

Remarkable Improvement of Hemodynamics by Continuous Hemodiafiltration in Patients after Operation for Thoracic Aortic Dissection

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Severe circulatory failure after cardiovascular surgery is occasionally difficult to treat and the mortality risk is high. Systemic inflammatory response syndrome (SIRS) is one of the complications resulting in circulatory failure and, continuous hemodiafiltration (CHDF) seems to be a potentially effective treatment to improve the critical condition by removing proinflammatory cytokines. We present two recent cases of SIRS with critical circulatory failure which were successfully treated by CHDF after operation for thoracic aortic dissection. (Ann Thorac Cardiovasc Surg 2005; 11: 277–80)

Key words: systemic inflammatory response syndrome, continuous hemodiafiltration, circulatory failure, cardiovascular surgery

Introduction

Systemic inflammatory response syndrome (SIRS) is a serious problem after cardiovascular surgery inducing multiple organ dysfunction syndrome (MODS). Some recent reports have shown that continuous hemodiafiltration (CHDF) has beneficial effects for treating SIRS by removing cytokines.^{1,2} However, SIRS complicated with MODS still has high mortality after cardiovascular operation. We report two recent cases of thoracic aortic dissections who suffered severe SIRS with MODS after operation, and both showed remarkable improvement of hemodynamics by the induction of CHDF.

Case Report

Case 1

A 66-year-old man who had undergone a Koster-Collins

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operation two years previously showed enlargement of the dissecting distal aortic arch aneurysm to 69 mm in diameter. He underwent replacement of the distal aortic arch with reconstruction of the left subclavian artery with cardiopulmonary bypass (CPB) and selective cerebral perfusion (SCP). As the adhesion of the left lung was very hard, severe bleeding from the injured lung occurred. The times of operation and CPB were 750 and 448 min, respectively. Swelling of the right lower leg occurred due to arterial access. Postoperative maximum blood level of creatinine phosphokinase was 35,400 U/L. Ventilation was performed only in the right lung the morning after operation due to bleeding from the left lung. Oliguria due to hypotension with normal cardiac index (CI) continued despite high dose administration of norepinephrine (1 μ g/kg/min). White blood cell count was elevated to 20,430/ μ l and high grade fever up (39.1°C) was evident. In addition to acute renal failure (ARF), those critical conditions were suspected to be the result of SIRS. Venovenous CHDF using polyacrylonitrile (PAN) membrane hemofilter (Asahi Medical Co., Ltd., Tokyo, Japan) was started with the administration of nafamostat mesilate at the second postoperative day. Hypotension improved after the initiation of CHDF followed by amelioration of his general condition including renal function with slight removal of the water from the CHDF

