Case Report

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Perioperative Neonatal Cardiac Tamponade Associated with Central Venous Catheters: A Case Report

Chih-Fang Changchien[1], Cheng-Yuan Lu[2,]*

Cardiac tamponade is a rare but fatal condition. Central venous catheter (CVC) insertion is a major risk factor for the complication. Timely diagnosis and drainage are vital. A newborn baby was hospitalized for brain tumor surgery, when sudden onset of bradycardia and cardiac arrest occurred during the operation. Echocardiography revealed a large amount of pericardial effusion, and pericardiocentesis was immediately performed in the operating room to recover his heart beat and blood pressure. A literature review was made to offer insights into the current knowledge for CVC including the proper position of the catheter tip and the optimal length. With the substantive knowledge for correct positioning of CVC, the incident of cardiac tamponade for infant patients in the operating room could be effectively decreased.

Key words: cardiac tamponade, central venous catheter, neonate, pericardial effusion

Introduction

Cardiac tamponade is a rare but fatal complication, which is closely associated with the incorrect positioning of central venous catheter (CVC). Timely diagnosis with echocardiography and urgent pericardiocentesis are proven methods to restore vital signs.[1] Though, there have been many reports described about CVCs related to cardiac tamponade but in intensive care unit.[2-4] There is only a few cases reported during the operation, especially in infants receiving noncardiac surgery. However, immediate diagnosis and treatment is still a challenge during the operation. Since before cardiac tamponade is confirmed, you will still have to rule out any other possible causes of cardiac arrest at first. To do this, you need to check all the anesthetic equipment and drugs used in the patient. Furthermore, you might even have to ask the surgeon to pause the operation. So, it is more likely to miss out the cardiac tamponade diagnosis resulting in delay treatment.

We hereby present a newborn baby who received a brain tumor surgery and experienced sudden onset of bradycardia and cardiac arrest during the operation. Cardiac tamponade was then diagnosed and immediately managed. A literature review was made to offer insights into the knowledge for CVC including the proper position of the catheter tip, the optimal length, insertion site and material of CVC in neonates.

From the [1]Department of Anesthesiology, Cishan Hospital; [2]Department of Anesthesiology, E-Da Hospital and E-Da Dachang Hospital, Kaohsiung, Taiwan

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* Address reprint request and correspondence to: Cheng-Yuan Lu, Department of Anesthesiology, E-Da Hospital, No.1, Yida Road, Jiaosu Village, Yanchao District, Kaohsiung City 82445, Taiwan.
Tel: +886-7-615-0011 ext. 2561, E-mail: ed100216@edah.org.tw; lioansin@yahoo.com.tw

Case Report

A 3-day-old male newborn was with gestation age of 37 weeks and body weight of 2,470 grams. Brain stem and hypothalamic cystic lesion were diagnosed after birth according to brain sonography, and then he was transferred to our neurosurgery department for surgical evaluation. On admission, he was acute ill-looking with O_2 supplement, bilateral coarse breathing sound, mild yellowish skin, NG tube insertion, and sometimes bradycardia. His vital sign showed body temperature 36.3°C, pulse 130/min, respiratory rate 36/min, and blood pressure 70/40 mmHg. Brain MRI showed a cystic lesion (measuring approximately 18 mm × 28 mm in dimension) is located at supra-sellar region, and the differential diagnoses should include epidermoid cyst, arachnoid cyst or enteric cyst or other etiology (Fig. 1). The preoperative diagnosis was prepontine cystic lesion.

After some examinations and a detailed discussion with the family, the infant was sent to operating room at 8:30 AM on the 5th day after admission. His vital sign revealed a blood pressure of 110/71 mmHg, heart rate of 175 beat/minute, and SpO_2 of 99%. A D_{10} 1/4S solution infusion was offered at his right hand, and he was then provided with sevoflurane for induction and maintenance of anesthesia. Intubation was performed with a 3.0-mm endotracheal tube which was fixed at 7 cm. Being a major craniotomy surgery, the CVC was inserted through the right jugular vein smoothly, fixed at 5 cm, and a D_5 1/3S solution with 10 mL/hr infusion was offered. However during the operation, sudden onset of bradycardia and hypoxemia occurred at 10:45 AM. The endotracheal tube, anesthetic circuit, anesthesia drugs and intravenous lines were quickly evaluated for any malfunction, and then cardiopulmonary resuscitation was initiated. However, the vital signs of the infant had not been recovered. We suspected mechanical cardiac problems, and urgently consulted the cardiologist, who used echocardiogram revealing large

