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Original article

# Association between the visiting time and the clinical findings on admission in patients with acute heart failure

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ABSTRACT

*Background:* There have been few reports about the clinical significance of the time of admission for acute heart failure (AHF).
*Methods:* Five hundred thirty-one patients with AHF admitted to the intensive care unit (ICU) were analyzed. The patients were assigned to either the daytime HF group ($n = 195$, visited from 08:00 to 20:00, Group D) or nighttime HF group ($n = 336$, visited from 20:00 to 08:00, Group N). The clinical findings and outcomes were compared between these groups.
*Results:* The systolic blood pressure (SBP), the number of patients with clinical scenario (CS) 1, and the heart rate (HR) were significantly higher in group N (SBP, 171.0 ± 38.9 mmHg; CS 1, 80.9%; HR, 116.9 ± 28.0 beats/min) than in group D (SBP, 154.2 ± 37.1 mmHg; CS 1, 66.2%; HR, 108.6 ± 31.4 beats/min). The patients in group N were more likely to have orthopnea (91.1%) than those in group D (70.3%). A multivariate logistic regression model identified a SBP ≥164 mmHg [odds ratio (OR): 2.043; 95% confidence interval (CI): 1.383–3.109], HR ≥114 beats/min (OR: 1.490; 95%CI: 1.001–2.218), and orthopnea (OR: 2.257; 95%CI: 1.377–3.701) to be independently associated with Group N. The length of ICU stay was shorter in group N (5.8 ± 10.5 days) than in group D (7.8 ± 11.5 days).
*Conclusion:* The nighttime HF was characterized by high SBP, high HR, and orthopnea, and the length of ICU stay was shorter in the nighttime HF group.


## 1. Introduction

The European Society of Cardiology (ESC) guidelines proposed the clinical classification of acute heart failure (AHF) into five categories: peripheral edema/congestion; pulmonary edema; cardiogenic shock (low output syndromes); high blood pressure [hypertensive heart failure (HF)]; and right HF [1]. Peripheral edema/congestion and right HF might be classified as gradual onset presentations, while pulmonary edema and high blood pressure (hypertensive HF) might be classified as abrupt onset presentations [2,3].

Although these differences in the HF categories might influence the time of admission, there have so far been few reports examining the differences in the clinical findings of AHF according to the time of admission. It would be helpful for treating AHF to evaluate the differences in the clinical findings according to the time of admission. In the present study, we investigated the relationship between the time of admission and the clinical findings on admission, the management of HF, and the outcomes in patients with AHF.

## 2. Methods

### 2.1. Subjects

This study analyzed 531 patients with AHF who were admitted to the intensive care unit (ICU) of Chiba Hokusoh Hospital, Nippon Medical School between January 2004 and October 2011. The data were retrospectively reviewed from hospital medical records. AHF was defined as either new-onset HF or decompensation of chronic

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HF with symptoms sufficient to warrant hospitalization [4]. HF was diagnosed based on the Framingham criteria for a clinical diagnosis of HF, based on the satisfaction of 2 major criteria or 1 major and 2 minor criteria [2,5]. Patients with HF caused by acute coronary syndrome were excluded from this study, and the AHF patients with in-hospital onset were also excluded from this study.

### 2.2. Procedures

Patients were assigned to a daytime admission group (Group D), which included the patients admitted between 08:00 and 19:59, and a nighttime admission group (Group N), which included the patients admitted between 20:00 and 07:59. The average bedtime and wake-up time of Japanese people over 50 years of age have been reported to be around 22:00 and around 06:00, respectively. The nighttime was thus defined based on the average bedtime and wake-up-time, including the sleeping hours.

The study examined the differences in the clinical information on admission, treatments during the first 5 days, and the outcome between the two groups. The clinical findings included the systolic blood pressure (SBP), heart rate (HR), body temperature (BT), respiratory rate (RR), clinical scenarios (CS), presence of orthopnea, laboratory data, chest X-ray results (pulmonary congestion and pleural effusion), and left ventricular ejection fraction (LVEF) on echocardiograms between the two groups. The white blood cell count (WBC), blood urea nitrogen (BUN), total bilirubin, hemoglobin, brain natriuretic peptide (BNP), C-reactive protein (CRP), glucose, and arterial blood gas parameters (pH, $PCO_2$, $PO_2$, $HCO_3^-$, $SaO_2$) were evaluated as laboratory findings. The treatments included the use of respiratory supports and medications prescribed during the first 5 days. The duration of ICU stay, hospital stay, and in-hospital mortality were evaluated as outcomes.

