The impact of "admit no bed" and long boarding times in the emergency department on stroke outcome

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ABSTRACT

الأهداف: دراسة العلاقة المحتملة بين فترة الإنتظار في قسم الطوارئ وإنذار السكتة الدماغية.

الطريقة: هذه الدراسة هي عباره عن إستعراض رجعي لمرضى السكتة الدماغية الذين راجعوا قسم الطوارئ في مدينة الملك عبدالعزيز الطبية بالرياض، المملكة العربية السعودية من 2007م الى 2010م. لقد إستثنينا المرضى اللذين تلقوا العلاجات الحالّه للخثره كما تم إستثناء الحالات الصحية الحرجة من هذه الدراسة. وقد تم جمع المعلومات التي تتعلق بوقت حدوث السكتة الدماغية وفترة البقاء في قسم الطوارئ ووقت إتخاذ قرار التنويم و وقت الوصول إلى جناح التنويم. لقد عرّفنا وقت إنتظار الطوارئ بفارق الوقت بين وصول المريض الى جناح التنويم ووقت إتّخاذ القرار بالتنويم. كما تم تحديد الإنذار الأولي للدراسة بمجموع حالات الوفيات مع/أو أي من مضاعفات ما بعد السكتة الدماغية.

النتائج: شملت هذه الدراسة 300 مريض بمتوسط عمر 12±69 عاما وكانت نسبة الذكور 66.3%. لقد كانت نسبة الإنذار الأولي المعتبر للدراسه هي 37.7% من الحالات. هذا و لم يكن هناك أي إرتباط بين وقت إنتظار الطوارئ والإنذار الأولي للدراسة (نسبة الأرجحية OR=0.97, p=0.3)، أو أي من الإنذارات الثانوية، مثل نسب الوفيات (OR=0.97, p=0.5)، أو العجز الشديد (OR=0.97, p=0.3)، أو الإلتهاب الرئوي (OR=1, p=0.9)، أو إلتهاب المسالك البولية (OR=1, p=0.9)، أو تدهور حلة المريض الصحيه (OR=0.8, p=0.1). كما قمنا بتحليل متعدد المتغيرات الشامل لجنس المريض وعمره وشدة ونوع السكتة الدماغية وإرتفاع ضغط الدم والسكري وأمراض الشريان التاجي والرجفان الأذيني والقصور القلبي ووقت إنتظار الطوارئ. وكانت النتيجه هي وجود إرتباط بين الإنذار الأولي المعتمد للدراسه و بين كل من القصور القلبي وقصة سكتة دماغيه قديمة عند المرضى المصابين بسكتة دماغيه متوسطه إلى شديده.

الخاتمة: عدم وجود إرتباط بين تأخر وصول المرضى إلى غرفهم (إنتظارهم في قسم الطوارئ) بسبب عدم توفر أسرّه و بين الإنذارات أو النتائج السلبية للسكتة الدماغية. ولكن ينبغي تفسير نتائج هذه الدراسة بحذر. وإن سرعة دخول مرضى السكتة الدماغية إلى وحدة السكته الدماغيه المتخصصة أمر مشجّع عليه.

Objectives: To examine and test the possible association between boarding time and stroke patients' outcome.

Methods: This study is a retrospective review of stroke patients presenting to the Emergency Department (ED) of King Abdulaziz Medical City, Riyadh, Kingdom of Saudi Arabia from 2007-2010. We excluded thrombolysis cases and those deemed critically ill. We collected time of stroke onset, ED arrival, decision to admit, and arrival to ward. Boarding time (BT) was defined as time of arrival to ward minus time of decision to admit. Primary outcome (PO) was defined as a composite of mortality, and/or any of post-stroke complications.

Results: We included 300 patients with a mean age ± standard deviation of 69 ± 12 years, and 66.3% were men. The PO occurred in 37.7%. There was no association between BT and PO (odds ratio [OR]=0.9, p=0.3), or any of the secondary outcomes, such as, death (OR=0.97, p=0.5), severe disability (OR=0.97, p=0.3), pneumonia (OR=1, p=0.9), urinary tract infection (OR=1, p=0.9), or neurological deterioration (OR=0.8, p=0.1). Multivariate analysis included gender, age, stroke severity, subtype, hypertension, diabetes, coronary disease, atrial fibrillation, heart failure (HF), onset to ED, BT and ED wait time; only moderate to severe stroke, HF, and previous stroke predicted poor outcome.

