Predicting mortality in acute cardiogenic pulmonary edema: validation of the BACH-score in a prospective cohort.

Federico Piffer[1], Valentina Rosti[1], Tommaso Maraffi[2], Stefano Aliberti[1], Annamaria Brambilla[2], Adolfo Di Nardo[3], Elena Paschetta[4], Giuseppina Petrelli[5], Antonino Maffei[6], Federico Furlan[7], Elisa Gatti[7], Valter Monzani[2], Roberto Cosentini[2]

[1] Respiratory Medicine Department, University of Milan – [2] Emergency Department, Fondazione IRCCS Ca' Granda Milan – [3] Emergency Department, San Pietro Hospital Bergamo – [4] Emergency Department, Gradenigo Hospital Turin – [5] Emergency Department, San Benedetto del Tronto Hospital – [6] Emergency Department, San Paolo Hospital Naples – [7] Emergency Department, San Raffaele Hospital Milan

ABSTRACT

INTRODUCTION: ACPE is a common cause of presentation to the Emergency Department (ED). We previously retrospectively elaborated a score based on clinical and laboratory data on admission to identify patients at high-risk of mortality, the BACH-score (Blood pressure(BP),Age,hypoCapnia,Haemoglobin).

AIM: To validate the BACH score in an independent prospective cohort.

METHODS: Prospective observational study of patients admitted to the ED with ACPE; data from Jan 2007 to Apr 2009 were collected in our ED; data from May 2009 to Jan 2010 were collected from 11 ED in a web-based multicentric ongoing study (www.acpe.it). The BACH-score was computed as follows: 3 points for systolic BP <140 mmHg or diastolic < 90 mmHg, 3 for age ≥ 85 years and 2 for age 75-84; 3 for $PaCO_2$ < 35 mmHg, 1 for haemoglobin < 12 g/dl for women and 13.5 g/dl for men. High risk patients were considered those with a score > 4.

RESULTS: 381 patients were analysed. Mean age was 80 ± 10 and males were 198 (52%). Baseline values were: pH 7.27 ± 0.12; $PaCO_2$ 50 ± 17 mmHg; Hb 13.0 ± 2.4 g/dl; SBP 168 ± 37 mmHg and DBP 93 ± 21 mmHg. 128 patients (34%) had a score > 4. Overall mortality was 8% (32/381). Mortality was 18% (23/128) among high- score patients and 4% (9/253) among low-score patients (p<0.001 OR 5.9 CI95% 2.65-13.26). Sensitivity and specificity are shown in table 1.

CONCLUSION: The BACH score could be an useful tool to promptly identify in the ED ACPE high-risk patients in order to optimise treatment intensity and site of care decision.

INTRODUCTION

Acute cardiogenic pulmonary edema (ACPE) is a common cause of respiratory failure in patients admitted to the Emergency Department ED).

In-hospital mortality of ACPE patients previously reported in the literature is roughly 10%.

Early recognition of high-risk patients could help in better locating human and technical resources and in deciding adequate treatment and site of care.

In order to detect high-risk patients with ACPE we previoulsy developed a score (named "BACH-score") based on a retrospective 4-year cohort of ACPE patients followed for consecutive years at the ED of Policlinico Hospital, Milan[2].

On this population a multivariable logistic regression analysis was performed to identify the independent predictors of in-hospital mortality among all the study variables. A score greater than 4 was able to identify patients with a significantly higher mortality risk (more than 3-fold).

Objective
The aim of this study was to validate the BACH-score in a prospective multicentric Italian cohort of ACPE patients.

MATERIALS AND METHODS

Study design
The present study was an Italian multicenter observational prospective study performed using a web-based database (www.acpe.it).

Subjects
All consecutive patients admitted to 11 ED with ACPE between May 2009 and January 2010 were enrolled in the study.

Study definitions
Diagnosis of ACPE was made in presence of acute-onset dyspnea at rest and typical physical findings (widespread pulmonary rales), with chest radiograph confirming pulmonary vascular congestion.

Score
BACH-score includes 4 variables collected on admission of the patient to the ED: blood pressure, age, $PaCO_2$, haemoglobin.
BACH-score composition is summarised in table 1.
BACH-score ranges from 0 to 10 points.
High risk patients were considered those with a score > 4.

