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Intravenous crystalloid fluid for acute alcoholic intoxication prolongs emergency department length of stay

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ABSTRACT

Objectives: Acute alcohol intoxication is often treated in emergency departments by intravenous crystalloid fluid (IVF), but it is not clear that this shortens the time to achieving sobriety. The study aim was to investigate the association of IVF infusion and length of stay in the ED.

Methods: This single-center retrospective cohort study was conducted in Japan and included patients aged ≥ 20 years of age and treated for acute alcohol intoxication without or with IVF. The primary outcome was the length of the ED stay and the treatments were compared by time-to-event analysis.

Results: A total of 106 patients, 42 treated without IVF and 64 with IVF. The baseline characteristics of the two groups were similar. Kaplan–Meier analysis and the generalized Wilcoxon test found no significant difference between the two treatments in the time to ED discharge. The median time was 189 (IQR 160–230) minutes without IVF and 254.5 (203–267 minutes with IVF; $p = 0.052$). A Cox proportional hazards regression model adjusted for potential confounding variables found that patients treated with IVF were less likely to be discharged earlier than those treated without IVF (HR 0.54, 95% CI: 0.35–0.84, $p = 0.006$).

Conclusions: IVF for treatment of acute alcoholic intoxication prolonged ED length of stay even after adjustment for potential confounders. Patients given IVF for acute alcohol intoxication should be selected with care.

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1. Introduction

The number of alcohol intoxicated patients transferred to hospitals by ambulance is increasing annually [1–3], and is the most frequent alcohol-related disorder to present in emergency departments (EDs) [4]. These patients occupy ED observation beds [5], require substantial healthcare provider time and effort [6], and increase medical costs [7]. In many countries, treatment of patients with acute alcohol intoxication includes intravenous crystalloid fluid (IVF) [3,8,9]. Most physicians believe that IVF infusion promotes alcohol metabolism and shortens the time until awakening from alcohol intoxication [5,10]. However, data on the effectiveness of IVF for treatment of acute alcoholic intoxication is limited [11,12], and IVF may not affect long-term (4–6 h) blood alcohol clearance [3]. Whether IVF speeds awakening of patients with acute alcohol intoxication or shortens ED stay is not clear, and confirmation is

of importance. This study assessed the association of IVF treatment following acute alcoholic intoxication and length of ED stay.

2. Methods

2.1. Study design

The study was approved by the ethics committee of the Tokyo Bay Urayasu Ichikawa Medical Center and was conducted following the ethical guidelines of the Declaration of Helsinki. As the analysis was retrospective and patient information was anonymized and de-identified prior to analysis, the need for patient consent was waived. The study was conducted at a single-center, Tokyo Bay Urayasu Ichikawa Medical Center, a 344 bed urban acute care community hospital in eastern Tokyo, with an annual ED census of 29,938. It is a regional trauma center and designated stroke/cardiovascular center with a 24-h capability of percutaneous coronary artery intervention and infusion of tissue plasminogen activator.

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2.2. Study setting and population

In Japan, alcohol can be legally consumed beginning at 20 years of age. Patients with acute alcohol intoxication seen at the hospital between April 1, 2013 and March 31, 2015; who were ≥ 20 years of age, had a laboratory-estimated blood alcohol concentration (BAC), and required observation in the ED were eligible. Patients who were admitted to the hospital, with trauma or other medical problems that required ED observation, who had taken sedating medications in combination with alcohol, or with aggressive behavior that prevented compliance with medical instructions were excluded.

2.3. Study protocol

Uncomplicated alcohol intoxication was diagnosed by patient history, physical examination, and laboratory testing that excluded patients with the criteria listed above. Histories were obtained by interviewing patients, others in attendance, and ED medical staff. Patient evaluation included 11 signs of alcohol intoxication. These were the smell of alcohol, impaired fine motor control, impaired gross motor control, slurred speech, change in speech volume, decreased alertness, sweating, slow and/or shallow breathing, sleepiness, change in speech speed, and red eyes [13]. Patients were also evaluated for trauma. BAC was estimated as follows [1,14].

$$\text{BAC (mg/dl)} = \text{serum osmolar gap} \times 4.6 \quad (1)$$

Serum osmolar gap

$$\begin{aligned} &= \text{measured plasma osmolality (mOsm/kg)} - 2 \text{ Na}^+ \text{ (mEq/L)} \\ &+ \text{urea concentration (mg/dL)}/2.8 \\ &+ \text{glucose concentration (mg/dL)}/18 \end{aligned} \quad (2)$$

Laboratory testing was performed with a TMA—2000FR chemistry analyzer (Toshiba Medical Systems Corporation, Japan), Centaur CP immunoassay system (Siemens Healthineers, Germany), and an OM-6060 osmometer (Arkray, Japan). IVF and imaging were performed at the discretion of the treating physician. Normal saline was used for IVF. Patient blood pressure, heart rate, respiratory rate, and oxygen saturation were continuously monitored. Responsiveness was monitored routinely, and Glasgow Coma Scale (GCS) scores were recorded until clear consciousness was achieved.

