Relationship of Plasma Osmolarity within Hospital Mortality in Patients with Acute Pulmonary Embolism

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ABSTRACT

Objective: To determine the relationship between plasma osmolarity and within-hospital mortality in patients with acute pulmonary embolism.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: Pak-Emirates Military Hospital, Rawalpindi Pakistan, Jan 2019 to Jan 2020.

Methodology: The sample population consisted of 210 patients diagnosed with pulmonary embolism and admitted to the pulmonology unit at our hospital during the study period. Patients underwent all routine investigations, including plasma osmolarity, and were followed up until discharge or death.

Results: Out of 210 patients with pulmonary embolism admitted to the pulmonology unit during the study period, 194 (92.4%) were discharged as they had complete recovery, while 16(7.6%) died during their stay at the hospital despite vigorous management. After applying the inferential statistics, it was found that patients with high plasma osmolarity and low systolic blood pressure (SBP) at presentation had a significant association with in-hospital mortality among the patients suffering from pulmonary embolism.

Conclusion: Pulmonary embolism emerged as a condition with considerable in-hospital mortality in our study. Increased plasma osmolarity and low systolic blood pressure (SBP) at presentation emerged as strong factors associated with increased mortality among our study participants.

Keywords: Mortality; Plasma osmolarity; Pulmonary embolism.

INTRODUCTION

Pulmonary embolism is one of the main differential diagnoses among the patients who report in accidents and emergency departments with acute onset shortness of breath and chest pain.[1] Epidemiological studies from all over the world suggest that this catastrophic condition is not rare and has considerably significant mortality and morbidity, especially if not diagnosed and managed in time.[2,3] Levels of D-dimers and ventilation-perfusion scan have been the usual investigations in our part of the world to screen and diagnose a patient for acute pulmonary embolism presenting with new-onset pulmonary symptoms.[4] A lot of other radiological and laboratory investigations are also carried out to rule out the various differential diagnoses among these patients.[5,6] Clinicians and researchers have paid less attention to looking upon the markers related to good prognosis among these patients once they have been diagnosed with acute pulmonary embolism and put on the standard treatment.[7,8]

Several serum markers have been studied in this regard, and researchers from various parts of the world have been trying to find a marker with high sensitivity and specificity in determining the mortality or prognosis among patients admitted to hospitals with pulmonary embolism.[9,10]

Due to a gap in the literature regarding the appropriate biochemical marker to predict in-hospital mortality among patients admitted with acute pulmonary embolism, we designed this study to look for a relationship between plasma osmolarity and in-hospital mortality in patients with acute pulmonary embolism in the medicine/Pulmonology department of our hospital.

METHODOLOGY

The cross-sectional analytical study was conducted at the Medicine/Pulmonology Department of Pak-Emirates Military Hospital, Rawalpindi Pakistan, from January 2019 and January 2021. Ethical approval was obtained from Hospital Ethical Review

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Received: 13 Feb 2021, revision received: 26 Apr 2021; accepted: 29 Apr 2021

Board Committee (letter no A/124/EC/234/2021). The sample size was calculated using the WHO calculator, and the population proportion of plasma osmolarity specificity in predicting hospital mortality in pulmonary embolism patients was 67.1%.[7] The non-probability consecutive sampling technique was used to gather the sample.

Inclusion Criteria: All the patients who presented with acute chest symptoms and were diagnosed with acute pulmonary embolism by a consultant pulmonologist based on relevant investigations were included.

Exclusion Criteria: Patients less than 18 years or more than 65 years of age, or those with a recent history of myocardial infarction or haematological or solid malignancy, patients who were pregnant or had a history of pulmonary embolism, renal failure, or other electrolyte abnormalities, patients using alternative medicines or allopathic medications that could interfere with the plasma osmolarity were excluded.

Subjects and their next of kin were provided with a detailed description of the study and were inducted into the study after written informed consent from the subject or, in case the subject was not conscious, then the next of kin. Pulmonary embolism was diagnosed on CT pulmonary angiogram once patients were found to have raised levels of D dimers.[11,12] Echocardiograms were also performed on all patients to rule out the cardiac causes of acute chest symptoms. Patients underwent all the routine baseline investigations, and plasma osmolarity was calculated as osmolality =1.86×sodium mmol/l + (glucose mg/dl/18) + (BUN mg/dl/2.8) + 9. 280-300 mOs/kg was considered as the normal range of plasma osmolarity and >300 mosm/kg was regarded as high osmolarity for this study.[13,14]

Statistical Package for Social Sciences (SPSS) version 24.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The p-value lower than or up to 0.05 was considered as significant.

