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Increased Mortality was not Associated with Weekend or Nighttime but was Associated with Out-of-Hours in Patients Admitted to the Emergency Department of a Tertiary Care Center: Possibilities of Emergency Intervention

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Abstract

Background: The aim of this study is to elucidate the outcomes of patients admitted to the Emergency Department (ED) of our tertiary care center by time or day of arrival at the ED, which is known as "nighttime or weekend effect'.

Methods: Of all patients admitted to the ED of our tertiary care center from July 1, 2012 to July 31, 2017. We collected data about the clinical severity, including the Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation (APACHE) II scores at admission, and assessed the impact of time and day (daytime/nighttime, weekday/weekend, regular business hours/out-of-hours, and holidays/non-holidays) of the ED arrival as well as the performance of emergent treatment, including endovascular, endoscopic, and surgical interventions, on the cumulative 90-day in-hospital mortality of ED patients.

Results: No significant differences were observed among the aforementioned factors, excluding business hours/out-of-hours and emergency intervention. In patients who did not receive an emergency intervention, the 90-day out-of-hours, in-hospital mortality was significantly higher than that at business hours (p =0.01); however, in patients who received an emergency intervention, the mortality was similar between business hours and out-of-hours (p =0.99). In patients who did not receive an emergency intervention, SOFA and APACHE II scores were higher at out-of-hours than those at business hours.

Conclusions: In patients admitted to the ED of our tertiary care center in Japan, the 90-day mortality increased in correlation with the out-of-hours ED arrival. The increased out-of-hours mortality could be improved by an emergency intervention as well as by arriving at business hours in patients who benefit from an emergency intervention.

Keywords: Weekend effect; Nighttime effect; Tertiary care center; Emergency admission; Out-of-hours effect

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Introduction

Previously, several studies have established that patient outcomes partially depend on the arrival time of patients at a hospital, their admission to a specific ward or whether they undergo surgery after acute illness and injuries; this is also known as "night or weekend effect" and has been considered to increase mortality in patients with acute myocardial infarction stroke, gastrointestinal bleeding emergency surgeries performed by gastrointestinal and orthopedic surgeons and critical illness [1-13]. Previous studies have also revealed that the increased mortality in the night or on the weekend is accountable for limited hospital resources, such as the lack of staff and services at that time; however, some early intervention may contribute in diminishing this effect [1,6,14-17]. Nonetheless, in Japan, the outcomes of patients admitted to a tertiary care center by time or day of admission remains unknown. We hypothesize that the patient outcomes correlate with the time or day of arrival at the Emergency Department (ED). Thus, this study aims to elucidate the outcomes of patients admitted to the ED of our tertiary care center by time or day of arrival at the ED.

Table 1: The 90-day in-hospital mortality in association with several factors.

Factors	90-day in-hospital mortality (%)					P
Male	281/2289	-12.3	Female	148/1215	-12.2	0.99
Elderly patients (³65 y)	299/1710	-17.5	Non-elderly patients (<65 y)	130/1794	-7.2	<0.001
Business hours	178/1634	-10.9	Out-of-hours	251/1870	-13.4	0.03
Daytime	234/1976	-11.8	Nighttime	195/1528	-12.8	0.45
Weekday(Mon-Fri)	327/2717	-12	Weekend (Sat-Sun)	102/787	-13	0.47
Non holidays	362/3030	-11.9	Holidays	67/474	-14.1	0.16
Weekday and non-holidays	314/2611	-12	Weekend or holidays	115/893	-12.9	0.48
No interventions	332/2587	-12.8	Emergency interventions	97/917	-10.6	0.07
Day of week						0.95
Mon	60/503	-11.9				
Tue	72/577	-12.5				
Wed	63/558	-11.3				
Thu	64/545	-11.7				
Fri	68/534	-12.7				
Sat	54/438	-12.3				
Sun	48/349	-13.8				
Total	429/3504	-12.2				

Table 2: SOFA and APACHE II scores and the APACHE II-related predicted mortality between business hours and out-of-hours in patients with or without emergency interventions.

