

症 例

## Anesthetic management of a patient with severe heart failure undergoing total gastrectomy

Seijiro Sonoda\*, Kinya Nishimura\*, Eiichi Inada\*,  
Toyoki Kugimiya\*, Toyo Miyazaki\*

### Abstract

We report successful anesthetic management of a patient with severe congestive heart failure (CHF). A 77-year-old male underwent total gastrectomy for the gastric cancer. He had been diagnosed of severe CHF like as dilated cardiomyopathy previously. The cardiac ultrasonography showed the enlarged left ventricle (LV) with LV diastolic internal dimension of 62mm and LV ejection fraction of 20%. Dopamine and colforsin daropate hydrochloride were administered to support cardiovascular performance. The cardiac index monitored by Hemosonic™ was maintained over 3.0 liters/min/m<sup>2</sup>. The patient was weaned from the respirator 5 days after surgery and recovered to discharge by about 2 months.

**Key words;** heart failure, dilated cardiomyopathy, colforsin daropate, Hemosonic, anesthetic management

### Introduction

The anesthetic management of the patients with congestive heart failure (CHF) undergoing major surgery such as upper abdominal surgery is often challenging. Although combined general anesthesia with epidural anesthesia is most commonly used for total gastrectomy, both anesthetic techniques suppress myocardium by different mechanisms. Volatile

anesthetics depress myocardial contractility by reducing calcium (Ca<sup>2+</sup>) currents, and epidural anesthesia depresses myocardial contractility by suppressing sympathetic nervous system. Positive inotropic agents are often necessary to support hemodynamics in these CHF patients. However the decreased number and desensitization of beta-adrenergic receptors can be at issue during the administration of catecholamines. Phosphodiesterase III inhibitor (PDE III-I) is often used for the anesthetic management of the patients with CHF because it bypasses beta-adrenergic receptors and increases intracellular cyclic adenosine monophosphate (cAMP) by inhibiting phosphodiesterase III. Colforsin daropate hydrochloride (CDH) may also be useful for the patients with CHF and decreased beta-adrenergic receptors because it directly activates adenylate cyclase and increases intracellular cAMP bypassing beta-adrenergic receptors. The application of the Hemosonic™, a noninvasive device that uses Doppler ultrasonography, to monitor cardiac function during anesthesia would enable better management of CHF patients.

We present a patient with severe CHF in which the usefulness of CDH administration and the Hemosonic™ for the anesthetic management of this disease is demonstrated.

### Case report

A 77-year-old man was planned to undergo total gastrectomy for gastric cancer. He was admitted to

\*Department of Anesthesiology, Juntendo University, School of Medicine, Tokyo, Japan

the emergency room with hematemesis, and gastric cancer was diagnosed by fiber optic gastroscopy. At the age of 69 and 71, hypothyroidism and CHF were diagnosed, respectively. Preoperative routine tests showed moderate anemia (hemoglobin  $9.6\text{g} \cdot \text{dl}^{-1}$ ), and renal dysfunction (BUN  $34\text{mg} \cdot \text{dl}^{-1}$  and creatinine  $2.17\text{mg} \cdot \text{dl}^{-1}$ ). In addition, he had severe CHF and severe coronary artery disease (CAD). Echocardiography showed severely impaired left ventricular (LV) function with dilatation of LV and left arterial (LA) as LV ejection fraction of 20% and fractional shortening of LV of 10%, LV diastolic internal dimension of 62mm, and LV systolic internal dimension of 58mm. LV wall motion was diffusely hypokinetic. Ventricular tachycardia continuing below 10 beats was found after the admission.

These findings suggested that the severe CHF may have been due to CAD-induced ventricular wall hypokinesis. However, the CHF was so severe that not only CAD but also dilated cardiomyopathy was strongly suspected as the cause. The indications of the surgical procedure for gastric cancer were carefully discussed. Gastric bleeding was the main reason for surgery why the patient and his family agreed to the operation, and thus it was scheduled. Amiodarone was administered for ventricular arrhythmia preoperatively.