Conclusion: Although "admit no bed" was not associated with adverse effects, the results should be interpreted with caution, and early admission to the stroke unit should be encouraged.

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Overcrowding in the emergency department (ED) is a growing problem and is considered to be one of the most difficult challenges in care delivery worldwide.[1-5] Several factors contribute to overcrowding but inability of patients requiring inpatient care to gain access to appropriate hospital beds within a reasonable time frame (access block) is considered one of the most important factors.[6-8] This causes a prolonged stay for some patients in the ED as they wait for transfer into inpatient hospital beds, which is a situation that is known as "ED boarding" and commonly referred to as "admit no bed" situation in our institution. The ED boarding is not only a matter of inconvenience, but may predispose patients to adverse events. It has been linked to a poorer adherence to the American Heart Association guidelines for management of patients with non-ST-elevation myocardial infarction.[9] Likewise, ED overcrowding is associated with delayed administration of thrombolytic therapy for heart attack, inadequate pain management, delayed administration of antibiotics for patients with pneumonia, medication errors, and longer hospital stay.[10-14] Some reports link ED crowding and boarding to mortality. The link was evident in the 2002 Sentinel Event Alert Report from the Joint Commission on Accreditation of Healthcare Organizations (JCAHO),[15] which indicates that more than half of sentinel events occur in the ED, and in nearly one-third, crowding is considered to be a contributing factor. Stroke is one of the most common neurological emergencies that often require timely, complex, and multidisciplinary care that is typically delivered in designated areas other than the ED. Overcrowding and ED boarding may compromise the delivery of this complex care due to limited space, understaffing, and staff members' feeling the need to rush. Our study examines this issue and tests the possible association between boarding time (BT) and stroke patients' outcome.

Methods. This was a retrospective, descriptive study involving a cohort of patients that presented to the ED with acute stroke between January 2007 and July 2010. The study was conducted at King Abdulaziz Medical City (KAMC), which is a tertiary care center in the city of Riyadh, Saudi Arabia. The KAMC hospital has 900 beds, and is accredited by the Joint Commission International (JCI). This center provides free services to the National Guard employees and their dependents, which is approximately half a million, and are reasonably representative of the general Saudi population. The KAMC also provides free services to any patient with life-threatening medical condition, including acute stroke. It has one of the largest and busiest EDs in the region with approximately 200,000 annual patient visits, and it has a well-established thrombolytic program for acute stroke patients that provide around-the-clock service, a stroke team, and an effective triaging mechanism. The hospital does not have a stroke unit, meaning that patients are typically cared for by general internists in consultation with neurologists (one of whom specializes in stroke).

Study participants. All cases of acute stroke admitted to the hospital through the ED from January 2007-July 2010 were retrieved through electronic medical records. Patient was eligible for the study if they met the case definition of acute stroke based on coding from the International Classification of Diseases, 9th revision (ICD-9), and 18 years of age or older. We excluded patients that received thrombolysis, was critically ill on arrival, or if they deteriorated in ED before the decision of admission was made. A patient was considered critically ill if he had any decreased level of consciousness; requiring ventilation, hypoxic (an oxygen saturation <89%), hypotensive (systolic blood pressure <90 mm Hg), life-threatening arrhythmia that needed continuous cardiac monitoring, acute coronary syndrome, and decompensated heart failure. Five trained abstractors (3 physicians and 2 research coordinators) reviewed hand written charts, QuadraMed (Health Care Information Technology Systems, QuadraMed Corporation, Reston, VA, USA), and the Picture Archiving and Communication System (PACS), and the data were collected on a previously generated electronic case report form. We collected data on demographic characteristics, risk factors, relevant information on history and physical examination at presentation, details on relevant radiological and laboratory investigations, acute management, and complications during hospitalization. We estimated the severity of stroke by retrospective scoring algorithm applied to history and physical examinations documented on the charts to estimate the National Institutes of Health Stroke Scale (NIHSS). This method has been previously validated with a good agreement across the spectrum of scores.[16] We categorized stroke severity to mild (NIHSS <5), moderate (NIHSS 5-14) or severe (NIHSS >14). The

