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Temporary use of unusually high dose of catecholamine improved severe ventricular dysfunction associated with stunned myocardium without significant myocardial injury in a post cardiac surgical patient: A case report

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ABSTRACT

INTRODUCTION: Some cardiac surgical patients present low cardiac output syndrome due to ventricular dysfunction resulting from postischemic myocardial stunning. We present a case of using unusually high dose of inotropes so that we could avoid mechanical circulatory support after cardiac surgery.

PRESENTATION OF CASE: A 65-year-old man underwent elective cardiac surgery. His immediate cardiac output was poor and vital signs were unstable. We aggressively increased the dose of catecholamine above usual dose and the cardiac output was elevated. The patient recovered without significant myocardial injury. After a few years, TTE showed more improved left ventricular function compared with preoperative state.

DISCUSSION: In a stunned myocardium, response to catecholamine is thought to be dull. Thus, if adequate response to usual dose of catecholamine is not achieved in a post cardiac surgical patient, we think that there may be a room for more increment of inotropes.

CONCLUSION: Unusually high dose of catecholamine may be helpful in a patient with severe ventricular dysfunction associated with stunned myocardium.

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1. Introduction

A number of cardiac surgical patients have difficulty weaning off cardiopulmonary bypass (CPB) due to various reasons including ventricular dysfunction resulting from postischemic myocardial stunning [1]. Even if separation from CPB was successful, many patients present low cardiac output postoperatively. In this case, therapeutic decisions whether to utilize inotropes or to apply mechanical support have to be taken quickly to improve the situation.

Here, we report a case involving a patient with severe ventricular dysfunction who underwent cardiac surgery. We increased the dose of catecholamine so aggressively that that we could avoid unnecessary mechanical circulatory support.

This paper is written according to the SCARE criteria [2].

2. Presentation of case

A 65-year-old man was admitted to our hospital for aggravated dyspnea. He had been followed up for his valvular heart disease at the cardiology department of our institution. On admission, transthoracic echocardiography (TTE) demonstrated severe aortic insufficiency and mitral steno-insufficiency. TTE also revealed a severely enlarged left ventricle (LV) with a diameter of 82 mm and LV dysfunction with a left ventricle ejection fraction (LVEF) of 33%, which were aggravated compared with last study. Coronary angiography showed no significant stenotic lesions. Computed tomographic (CT) angiography found aneurysm of ascending aorta with a diameter of 58 mm. An elective double valve replacement with combined ascending aorta replacement was planned.

Via standard median sternotomy, CPB was initiated through aortic and bicaval venous cannulae. After the patient was cooled down to 20 °C and total circulatory arrest (TCA) was started. Tailoring of ascending aorta and distal anastomosis of the vascular graft to ascending aorta were done. Then systemic perfusion was resumed and replacement of mitral and aortic valve with tissue valves was performed. There were no intraoperative events, but the patient weaned from CPB with high dose of inotropic support. The total CPB time was 377 min and the aortic cross clamp time was 249

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Table 1

Dose of continuously infused catecholamines, blood pressure and cardiac index according to timeline (cardiac index was not available after postoperative 3 days because Swan-Ganz catheter was removed).

Postoperative time	Dopamine (mcg/kg/min)	Dobutamine (mcg/kg/min)	Epinephrine (mcg/kg/min)	Nor-epinephrine (mcg/kg/min)	Blood pressure (mm Hg)	Cardiac index (L/min./m ²)
0 h	40	40	0.05	0.4	79/42	1.6
1 h	50	50	0.2	0.6	89/49	1.8
3 h	60	60	0.5	0.8	101/54	1.9
6 h	60	60	1.0	0.9	121/59	2.2
8 h	50	50	0.5	0.6	127/64	2.8
10 h	40	40	0.2	0.4	112/58	2.5
12 h	30	15	0.1	0.3	124/64	2.6
1 day	10	10	0.05	0.2	132/83	2.7
2 days	7	5	0.02	0.08	116/86	2.4
3 days	7	2	0.02	0 (stopped)	116/92	N/A
4 days	5	2	0 (stopped)	0	101/78	N/A
5 days	5	0 (stopped)	0	0	96/65	N/A
6 days	2	0	0	0	100/45	N/A
7 days	0 (stopped)	0	0	0	92/56	N/A

*The highest dose of each catecholamine used.

min including 15 min of TCA. The patient was transferred to the cardiac intensive care unit.

