In this study, the SI, defined as the ratio of heart rate and systolic blood pressure at admission, emerged as an independent predictor of mortality in multivariate analysis by logistic regression with respectively adjusted OR of intra-hospital mortality at 11 ($CI_{95\%}$: 1-136; p =0.05) and after one month to 54 ($CI_{95\%}$: 1.3-23; p = 0.021; p=0.02).

Although heart rate and blood pressure have traditionally been used to detect shock in these patients, they often appear to be normal during the initial compensatory phase of the shock and may be distorted by other factors mainly drugs (antihypertensives drugs, beta-blockers..).

SI is now widely used in unstable patients as an indicator of clinical severity in differents pathologies such as polytrauma, stroke, septic shock and pulmonary embolism, and for identifying patients in need of critical care [3, 8-11].

Several studies have investigated the relationship between SI and short-term mortality after STEMI and have concluded that there is a significant association between high SI and high risk of early mortality.

Indeed, Bilkova Dana [12] was the first to show that patients admitted for STEMI with a SI ≥ 0,8 had significantly higher inhospital mortality than those with a SI <0.8 with an adjusted OR to 81,6 ($CI_{95\ \%}$= 9,76-676,51; p <0,001). The association between SI and inhospital mortality remained significant after adjusting for demographic and clinical variables.

In addition, a recently study published by El Menyar et al. [13] found that SI ≥ 0,8 was independently associated with a higher incidence of cardiogenic shock, heart failure, and mortality in patients with STEMI (OR = 3,40 ; p <0,001). The SI has also been defined as an independent predictor of microvascular damage, the extent of myocardial damage and short- and long-term mortality in patients with STEMI who have undergone primary angioplasty.

Huang Bi et al.[14] also showed in a large series of patients with STEMI that those with SI≥ 0,7 had a 2,2 times higher risk of 7-day mortality (OR = 2,21; $CI_{95\%}$ = 1,71-2,86) and a risk of mortality at one month 1,9 times higher than the other patients (OR=1,94; $CI_{95\%}$= 1,54-2,44).

Reinstadler et al. [15] concluded that an SI ≥ 0,62 was an independent predictor of the occurrence of major short-term cardiac events after myocardial infarction (adjusted OR = 2,92 ; $CI_{95\%}$ = 1,24-4,22; p <0,01) and that it is correlated with the degree of severity of the myocardial lesions found on cardiac MRI.

Veemal et al. [16], which included 7412 patients admitted for STEMI and treated by primary angioplasty, aimed to compare the prognostic value of the SI against to the state of cardiogenic shock on the mortality at 30 days and one year. This study demonstrated that SI ≥ 0,7 was associated with an increased risk of mortality. In patients with cardiogenic shock on admission, an SI ≥ 0,7 was associated with a significantly poorer prognosis. The SI could be an easy tool to identify patients at high risk of mortality at one year and to guide the treatment strategy in those at risk.

All of these studies, including our study, support the use SI as a simple bedside risk assessment tool to estimate clinical severity and short-term prognosis in patients admitted for STEMI.

Strengths of the study

Our study is a prospective one with univariate and multivariate analysis which evaluated various clinical characteristics of STEMI patients and therefore which was able to reveal several independent predictors of mortality. It's interest lies mainly in the assessment of the contribution of SI in the prediction of prognosis in patients admitted for STEMI, a subject that remains controversial, mainly regarding the cut-off value above which it would be considered pathological.

Limitations of the study

The present study is a small scale one(n=50) and is limited to the experience of a single centre, not predictive of the situation in a large-scale population. Added to that, we did not compare the prognostic value of SI in early mortality after STEMI with stratification scores already validated in the literature such as GRACE and TIMI scores. Finally, a long-term monitoring would have been of great interest in assessing the relationship between SI and long-term mortality after STEMI.

CONCLUSION

In our study, the shock index appears as a simple clinical tool for the initial assessment of the clinical severity of patients admitted in ED for STEMI. It also represents a predictor of intra-hospital and one month mortality when it initially exceeds 0,7 on admission with a positive predictive value between 86% and 97%. This has already been proven in several studies in the field of acute coronary artery disease, but the cut-off value above which there would be a significant increase in early mortality remains a subject of controversy. Further large-scale, epidemiologically powerful studies are needed to confirm and validate the use of SI in the early assessment of the severity of STEMI.

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