Successful prolonged cardiopulmonary resuscitation for circulatory arrest followed by implantation of two mechanical cardiac support devices

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SOUHRN

Akutní srdeční selhání při dekompenzaci chronické srdeční nedostatečnosti je život ohrožující stav. Na lůžkových odděleních zdravotnických zařízení dochází k srdeční zástavě přibližně u pětiny z každých 1 000 přijatých pacientů. Pravděpodobnost přežití po propuštění z nemocnice je pouhých 17,6 %.[1]
U mnoha resuscitovaných pacientů dochází během několika minut po kardiopulmonální resuscitaci (KPR) k rozvoji neurologických poruch,[2] zvláště v případech, kdy je v pacientově anamnéze závažné postižení myokardu. Tuto situaci lze nicméně významně příznivě ovlivnit časnou léčbou kardiogenního šoku v kombinaci s profesionálně provedenou KPR.[3]
Naše kazuistika pojednává o úspěšné delší KPR mladé ženy, u níž kardiogenní šok vyvolal v nemocnici zástavu oběhu. Kardiopulmonální resuscitace v délce 115 minut byla doplněna implantací dvou mechanických zařízení pro podporu srdeční funkce – perkutánního zařízení pro krátkodobou podporu na přemostění do rozhodnutí o další léčbě a druhého zařízení pro dlouhodobou podporu na přemostění do transplantace.[4]

Keywords:
Acute heart failure
Cardiogenic shock
Cardiopulmonary resuscitation
Mechanical heart support device

ABSTRACT

Acute heart failure caused by decompensation of chronic cardiac insufficiency is a life-threatening condition. Cardiac arrest in inpatient health facilities occurs at a frequency of approximately one in five cases for every 1,000 admitted patients. The likelihood of survival following release from hospital is only 17.6%.[1]
In many resuscitated patients, neurological disorders occur a few minutes after cardiopulmonary resuscitation (CPR),[2] especially if a serious myocardial disease is indicated in the patient's case history. However, early treatment of shock in combination with high-quality CPR[3] can significantly improve such an outcome.
Our case history presents the successful prolonged CPR of a young woman, who suffered an in-hospital circulatory arrest caused by cardiogenic shock. CPR lasting 115 minutes was supplemented by the implantation of two mechanical cardiac support devices – a percutaneous short-term mechanical cardiac support device as a bridge to decision and a long-term cardiac support device as a bridge to transplantation.[4]

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Introduction

Cardiogenic shock is a life-threatening condition with mortality ranging from 50–80 %.[5] The most important aspect with regard to the management of cardiogenic shock is maintaining adequate perfusion of the target organs. Where standard treatment fails to improve the condition, refractory cardiogenic shock occurs. At this stage, consideration must be given to the insertion of a mechanical circulatory support device to secure organ perfusion (Table 1).

Table 1 – Use of mechanical heart support devices (MHP)

Short-term MHP	Bridge to recovery
	Bridge to decision
Long-term MHP	Bridge to transplantation
	Bridge to candidacy
	Destination therapy

Case history

A 28-year-old woman with no previous health history was newly diagnosed with dilated cardiomyopathy (DCM) in 2014. At the beginning of her second pregnancy in 2014, myocarditis (Coxsackie-positive) was diagnosed with the left ventricular ejection fraction (LVEF) at 45%. Toward the end of the pregnancy LVEF had decreased to 35% and by the 39th week of pregnancy (October 2014) it had dropped to 20–25%. At this point the patient presented with signs of heart failure, an acute indication for caesarean section. The patient, whose lactation had also stopped, was subsequently transferred to the Department of Anesthesiology and Intensive Care because of respiratory insufficiency due to incipient pulmonary edema and respiratory infection. Upon stabilization, she was transferred to the in-patient ward of the Cardiology Department where magnetic resonance imaging (MRI) of the heart was performed to highlight DCM. No inflammatory changes were observed. Two weeks after delivery she was released to homecare. Due to her inclination for hypotension, she was not prescribed ACE inhibitors and only given a small amount of beta-blockers. Three months later (January 2015), she was re-admitted to the in-patient ward of the Department of Internal Medicine due to bilateral cardiac decompensation after voluntarily discontinuing her course of medicine. She was given dobutamine and furosemide therapy, which led to stabilization. LVEF echocardiography was 20% with a malignant thrombus at the LV apex. Displaying echocardiographically significant AV regurgitation and serious pulmonary hypertension, she was subsequently transferred to our department for further treatment. According to heart MRI inspection, she had severe systolic dysfunction of both chambers, but the thrombus was no longer present according to DCM echo imaging. In early February 2015, an implantable cardioverter-defibrillator (ICD) was used for primary prevention of sudden cardiac death. The patient was then released after achieving cardiopulmonary compensation. Three weeks after ICD, she was admitted to the in-patient ward of the hospital for left-sided acute heart decompensation. Her condition rapidly progressed to cardiogenic shock and circulatory arrest (pulseless electrical activity – PEA), requiring prolonged CPR (115 minutes in total) and high inotropic support. After reactivating blood circulation using a high dose of noradrenaline, she was again transferred to our department. Here, using comprehensive treatment with combined inotropic support (dobutamine, milrinone, noradrenaline), her condition was stabilized and the patient extubated. Using prolonged CPR, complete neurological recovery was achieved (Cerebral Performance Category Scale, Chart No. 1 [CPC 1]) (Table 2). As a result of a re-exacerbation of heart failure along with organ hypoperfusion (cardiac index [CI] 1.8 l/min/m^2) and given her dependence on combined inotropic treatment, a short-term mechanical heart support device (Thoratec PHP – percutaneous heart pump; as part of the clinical therapy, Fig. 1) was inserted as a bridge to decision (INTERMACS score 3[8]). Forty-eight hours after stabilization of her condition, the long-term mechanical heart support device HeartMate II (Fig. 2) was inserted as a bridge to transplantation. As part of the postoperative development, inotropic support was gradually reduced and finally discontinued; laboratory findings were considered satisfactory and her peroral intake improved. She was administered the anticoagulant medication warfarin, rehabilitated and instructed with regard to the use of HeartMate II. In May 2015, she was released to outpatient care. Four months later, right-sided cardiac catheterisation (without evidence of pulmonary hypertension) was performed and the patient was then enrolled on a waiting list for heart transplantation. She is currently cardiopulmonary compensated and awaiting