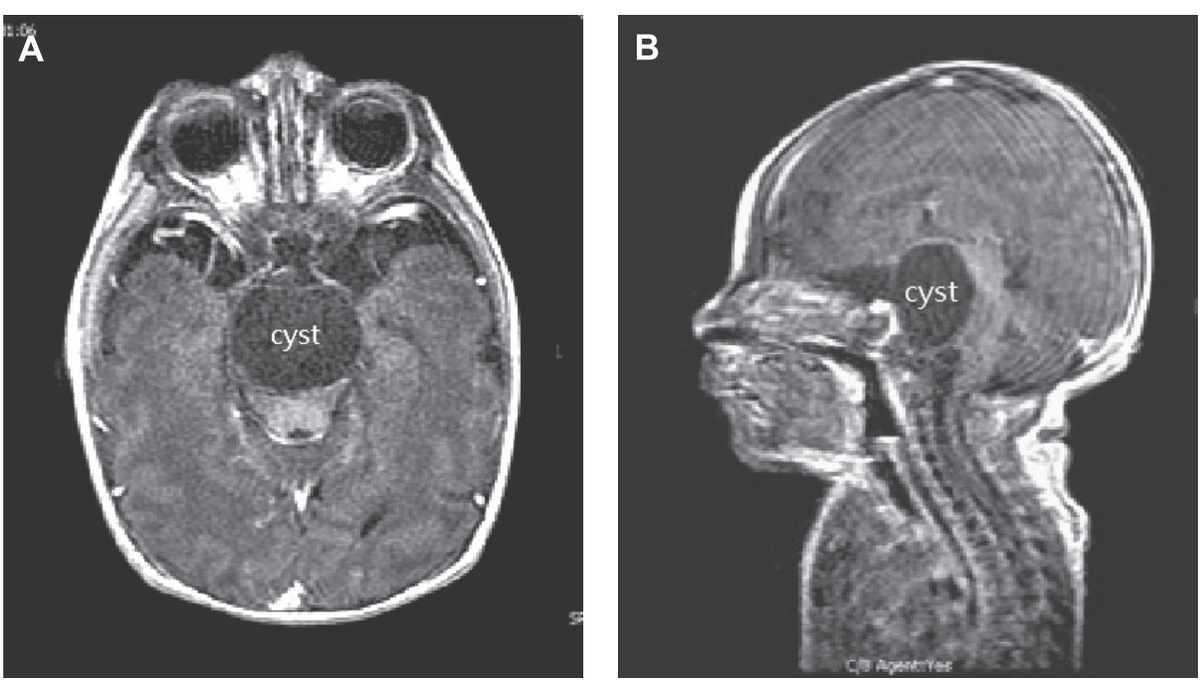

Fig. 1 (A) and (B) brain MRI revealed (1) A relatively well-defined, non-enhanced cystic lesion (measuring approximately 18 mm × 28mm in dimension) is located at supra-sellar region that results in external compression to midbrain posteriorlly displacement. (2) Bil. middle cranial fossa arachnoid cysts are likely. (3) Small amounts of subdural effusions at posterior fossa.

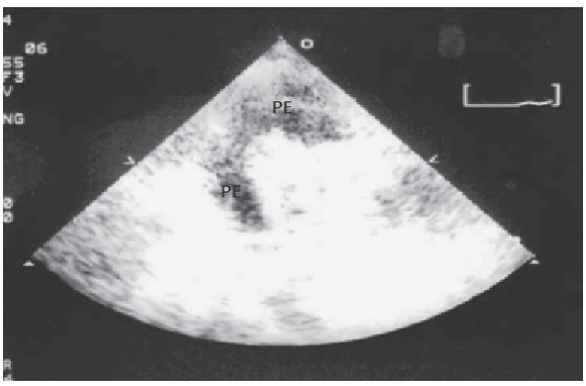

Fig. 2 The heart was compressed before aspiration in the operating room. PE: pericardial effusion.

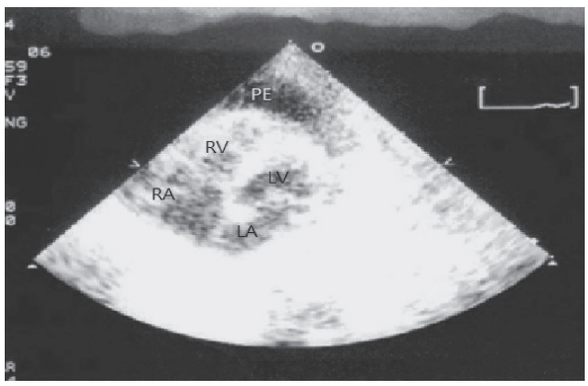

Fig. 3 Pericardial effusion was aspirated about 18 mL with yellowish color. RA: right atrium; RV: right ventricle; LA: left atrium; LV: left ventricle.

