

Application of Percutaneous Cardiopulmonary Support for Cardiac Tamponade Following Blunt Chest Trauma: Two Case Reports

Seon Hee Kim, M.D., Seunghwan Song, M.D., Yeong Dae Kim, M.D.,
Jeong Su Cho, M.D., Chung Won Lee, M.D., Jong Geun Lee, M.D.

Since the advent of percutaneous cardiopulmonary support (PCPS), its application has been extended to massively injured patient. Cardiac injury following blunt chest trauma brings out high mortality and morbidity. In our cases, patients had high injury severity score by blunt trauma and presented sudden hemodynamic collapse in emergency room. We quickly detected cardiac tamponade by focused assessment with sonography for trauma and implemented PCPS. As PCPS established, their vital sign restored and then, they were transferred to the operation room (OR) securely. After all injured lesion repaired, PCPS weaned successfully in OR. They were discharged without complication on day 26 and 55, retrospectively.

Key words: 1. Extracorporeal circulation
2. Trauma, blunt
3. Cardiac tamponade
4. Ultrasonic diagnosis
5. Cardiac rupture

CASE REPORT

1) Case 1

A 34-year-old woman involved in car accident was admitted to the emergency department (ED) in a drowsy, hemodynamically unstable. Her clinical data presented in Table 1. There was no evidence of external wound except skin laceration on nose. Initial chest X-ray showed enlargement of cardiac shadow only (Fig. 1). Focused assessment with sonography for trauma (FAST) revealed the hemopericardium compressing the right ventricle (RV). At that time, sudden cardiac arrest occurred. We started cardiopulmonary resuscitation (CPR) and performed subxiphoid drainage. We also set percutaneous cardiopulmonary support (PCPS) by using Capiox-

mergency bypass system (CapioxEBS; Terumo Inc., Tokyo, Japan) within few minutes because the vital sign did not restore. Following that, the patient was rushed into the operation room (OR). We performed median sternotomy and identified rupture of the right atrium appendage (2×1 cm) and superior vena cava (1 cm). After repairing all injured sites, PCPS was weaned smoothly. Total 73 units of blood components were given to correct circulation and coagulopathy. Postoperatively, the patient required ventilatory support for 14 hours due to pulmonary edema. Visual disturbance appeared due to multifocal embolic infarctions, but recovered during follow-up. She discharged on postoperative day (POD) 22 after closed reduction of nasal bone.

Department of Thoracic and Cardiovascular Surgery, Pusan National University School of Medicine

Received: February 1, 2012, Revised: February 27, 2012, Accepted: March 3, 2012

Corresponding author: Seunghwan Song, Department of Thoracic and Cardiovascular Surgery, Pusan National University Hospital, Pusan National University School of Medicine, 179 Gudeok-ro, Seo-gu, Busan 602-739, Korea
(Tel) 82-51-240-7267 (Fax) 82-51-243-9389 (E-mail) song77.sh@gmail.com

© The Korean Society for Thoracic and Cardiovascular Surgery. 2012. All rights reserved.

© This is an open access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Table 1. Clinical characteristics and surgical details

Characteristic	Case 1	Case 2
Age/sex	34/female	45/male
Injury mechanism	High speed MVA	Fall-down
Cardiac lesion	RAA rupture (2×1 cm)	Left pericardial laceration (10 cm)
Associated injuries	SVC laceration 1 cm	Bronchial artery rupture
	Sternal fracture	Left hemothorax with multiple rib fractures
	Nasal bone fracture	2nd cervical spine fracture
		Left pelvic bone fracture
		Left humerus fracture
Arrival (hr) ^{a)}	0.67	6
Initial BP, HR, SpO ₂	70/50, 133, 92	100/60, 90, 89
CPR	Yes	No
GCS	15	9
ISS	26	22
RTS	5.4388	7.8408
TRISS (%)	85.5	98.3
First diagnostic tool	FAST	FAST
Diagnose to surgery (hr)	0.67	3.5
PCPS		
Catheter size (Fr.)	Artery: 16, vein: 20	Artery: 16, vein: 20
Flow (L/min/m ²)	1–2	2–2.5
Running time (hr)	3	3
ACT (sec)	220	150
ICU satys (day)	4	6
Intubation time (hr)	14	30
Hospital stay (day)	26	55