	Emergency intervention (-)			Emergency intervention (+)		
	Business hours	Out-of-hours	P	Business hours	Out-of-hours	P
SOFA score	3.7 ± 0.1	4.1 ± 0.1	0.1	3.4 ± 0.2	3.3 ± 0.2	0.98
APACHE II score	12.6 ± 0.3	13.6 ± 0.3	0.08	12.5 ± 0.5	12.3 ± 0.5	0.99
Predicted mortality from APACHE II (%)	17.6 ± 0.8	21.0 ± 0.8	0.01	26.9 ± 1.3	28.1 ± 1.2	0.91

Abbreviations: SOFA: Sequential Organ Failure Assessment; APACHE II: Acute Physiology and Chronic Health Evaluation II

Methods and Patients

At our hospital, the tertiary care center was established on July 1, 2012, and authorized by the Tokyo metropolitan government in December 2012. Our tertiary care center comprises the ED for out-patients (non-appointed and by ambulance) and an exclusive Intensive Care Unit (ICU) as well as a ward for in-patients through the ED requiring emergency and critical care. An attending emergency physician at the ED assesses the condition of all patients admitted to our tertiary care center and then decides whether hospitalization because of critical illness is required. In this retrospective study, we reviewed all patients who were admitted to our tertiary care center through the ED from July 1, 2012, to July 31, 2017. Of note, we excluded patients who died before admission to the emergency-ICU or ward at our tertiary care center. We collected the following patient data: age; gender; time and day of the week at the ED arrival; vital signs, such as the Glasgow Coma Scale, respiratory rate, heart rate, blood pressure, and body temperature from the ED arrival to admission to the emergency-ICU or ward at our tertiary care center; blood tests comprising blood counts, biochemistry, and blood gas analysis; emergency interventional treatment undergone within 12 h after the ED arrival, such as percutaneous coronary intervention, trans-arterial embolization (for acute internal hemorrhage, thrombolytic therapy, and intracranial endovascular treatment), endoscopic hemostasis for gastrointestinal hemorrhage, and general surgery for critical illness or severe injuries; in-hospital diagnosis; in-hospital survival or death at hospital discharge; and duration of hospitalization. Since April 1, 2014, we routinely gathered the Sequential Organ Failure Assessment (SOFA) score, Acute Physiology and Chronic Health Evaluation (APACHE) II score and predicted mortality from the APACHE II score at admission for all patients admitted to our tertiary care center. We classified days of the week at the ED arrival into two categories: Monday-Friday as weekday and Saturday and Sunday as weekend. In this study, we derived holidays from national holidays and hospital holidays (May 30, December 30, December 31, January 1, January 2, January 3, and January 4). Regular business hours was 7:30-17:30 on weekdays and 7:30-13:00 on every Saturdays, except holidays; out-of-hours included all nighttime throughout the week in addition to 13:00-17:30 on Saturdays and Sundays and holidays (Figure 1). During regular business hours, every patient visiting our ED is first assessed by a team of doctors led by attending ED physicians and only patients with critical illness or injuries are allowed admission to the emergency-ICU or ward at our tertiary care center. During out-of-hours, an attending ED physician only treats the third-degree emergency patients at the ED and two shift doctors, such as one from internal medicine and other form surgical departments treat other ED patients. As a general rule of our hospital, all treatments should be provided immediately when there are needs and indications of an emergency intervention for an ED patient and should not be postponed for reasons such as the nighttime or weekend. In addition, a cardiologist is present 24 × 7 at our ED, but endoscopists and surgeons are mostly on-call 24 × 7. In fact, surgeries, endoscopies, and radiological interventions by cardiologists, neurologists, and radiologists can be performed 24 × 7, which can start within 1 h

