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Analysis of the Alarms From a Blood Purification Machine During Continuous Haemodiafiltration

Sürekli Hemodiafiltrasyon Süresince Kan Pürifikasyon Cihazından Gelen Alarmların Analizi

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Dear Editor,

Continuous haemodiafiltration (CHDF) is useful to maintain the volume of body fluid and electrolytes in a patient in whom haemodynamic instability has developed (1). Because CHDF does not require a dialysis fluid delivery system, it can be performed regardless of the patient's location. However, the details of difficulties in CHDF implementation remain unclear. In this study, we aimed to analyse the equipment alarms during CHDF. We also investigated the correlation between the frequency of alarms and patient's haematological and inflammatory status.

After the institutional review board approval was obtained, this multicentre study was performed retrospectively in the Kobayashi Municipal Hospital, Miyazaki Prefectural Nobeoka Hospital and University of Miyazaki. Patients who underwent CHDF for acute or chronic renal failure from January 2014 to September 2015 were enrolled. Patient information and blood test results were obtained from the electronic health record system of each hospital. CHDF was performed using one type of blood purification machine, ACH-Σ (Asahi Kasei Medical, Tokyo, Japan). Recorded alarm histories were obtained from ACH-Σ and evaluated using a software program (Σ Log Helper ver 3.04d, Asahi Kasei Medical, Tokyo, Japan). The statistical relationship between the frequency of alarms and a patient's haematological and inflammatory status was evaluated by Spearman rank correlation analysis using statistical software (JMP 8, SAS Institute, NC, USA). Statistical significance was set at $p<0.05$.

Twenty-seven patients were enrolled. Causes of admission were sepsis (22%), peritonitis (11%), acute cardiac infarction (7%), acute respiratory failure (7%), etc. Most of the patients received CHDF due to acute kidney injury. The same type of temporary vascular access (Blood Access UK Catheter Kit, 12 Fr, Unitika, Tokyo, Japan) and CHDF circuit (CHDF-SGB, Naniwa Rubber, Nara, Japan) were used in all the patients. Insertion sites for the temporary vascular access were internal jugular vein (right: 22%; left: 11%) and femoral vein (right: 59%; left: 7%). As for a CHDF membrane, four types of dialysers were used [AEF-10: 37% (Polysulfone dialyser, Asahi Kasei Medical, Tokyo, Japan), CH-1.0N: 30% and CH-1.8W: 22% (Polymethylmethacrylate dialyser, Toray Medical, Tokyo, Japan) and UT1100S: 11% (Cellulose triacetate dialyser, Nipro Medical, Osaka, Japan)]. Nafamostat mesilate was used as anticoagulant in all CHDFs. The average CHDF time was 118±100 h (mean±SD).

Alarms during CHDF were allowed in all patients. The total number of alarms that went off was 3399. The most common recorded alarm was caused by extremely negative prepump pressure (automatic recovery) (47.9%). The others were blood pump stop alarm due to low prepump pressure (14.2%), empty dialysate bag (9.5%), empty replacement fluid bag (3.4%), etc. According to the details of the alarm occurrence, temporal disturbance of the blood flow through the vascular access catheter was the most common cause of problems with CHDF implementation.

The frequency of alarms, which was 1.2±1.7 times/h, significantly correlated with the decrease in platelet count (correlation coefficient; $R=-0.551$, $p=0.003$) and the increase in C-reactive protein level ($R=0.523$, $p=0.005$). There were no significant

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correlations between the frequency of alarms and patients' white blood cell count, erythrocyte count, haemoglobin level and blood coagulation function (prothrombin time and activated partial thromboplastin time).

Inflammation stimulates blood clotting and disrupts the balance of coagulation systems (2). Sepsis-induced anticoagulant dysfunction, which is caused by a marked inflammatory response, makes CHDF difficult (3). In this study, a significant correlation was observed between the alarms during CHDF and patients' inflammation levels. Disruption of the balance of coagulation systems due to inflammation with thrombocytopenia might be related to incidents during CHDF implementation. Because the insertion site for the temporary dialysis catheter influences circuit life in CRRT (4), our results should be reconsidered in light of this condition. In addition, due to the small number of patients in this study, a further broad-scale analysis should be performed.

In conclusion, the most common incident during CHDF implementation was blood removal failure. Inflammation and thrombocytopenic disorder might be related to difficulties in CHDF implementation. The incidents observed in this study were mostly temporal problems that were fixed by automatic restoration.

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