MVA, motor-vehicle accident; RAA, right atrium appendage; SVC, superior vena cava; BP, blood pressure; HR, heart rate; SpO₂, peripheral oxygen saturation; CPR, cardiopulmonary resuscitation; GCS, Glasgow Coma Scale; ISS, injury severity score; RTS, revised trauma score; TRISS, survival probability of trauma score-injury severity score; FAST, focused assessment with sonography for trauma; PCPS, percutaneous cardiopulmonary support; Fr., French; ACT, activated clotting time; ICU, intensive care unit.

^{a)}Elapsed hours from injury to arrive the hospital.

2) Case 2

A 45-year-old man who sustained a 3 m fall-down accident was transported from other hospital to Pusan National University Hospital. He had a history of Mycobacterium tuberculosis pleurisy on his left side. His clinical characteristics demonstrated in Table 1. Outside computed tomography scan revealed multiple injuries (Fig. 2). While proceeding with the initial examination, blood pressure suddenly dropped to 60 mmHg. We performed FAST evaluation and determined that the RV was compressed by increased pericardial blood. Due to progressive deterioration of hemodynamics, the patient received PCPS by using CapiioxEBS. After establishing PCPS, he was recovered hemodynamically and arrived at the OR

safely. Operation was conducted via median sternotomy. Left pericardium tear (10 cm) and active bleeding at bronchial artery were observed. Other heart structures were intact. As there was a severe adhesion in the entire left pleural cavity, cardiac tamponade was presented. After achieving adequate bleeding control and pericardial repair, PCPS was weaned easily. He was suffered from pulmonary edema and coagulopathy and needed mechanical ventilation for 30 hours. The total amount of transfusion was 62 units. The patient underwent surgery related to the cervical spine fracture on POD 25 and was discharged on POD 55.



Fig. 1. Preoperative chest X-ray showed enlargement of cardiac shadow.

DISCUSSION

Blunt chest injuries are a common cause of death accounting for 20% of road traffic fatalities [1,2]. Along with rapid advances in medical resources, the detection rate of blunt chest trauma has notably increased. Besides the clinical utilization of extracorporeal life support (ECLS) systems that became commercially available in 1980s, lifespan has been extended to massively injured patient. Some papers have already reported good results in multiple trauma because ECLS offers supplemental capability in the resuscitation [3,4].

The patients with cardiac rupture following blunt chest trauma has high mortality rate, thus previous reports emphasize that the early surgical approaches are important to save life [5,6]. Once a cardiac lesion is suspected, surgical exploration should be applied without hesitation and median sternotomy is the easiest way to exposure cardiac structures. Nan et al. [6] recommend subxyphoid drainage at ED in case of non-recordable blood pressure (BP) patients and then, to perform definitive cardiac repair at OR. If the patient does not response to drainage, resuscitation should be continued at ED. On the other hand, in case of recordable BP patients, they advise to move the patient to the OR directly and conduct exploratory sternotomy. This protocol is consistent with ours. In the first case, we perform subxyphoid drainage under

