



Successful resuscitation from two cardiac arrests in a female patient with critical aortic stenosis, severe mitral regurgitation and coronary artery disease

Uspešna reanimacija dva srčana zastoja kod bolesnice sa kritičnom aortnom stenozom, teškom mitralnom regurgitacijom i stenozom koronarnih arterija

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Abstract

Introduction. The incidence of sudden cardiac death in patients with severe symptomatic aortic stenosis is up to 34% and resuscitation is described as highly unsuccessful. **Case report.** A 72-year-old female patient with severe aortic stenosis combined with severe mitral regurgitation and three-vessel coronary artery disease was successfully resuscitated following two in-hospital cardiac arrests. The first cardiac arrest occurred immediately after intraarterial injection of low osmolar iodinated agent during coronary angiography. Angiography revealed 90% occlusion of the proximal left main coronary artery and circumflex branch. The second arrest followed induction of anesthesia. Following successful open-chest resuscitation, aortic valve replacement, mitral valvuloplasty and three-vessel aortocoronary bypass were performed. Postoperative pericardial tamponade required surgical revision. The patient recovered completely. **Conclusion.** Decision to start resuscitation may be justified in selected patients with critical aortic stenosis, even though cardiopulmonary resuscitation in such cases is generally considered futile.

Key words:

heart arrest; resuscitation; aortic valve stenosis; mitral valve insufficiency; coronary artery disease; treatment outcome.

Apstrakt

Uvod. Incidencija iznenadne srčane smrti kod bolesnika sa simptomatskom aortnom stenozom je 34%, a reanimacija tih bolesnika ima nepredvidiv ishod. **Prikaz bolesnika.** Bolesnica, stara 72 godine, sa kritičnom aortnom stenozom kombinovanom sa trosudovnom koronarnom bolešću, uključujući 90% stenozu glavnog koronarnog stabla imala je dva srčana zastoja, ali je uspešno reanimirana. Prvi zastoj bio je u toku koronarografije, a drugi posle uvoda u anesteziju. Uspešna reanimacija na otvorenom grudnom košu bila je praćena hirurškim zahvatom, zamenom aortne valvule, mitralnom valvuloplastikom i trostrukim aortokoronarnim *bypass*-om. Postoperativna perikardijalna tamponada rešena je hirurškom revizijom. Bolesnica se uspešno oporavila. **Zaključak.** Postoji mogućnost uspešne reanimacije kod pojedinih bolesnika sa aortnom stenozom, mada se, uopšteno, smatra da je to uzaludno.

Ključne reči:

srce, zastoj; reanimacija; zalistak, aortni, stenoza; zalistak, mitralni, insuficijencija; koronarna bolest; lečenje, ishod.

Introduction

Severe aortic stenosis (AS) is defined as aortic valve area $< 0.8 \text{ cm}^2$ (normal $2.5\text{--}3.5 \text{ cm}^2$)¹ whereas critical AS is defined as aortic valve index $< 0.5 \text{ cm}^2/\text{m}^2$ ². Sudden death occurs in up to 34% of symptomatic AS patients³ and car-

diopulmonary resuscitation (CPR) is highly unsuccessful¹. We presented a 72 year-old-female with critical AS, severe mitral regurgitation (MR) and three-vessel coronary artery disease with critical left main (LM) stenosis who, after successful resuscitation from two cardiac arrests, had emergency coronary artery bypass grafting (CABG), aortic valve re-

placement (AVR) and mitral valve replacement (MVR), survived and went home in good condition.

Case report

A 72-year-old Caucasian female experienced dyspnea on exertion and retrosternal pain at the age of 70, and developed dyspnea at rest at the age of 72. The patient had no other medical problems. Administered medications included oral aspirin, atorvastatin, enalapril, metoprolol, furosemide and nitrates. Examination revealed 4/6 holosystolic murmur propagating to the axilla and neck. Electrocardiogram showed sinus rhythm, without Q waves or acute ST-T abnormalities. Echocardiography revealed aortic valve calcification, aortic valve area 0.6 cm², peak pressure gradient 111 mmHg by Doppler, mild aortic regurgitation, severe MR and preserved left ventricular function (Table 1). Clinically, the patient was at the New York Heart Association (NYHA) III functional status.

Table 1
Transthoracic echocardiography findings before hospital admission

Variable	Value
Aortic valve area (cm ²)	0.6
Aortic valve index (cm ² /m ²)	0.353
Peak aortic gradient (mmHg)	111
Mean aortic gradient (mmHg)	89
Left ventricular end diastolic diameter (mm)	42
End systolic pressure (mmHg)	30
Left atrial diameter (mm)	40
Left ventricular ejection fraction (%)	60
Left ventricular septum wall thickness (mm)	13
Right heart chamber	Normal
Pericardium	Normal

During catheterization, immediately after contrast iohexol⁴ (Omnipaque 350, GE Healthcare, Norway) was injected into the LM, the patient developed bradycardia and hypotension, rapidly deteriorating to severe dyspnea and asystolic cardiac arrest. Resuscitation started promptly, according to the American Heart Association guidelines. Twenty minutes following resuscitation, circulation was restored and spontaneous breathing returned. In the Intensive Care Unit (ICU), the patient regained consciousness, responded to instruction and was able to move all extremities after thirty minutes. Catheterization showed 90% LM, 60% left anterior descending and 90% circumflex stenosis. Left ventriculogram and right coronary artery angiogram were aborted.

Then, 95 minutes after the first arrest, the patient came to the operating room for emergency CABG-AVR-MVR.

