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ASSOCIATION BETWEEN INTENSIVE CARE UNIT TRANSFER DELAY AND HOSPITAL MORTALITY

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Abstract: *This study assessed the impact of ICU admission delay on hospital mortality using electronic Cardiac Arrest Risk Triage (eCART). An observational cohort study was conducted in the Intensive care unit of Shifa International Hospital from April 2022- April 2023. A total of 400 patients admitted to medical and surgical wards were included in the study. The eCART score was used to estimate the extent of critical illness using demographic data from the records, vital signs, and laboratory data. A duration of 6 hours was considered a cut-off for the delay as it is usually a critical threshold in critically ill patients. The patients in both groups varied slightly with respect to age (69 vs. 71 years); all the other factors did not vary significantly. However, in-hospital mortality was higher in the delayed admission group (33.3%) than in the non-delayed group (25%). The length of ward stay did not vary between groups (1.3 vs. 1.4 days), but the total length of hospital stay was 2 days longer in the delayed transfer group. Based on the results, A delay in ICU admission is significantly related to high in-hospital mortality and longer hospital stays.*

Keywords: Intensive Care Unit, In-Hospital Mortality, Electronic Cardiac Arrest Risk Triage, Critically Ill Patients

Introduction

Patients admitted to general wards often become critically ill during their hospital stay due to poor prognosis of the disease they were admitted for. Patients are assessed and admitted to the intensive care unit to prevent further worsening of the condition. As many critical conditions such as sepsis and respiratory failure can better be treated if diagnosed early, early admission to ICU can improve prognosis and considerable delay in transfer can worsen the outcome, lengthen the hospital stay, and may lead to death (Sakr et al., 2018). However, transfer to ICU depends upon the availability of space, deterioration assessment, and physicians' decision regarding the transfer (Mathews et al., 2018). Therefore, the severity of the disease and patient outcome varies greatly at the time of ICU admission (Doiron et al., 2018).

Research conducted to evaluate the relationship between delay in ICU admission and patient outcomes used the consultation time by the ICU team to estimate the onset of disease (Gunnerson et al., 2019). But the decision to ICU transfer is mostly subjective, and studies have reported dangerously high error rates in making the right diagnosis and management of patients (Viglianti et al., 2018). Therefore, a more objective approach should be taken to assess the onset of acute diseases and the impact of ICU admission delay on patient outcomes.

Early warning scores are a useful objective tool to evaluate critical illness in patients outside ICU (Gerry et al., 2020). Cardiac Arrest Risk Triage is an early warning score that estimates critical illness with respect to demographic and laboratory data (Winslow et al., 2022). We conducted this study to assess the impact of ICU admission delay on hospital mortality using electronic Cardiac Arrest Risk Triage (eCART).

Methodology

An observational cohort study was conducted in the Intensive care unit of Shifa International Hospital from April 2022- April 2023. A total of 400 patients admitted to medical and surgical wards were included in the study.

All the patients provided informed consent to participate in the study. The ethical board of the hospital approved the study design.

The eCART score was used to estimate the extent of critical illness using demographic data from the records, vital signs, and laboratory data. A duration of 6 hours was considered a cut-off for the delay as it is usually a critical threshold in critically ill patients. A patient with a 95% specificity cut-off score was considered critically ill. Patients who were transferred to ICU after cardiac arrest and resuscitation were regarded as ICU admission when the arrest occurred.

Only the first transfer was counted in patients who were admitted multiple times to the ICU.
All the data were analyzed by Stata version 12. Delayed n-and non-delayed transfers were compared by using the t-test and Wilcoxon test. Logistic regression analysis determined the relation between ICU transfer delays and mortality. A two-tailed probability value of less than 0.05 was regarded as significant.

Results

400 patients reached the eCART cut-off score within 24 hours after ICU admission. These patients were divided based on non-delayed and delayed ICU admission. The patients in both groups varied slightly with respect to age (69 vs. 71 years); all the other factors did not vary significantly. However, in-hospital mortality was higher in the delayed admission group (33.3%) than in the non-delayed group (25%) (Table I).
The relationship between delay in ICU admission and mortality did not change after adjusting baseline factors and did not depend upon the initial eCART score. The length of ward stay did not vary between groups (1.3 vs. 1.4 days), but the total length of hospital stay was 2 days longer in the delayed transfer group.
Patients transferred late to the intensive care unit had low diastolic and systolic blood pressure, hemoglobin, respiratory rate, and heart rate but had high WBCs and creatinine levels compared to the non-delayed group (Table II).