Immediate postoperative vital signs were unstable. Systolic arterial blood pressure was less than 80 mm Hg even though high dose of dopamine, dobutamine and norepinephrine (Table 1). Despite the absence of significant postoperative bleeding and signs of volume depletion, cardiac index monitored by Swan-Ganz catheter was not satisfactory (< 2.0 L/minute/m²). Moreover, systolic pulmonary arterial systolic pressure was elevated over 70 mm Hg. Arterial blood gas analysis showed persistent metabolic acidosis due to lactic acidosis. Therefore, we increased the dose of catecholamine with careful observation of vital signs and cardiac output. Until 6 h after operation, concentration of continuously infused dopamine, dobutamine and epinephrine had been titrated up at maximum to 60 mcg/kg/min, 60 mcg/kg/min, and 1.0 mcg/kg/minute, respectively. And then the vital signs became stable. Systolic blood pressure increased over 120 mm Hg and pulmonary arterial systolic pressure decreased below 60 mm Hg. Cardiac index also rose above 2.2 L/minute/m². Hourly urine output kept on exceeding 200 mL without the use of diuretics. Lactic acidosis also improved. The patient was extubated on the next day afternoon. Then we slowly tapered down catecholamines to the usual dose after a day. He stayed at intensive care unit for four days after surgery. On the seventh postoperative day, all intravenous inotropes were tapered off. Postoperative TTE demonstrated well-functioning both bioprosthetic valves and decreased LV volume. The highest creatine kinase-MB was 30.1 ng/mL postoperatively. Postoperative CT angiography (Fig. 1) showed usual postoperative findings. He was discharged on the fourteenth postoperative day without major complications. After a few years, follow-up TTE showed well-functioning prosthetic valves, normal LV volume and LVEF of 42%. The patient has been doing well for five years so far.

3. Discussion

This report demonstrates a successful management of low cardiac output syndrome resulting from postischemic myocardial dysfunction after cardiac surgery without mechanical circulatory support. The viable reperfused myocardium might not return to contracting properly immediately following reperfusion. The subsequent prolonged but transient postischemic dysfunction after reperfusion is known as the stunned myocardium [3]. Despite the optimal myocardial protection by several methods including cardioplegia, stunned myocardium is a well-recognized sequela of prolonged CPB [4]. In some institutions, inotropes were used routinely to reverse postischemic myocardial stunning or to normalize



Fig. 1. 3-dimensional reconstruction of postoperative computed tomographic angiography showing replaced ascending aorta and aortic valve.

blood pressure, even in the absence of clear documentation of ventricular insufficiency [5].

In our institution, we have a strategy of actively using high dose of catecholamines especially epinephrine in this postoperative setting. Even while baseline contractile function of the stunned myocardium is depressed, it retains the capacity to respond to various inotropic intervention [6]. In a stunned myocardium, response to cardiovascular drug is thought to be dull frequently. Thus, we think that increase of catecholamine over usual dose could be acceptable in this clinical setting. If adequate response to inotropes is not observed in a post cardiac surgery patient with marginal blood pressure and poor cardiac output, there may be a room for more increment of inotropes. For example, we increased epinephrine upto 1.0 mcg/kg/min at maximum, although usual infusion dose of epinephrine is known to range from 0.01 to 0.5 mcg/kg/min [7]. We think that the important point is not the numerical dose of inotropes itself, but the response of myocardium. Thus, we suggest that the dose of inotropes could be rapidly increased upto the dose described above (e.g. 1.0 mcg/kg/min

of epinephrine) before considering mechanical circulatory support (e.g. ECMO). Undoubtedly, close monitoring of cardiac index and readiness for expedite mechanical circulatory support should be guaranteed during titration. With this unusually high dose of inotropes during short-term interval, we think that we could avoid unnecessary mechanical circulatory support and the patient improved without major morbidities.

Although the administration of the catecholamines in high doses over a long period of time is associated with increased mortality and morbidities, there is a report that concluded short-term application of high dose catecholamines is not associated with poor outcome [8], which was consistent with our case.

4. Conclusion

In conclusion, temporary use of unusually high dose of catecholamine under close monitoring in a post cardiac surgical patient with severe ventricular dysfunction associated with stunned myocardium may be tolerated and helpful for recovery without significant myocardial injury.

Declaration of Competing Interest

The authors report no declarations of interest.

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Ethical approval

None to be declared.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Dr. Hakju Kim: case conceptualization, drafting of the manuscript.

Dr. Yoon Cheol Shin: revising of the manuscript, final approval of the version.

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