RESULTS

Two hundred fifteen patients with pulmonary embolism were diagnosed at the hospital during the study period. Five of them could not fulfil the criteria of the study due to pregnancy or the presence of a malignant condition. Two hundred ten patients presenting with acute pulmonary embolism during the

study period were investigated for plasma osmolarity and included in the final analysis. The mean age of the patients was 38.1±2.115 years. Out of 210 patients with acute pulmonary embolism, 194 (92.4%) were managed successfully and were discharged from the unit, while 16(7.6%) could not be managed effectively and died during the hospital stay. High plasma osmolarity and low systolic blood pressure (SBP) at presentation were significantly associated with increased mortality when chi-square was applied (Table).

Table: Characteristics of the Study Population and in Hospital Mortality Among the Patients of Pulmonary Embolism (n=215)

Socio-Demographic Factors	Recovery and Discharge	Death of the Patient	p-value
Age			
40 year or less	97(50%)	05(31.3%)	0.114
>40 years	97(50%)	1(68.7%)	
Gender			
Male	137(70.6%)	10(62.5%)	0.504
Female	57(29.4%)	06(37.5%)	
Plasma Osmolarity			
Normal	169(87.1%)	07(43.7%)	<0.001
High	25(12.9%)	09(56.3%)	
Systolic Blood Pressure <90 mm Hg			
No	138(70.7%)	06(37.5%)	0.008
Yes	56(29.3%)	10(62.5%)	

DISCUSSION

This study was planned to give a different perspective to a common clinical condition with a considerably high mortality. D-dimers and CT angiograms are the fancy investigations to diagnose pulmonary embolism in tertiary care settings. Prediction of the prognosis of such a condition could not be left without attention as the patient himself and caregivers from the initial day get worried about the acute chest symptoms and myocardial infarction, which is another high mortality condition and is one of the common differentials. In a developing country like Pakistan, where health resources are not ample, and clinicians usually have to confine themselves to cost-effective methods, we need to look for a routine marker which could serve the purpose and predict the prognosis in patients suffering from acute pulmonary embolism. Therefore, we followed the footsteps of Oz *et al*.[7] and planned this study intending to look for the relationship between plasma osmolarity and hospital mortality in patients with acute pulmonary embolism at our hospital's medicine/pulmonary department.

The mortality rate in our study was around 7.6%, as 16 out of 210 patients diagnosed and admitted with

acute pulmonary embolism died during the study period. These results have been very much comparable with the studies done on similar subjects in our part of the world. Husain *et al.* in 2009 and Kausar *et al.* in 2019 concluded that in hospitals, mortality with this condition is around 7%, and early diagnosis by use of modern radiological techniques followed by prompt treatment is the only way by which clinicians could reduce the mortality linked to this condition.[15,16]

Plasma osmolarity, though linked with the volumes of fluid and electrolytes in the blood compartment, yet many clinical conditions may alter this parameter in one way or another. Changes in this parameter may be used to predict the prognosis of various clinical conditions. We tried it for acute pulmonary embolism following the footsteps of Oz *et al.*[7] Mc Causland et al., used this marker to predict the blood pressure decline in between the sessions of hemodialysis.[17] Similarly, Tallistu *et al.* used the parameter of change in plasma osmolality to predict the mortality for ST-segment elevation myocardial infarction and came up with the conclusion that plasma osmolality was found to be a predictor of both in-hospital and long-term all-cause mortality. Hence, plasma osmolality can be used to detect high-risk patients in STEMI.[18]

Oz *et al.* (2019) did a detailed analysis and summarised their findings, stating that patient mortality was significantly higher in a group with high plasma osmolarity. Not only mortality but also the presence of all cardiac-related complications was significantly higher among patients who had high plasma osmolarity.[7] Our results were comparable to their results as the sample size was also similar, and both chi-square and binary logistic regression analysis revealed that high plasma osmolarity has a strong association with high mortality among patients presenting with acute pulmonary embolism.

LIMITATION OF STUDY

As the study design was not prospective, it could not be determined whether high plasma osmolarity predicted high mortality or other confounding factors also played a role. Future studies with a large sample size and involvement of multiple centres may generate better results.

CONCLUSION

Pulmonary embolism emerged as a condition with considerable in-hospital mortality in our study. Increased plasma osmolarity and low systolic blood pressure (SBP) at presentation emerged as strong factors associated with increased mortality among our study participants.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AA & KMU: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

MT & MH: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

HZ & MM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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