

Timing of Conversion from Percutaneous Cardiopulmonary Support System to Left Ventricular Assist System for Severe Fulminant Myocarditis

[Letter regarding “Successful Management of Fulminant Myocarditis with Left Ventricular Assist Device: Report of a Severe Case” (Ann Thorac Cardiovasc Surg 2010; 16: 48–51)]

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Congratulations to Unosawa, et al., who succeeded in using a left ventricular assist system (LVAS) for severe fulminant myocarditis that was a percutaneous cardiopulmonary support system (PCPS) refractory.¹⁾

Fulminant myocarditis is an inflammatory disease and may lead to rapid cardiac deterioration and death. PCPS is widely known to be effective for resolving the circulatory collapsed status caused by this disease. However, aside from cases in which lives were saved with PCPS, it is speculated that there are many the cases in which the patient died because it was too late to shift the LVAS. Because LVAS implantation is an invasive procedure, judging the best time to shift from PCPS to LVAS is critical, but difficult.

We treated a 15-year-old female (ht 154 cm; wt 47 kg; BSA 1.43 m²) suffering from cardiogenic shock resulting from fulminant myocarditis by PCPS and intra-aortic balloon pump (IABP). Despite conservative treatment for high fever, her general condition had been gradually deteriorating, and it eventually collapsed. Here was her condition when she arrived at an intensive care unit: BP 50/-mmHg; HR 130 bpm; PaO₂ 60 torr (under O₂ 10 L/min mask), under dopamine 7 µg/kg/min and noradrenaline 0.05 µg/kg/min. Then, PCPS (right femoral arterial,

16 Fr; right femoral vein, 20 Fr) and IABP (8 Fr, left femoral artery) were then inserted immediately. Two to three days after PCPS and IABP, her hemodynamic status was as follows: BP 70/46 mmHg, HR 103 bpm, CVP 13 mmHg, C.I. 1.7 L/min/m², under PCPS 3.4 L/min, IABP 1 : 1, dopamine 10 µg/kg/min, dobutamine 3 µg/kg/min, and hANP 0.1 µg/kg/min. We had then thought that LVAS was essential because the LV function did not improve until 4 days after circulatory assist (LVDd/Ds 45/42, LVEF 16, BP 78/40 mmHg; HR 110 bpm, CVP 13 mmHg, C.I. 2.4 L/min/m², PCPS 3.2 L/min, IABP 1 : 1, dopamine 10 µg/kg/min, noradrenaline 0.02 µg/kg/min, hANP 0.1 µg/kg/min). However, improvement in the LV function was seen at 5 days after assists (LVDd/Ds 52/43, LVEF 38%, BP 80/46 mmHg, HR 110 bpm, CVP 15 mmHg, C.I. 2.8 L/min/m², under PCPS 2 L/min, IABP 1 : 1, dopamine 6 µg/kg/min, dobutamine 6 µg/kg/min, and hANP 0.1 µg/kg/min). PCPS was then weaned at day 6 after assists. These were the results 7 days after assists: BP 96/68 mmHg, HR 104 bpm, CVP 14 mmHg, C.I. 2.2 L/min/m², under IABP 1 : 1, dopamine 3 µg/kg/min, dobutamine 3 µg/kg/min, and hANP 0.1 µg/kg/min. Respirator and IABP were weaned at 9 days and 10 days after the assists, respectively. We reviewed retrospectively in this case; the PCPS-assisted flow was substantial (2.5–3.5 L/min), and her systolic BP of nearly 70–80 mmHg had been maintained with CVP of less than 15 mmHg. No significant sign of major organ damage (total bilirubin <2.0 mg/dl, urine output >1 ml/kg/hr) or complication resulting from PCPS or IABP were observed.

Generally, LVAS conversion may be necessary if appropriate systemic circulation (ex., systolic BP >80 mm, CI >2.0 ml/min/m², SvO₂ >65%) could not be maintained with low flow PCPS (<1.0 L/min) after a certain period of PCPS assist. Moreover, earlier LVAS conversion would be essential if major organ dysfunction damage is

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observed as a result of low output syndrome.

Aoyama et al. found that the average period of PCPS use for fulminant myocarditis patients who were successfully weaned from PCPS was 7.8 days.²⁾ Furthermore, high flow assist, bigger LVDd size, preserved EF, and thinner LV wall (which may be correspond to less edema) seemed to be positive impact factors in the weaning of PCPS.²⁾

We totally agree with the policy that LVAS should be applied prior to an increase in bilirubin. Hata et al. previously reported that early conversion from PCPS to LVAS, such as in 2 or 3 days, is better if no improvement of cardiac function is seen under PCPS.³⁾ This criterion may be appropriate for postcardiotomy shock, but we feel that it is too early to convert to LVAS in the treatment of fulminant myocarditis. If substantial flow and major organ function are preserved, it may be possible to watch the course for several more days. PCPS prolonged excessively may lose the opportunity to save a life with LVAS support. So we believe that 5 or 6 days after PCPS support is the best

timing to judge convert to LVAS or not. Actually, Unosawa et al. observed the clinical course for 5 days under PCPS.

The judgment of when and in which cases to move to LVAS is critical in clinical situations.

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Reply:

We thank Dr Tayama for his comments on our paper.¹⁾ It remains controversial when we should change percutaneous cardiopulmonary support (PCPS) to left ventricular assist device (LVAD) to treat fulminant myocarditis. We also agree to a strategy of Dr Tayama to convert into LVAD in 5 or 6 days after PCPS. Actually, we reported another case that we had converted into LVAD after 5 days under PCPS because major organ functions were preserved.²⁾

Reinhartz et al. reported that preoperative bilirubin level is identified as the most important predictor of survival in patients with LVAD support.³⁾ After a review of this case, we concluded that we should have switched to LVAD on the 3rd day following PCPS implantation when bilirubin level started increasing.

We also reported seven cases of fulminant myocarditis treated with PCPS.⁴⁾ Six of them were children and young people, and were successfully weaned within 4 days. However, elderly patients usually have a lack of functional reserves and tend to develop multiple organ failure (MOF). Especially in elderly patients, we should immediately make a decision to convert to LVAD from PCPS before MOF occur.

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