Table I: Comparison between Delay and Non-Delayed ICU Transfers

Variable	Non-delayed transfer (n=220)	Delayed transfer (n=180)	P-value
Age, median (years)	69 (55-80)	71 (58-81)	0.001
Female gender	110 (50%)	87 (48.3%)	0.65
Surgical patient	60 (27.2%)	45 (25%)	0.05
Length of hospital stay before critical eCART score (days)	1.3 (0.2-3.5)	1.4 (0.3-3.7)	0.02
The total length of hospital stays	10 (6-18)	12 (7-20)	<0.001
In-hospital mortality	55 (25%)	60 (33.3%)	<0.001

Table II: Physiologic Variables in Delayed and Non-Delayed Transfers

Variable	Non-Delayed Transfer	Delayed transfer	P value
Respiratory rate	20 (15-27)	19 (15-25)	<0.001
Systolic BP	109 (89-132)	107 (89-127)	0.001
Diastolic BP	58 (47-72)	56 (46-68)	<0.001
Heart rate	105 (87-123)	101 (84-116)	<0.001
Oxygen saturation	95 (92-97)	95 (93-97)	0.13
Temperature (°F)	98 (97-99)	98 (97-99)	0.001
Alerted mental status	188 (85.5%)	150 (83.3%)	<0.001
eCART score at ICU admission	59 (24-120)	47 (19-119)	0.909
White blood cells	9.9 (7.1-14.1)	11.4 (7.8-16.8)	<0.001
Haemoglobin	10.5 (8.9-11.7)	10.1 (8.8-11.3)	<0.001
Platelets	212 (134-272)	192 (115-266)	0.015
Sodium	135 (132-138)	135 (132-139)	0.67
Potassium	3.8 (3.6-4.4)	3.9 (3.6-4.5)	0.005
Anion gap	9 (7-12)	9 (7-13)	<0.001
Carbon dioxide	22 (18-24)	21 (16-24)	<0.001
BUN	22 (14-38)	30 (16-51)	<0.001
Creatinine	1.0 (0.8-1.8)	1.3 (0.9-2.5)	<0.001
Glomerular filtration rate	69 (69-69)	69 (49-69)	<0.001
Glucose	121 (104-159)	127 (103-163)	0.45
Calcium	8.3 (7.7-8.6)	7.9 (7.5-8.5)	<0.001
Serum glutamic-oxaloacetic transaminase	24 (24-34)	24 (24-33)	0.001

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Serum glutamic pyruvic transaminase	19 (19-25)	19 (18-31)	0.001
Total bilirubin	0.5 (0.5-0.9)	0.5 (0.5-1.2)	<0.001
Alkaline phosphatase	79 (79-95)	79 (78-109)	0.170
Albumin	2.8 (2.5-2.8)	2.8 (2.1-2.8)	<0.001

Discussion

The results of our study proved that delay in ICU admission was associated with high in-hospital mortality and longer hospitalization. These findings highlight the importance of early ICU admissions before reaching deterioration in critical illness. Previous studies on the relationship between ICU transfer and mortality comply with our results (Peyrony et al., 2019; Zhang et al., 2019).

In Young et al., there was a significant difference between the mortality of the delayed group (41%) and the non-delayed group (11%) (Young et al., 2003). Similarly, Cardoso et al. (Cardoso et al., 2011) and Mueller et al. (Mueller et al., 2019) studied the effect of delay in ICU admission due to lack of space on mortality. The average waiting time was 18 hours; hence each hour increased the risk of death to 1.5 folds. Several studies have reported that patients who were given a waiting time had an increased mortality rate than patients who were transferred to ICU immediately (Kadar et al., 2019; Sabaz et al., 2020).

In our study, the patients in the delayed admission group were older and may not have vital sign abnormalities. Hence, early identification of critical illnesses in ward patients may improve the mortality rate. Previous studies have also reported these findings (Long and Mathews, 2018). Another implication this finding gives is that duration of ICU transfer should be influenced by considering age. Earlier research has also considered this factor but did not prove whether age directly impacted patient outcomes (Oliveira et al., 2019).

Our study used the eCART threshold to measure critical illness and not the call for help by the ICU team. Several studies have reported the failure of ICU teams to report the extent of patients' illness which causes further delays in treatment (Harris et al., 2018; Soni et al., 2018). Hence, we could track patients' outcomes in real-time by eCART score and could better understand the factors influencing hospital mortality.

Our study has some limitations. We included patients with a 95% cut-off score which included only patients who were critically ill with extremely deranged physiology. Secondly, we did not assess patients with respect to specific illnesses due to which they were transferred to ICU.

Conclusion

A delay in ICU admission is significantly related to increased in-hospital mortality and longer hospital stays.

Conflict of interest

The authors declared absence of conflict of interest.

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