The CS was defined based on a previous report [6]; CS 1: dyspnea and/or congestion with SBP >140 mmHg; CS 2: dyspnea and/or congestion with SBP 100–140 mmHg; CS 3: dyspnea and/or congestion with SBP <100 mmHg. Pulmonary congestion on chest X-rays was defined based on the expansion of bilateral pulmonary arteries in the hilar area or a butterfly shadow on the lung field, and pleural effusion was defined based on dulling of the cardiophrenic angle on at least one side of the lungs or the existence of a vanishing tumor. LVEF was calculated using the Teicholz method or Simpson's method on admission (Sonos 5500, Hewlett Packard, Palo Alto, CA, USA or Vivid I, GE Yokogawa Medical, Tokyo, Japan).

The significant factors associated with nighttime HF were determined by a multivariate logistic regression analysis. All variables that were identified to be significant by a univariate analysis on admission were selected for further evaluation using the multivariate logistic regression model. The arterial blood gas parameters (pH, $PCO_2$, $PO_2$, $HCO_3^-$, $SaO_2$) were significantly correlated with each other, therefore, the pH value was selected for evaluation in the multivariate logistic regression model. The continuous variables were evaluated by dividing subjects into two groups using a cut-off value. The cut-off value of the continuous variables was decided based on the median value.

### 2.3. Statistical analysis

All data were statistically analyzed using the StatView 5 software package (SAS Institute, Cary, NC, USA), and the SPSS 14.0J software program (SPSS Japan Institute, Tokyo, Japan). All numerical data were expressed as the mean ± standard deviation. An unpaired Student's *t*-test or a one-way analysis of variance (ANOVA) was used to compare mean values. Comparisons of all proportions were performed with a chi-square analysis. The factors that were not normally distributed were compared by the Mann–Whitney *U* test. A *p*-value of <0.05 was considered to be statistically significant. The significant factors associated with nighttime admission for HF were determined using the multivariate logistic regression model.

### 2.4. Ethical concerns

The institutional review board at Chiba Hokusoh Hospital, Nippon Medical School approved the study protocol.

## 3. Results

### 3.1. Patient characteristics

The distribution of AHF patients according to the time of admission is shown in Fig. 1. Patients were admitted most frequently

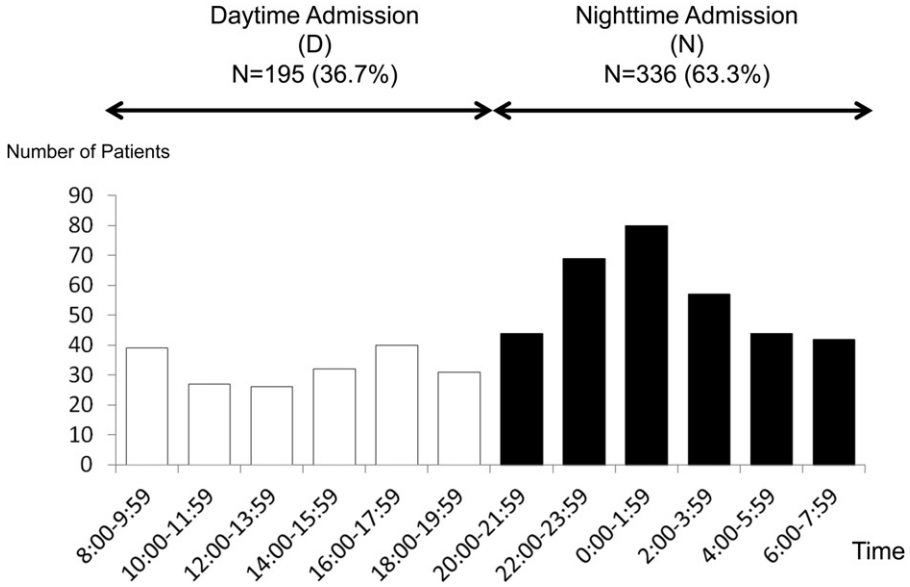


**Fig. 1.** The distribution of acute heart failure patients according to the time of admission. One hundred ninety-five patients (36.7%) were admitted during the day (between 08:00 and 19:59), and 336 patients (63.3%) were admitted at night (between 20:00 and 07:59).