Outcome
Outcome variable was all-causes in-hospital mortality.

Data analysis
All data were statistically analyzed with SPSS (version 14.0, Chicago, Il) for Windows. Descriptive statistics were reported at baseline with continuous data expressed as a mean ± SD and categorical data expressed as counts. Categorical data were compared between groups using the χ^2 test. A p-values <0.05 was considered statistically significant. Sensitivity, specificity, positive and negative predictive values and likelihood ratio for a BACH-score greater than 4 were calculated.

Variable	Points
Blood Pressure < 140/90 mmHg	3
Age > 74 years	2
> 84 years	3
$PaCO_2$ < 35 mmHg	3
Haemoglobin < 12 g/dl (women) < 13.5 g/dl (men)	1

Table 1. Composition of the BACH-score (values registered "on admission")

RESULTS

381 patients were enrolled in the study. Males were 198 (52%) Baseline patients' characteristics are shown in table 2.

Variable	Value (mean ± SD)
Age (years)	80 ± 10
pH	7.27 ± 0.12
$PaCO_2$ (mmHg)	50 ± 17
Haemoglobin (g/dL)	13 ± 2.4
Systolic Blood Pressure (mmHg)	168 ± 37
Diastolic Blood Pressure (mmHg)	93 ± 21

Table 2. Baseline characteristics of the study population

Overall in-hospital mortality was 8% (32/381 patients).
In hospital-mortality according to the different risk subgroups of patients is shown in figure 1.
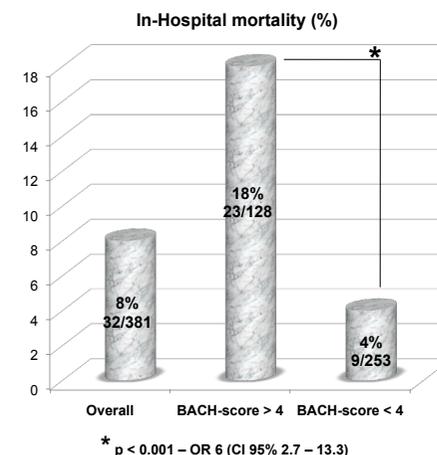

In-Hospital mortality (%)

- Overall: 8% 32/381
- BACH-score > 4: 18% 23/128
- BACH-score < 4: 4% 9/253

* p < 0.001 – OR 6 (CI 95% 2.7 – 13.3)

Figure 1. In-hospital mortality of different groups of patients.

RESULTS

Sensitivity, sensibility, predictive values and likelihood ratio of BACH-score levels > 4 points in predicting in-hospital mortality are reported in table 3.

SENSITIVITY	72%
SPECIFICITY	70%
POSITIVE PREDICTIVE VALUE	18%
NEGATIVE PREDICTIVE VALUE	96%
LIKELIHOOD RATIO (positive)	2.389
LIKELIHOOD RATIO (negative)	0.402

Table 3. Efficacy of BACH-score > 4 in predicting in-hospital mortality in ACPE-patients.

CONCLUSIONS

In our prospective study of ACPE patients overall in-hospital mortality was 8%. This value is comparable with previous reported literature data.

Mean age was high, with a mean value of 80 years.

The application of the BACH-score in this prospective multicentric cohort of ACPE-patients showed that a value greater than 4 is significantly related with a worse prognosis, with a 4-fold higher in-hospital mortality.

The possibility to recognise high-risk ACPE-patients early on admission to the Emergency Department could be useful in order to better decide intensity of treatment and appropriate site-of care.

Moreover, the 96% negative predictive value of the BACH score suggests that ACPE patients with a value less than 4 are less likely to die during hospital course.

Furthermore, early obtainable prognostic informations could be useful for the physician in the management communication issues with patients and relatives.

REFERENCES

1. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2008. Eur Heart J (2008) vol. 29 (19) pp. 2388-442
2. Cosentini et al. Mortality in acute cardiogenic pulmonary edema treated with continuous positive airway pressure. Intensive care medicine (2008)
3. Peter et al. Effect of non-invasive positive pressure ventilation (NIPPV) on mortality in patients with acute cardiogenic pulmonary oedema: a meta-analysis. Lancet (2006) vol. 367 (9517) pp. 1155-63