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classification of the acute ischemic stroke subtypes was defined according to Trial of ORG 10172 in Acute Stroke Treatment (TOAST).[17] We collected date and time of stroke onset, date and time of arrival to ED (ED door time), date and time of the decision to admit to the medical ward, and date and time of each patient's arrival to the medical ward using QuadraMed (Health Care Information Technology Systems, QuadraMed Corporation, Reston, VA, USA). Boarding time was defined as the time of arrival to the medical ward minus the time of the decision to admit. Total ED wait time was defined as the time of arrival to the medical ward minus the time of arrival to the ED door.

Outcome measures. Primary outcome (PO) was defined as a composite of in-hospital case fatality and any of the following complications: aspiration pneumonia; venous thromboembolism (deep vein thrombosis [DVT] and/or pulmonary embolism); neurological deterioration; subsequent intensive care unit admission as per deterioration occurring after the decision to admit was made; and urinary tract infection (UTI). Secondary outcomes included any of the aforementioned complications alone, in addition to neurological outcomes at discharge. In-hospital case fatality was defined as death due to any cause during hospitalization following an acute stroke. Neurological deterioration was defined as new neurological deficit that occurred after the decision of admission was made that has been documented in charts. Neurological outcomes at discharge were roughly estimated from the charts and were categorized as complete neurological recovery, partial recovery, or severe neurological disability. A patient was considered to have complete recovery if physical examination was normal at discharge, partial recovery if there was a neurological deficit but patient was independent in activity of daily livings (ADLs), or severe disability if records indicated that the patient needed assistance in ADLs upon discharge. A complication was considered to be present when it is documented in a chart by the primary treating team. No further verification was sought by the reviewers beyond the treating team's diagnostic impression. This study was approved by the Institutional Review Board.

Statistical analysis. Simple descriptive statistics were calculated to describe the study population. Univariate and multivariate logistic regression analyses were performed to examine the association between BT and primary and secondary outcomes. Differences were considered to be statistically significant at $p<0.05$. The Statistical Package for Social Sciences version 17 (SPSS Inc. Chicago, IL, USA) was used for analyses.

Results. Three hundred sixty-seven stroke patients were identified of whom 300 met the inclusion and exclusion criteria. Sixty-seven patients were excluded from the study for the following reasons: immediate admission to the ICU (n=46); direct admission to a medical ward (n=12); incomplete records (n=7); and hospitalized and discharged from the ED without admission to a medical ward (n=2). **Table 1** shows the study participants' characteristics. The mean age ± standard deviation was 69 ± 12 years, and 66.3% were men. Stroke risk factors at presentation included hypertension (81.7%), diabetes (65.3%), dyslipidemia (27.7%), smoking (7.3%), coronary artery disease (17%), coronary bypass surgery (5.7%), atrial fibrillation (AT [7.7%]), heart failure (HF [7.3%]), and previous stroke (31.7%). Nearly 94.3% of the patients had ischemic strokes, whereas the remaining had hemorrhagic strokes. Among those who had ischemic stroke, 25% had the lacunar subtype, 14% large artery disease, and 11% the cardioembolic subtype, whereas the remaining half of the patient sample were cryptogenic. The mean NIHSS was 7 ± 3.4, and the median was 6 (interquartile range [IQR]=5). The median pre-hospital time (the time from stroke onset to ED arrival) was 24.8 hours (IQR=72). The mean total ED wait time

Table 1 - Characteristics of the stroke patients presenting to the Emergency Department.

Variable	n (%)
Age (years)	
Mean ± standard deviation	69 ±12
Range	28-100
Male gender	199 (66.3)
Hypertension	241 (81.7)
Diabetes	196 (65.3)
Dyslipidemia	83 (27.7)
Smoking	22 (7.3)
Coronary artery disease	51 (17.0)
Atrial fibrillation	23 (7.7)
Congestive heart failure	22 (7.3)
Coronary bypass surgery	17 (5.7)
Previous stroke	95 (31.7)
Type of stroke	
Ischemic	283 (94.3)
Hemorrhagic	16 (5.3)
Stroke severity (NIHSS)	
Mean ± standard deviation	7 ± 3.4
Median (IQR)	6 (5)

NIHSS - National Institutes of Health Stroke Scale, IQR - interquartile range

Table 2 - Association between primary outcome and other factors using univariate and multivariate analysis on stroke patients presenting to the Emergency Department.

