Case Report

Saving patients with out-of-hospital cardiac arrest using Impella: three case reports

Kenta Aida, Kazunari Azuma, Yuri Ishii, Shoji Suzuki, and Jun Oda

Department of Emergency and Critical Care Medicine, Tokyo Medical University, Tokyo, Japan

Background: The efficacy of Impella for patients with out-of-hospital cardiac arrest is unknown. We report the cases of three patients with cardiogenic out-of-hospital cardiac arrest who received hemodynamic support with Impella.

Case presentation: Two patients, Case 2 and Case 3, received concomitant treatment with venoarterial extracorporeal membrane oxygenation and Impella. Percutaneous coronary intervention was undertaken in two patients, Case 1 and Case 3. Two patients, Case 1 and Case 3, showed favorable neurological function with the Glasgow–Pittsburgh cerebral performance and overall performance categories score of 1 at discharge.

Conclusion: These findings suggest that Impella is effective in patients with out-of-hospital cardiac arrest. Further studies are required to understand the use of Impella for patients with out-of-hospital cardiac arrest.

Key words: Cardiopulmonary resuscitation, intensive care, out-of-hospital cardiac arrest, ventricular assist device

INTRODUCTION

RECENT RESEARCH HAS shown the usefulness of extracorporeal cardiopulmonary resuscitation (ECPR) using venoarterial extracorporeal membrane oxygenation (VA ECMO) for patients with out-of-hospital cardiac arrest (OHCA).[1] Venoarterial ECMO provides hemodynamic support by retrograde blood flow from the arterial system. It has been reported that retrograde blood flow increases left ventricular (LV) afterload, thereby resulting in ventricular dilatation and pulmonary edema.[2]

Impella (Abiomed, Danvers, MA, USA) is a microaxial blood pump that reduces LV afterload by aspirating blood from the LV cavity and expelling it into the ascending aorta.[3]

Therefore, we hypothesized that circulatory support using Impella would be useful in patients with OHCA requiring early improvement of organ perfusion. Herein, we report three cases of using Impella that saved the life of patients with OHCA.

Corresponding: Kenta Aida, MD, Department of Emergency and Critical Care Medicine, Tokyo Medical University, 6-7-1 Nishishinjuku, Shinjuku-ku, Tokyo 160-0023, Japan. E-mail: kenta-a@tokyo-med.ac.jp.

Received 22 Mar, 2020; accepted 3 Aug, 2020

Funding information

No funding information provided.

CASE REPORT

Case 1

A 53-YEAR-OLD MAN collapsed while exercising with his friends. His friend witnessed his fall and initiated bystander cardiopulmonary resuscitation (CPR). When the emergency medical services (EMS) arrived, his electrocardiogram (ECG) showed ventricular fibrillation (VF).

It took 27 min from onset to arrival at the emergency department (ED). We administered advanced life support (ALS), and it was 35 min from the onset to the return of spontaneous circulation (ROSC).

After entering the catheter laboratory, as the patient developed cardiogenic shock with vasopressors, Impella 2.5 was established. Emergency coronary angiography (CAG) was carried out and a drug-eluting stent was deployed in the left anterior descending artery (LAD).

At the time of admission to the emergency intensive care unit (EICU), transthoracic echocardiography (TTE) revealed a left ventricular ejection fraction (LVEF) of 40%, a cardiac index (CI) of 1.5 L/min/m^2, a pulmonary artery wedge pressure (PAWP) of 31 mmHg, and a blood lactate concentration of 1.6 mmol/L. After the introduction of Impella, the CI increased and the PAWP and blood lactate concentration gradually decreased (Fig. 1). The TTE showed that the LV wall motion was improving, and Impella was removed on

the 7th day. The patient was transferred to the rehabilitation hospital on the 50th day. Both the Glasgow–Pittsburgh cerebral performance and overall performance categories (CPC) scores were 1.

Case 2

A 68-year-old man collapsed while working. His colleague at work witnessed his fall and initiated bystander CPR. When the EMS arrived, his ECG revealed VF.

It took 24 min from onset to arrival at the ED. Return of spontaneous circulation was not achieved after ALS, and then we undertook ECPR. It was 93 min from onset to ROSC.