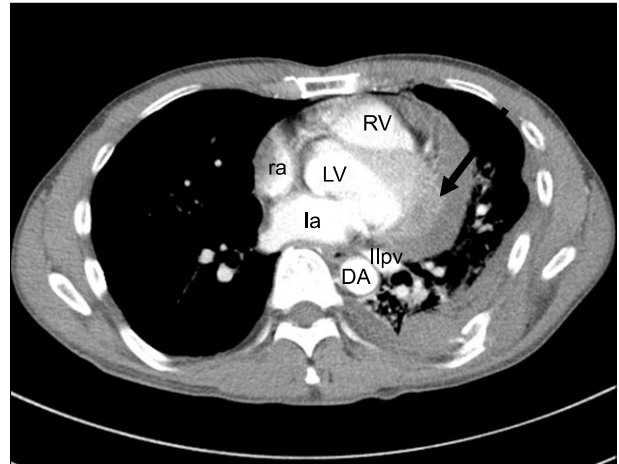


Fig. 2. Preoperative chest computed tomography scan showed left rib fractures, hemothorax, and blood collection around left side of heart compressing ventricles (arrow). ra, right atrium; la, left atrium; RV, right ventricle; LV, left ventricle; llpv, left lower pulmonary vein; DA, descending aorta.

CPR. Despite gushing out of large blood, hemodynamic collapse did not recover. For this reason, we implemented PCPS within minutes and were able to get better chance to cardiac repair in OR. In contrast to the first, the second patient with recordable BP should be rushed to the OR according to protocol, but the operating team and room did not setup at that time. We applied PCPS for buying time and stabilizing the patient. Subxyphoid drainage was omitted because it may have brought to gush out blood through the pericardiostomy site and needed more transfusion only.

The medical resources for the early surgical exploration at ED are well-established in Western countries. Most hospitals in Korea, however, do not have the capacity to conduct cardiac surgery at the ED because of a lack of operating team, medical equipment and personnel for anesthesia and surgery. Hence application of PCPS is thought to be good option to stabilize the patient until all medical resources are prepared, when cardiac arrest or collapse incurred by cardiac rupture happens at ED.

Although Several prior studies demonstrates improved survival rate up to 30% after application ECLS as part of initial resuscitation from cardiac arrest, the majority of studied patients had cardiac disease such as acute myocardial infarction, myocarditis, and cardiomyopathy [4]. Moreover, lack of the

published reports about trauma, we did not review accurate indication and outcome of ECLS in these patients.

ECLS is generally contraindicated in patients with head injury since heparinization will aggravate intracranial bleeding. To rule out head injury, we checked the patient's Glasgow Coma Scalescore. Absence of intracranial bleeding influenced our favorable outcome. Massively injured patients also tend to bleed due to post-traumatic coagulopathy. Considering the bleeding risk in these patients, we used half dose heparinization and tried to wean PCPS as soon as possible. Patients received massive transfusion during perioperative period. This may be a risk factor of pulmonary complication but, post-operative ventilation time was 14 and 30 hours, retrospectively.

In summary, we report our cases here because we have good results of using PCPS in traumatic cardiac rupture by using FAST for early diagnosis and PCPS application for stabilizing patients.

ACKNOWLEDGMENTS

This work was supported by clinical research grant from

Pusan National University Hospital 2012.

REFERENCES

1. Karmy-Jones R, Jurkovich GJ. *Blunt chest trauma*. *Curr Probl Surg* 2004;41:211-380.
2. Krasna MJ, Flancbaum L. *Blunt cardiac trauma: clinical manifestations and management*. *Semin Thorac Cardiovasc Surg* 1992;4:195-202.
3. Perchinsky MJ, Long WB, Hill JG, Parsons JA, Bennett JB. *Extracorporeal cardiopulmonary life support with heparin-bonded circuitry in the resuscitation of massively injured trauma patients*. *Am J Surg* 1995;169:488-91.
4. Thiagarajan RR, Brogan TV, Scheurer MA, Laussen PC, Rycus PT, Bratton SL. *Extracorporeal membrane oxygenation to support cardiopulmonary resuscitation in adults*. *Ann Thorac Surg* 2009;87:778-85.
5. Grande AM, Rinaldi M, Pasquino S, Dore R, Vigano M. *Nonpenetrating rightatrial and pericardial trauma*. *Ann Thorac Surg* 2003;76:923-5.
6. Nan YY, Lu MS, Liu KS, et al. *Blunt traumatic cardiac rupture: therapeutic options and outcomes*. *Injury* 2009;40:938-45.