Variable	n*	n (%) with primary outcome	OR	95% CI for OR		*P*-value	Adjusted OR (95% CI)	*P*-value for adjusted OR
				Lower	Upper			
Age			3.7	1.07	13.0	0.03	3.1 (0.7, 14)	0.13
≥50 years	274	109 (39.7)						
<50 years	20	3 (15.0)						
Gender			0.6	0.39	1.05	0.08	0.59 (0.3, 1.1)	0.11
Male	199	68 (34.2)						
Female	101	45 (44.6)						
Hypertension			1.9	1.02	3.8	0.04	1.6 (0.7, 3.9)	0.23
Yes	245	99 (40.4)						
No	55	14 (25.5)						
Diabetes			1.48	0.89	2.4	0.12	1.01 (0.5, 2)	0.77
Yes	196	80 (40.8)						
No	104	33 (31.7)						
Atrial fibrillation			2.7	1.16	6.6	0.02	1.2 (0.4,3.9)	0.67
Yes	23	14 (60.9)						
No	276	99 (35.9)						
Heart failure			4.9	1.8	13.0	0.001	4.9 (1.4,17)	0.01
Yes	22	16 (72.7)						
No	277	97 (35.0)						
Previous stroke			3.2	1.95	5.37	0.001	2.2 (1.1,4)	0.01
Yes	95	54 (56.8)						
No	204	59 (28.9)						
Hemorrhagic stroke			2.2	0.81	6.21	0.11	2.1 (0.6,7)	0.20
Yes	16	9 (56.2)						
No	283	103 (36.4)						
Severity of stroke								
Mild (NIHSS <5)	101	17 (16.8)	-	-	-	-	-	-
Moderate (NIHSS 5-14)	174	80 (46.0)	4.2	2.3	7.6	0.00	3.5 (1.7, 6)	0.000
Severe (NIHSS >14)	8	7 (87.5)	34	3.9	299.0	0.001	45 (3.2, 655)	0.005
Boarding time, hours								
0 - 0.75	75	32 (42.7)	-	-	-	-	-	
0.76 - 1.42	68	24 (35.3)	0.7	0.37	1.44	0.36	0.6 (0.27, 1.6)	0.36
1.43 - 2.97	73	35 (47.9)	1.2	0.64	2.36	0.51	1.8 (0.8, 4.1)	0.15
2.98+	72	20 (27.8)	0.5	0.25	1.03	0.06	0.6 (0.2, 1.6)	0.40
ED wait time, hours								
0 - 11	75	26 (34.7)	-	-	-	-	-	-
11.1 - 20	75	29 (38.7)	1.1	0.61	2.3	0.61	0.8 (0.3, 2)	0.77
20.1 - 31.4	75	28 (37.3)	1.1	0.57	2.1	0.73	0.9 (0.3, 2.2)	0.85
31.5+	75	30 (40.0)	1.2	0.64	2.4	0.50	1.2 (0.48, 2.9)	0.68

*N=300, however some of the variables presented contain missing data. OR - odds ratio, CI - confidence interval, NIHSS - National Institutes of Health Stroke Scale, ED - emergency department

was 26.7 ± 45 hours, whereas the median was 19.8 hours (IQR=20). The mean BT was 4.3 ± 9 hours with a median of 1.36 hours (IQR=2.7). The mean length of hospital stay was 15.5 ± 33 days, and the median was 6.1 days (IQR=9.2). The in-hospital mortality for the study patients was 5.3%. Among those who survived, 26.7% had complete neurological recovery, 49.3% had partial recovery, and 18% had severe neurological disability. The identified in-hospital complications included aspiration pneumonia (13%), UTI (15.7%), neurological deterioration (9.3%), subsequent ICU admission (5.3%), and DVT (1%). The PO was observed in 37.7% of patients. According to bivariate analysis, there was no association between BT and the primary composite outcome (OR=0.9, p=0.3). Additionally, there was no observable association between BT and any of the secondary outcomes: death (OR=0.97, p=0.5); severe neurological disability (OR=0.97, p=0.3); aspiration pneumonia (OR=1, p=0.9); UTI (OR=1, p=0.9); and neurological deterioration (OR=0.8, p=0.1). There was no association between the total ED wait time and PO (OR=1, p=0.3), nor was there an association between