After entering the catheter laboratory, as the patient developed cardiogenic shock with vasopressors, Impella 2.5 was established. The CAG showed chronic total occlusion of the LAD. The cause of this cardiac arrest was determined to be fatal arrhythmia due to ischemic heart disease.

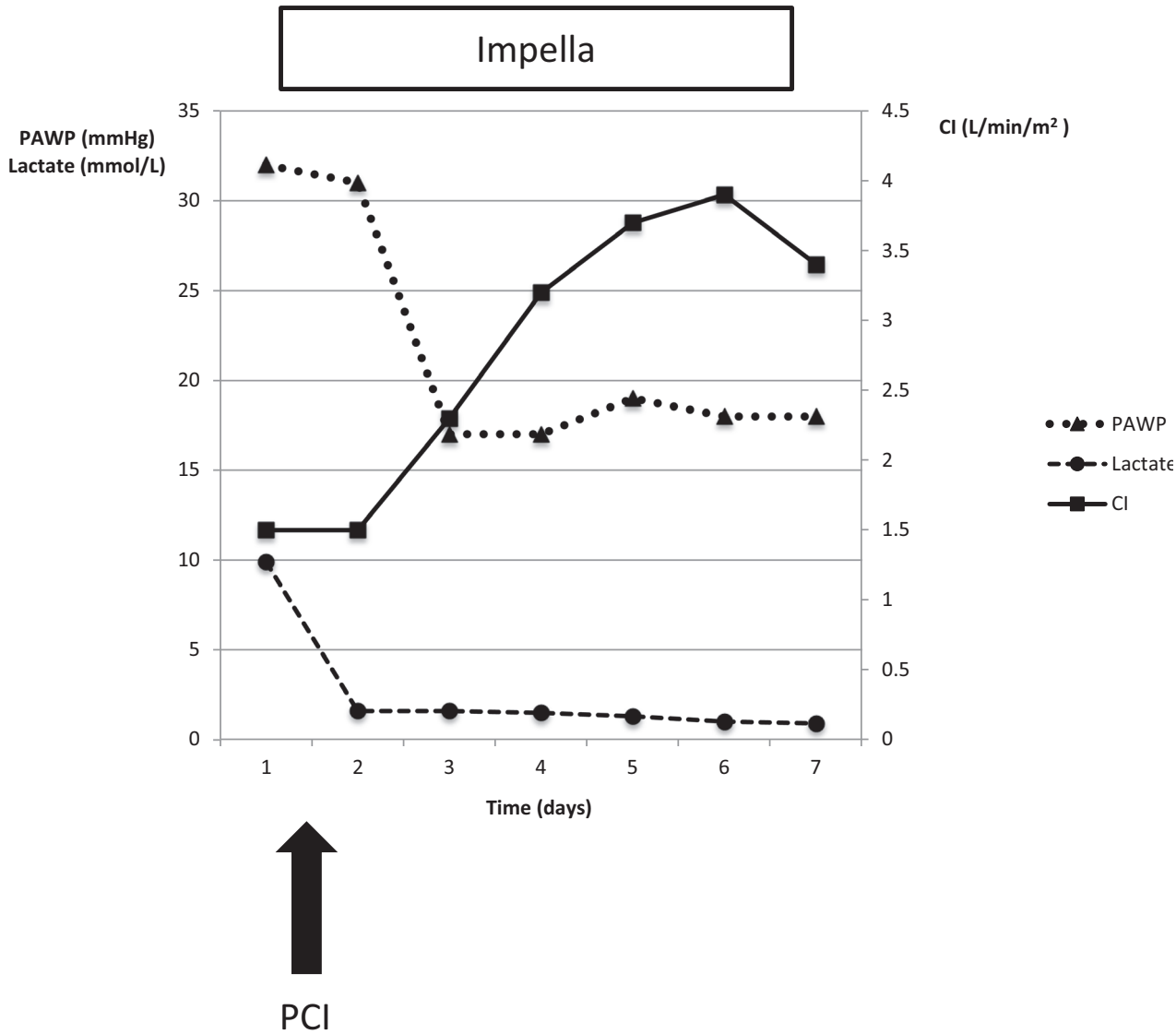

Fig. 1. Trends of cardiac index (CI), pulmonary artery wedge pressure (PAWP), and blood lactate concentration in a 53-year-old man with cardiogenic out-of-hospital cardiac arrest who received hemodynamic support with Impella (Case 1). Percutaneous coronary intervention (PCI) was carried out after Impella insertion. The CI increased and the PAWP and blood lactate concentration gradually decreased.