2.4. Measurements

Data were obtained from hospital medical records and included ten variables that might affect the study outcome. These were sex, age, initial GCS, time of ED visit, trauma, computed tomography (CT) scans, escort when leaving the hospital, estimated BAC, IVF, and length of stay (LOS) in the ED. The variables were chosen by clinical relevance and previous studies [11,15]. The number of self-removals of peripheral intravenous catheters by patients given IVF infusions was also recorded.

2.5. Outcomes

The primary outcome was the LOS, defined as the time from the initial medical staff contact to ED discharge. Intoxicated patients were discharged if they were alert, had a GCS of 15, were able to walk independently and safely, had no condition or injury requiring further evaluation or treatment, and were judged as safe for discharge by the attending physician. IVF was discontinued when the attending physician judged the patient safe for discharge.

2.6. Data analysis

Based on a pilot evaluation, we expected that by 200 min of a total 700 min of observation, 55% of those without IVF, and 30% of those

with IVF would be discharged. It was estimated that a sample of 102 patients would be needed to detect the difference between those groups with a power of 80% and a two-sided significance level of 0.05. Continuous values were expressed as medians and interquartile range (IQR). Categorical values were expressed as n (%). Patient characteristics and outcomes were evaluated using the chi-square test for categorical variables and the Mann-Whitney *U* test for continuous variables, including the outcome, as appropriate. A time-to-event analysis was performed to evaluate the effects of IVF on LOS, medians and IQRs were obtained by Kaplan–Meier analysis, and the generalized Wilcoxon test was used to assess the effect of IVF administration. Adjusted hazard ratios (HRs) of ED discharge time were obtained with Cox proportional hazards regression adjusted for potential confounding factors. HRs and their 95% confidence intervals (CI) for the study outcome were calculated. The potential confounders, factors that were biologically relevant, considered as possibly associated with outcome were included in the Cox proportional hazards model. They were sex, age, initial GCS, visit time (daytime was 8 am to 8 pm and nighttime was 8 pm to 8 am), trauma (yes/no), head CT scan (yes/no), escorted when leaving the hospital (yes/no), and estimated BAC. The statistical analysis was performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R 3.3.4 (R Foundation for Statistical Computing, Vienna, Austria) that adds statistical functions frequently used in biostatistics [16]. A *p*-value < 0.05 was considered statistically significant. A sensitivity analysis was used to determine the consistency of the association between the IVF and LOS. The multiple linear regression analysis was repeated with LOS in the ED as a continuous variable.

3. Results

3.1. Characteristics of study population

During the study period, 286 patients presenting in the ED were diagnosed with acute alcohol intoxication; 106 were found eligible and were included in the analysis. Patient selection and disposition are shown in Fig. 1. The baseline characteristics of the included patients are shown in Table 1. Sixty-four (60.4%) patients were treated with IVF, and there were no statistically significant differences in any of the demographic or clinical variables in the two study groups, and univariate analysis found that the two groups were similar at baseline. No patients had hypoglycemia or electrolyte abnormalities that needed treatment.

3.2. Main results

The median LOS was 189 min (142.5–266.75) for patients with IVF and 254.50 min (171.5–296.25) for those without IVF. The difference in LOS was not significantly different (Mann–Whitney *U* test, $p = 0.057$). The number of patients and their LOS are shown in Fig. 2. Four patients in the IVF group (6.3%) removed the peripheral intravenous catheter by themselves. As shown in Fig. 3, the effect of IVF infusion on LOS was estimated by the Kaplan–Meier method and the outcomes in the two study groups were compared by the generalized Wilcoxon test. The difference in cumulative probability of ED discharge of patients in the two study groups was not significant. The median minutes to discharge was 189 (160–230) minutes without IVF infusion and 254.5 (203–267) minutes with IVF ($p = 0.052$). When adjusted for potential confounding variables, Cox proportional hazards regression (Table 2) indicated that patients treated with IVF were less likely to be discharged from the ED sooner than patients treated without IVF (HR 0.54, 95% CI: 0.35–0.84, $p = 0.006$).

The result of a sensitivity analysis was consistent with multiple linear regressions. A time-to-event analysis with the LOS as a continuous variable confirmed that IVF infusion prolonged the LOS (beta coefficient 56.83, 95% CI 17.08–96.58, $p = 0.006$).

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