the total ED wait time, and any of the secondary outcomes: death (OR=0.9, p=0.8); severe neurological disability (OR=0.99, p=0.5); aspiration pneumonia (OR=0.9, p=0.6); UTI (OR=1, p=0.2) and neurological deterioration (OR=0.9, p=0.4). Patients who were older than 50 years, or who had a history of severe stroke or hypertension, AT, HF, or a previous stroke were more likely to have adverse outcomes. After the multivariate analyses, only a history of HF and a previous stroke, in addition to the patient having a moderate to severe stroke were associated with adverse events (**Table 2**).

Discussion. Stroke patients who experience the "admit no bed" phenomenon may be at risk of further neurological deterioration and complications that can lead to significant mortality and morbidity. Fortunately, these risks can be anticipated and minimized in most cases, however, such care is complex and necessitates a multidisciplinary and timely approach that may be lacking in the ED setting. Nevertheless, our data did not support an association between ED BT or total ED wait time and post-stroke, in-hospital mortality, or complications. Our study addressed this issue, however, organized stroke care in a geographically allocated stroke unit with trained personnel and implemented pathways has been previously studied.[18] Stroke units have been proven to decrease mortality and improve outcomes when compared with the care that is typically provided in general medical wards.[18,19]

The ED length of stay and a delay of more than 5 hours during the admission of critically sick stroke patients to neurocritical care are independently associated with poor patient outcomes at hospital discharge.[20] It is possible that the absence of stroke units at our institution affected the results of this study because we compared a potentially suboptimal quality of care in the ED to a fragmented quality of care in general medical wards, which are demonstrably inferior to stroke units. Moreover, we excluded those patients who were ill on arrival, which often reflects a more severe stroke. This exclusion resulted in a cohort of patients who were stable and, therefore, less likely to develop adverse events; however, severe stroke sufferers are expected to obtain the most benefit from organized care in a stroke unit.[20] Likewise, the data showed that the median time from onset to ED door was more than 24 hours. It is possible that patients who presented to ED late had missed a golden period for effective early preventative measures for complications. Thus, several hours of boarding in ED may not make a significant difference. Furthermore, boarding stroke patients still receive care provided by related disciplines as a mobile service in our institution, which could have eliminated some of the effect of prolonged BT. It is also important to consider the potential impact of the operational definitions of outcomes. We exclusively depended on the treating physicians' notes to ascertain the occurrence of complications. One of the drawbacks of handwritten charts is that stroke complications might have been underreported.

This study has several limitations. First, the retrospective cohort design relies on the accuracy and comprehensiveness of data that have been collected in the past, that is, existing information in patient records. Second, there was a problem in ascertaining BT. We noted that nurses may not immediately document the time of admission after the decision to admit has been made. In fact, some may wait to record the time until a hospital bed is available, which leads to inaccurate BTs. However, this would have not changed our results as the total ED wait time had no effect on the outcomes, which was accurately obtained. The pre-hospital time (the time from stroke onset to ED arrival) was not included in the analysis due to inaccurate documentation in the patient files. Third, in the absence of a stroke unit, potentially non-organized care in the ED was compared with potentially non-organized care in the wards. This comparison could have underestimated the effect of long BTs in the ED. Fourth, it is possible that a small effect was overlooked due to the limited sample size. Although no association emerged, the results should be interpreted with caution. The safety that is associated with long BTs for stroke patients in the ED will remain uncertain until more definitive evidence becomes available. Although long BT in ED was hypothesized to be associated with worse outcome and patients unsatisfaction,[21] we did not find association with adverse effects. The results should be interpreted with caution, and early admission to stroke unit should be encouraged.

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