At the time of admission to the EICU, TTE revealed an LVEF of 20%. Under the combined application of VA ECMO and Impella, the CI was 2.0 L/min/m^2, the PAWP was 29 mmHg, and the blood lactate concentration was 12.6 mmol/L. Thereafter, the CI increased and the PAWP and blood lactate concentration gradually decreased (Fig. 2). The TTE showed that the LV wall motion was improving. Venoarterial ECMO was removed on the 7th day, and Impella was removed on the 8th day. On the 38th day, the patient was transferred to a long-term care hospital, during which his CPC score was 4.

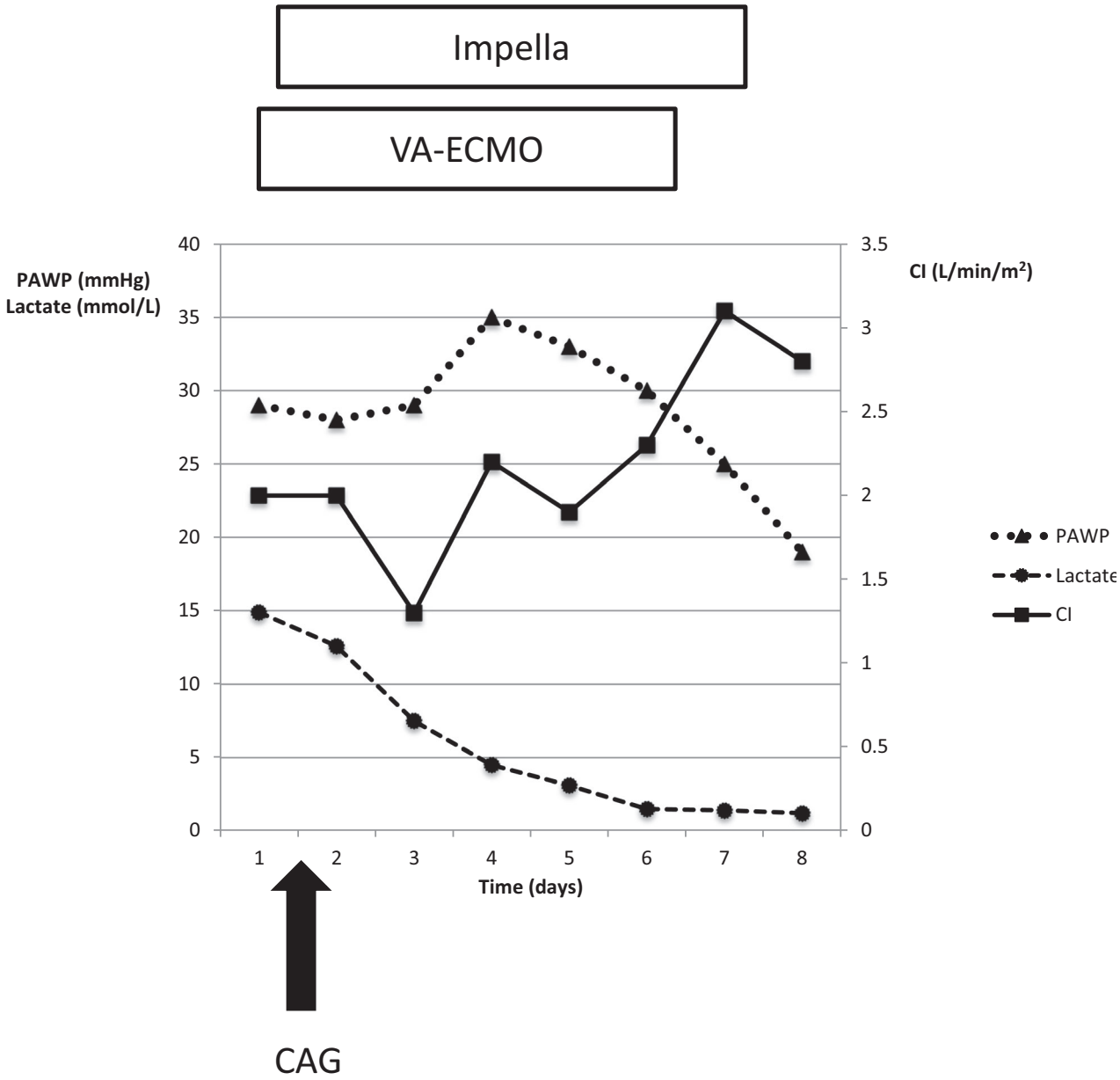

Fig. 2. Trends of cardiac index (CI), pulmonary artery wedge pressure (PAWP), and blood lactate concentration in a 68-year-old man with cardiogenic out-of-hospital cardiac arrest who received hemodynamic support with Impella (Case 2). Impella was established after extracorporeal cardiopulmonary resuscitation; subsequently, coronary angiography (CAG) was carried out. The CI increased and the PAWP and blood lactate concentration gradually decreased. VA ECMO, venoarterial extracorporeal membrane oxygenation.

Case 3

A 65-year-old man collapsed on the street. A passerby witnessed the fall and initiated bystander CPR. When the EMS arrived, his ECG showed VF.

It took 47 min from onset to arrival at our ED. We carried out ALS, and it was 57 min from onset to ROSC.

As the patient developed cardiogenic shock with vasopressors, percutaneous coronary intervention (PCI) was carried out for LAD after intra-aortic balloon pump (IABP) insertion. During PCI carried out for LAD, VF appeared. Extracorporeal cardiopulmonary resuscitation was undertaken, but the hemodynamics did not stabilize even under the combined application of VA ECMO and IABP. To