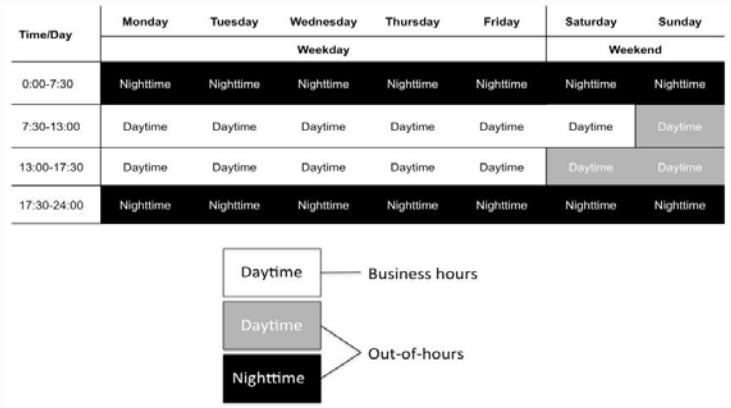

Figure 1: An illustration diagram of regular business hours and out-of-hours by the time and day of the week at our hospital.
At our hospital, regular business hours comprise the white background area, including the daytime during weekdays and 7:30–13:00 on Saturdays, except for holidays, whereas out-of-hours comprise the nighttime throughout the week in the black background, daytime in the gray background on the weekend, and holidays.

when required. In the present study, we evaluated the effect of several factors of the time and day of the week at the ED arrival (daytime/nighttime, weekday/weekend, regular business hours/out-of-hours, and holidays/non-holidays) and performance of emergency interventions on the cumulative 90-day in-hospital mortality in ED patients admitted to our tertiary care center.

This study was approved by Research Ethics Committee, Tokyo Saiseikai Central Hospital (#28-08). Regarding statistical analysis, we used the Kaplan-Meier test (log-rank) by SPSS version 19 for the cumulative 90-day in-hospital mortality in correlation with several factors mentioned above. Data are presented as mean ± SEM, and a p value of <0.05 was considered statistically significant.

Results

During the study period, we reviewed 3504 patients (male, 2289; female, 1215; mean age, 61.3 ± 0.3 (range, 11-103) years) with acute illness or injuries who were admitted to our emergency-ICU or ward through the ED of our tertiary care center. The causes of admission were consciousness disturbance (n =494), respiratory failure (n =262), cardiac failure (n =386), intoxication (n =137), shock (n =722), metabolic disorders (n =69), extended burns (n =3), emergency surgeries under general anesthesia (n =312), successful resuscitation of cardiac arrest (n =227), major trauma (n =692), and others (n =201). Because of missing values, the SOFA and APACHE II scoresand the predicted mortality from the APACHE II score were finally calculated in 2455 of 2475 patients during the study period. Mean SOFA score was 3.7 ± 0.1 (range, 0-19), APACHE II score was 13.0 ± 0.2 (range, 0-49), and mortality was predicted in 21.7% ± 0.5% (range, 0.1% to 98.3%). n this study, the overall 90-day in-hospital mortality was 12.2% (429/3504), with no significant difference in the mortality by day of the week (Table 1). Regarding the time and day of admission, Table 1 summarizes several results by log-rank tests, suggesting marked differences in the mortality only in business hours/out-of-hours (p =0.03) and performance of emergency interventions (p =0.07) but not in other factors, including daytime/nighttime, weekday/weekend, and holidays/non-holidays.

Figure 2 shows the cumulative 90-day in-hospital mortality during regular business hours and out-of-hours in patients with or without emergency intervention, suggesting that the out-of-hours mortality was significantly higher than business-hours mortality in patients who did not undergo an emergency intervention (p =0.01); however, the mortality was similar between business hours and out-of-hours in patients with an emergency intervention (p =0.99).

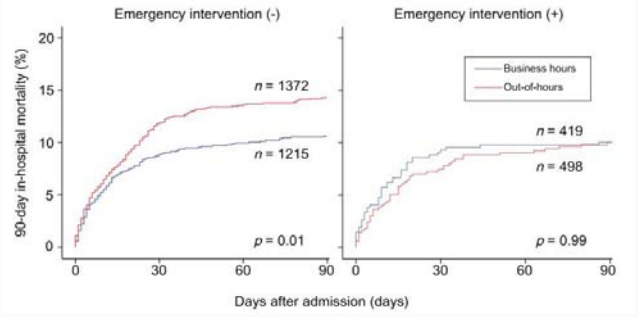

Figure 2: The 90-day in-hospital mortality between business hours and out-of-hours in patients with or without emergency interventions.
In patients who did not undergo an emergency intervention, the cumulative 90-day in-hospital mortality at the out-of-hours (red line) was significantly higher than that at the business hours (blue line; p =0.01). However, in patients with an emergency intervention, the mortality was similar between business hours (blue line) and out-of-hours (red line; p =0.99).