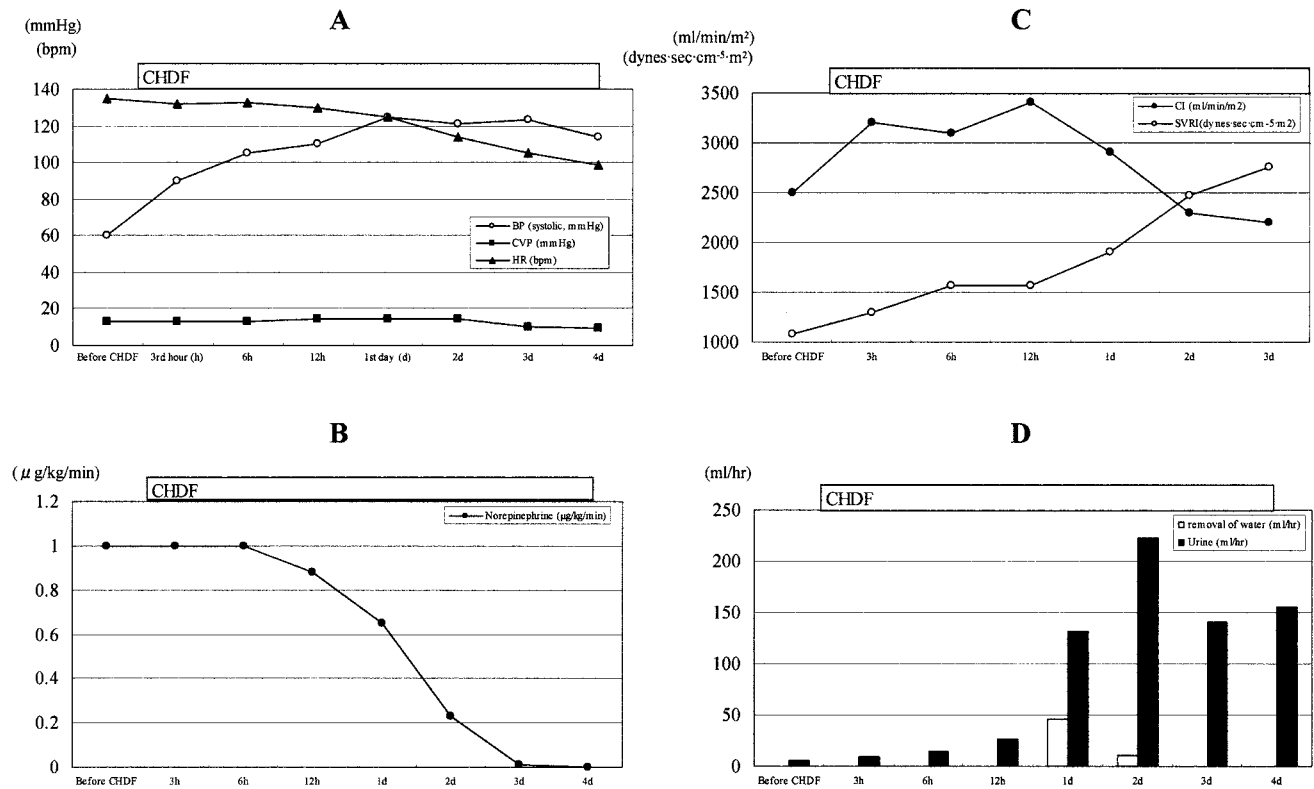


Fig. 1. Course after the operation in case 1.

BP, blood pressure; CVP, central venous pressure; HR, heart rate; CI, cardiac index; SVRI, systemic vascular resistance index.

(Fig. 1). CHDF was terminated at the 6th postoperative day (4th day after the initiation of CHDF). The patient was weaned from the respirator on the 8th postoperative day. Although the patient needed long term care to improve his respiratory condition and provide rehabilitation, he was ambulatory when he was discharged from the hospital on the 65th postoperative day.

Case 2

An 82-year-old man was transferred to our hospital diagnosed with an acute type A dissection complicated by cardiac tamponade. Although he needed emergent operation, his blood type was Rh(-) and he had to wait for five hours before undergoing the operation due to blood availability for transfusion. As hypotension continued and severe acidosis progressed, endotracheal intubation and pericardial drainage were performed before operation. Graft replacement of the ascending aorta was done with support of CPB with SCP. The times of operation, cardiac arrest and CPB were 386, 113 and 245 min, respectively. Postoperative hypotension continued despite high dose administration of norepinephrine (0.8 $\mu\text{g}/\text{kg}/\text{min}$). High grade fever (38.3°C) was also present. Additionally, the

patient’s clinical course was complicated with anuria due to circulatory failure and respiratory failure due to lung edema. SIRS seemed to cause his severe circulatory failure and ARF was also evident, venovenous CHDF using PAN membrane hemofilter was commenced with administration of nafamostat mesilate 15 hours after the surgery. As hypotension improved, removal of water from CHDF was started as a strategy to treat ARF and lung edema (Fig. 2A and D). PaO₂/FiO₂ ratio improved gradually and the renal function recovered from the 3rd day after beginning CHDF (Fig. 2C and D). The patient was weaned from the CHDF at the 5th postoperative day (5th day after initiation CHDF) and from the respirator at the 8th postoperative day. Postoperative echo cardiography revealed normal cardiac function without aortic regurgitation. Thereafter, he recovered without any significant problems and was moved in an ambulatory condition to another hospital for recuperation on the 40th postoperative day.