pericardial effusion, heart compressed and the CVC tip in right atrium (Fig. 2). Immediate pericardiocentesis was performed to aspirate 18-mL yellowish color fluid (Fig. 3), and the CVC was withdrawn to 4 cm. His heartbeat, blood pressure and oxygen saturation recovered at 11:30 AM eventually. The infant patient was sent to NICU with BP of 79/54 mmHg, HR of 171 beat/minute, and SpO_2 of 100%. However, the patient's condition continued to worsen. The chest X-ray showed pleural effusion on the left lung field at 11:00 PM. Another sudden onset of bradycardia occurred, followed by asystole shown on EKG. The family refused resuscitation, and the infant was pronounced dead.

Discussion

The malposition of central catheters is considered to be the main risk factor for pericardial effusion, particularly if the catheter tip projects into the right atrium.[3] Routine CXR should be performed, and the CVC tip should be readily identifiable. The CVC tip should remain outside the cardiac silhouette but still within the vena cava.[1] However, in some patients, the exact location of the pericardium may be difficult to verify on a normal CXR (e.g., large thymus gland). The carina is an alternative radiographic marker, which is superior to the pericardial reflection that can be used to identify the placement of CVC even in newborn and small children.[5]

In this case, since the vital sign recovered totally after pericardiocentesis, the pericardial effusion was highly suspected to be the direct cause for cardiac arrest. The majority of the pericardial effusion was the CVC intravenous fluid, since the large amount of effusion was accumulated in a very short time about two hours. However, on the other hand, according to the cytology report, there are presence of many foamy and reactive mesothelial cells (Table 1), which might indicate other pericardial cystic lesions have pre-existed in the pericardium. The aspirated effusion was clear and yellowish (Table 2), which might be due to a mixture of CVC intravenous fluid and patient's original pericardial cystic fluid.

Some studies have tried to develop guidelines for correct length of CVC in infants and children where CVC is either inserted via the right internal jugular vein or right subclavian vein. And the recommendations for correct length are proposed through weight-based

Table 1. Cytology diagnosis (pericardial effusion cytology).

1. Presence of many foamy and reactive mesothelial cells.
2. Neither inflammation nor malignant cell is noted.

Table 2. Pericardial effusion analysis.

Pericardial effusion	Result	Unit	Reference
Appearance	Clear		
Color	Yellow		
S.G	1.005		
Rivaltas	-		
WBC	0	/cmm	
RBC	113	/cmm	
Seg	0	%	
Lympho	0	%	
Mono	0	%	
Histiocyte	0	%	
TP	0.063	g/dL	6.3 – 8.0
LDH	180	U/L	230 – 460

criteria.[6-8] The suggestions are 2 – 2.9 kg for 4 cm, 3 – 3.9 kg for 4.5 cm, and 4 – 4.9 kg for 5 cm in infants less than 5 kg.[6,7]

Apart from the internal jugular vein, subclavian vein and femoral veins may be used for CVCs insertion. There are several other sites for neonates such as upper limb (mainly antecubital vein) and lower limb (mainly saphenous vein) for the peripherally inserted central catheters (PICCs).[2] The catheter tip of umbilical venous catheters (UVCs) should be positioned at the junction of the inferior vena cava and right atrium, with the tip lying outside of the cardiac silhouette.[3,4] However, optimal catheter tip positioning via the femoral veins has not been well elucidated, but for long-term use, the catheter tip should probably be positioned above the inferior cava entry points of the renal veins.[9]

There is no definitive conclusion regarding whether CVC insertion site, or the material of the catheters plays any role in the occurrence of cardiac tamponade.[10] However, a previous study for adult patients suggests that access from the left venous system increases the risk for perforation, attributing presumably to the increased angle between CVC tip and the superior vena cava (SVC).[1] Studies published previously had shown the polyurethane catheter is associated with the complication in the infants.[2,10] Polyurethane catheters, easier to place, are thought to be stiffer and less flexible than silastic catheters and could easily cause damage to the vascular wall when they are positioned in the SVC.[2]

In conclusion, cardiac tamponade should be kept in mind in any newborn receiving a CVC even if the catheter is believed to be positioned correctly. Timely diagnosis with echocardiography and urgent pericardiocentesis still pose a challenge in an operation. We suggest that the CVC should be positioned and the catheter tip should be checked with CXR before the infant patient enters into the operating room. However pre-op CXR is not possible, a safer insertion site with proper depth of CVC should be considered.

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