General anesthesia was induced with diazepam 15 mg, sufentanil 25 µg and pancuronium 10 mg, and maintained with sevoflurane 0.7–1.0 ET MAC. Ten minutes after induction, the patient acutely developed hypotension and bradycardia unresponsive to *iv* epinephrine, and rapidly progressed to asystole. Resuscitation included emergency sternotomy,

internal cardiac compressions and heparinization (400 units/kg). Heart exposure revealed 3 cm right ventricular wall laceration, likely from open heart massage. Following aortic and bi-caval cannulation, cardiopulmonary bypass (CPB) started. Myocardial protection included antegrade and retrograde cold blood cardioplegia. The patient had AVR (mechanical St. Jude 19, St. Jude Medical, Minnesota, USA), MVR (Duran Ancore ring 27, Medtronic, Minnesota, USA), three-vessel CABG (venous grafts to left anterior descending, circumflex and right coronary artery) and right ventricular (RV) wall laceration repair.

Cardiopulmonary bypass time was 230 min, aortic clamp time was 160 min, and the operation lasted 290 min. Intravenous epinephrine (0.067 µg/kg/min) and dobutamine (maximum 15 µg/kg/min) infusions were used, and the patient was stable after cardiopulmonary bypass (sinus rhythm, blood pressure 105/60 mmHg, central venous pressure 15 mmHg, hemoglobin 11.6 g/L, normal arterial blood gases). Postoperatively, a pulmonary artery catheter was inserted in the ICU (Table 2).

Table 2
Hemodynamic variables measured with a pulmonary artery catheter (PAC)

Variable	After surgery	Before PAC removal
PCWP (mmHg)	16	8
Cardiac index (l/m ²)	3.0	2.5
Stroke volume (mL)	44.8	45
SVR (dyn/s/sec)	1199	
PVR (dyn/s/sec)	138	
SvO ₂ (%)	71.8	64.7

*PCWP – pulmonary capillary wedge pressure; SVR – systemic vascular resistance; PVR – pulmonary vascular resistance; SvO₂ – mixed venous oxygen saturation

Two hours after surgery, the patient developed atrial fibrillation and received three synchronized cardioversions and *iv* amiodarone loading, followed by oral amiodarone 1,200 mg/day. Despite postoperative troponin elevation (1.60 ng/mL), there were no wall motion abnormalities on echocardiography.

Four hours after surgery, chest tube drainage increased (1,000 mL/2 hours), central venous pressure increased to 22, urine output decreased, and hemoglobin dropped to 8.1 g/L. The patient received red blood cells 645 mL, fresh frozen plasma 610 mL, platelets 6 units, epinephrine increased to 16 µg/kg/min, dobutamine to 20 µg/kg/min and norepinephrine to 12 µg/min for hypotension. Emergency echocardiography revealed large (18 mm thick) pericardial effusion, diastolic RV collapse, but no vena cava collapse. Emergency reexploration revealed bleeding from the right atrial cannulation site. After bleeding stopped and tamponade was relieved, epinephrine infusion decreased to 0.05 µg/kg/min, norepinephrine stopped and urine output increased.

Approximately 8 h after the 2nd operation, the patient woke up and responded to commands. Despite postoperative liver dysfunction and non-oliguric renal insufficiency, the patient gradually improved, left the ICU on the day 27 and

went home on the day 33. Two weeks after discharge, the patient was neurologically intact, and walked 5 km/day.

Discussion

This is probably the first report on successful resuscitation from two distinct cardiac arrests in a patient with a combined critical AS, severe MR and severe coronary artery disease. A predicted perioperative mortality for patients with NYHA III functional status, the same as the presented patient initially had, is 4.81% (logistic Euroscore). The first arrest occurred after iohexol injection for coronary angiography. Non-ionic contrasts are considered safer than ionic media⁵, and low-osmolar contrast is probably safe in patients with severe AS⁶. However, serious hemodynamic and electrophysiologic adverse events, including hypotension, myocardial dysfunction, arrhythmias, and cardiac arrest can occur after intraarterial or intracoronary iohexol injection⁷, and the reported risk of death was 6.6–100/ million during angiography with iohexol⁴. Although disastrous anaphylactic reactions to contrast are rare (0.03%)⁵, acute anaphylaxis cannot be excluded in this case. A predicted perioperative mortality (Logistic Euroscore) was at that moment 20.33%.

Emergency surgery was indicated in this case, due to symptomatic LM stenosis. As the second arrest occurred

shortly after general anesthesia induction, myocardial ischemia, intraoperative myocardial infarction and arrhythmias³ are all plausible etiologies. This particular patient had four reasons why resuscitation was unlikely to succeed: resuscitation from asystole has poor prognosis; external cardiac compressions are ineffective in severe AS, because overcoming the pressure gradient across the aortic valve is difficult¹; creating adequate cardiac output with CPR is problematic due to MR; and achieving adequate coronary perfusion is difficult due to severe LM stenosis. However, this patient was revived twice. Immediate sternotomy and internal cardiac compressions may explain CPR effectiveness after the 2nd arrest⁸. Prompt CPB initiation likely contributed to good outcome⁹, hypothermia during CBP probably provided some brain protection¹⁰.

Limitations of this report include not measuring serum triptase to exclude anaphylaxis to contrast, and not using a pulmonary artery catheter or transesophageal echocardiography for perioperative hemodynamic monitoring.

Conclusion

This report suggests that despite a low likelihood of survival, full resuscitation is worth pursuing in otherwise healthy patients with severe AS.

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