A CASE OF FULMINANT MYOCARDITIS RESCUED — By Long-Term Percutaneous Cardiopulmonary Support —

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We report the case of a 41-year-old man with acute fulminant myocarditis. The patient went into cardiac standstill immediately after admission and was placed on a percutaneous cardiopulmonary support system. The system remained in place for 302 h, after which the patient recovered from cardiogenic shock without complications and has returned to normal life.

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PROGNOSIS in cases of fulminant myocarditis is generally poor¹, but in some cases the deterioration of cardiac function is reversible if the patient can be brought through the critical phase with the aid of a cardiopulmonary support system². Percutaneous cardiopulmonary support (PCPS) systems have only recently been developed, and there are few reports of their use for extended periods of time. In this case, however, asystole occurred in a patient with fulminant myocarditis immediately after admission, and PCPS was initiated. Use of a simple PCPS circuit and continuous administration of nafamostat mesilate made it possible to use PCPS for a total of 302 h before the patient recovered.

CASE REPORT

The patient was 41 years old, with no particular family or past history. There were no symptoms of initial infection until the even-

ing of May 19, 1992, when he began feeling lethargic. This feeling increased over the next day until he was unable to move. On the evening of May 20, he began to complain of a chest pain. He was brought to the emergency room on the early morning of the 21st.

The patient was fully alert when brought to the hospital, but was covered with a profuse clammy sweat and was clearly in shock. Height was 174 cm, weight 54 kg, heart rate 82 beats per minute and regular, blood pressure 40 mmHg, and temperature 35.3 °C. There was no ocular jaundice or anemia. There were also no heart murmurs or pericardial friction rub. Wet rales were audible in both lungs, and the liver was palpable three finger-breadths below the right costal margin.

Chest x-ray showed that cardiothoracic ratio had increased to 59 percent, and there was slight pulmonary congestion (Fig. 1a). ECG showed a left axis deviation, with a slight elevation of the ST segment in V2 to V5 (Fig. 1b). Echocardiography revealed a severe weakening of ventricular wall motion, accompanied by slight pericardial effusion. Laboratory results showed metabolic acido-

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1a

1b

Fig.1. Chest roentgenogram (a) and ECG (b) on admission.

TABLE I LABORATORY RESULTS ON ADMISSSION

<i>Hemogram and blood chemistry</i>			
WBC	8500/mm ³	LAP	159 IU/l
RBC	4.62 × 10 ⁶ /mm ³	CHE	199 IU/l
Hb	14.0 g/dl	LDH	1796 IU/l
Ht	43.1%	CK	487 IU/l
Plt	241 × 10 ⁶ /mm ³	BUN	21.0 mg/dl
		CRE	1.5 mg/dl
TTT	1.0 U	TP	4.8 g/dl
ZTT	4.8 U	ALB	2.7 g/dl
GOT	551 IU/l	Na	150 mEq/l
GPT	182 IU/l	K	3.8 mEq/l
T-Bil	1.3 mg/dl	Cl	101 mEq/l
ALP	321 IU/l	CRP	0.36 mg/dl
<i>arterial blood gas</i>			
pH	7.310	HCO ₃ ⁻	7.8 mEq/l
PaCO ₂	15.2 torr	TCO ₂	8.2 mEq/l
PaO ₂	79 torr	Base excess	-15.2 mEq/l

sis and an increase in creatine kinase (CK) (Table I). We suspected acute myocarditis or acute myocardial infarction, cannulized the right femoral artery and vein with intravenous catheters, and placed the patient in the coronary cate unit (CCU) while preparations

were made for cardiac catheterization.

Immediately after entering the CCU, the patient fell into bradycardia and cardiac arrest. The previously inserted femoral catheters were exchanged for cannulas and PCPS was initiated at a rate of 3.9 l/min, us-

Fig.2. Serial Changes of Hemodynamics.

HR: heart rate, BP: arterial blood pressure, PAP: pulmonary arterial pressure, CVP: central venous pressure, SvO₂: oxygen saturation of central venous blood, DOA: dopamine, DOB: dobutamine, WMS: wall motion score, PCPS: percutaneous cardiopulmonary support, IABP: intraaortic balloon pumping.

Fig.3. Laboratory results after admission.

GOT: glutamic oxaloacetic transaminase, GPT: glutamic pyruvic transaminase, LDH: lactate dehydrogenase, T.BIL: total bilirubin, D.BIL: direct bilirubin, WBC: white blood cell, Hb: hemoglobin, Plt: Platelet, BUN: blood urea nitrogen, Cre: creatinin, CRP: C-reactive protein.

Fig. 4. Left ventriculogram in the right anterior oblique projection (RAO) on admission (a) and on the 102nd hospital day (b). ED; end-diastolic, ES; end-systolic.

TABLE II VIRUS NEUTRALIZING ANTIBODIES

	Admission	Day 18	Day 61
<i>Coxsackie B4</i>	×8	×512	×32
<i>Adeno 5</i>	×32	×256	×32

ing the following equipment; cannula: 96017, Femoral Cannula, DLP, MI, USA, Oxygenator: UNIVOX, Bentley/Baxter, CA, USA, Pump: BP80, Biopump, Medtronic Bio-medicus, MN, USA. Emergency coronary angiography showed no abnormalities, which indicated that the cause was acute myocarditis, accordingly, biopsies of the myocardium were taken from the septum of both ventricles. At the same time, a catheter for intra-aortic balloon pumping (IABP) was inserted into the left femoral artery.