Discussion

The toxic substances responsible for SIRS are believed

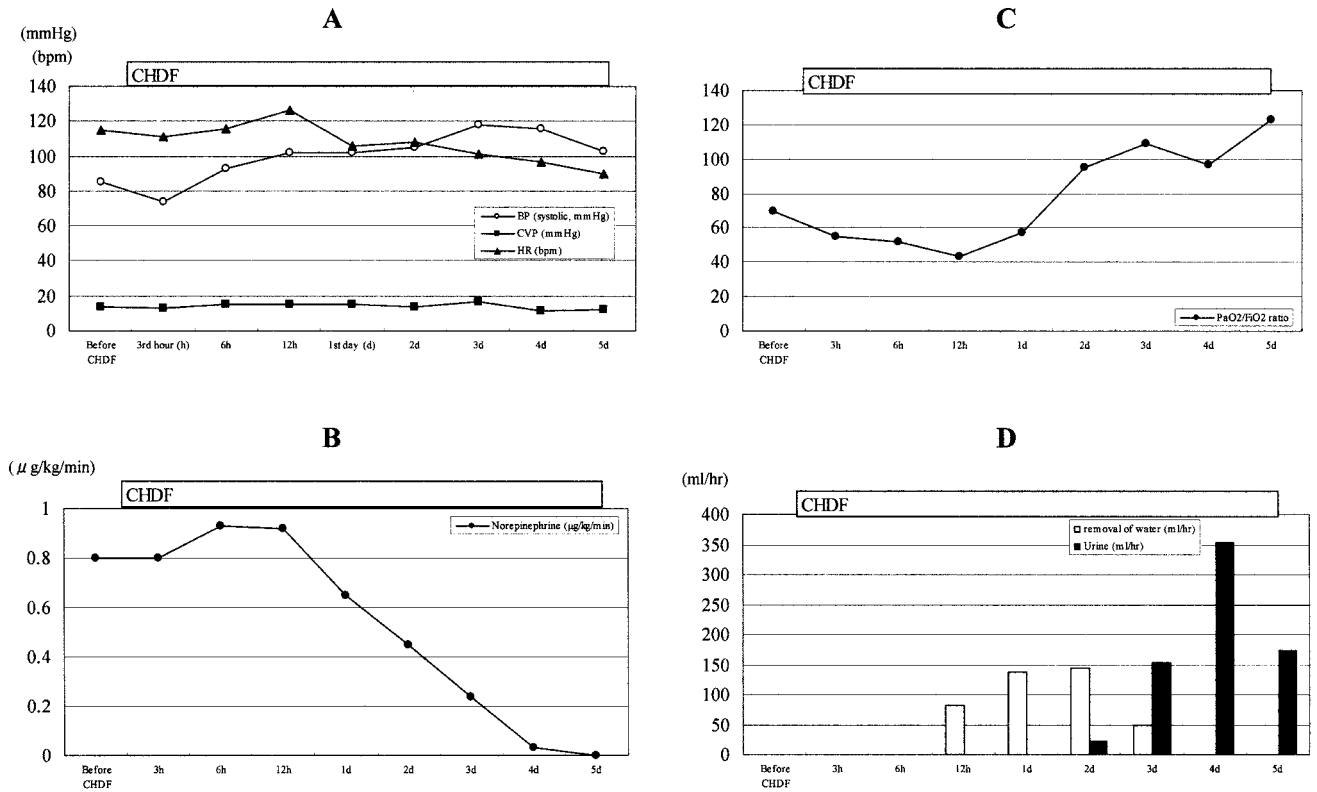


Fig. 2. Course after the operation in case 2.

to be proinflammatory cytokines and the critical state of SIRS shows the morbidity of septic-shock. Cardiovascular surgery can induce hypercytokinemia resulting in secondary MODS because it utilizes CPB which is reported to increase some cytokine levels in blood.^{3,4} Although the two cases in this report meet the criteria of SIRS, the importance is the existence of MODS which is often lethal. Critical circulatory failure that required high dose of α -constrictor which can furthermore attenuate the perfusion of organs was recognized in these cases postoperatively, and consequently ARF occurred. Over hydration during surgery to manage hypotension and the presence of generalized edema postoperatively can also impair organ function and cause heart failure, which were complications seen in cases in this report. Both cases in this report required intervention to improve their hemodynamics, and CHDF was considered a suitable therapeutic strategy to manage the combined complication of ARF and circulatory failure resulting from SIRS.

There is some evidence that CHDF improves hemodynamics in SIRS patients in critically ill condition with the use of various membrane hemofilters.^{1,5,6} Removal of cytokines is the most plausible explanation for the im-

provement of severe SIRS, and recent reports have shown that CHDF was able to remove cytokines including TNF- α , IL-6 and IL-8.^{1,2} To date however, there are few reports describing the decrease of blood level of certain cytokines using various types of membrane.^{2,6,7} Nakae et al. reported that PAN membrane, which is the hemofilter we used, decreased the blood levels of TNF- α and IL-8.² Although it was not fully clarified whether PAN membrane functions through the principle of convection, adsorption or another mechanism to reduce cytokines, severe circulatory failure due to suspected SIRS following cardiovascular operation was improved by initiation of CHDF treatment. CHDF using PAN membrane was therefore suggested to be effective in these patients by decreasing certain cytokines.

The starting point of CHDF treatment was important after these operations because bleeding from the airway was serious in case 1 and thrombosis of the false lumen was critical in case 2, despite nafamostat mesilate not affecting systemic coagulability to any degree. We believe that delaying the start of CHDF treatment until after hemostasis is achieved following cardiovascular surgery is safer. The efficacy of CHDF for the amelioration

of critical circulatory failure resulting from SIRS was very impressive in these cases, and removal of excess water from the body was possible within several hours after the initiation of CHDF resulting in improved circulation to vital organs.

Critical circulatory failure after cardiovascular surgery shows complex morbidity and high mortality. Based on the favorable outcome of these two cases, CHDF is highly recommended as adjunctive treatment to consider for management of critical conditions resulting from SIRS with MODS after cardiovascular surgery.

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