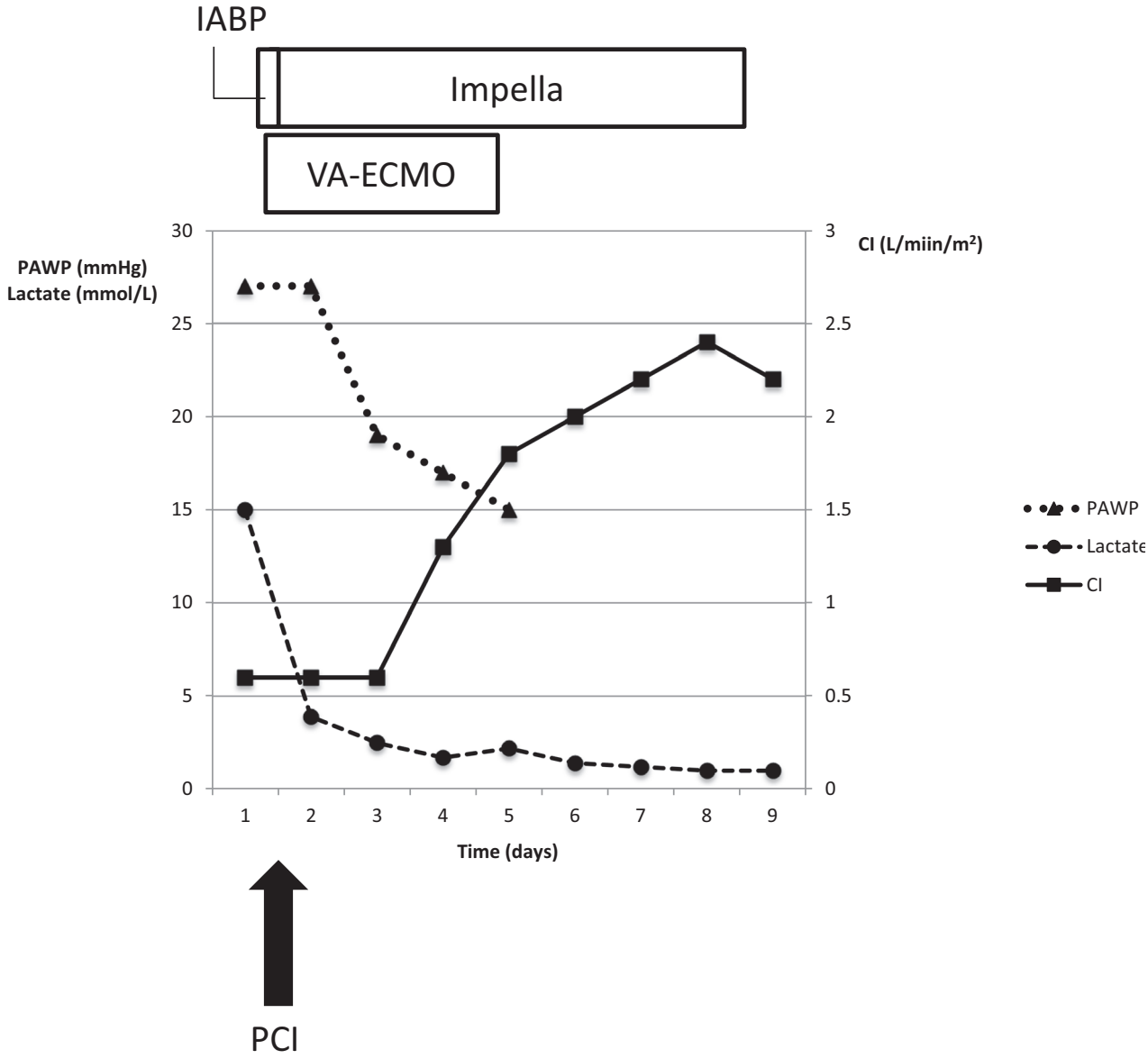

Fig. 3. Trends of cardiac index (CI), pulmonary artery wedge pressure (PAWP), and blood lactate concentration in a 65-year-old man with cardiogenic out-of-hospital cardiac arrest who received hemodynamic support with Impella (Case 3). Extracorporeal cardiopulmonary resuscitation was carried out during percutaneous coronary intervention (PCI); subsequently, intra-aortic balloon pump (IABP) was switched to Impella. The CI increased and the PAWP and blood lactate concentration gradually decreased. VA ECMO, venoarterial extracorporeal membrane oxygenation.

enhance the hemodynamic support, IABP was removed and Impella CP was inserted. Immediately after the insertion of Impella CP, the patient's hemodynamics stabilized.

At the time of admission to the EICU, TTE revealed an LVEF of 5%. Under the combined application of VA ECMO and Impella, the CI was 0.6 L/min/m^2, PAWP was 27 mmHg, and blood lactate concentration was 3.9 mmol/L. Thereafter, the CI increased and the PAWP and blood lactate concentration gradually decreased (Fig. 3). The pulmonary artery catheter was removed on the 5th day due to mechanical failure. The TTE showed that the LV wall motion was improving. Venoarterial ECMO was removed on the 5th day, and Impella was removed on the 9th day, during which his CPC score was 1.

DISCUSSION

PATIENTS WITH CARDIAC arrest and ongoing CPR who were treated with Impella have been reported to have very high mortality rates.[4] Among our three cases, two patients with OHCA treated using Impella showed good neurological prognosis. In patients with cardiogenic OHCA, the use of Impella as a part of resuscitation could lead to improved prognosis of the patient's life and neurological outcome. Compared with VA ECMO, the advantage of Impella lies in reducing the LV load.[5]

However, there are cases where Impella has been ineffective. We encountered a case in which VA ECMO and Impella were introduced, but the patient who had cardiogenic OHCA under similar prehospital conditions died on the 2nd hospital day. In this case, TTE on arrival showed that the LV cavity was narrowed. Consequently, proper blood removal from the left ventricle was not carried out by Impella and an effective circulation support was not obtained. Thus, Impella might not be effective in patients with a narrowed LV cavity.

In our Case 3, an improvement in hemodynamics was obtained after switching from IABP to Impella. Concerning Case 3, it has been suggested that patients with cardiogenic OHCA who had hemodynamic instability even with VA ECMO and IABP could be saved by introducing Impella.

CONCLUSION

IN THIS CASE study, three patients with OHCA were treated with Impella, all of whom were found to have hemodynamic stability and survived. Although Impella could be effective in patients with OHCA, further studies are required to understand the use of Impella for patients with OHCA.

DISCLOSURE

Approval of the research protocol: N/A.
Informed consent: Informed consent was obtained from the patients' families. For privacy reasons, minimal epidemiological information has been presented.
Registry and the registration no. of the study/trial: N/A.
Animal studies: N/A.
Conflict of interest: None.

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