A course of anesthesia was shown in **Fig. 1**. At first an arterial catheter was inserted to measure blood pressure directly. Fentanyl 0.1mg with normal saline 4ml was administered through an epidural catheter inserted at the Th10/11 interspace. Then continuous dopamine infusion at  $3\mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$  was started. As soon as the systolic blood pressure decreased below 60mmHg, phenylephrine was administered as a vasoconstrictor and CDH was started at  $0.5\mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ . The tracheal was intubated after fentanyl 0.1mg, midazolam 4mg and vecuronium  $0.08\text{mg} \cdot \text{kg}^{-1}$  were administered intravenously. A Swan-Ganz catheter with cardiac pacing lead was inserted through the right internal jugular vein and the Hemosonic™ was inserted into the esophagus. The anesthesia was maintained by intermittent epidu-

ral injection of fentanyl and intravenous midazolam. Phenylephrine and noradrenaline were used to maintain systolic blood pressure above 90mmHg because cardiac index was remained over  $3.0\text{ liters} \cdot \text{min}^{-1} \cdot \text{m}^{-2}$  throughout the operative period. The patient was moved to the intensive care unit after the operation with the trachea incubated. He was weaned from mechanical ventilation for 5 days after the surgery and recovered sufficiently to be discharged in about 2 months.

## Discussion

Forskolin increases intracellular cyclic AMP by activating adenylate cyclase directly, and then the elevated  $\text{Ca}^{2+}$  influx resulted in a potent positive inotropic effect and vasodilation<sup>1)</sup>. However, the clinical use of forskolin was limited by its insolubility in water. Recently, CDH has been developed as a water-soluble derivative of forskolin and reported to increase intracellular cyclic AMP, resulting in elevation of intracellular  $\text{Ca}^{2+}$  concentration<sup>2,3)</sup>. Like forskolin, CDH also has strong inotropic effects. The bypassing of the beta-adrenergic receptors can prevent desensitization of the receptor that slows weaning from catecholamine. Preoperative use of CDH was reported to be useful in a patient with severe CHF and CAD scheduled for Y-graft replacement<sup>4)</sup>. In this case cardiac output improved without profound hypotension or oliguria. In an experimental study, it has been shown that CDH inhibits a decrease in cortical renal blood flow induced by exogenous vasoconstrictors<sup>5)</sup>.

The Hemosonic™ measures the blood flow of the descending aorta by the ultrasonic Doppler method, uses an esophageal probe, and calculates cardiac output on a real time basis noninvasively<sup>6,7)</sup>. Using this monitor we can adjust doses and select of cardiovascular drugs immediately from hemodynamic readings, continuous measurements of cardiac output and arterial pressure. In the case of hypotension accompanied with preserved cardiac output, vasoconstrictor should be administered. Otherwise positive inotropic drug or volume loading is indicated for hypotension