Parameters of cardiovascular dynamics signs stabilized after PCPS and IABP were

initiated, and PCPS flow was reduced gradually. To prevent blood coagulation, nafamostat mesilate and heparin were given continuously to ensure activated clotting time of 200 sec. A growing plasma leak in the oxygenator at 15 h after the start of PCPS forced a change in the oxygenator to EL4000, MENOX, Kuraray, Hiroshima, JPN, while the circuit tubes were changed to Silastic Medical-Grade Tubing, Dow Corning, MI, USA. The patient was also treated with catecholamine and methylprednisolone (Fig. 2).

On the third day, echocardiography showed some improvement in wall motion, and on the following day PCPS flow was reduced from 2.8 to 2.2 l/min. However, after frequent ventricular premature contractions and a drop in oxygen saturation of central venous blood (SvO_2), flow was restored to 2.8 l/min. On Day 6, complications of pneumonia and atrial fibrillation led to deterioration in hemodynamics, with con-

Fig. 5. Histopathology of left ventricular biopsy specimens taken on admission (a) and on the 102nd hospital day (b). (hematoxylin eosin staining, $\times 400$)

tinuing respiratory and cardiac insufficiency, making removal of PCPS impossible. On Day 10, liver failure was complicated by the prospect of possible renal failure (Fig. 3). By Day 13, cardiac function and pneumonia had improved, and the patient was successfully removed from PCPS. IABP was discontinued on Day 15. Wall motion index (WMI) was measured by echocardiography³ to periodically evaluate left ventricular function (Fig. 2). Upon admission, WMI was 24 points with an ejection fraction (EF) of 18% (LVG), but on Day 102, this had improved to WMI 8 points and EF 53% (Fig. 4).

Serum was assayed for virus-neutralizing antibodies upon admission and on Days 18 and 91. There was a significant increase in Coxsackie B4 and Adeno 5 (Table II).

Biopsies of myocardial tissue were taken upon admission and on Day 102. Irregular nuclei were observed upon admission, but no inflammatory infiltration, myocardial necrosis, or other changes were observed (Fig. 5a). In the chronic stage, there was some exfoliation of myocardium, along with fibrosis and slight inflammatory infiltration (Fig. 5b). On September 16, 1992, the patient was discharged, and, although he is taking medication to prevent arrhythmia, has returned to normal life.

DISCUSSION

Based on the clinical course, coronary angiography, and the increase in antibodies for Coxsackie B4 and Adeno 5, the case was

considered clinically to be one of fulminant myocarditis caused by these viruses. No significant inflammation was seen in biopsy specimen specimens in the acute phase, but the chance of a successful diagnosis was reported to be near 50% when 4 to 5 samples were taken from patients with histologically confirmed myocarditis⁴. Thus, we could not exclude the presence of myocarditis with these specimens. Biopsy specimens in the chronic phase met the Dallas criteria for resolved myocarditis with fibrosis⁵.

Cardiac dysfunction due to myocarditis is thought to be reversible⁶, although the level of recovery is different in each case. Given that failure is bilateral, PCPS appears to be a highly effective form of therapy, since it enables the patient to rebound from acute cardiogenic shock, and relieves the load on the heart to allow gradual recovery of myocardial function⁷.

The prolonged use of PCPS in this case was considered acceptable because the patient was in critical condition and experiencing cardiac arrest, and recovery of heart function was extremely slow. Moreover, progress was retarded by complications, including pneumonia and multiple organ failure. The benefits of PCPS are the speed with which it can be initiated and its non-invasive nature, since surgical opening of the chest is not required. Its disadvantages are include hemorrhage from the catheter insertion site and peripheral ischemia distal to the cannulation. Long-term use also exacerbates the action of the coagulation system and

causes a breakdown in blood including hemolysis, while infection can lead to multiple organ dysfunction. For these reasons, long-term use has generally been considered inadvisable.

To reduce the effect of collision with foreign particles on blood, we eliminated the heater and reserve section from the PCPS circuit to shorten and simplify circulation through the system as much as possible. Using an appropriately-sized cannula and the best available oxygenator were also important for reducing the effects of pressure loss and damage to the blood within the PCPS circuit. The continuous administration of nafamostat mesilate, which not only has an anti-thrombin, anti-plasmin effect which suppresses both the coagulation and fibrolytic systems, but also an anti-complement effect, was key to the long-term use of PCPS⁸. This treatment may have been effective in preventing blood coagulation and bleeding, as well as critical organ failure. As a result, the patient was able to remain on PCPS for 302 h before the cardiac function was restored without fatal complications.

The possibility of adapting PCPS for long-term use and the speed with which this system can be implemented, indicate that it may represent the most effective known treatment for fulminant myocarditis. From resuscitation to relief of cardiogenic shock

and restoration of cardiac function, PCPS may be expected to play an increasingly important role in future therapy regimens.

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