We compared the 90-day in-hospital mortality between business hours and out-of-hours in the daytime on the weekend to distinguish a clinical significance of the out-of-hours effect from that of the nighttime or weekend effects (Figure 1). In this study, the daytime weekend mortality was 7.3% (9/123) in business hours and 16.8% (47/280) in the out-of-hours, and the log-rank test suggested a significant difference between them (p =0.01).

Table 2 presents the SOFA and APACHE II scores and the predicted mortality from APACHE II among four groups: business hours/emergency intervention (-) (n =840), out-of-hours/emergency intervention (-) (n =929), business hours/emergency intervention (+) (n =305), and out-of-hours/emergency intervention (+) (n =381). Both the SOFA and APACHE II scores and the predicted mortality were higher at out-of-hours than those within business hours in patients without emergency interventions, whereas we observed similar scores between business hours and out-of-hours in patients receiving emergency interventions.

Discussion

In the present study, we found that the patient prognosis was affected by ED arrival of patients admitted to our tertiary care center.

The out-of-hours admission had a significant effect on the mortality of patients, whereas admissions during the night, weekend, or holiday did not. Previous studies have anticipated that the availability of emergency treatment contributed to the increased mortality related to the so-called “a night effect” or “weekend effect” in several illness and surgeries [1-3,6,8,11-13]. In this study, no significant differences were observed in the 90-day in-hospital mortality between business hours and out-of-hours among patients who received an emergency intervention, and the mortality was, in fact, better at out-of-hours than that at business hours in the early phase after admission. In contrast, among patients who did not receive an emergency intervention, the patient severity, such as SOFA and APACHE II scores, and the predicted mortality at out-of-hours were considerably higher than those at business hours, and the 90-day in-hospital mortality was also substantially higher at out-of-hours than that at business hours. Therefore, this study indicated that the primary reason for the augmented mortality at out-of-hours depended on the high severity of out-of-hours patients without emergency interventions. In patients without emergency intervention at out-of-hours, we presume that some patients could be too critical to benefit from receiving an emergency intervention, thereby resulting in the poor prognosis.

Although the precise reason is unknown, a significant effect was noted on the 90-day in-hospital mortality between business hours and out-of-hours rather than no significant differences between the daytime and nighttime and between the weekday and weekend could be attributed to not only relatively fewer patients admitted on the weekend than on weekdays but also that the weekend mortality was substantially higher in out-of-hours patients than in business-hours patients at our tertiary care center. This study revealed that the 90-day in-hospital mortality did not differ between business hours and out-of-hours in patients admitted to our tertiary care center and who underwent an emergency intervention. These findings were consistent with those of several previous studies [15,17], suggesting that earlier emergency interventions provide better patient outcomes.

In patients without emergency intervention, the fact that some patients did not receive one despite necessity because of out-of-hours could be a concern. Although a precise number of these patients remained unknown in this retrospective study, we believe that emergency interventions were always performed consistently throughout the week because the severity scores between business hours and out-of-hours were not different.

Study Limitations

This study was conducted at a single institution located in an urban downtown area in Tokyo, where the daytime population isfive times higher than the nighttime population. In addition, we did not include emergency pediatric patients or patients who underwent cardiovascular surgery in this study because they were admitted to another specific ward rather than our tertiary care center. Finally, we included patients transferred from another hospital in this study but investigated the time and day of the ED arrival similarly regardless of the transfer.

Conclusions

Among patients admitted to our tertiary care center, the 90-day in-hospital mortality was significantly higher at out-of-hours than that at business hours rather than at nighttime or weekend. The early emergency intervention enhanced the patient outcome even at out-of-hours similar to that at business hours. Furthermore, the poor outcomes of out-of-hours patients who did not receive an emergency intervention depended on their high severity reflected by high values of the SOFA and APACHE II scores and the predicted mortality.

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