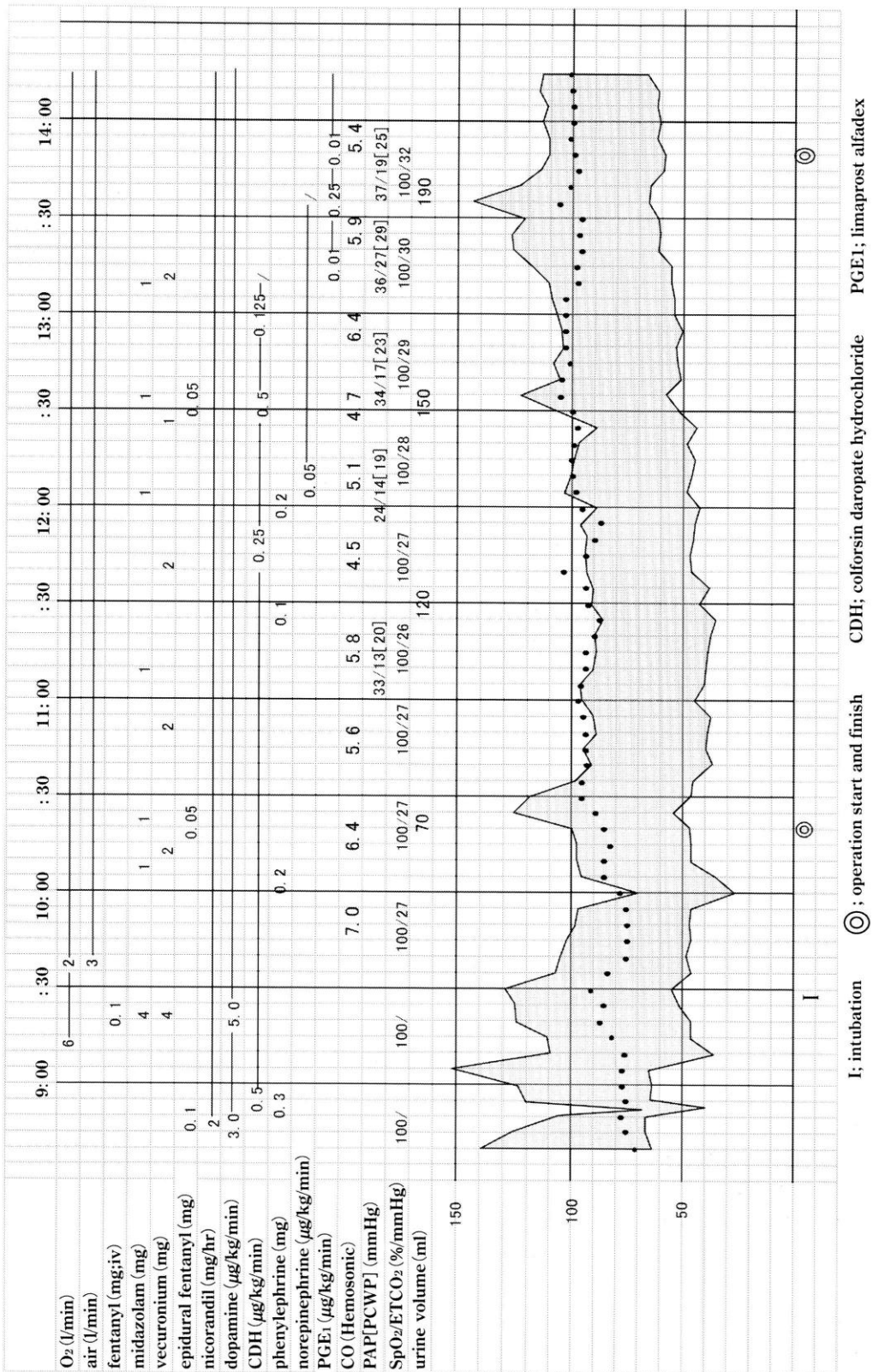


Figure 1 Anesthetic course.

with low cardiac output. A multi-purpose Swan-Ganz catheter was helpful to control heart rate and to measure pulmonary arterial pressure.

Amiodarone is reported to be effective for not only life-threatening arrhythmias but also hemodynamic state in the dilated cardiomyopathy<sup>8,9)</sup>. In this case preoperative administration of amiodarone could be helpful for preventing cardiac event during the operation.

In this report regarding anesthetic management of the patient with severe CHF, administration of CDH and monitoring by the Hemosonic™ monitor were a useful measure to maintain hemodynamics.

### References

- 1) Seamon KB, Padgett W, Daly JW: Forskolin: unique diterpene activator of adenylate cyclase in membranes and in intact cells. *Proc Natl Acad Sci U S A* 1981; 78: 3363-7.
- 2) Hosono M, Takahira T, Fujita A, et al: Cardiovascular and adenylate cyclase stimulant properties of NKH477, a novel water-soluble forskolin derivative. *J Cardiovasc Pharmacol* 1992; 19: 625-34.
- 3) Shafiq J, Suzuki S, Itoh T, Kuriyama H: Mechanisms of vasodilation induced by NKH477, a water-soluble forskolin derivative, in smooth muscle of the porcine coronary artery. *Circ Res* 1992; 71: 70-81.
- 4) Ogata J, Nakano K, Sakamoto K, et al: Preoperative use of colforsin daropate hydrochloride in a patient with severe cardiac function scheduled for Y-graft replacement. *Anesth Analg* 2001; 93: 1079-80.
- 5) Ogata J, Minami K, Segawa K, et al: A forskolin derivative, colforsin daropate hydrochloride, inhibits the decrease in cortical renal blood flow induced by noradrenaline or angiotensin II in anesthetized rats. *Nephron Physiol* 2004; 96: 59-64.
- 6) Bernardin G, Tiger F, Fouché R, Mattéi M: Continuous noninvasive measurement of aortic blood flow in critically ill patients with a new esophageal echo-Doppler system. *J Crit Care* 1998; 13: 177-83.
- 7) Cariou A, Monchi M, Joly LM, et al: Noninvasive cardiac output monitoring by aortic blood flow determination: Evaluation of the Sometec Dynemo-3000 system. *Crit Care Med* 1998; 26: 2066-72.
- 8) Suzuki T, Shiga T, Wakaumi M, et al: Hemodynamics during chronic amiodarone administration in Japanese patients with idiopathic dilated cardiomyopathy and ventricular arrhythmia: a retrospective study. *J Cardiol* 2003; 41: 169-73.
- 9) Toyama T, Hoshizaki H, Seki R, et al: Efficacy of amiodarone treatment on cardiac symptom, function, and sympathetic nerve activity in patients with dilated cardiomyopathy: comparison with beta-blocker therapy. *J Nucl Cardiol* 2004; 11: 134-41.