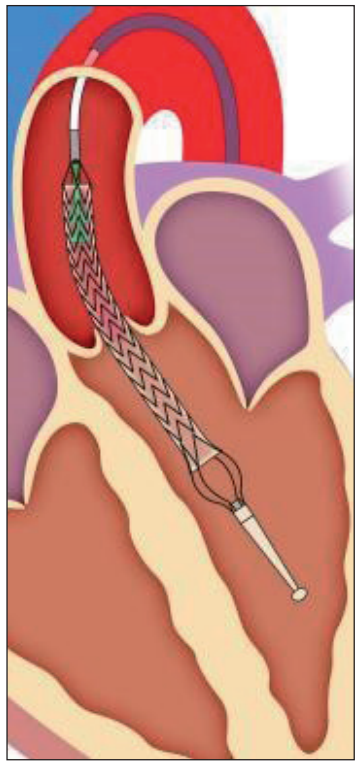

Fig. 1 – Position of the distal part of the Thoratec PHP blood pump in the left chamber cavity and ascending aorta

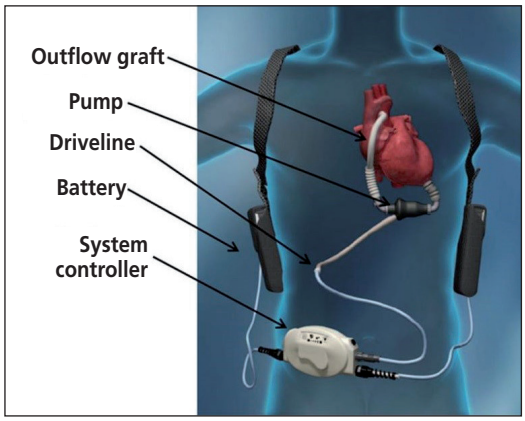

Fig. 2 – Left-sided support device: HeartMate II. Outflow cannula, pump, control cable, battery, control unit.

Table 2 – Cerebral Performance Category (CPC) Scale[9]

CPC Category
CPC 1: Good cerebral performance: conscious, alert, able to work, might have mild neurologic or psychologic deficit
CPC 2: Moderate cerebral disability: conscious, sufficient cerebral function for independent activities of daily life. Able to work in sheltered environment.
CPC 3: Severe cerebral disability: conscious, dependent on others for daily support because of impaired brain function. Ranges from ambulatory state to severe dementia or paralysis.
CPC 4: Coma or vegetative state: any degree of coma without the presence of all brain death criteria. Unawareness, even if appears awake (vegetative state) without interaction with environment; may have spontaneous eye opening and sleep/awake cycles. Cerebral unresponsiveness.
CPC 5: Brain death: apnea, areflexia, EEG silence, etc.

heart transplantation as an outpatient candidate. She is now able to manage most common tasks by herself and receives assistance from her family in taking care of her children.

Discussion

This case study is somewhat unusual for such cases. After initial successful CPR in the hospital's in-patient ward, the patient was transferred to a specialist department in order to insert a mechanical cardiac support device.[4] This was performed in keeping with a standard clinical course and in accordance with the following indication criteria: inability to discontinue inotropic support and rapid worsening of heart failure together with organ hypoperfusion (CI 1.8 l/min/m^2). This procedure enabled the patient's critical condition to be bridged, her candidacy for heart transplantation to be assessed and facilitated her release to outpatient treatment and monitoring.

Conclusions

Cardiac arrest affects approximately half a million people a year in Europe. Only 10.7% of patients who suffer from sudden circulatory arrest out of hospital survive without neurologic deficit.[1] Cardiac arrests that occur in in-patient health facilities are particularly unlike those that occur out of hospital. The incidence of heart failure in-hospital is reported to be within a variable range of 1 to 5 cases for every 1,000 hospitalized patients. Based on data from the National Registry of Cardiopulmonary Resuscitation of the American Heart Association (AHA), only 17.6 % of patients released to homecare after in-hospital resuscitation achieve high-quality survival. Defibrillating rhythms (ventricular fibrillation or pulse-free ventricular tachycardia) occur as an initial rhythm in only 25% of cases. In such instances, 37% of patients survive following their release from hospital, while only 11.5% patients survive after more frequent pulse-free electrical activity or asystole.[1]

Our case study shows the necessity for individually performed CPR, the recommended length of which is not clearly defined.[6] Particularly in relation to in-hospital cardiac arrest of younger individuals, there is a real possibility of the restitution of mental functions even after prolonged resuscitation.[2,7] As a supplementary phase, even an acute mechanical heart support device can be used as a bridge treatment for life-threatening conditions before arriving at a definite long-term solution, in our case a heart transplant.[4]

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