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Diagnosis and treatment of delayed large pericardial effusion after cardiac surgery.

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Abstract

This study aimed to investigate the outcomes of diagnosis and treatment towards post-Cardiac Surgery (CS)-Delayed Large Pericardial Effusion (DLPE). 62 patients among 8764 cases of cardiac surgery were enrolled in this study. The clinical data of them were summarized. The pericardiocentesis and drainage were performed, with open surgery in partial patients. Before and after treatment, the heart rate, blood pressure and blood oxygen saturation were determined and were compared. The short- and long-term outcomes were observed. Results showed that, among 62 post-CS-DLPE cases, 1 case died of invalid rescue, but the symptoms of the 61 survived patients were significantly mitigated. A total of 800 ± 180 ml of pericardial effusion was drained on the surgery day, and the total amount was 1800 ± 300 ml. There were significant differences of heart rate, systolic blood pressure, mean blood pressure and mean pulmonary artery pressure between before and after treatment (P<0.05). The postoperative 1-month electrocardiograph prompted no pericardial effusion in 57 cases, with small amount of pericardial effusion in 4 cases. The postoperative 6-month and 1-year follow-up revealed no pericardial effusion in all patients. The post-CS-DLPE is easily mis-, miss-, or delay-diagnosed, so the early diagnosis is crucial. Once diagnosed, it should be treated as early as possible, and the treatment effects in most patients are satisfactory.

Keywords: Cardiac surgery, Pericardial effusion, Diagnosis, Treatment.

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Introduction

Most patients suffer from the pericardial effusion after Cardiac Surgery (CS), and even the Delayed Large Pericardial Effusion (DLPE) is rare [1,2]. Due to its low incidence rate, many young doctors are not very familiar with this situation, and even the physicians who have seen such patients may not consider this disease when making their initial diagnosis. Therefore, this may result in mis-, miss-, or delay-diagnosed of post-CS-DLPE, and it has not been clearly diagnosed for a long period. However, the patient's conditions may deteriorate sharply in a very short time, with severe hemodynamic abnormalities and severe symptoms of acute cardiac tamponade as well as the risk of sudden cardiac arrest at any time in late stage [3]. Thus, post-CD-DLPE can cause serious consequences, though its incidence is low [4]. Increasing the awareness towards post-CD-DLPE can realize the early diagnosis and treatment, thus effectively preventing the occurrence of serious complications and reducing the mortality [5,6]. This study summarized the outcomes of diagnosis and treatment towards post-CS-DLPE in 62 patients. The objective was to provide certain reference for diagnosis and treatment of this disease.

Patients and Methods

Patient recruitment

Sixty-two post-CS-DLPE patients among the 8764 case with cardiac surgery in our department from June 2007 to June 2015 were enrolled in this study. The DLPE criteria were indicated by Computed Tomography (CT) or Electrocardiograph (ECG): the heart was wrapped by pericardial effusion, and the general thickness was more than 20 mm. There were 36 females (58%) and 26 males (42%), with weight of 20-75 (50 ± 23.5) kg and age of 7-77 (44 ± 22.5) years. The occurrence rate of post-CS-DLPE was 0.71% (62/8764). This study was approved by the ethics committee of Second Affiliated Hospital of Zhengzhou University. Written informed consent was obtained from all participants.

Treatment methods

Once diagnosed as post-CS-DLPE, ECG-guided pericardiocentesis and drainage were immediately performed at bedside, and 48 cases succeeded in the drainage. The specific methods were as follows: after routine disinfection and towel-dressing, under ECG guidance, the fifth intercostal space under xiphoid or left sternal border, where had the most amount of pericardial effusion, was selected as the puncture point; after

local anesthesia, the core needle (in the package of single lumen central venous catheter) was carefully pierced deeply with negative pressure; when sensed the feeling of emptiness and the pericardial effusion could be drained, the piercing was stopped, the guide wire was continued, and the needle was withdrawn. After broke the skin, the single lumen central venous catheter was inserted along the guide wire. One water-sealed bottle was then connected for the continuous drainage of pericardial effusion. The drainages in all patients were removed after the drainage was less than 50 ml within 24 h and the postoperative ultrasound review confirmed no or only a small amount of pericardial effusion. For cases who were not able to tolerate pericardiocentesis under local anesthesia or the drainage was unsmooth, they were sent to emergency operating room for open surgery under general anesthesia.

Observation indexes

Before and after treatment, the heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure, mean pulmonary artery pressure, blood oxygen saturation and other indexes were determined and were compared.

Statistical analysis

Statistical analysis was performed using SPSS17.0 software (SPSS Inc., Chicago, IL, USA). Data were presented as mean ± SD. Comparisons between before and after treatment were performed using t test. $P<0.05$ was considered as statistically significant.

Results

Clinical data of patients

Among 62 patients, 6 cases occurred after ventricular septal defect repair, 4 cases after atrial septal defect repair, 4 cases after radical correction of Tetralogy of Fallot, 2 cases after aortic sinus aneurysm rupture repair, 2 cases after total endocardial cushion defect correction, 2 cases after total anomalous pulmonary venous connection, 2 cases after left atrial myxoma excision, 14 cases after mitral valve replacement, 8 cases after aortic valve replacement, 8 cases after mitral valve replacement plus aortic valve replacement, 4 cases after mitral valve replacement plus coronary artery bypass, 2 cases after aortic valve replacement plus coronary artery bypass, and 4 cases after coronary artery bypass. All the patients were performed median chest incision, and no pleural rupture occurred during the surgery; therefore, only mediastinal and pericardial drainage tubes were placed while no pericardial fenestration and latero-chest drainage tube was placed.

The incidence of post-CS-DLPE all occurred at least 7 days after the drainage tubes were removed (14.2 ± 3.3 days), among which 26 cases were found and diagnosed during the postoperative hospital stay, and 36 cases were diagnosed after re-admitted. 59 patients exhibited early postoperative stable conditions but acute exacerbation of such symptoms as palpitation and oppression in chest in a short period after removed the chest tube; 2 cases exhibited the main symptoms as severe headache when readmitted while no severe palpitation or oppression in chest. Physical examination all revealed accelerated heart rate, low-blunt or distant heart sound, filled or engorged jugular vein, and liver touchable under ribs, etc. 54 patients exhibited paradoxical pulse, and 26 patients were firstly treated as heart failure after cardiac surgery and administrated cardiac diuretic medications in local hospitals, but the effects were ineffective so that they were readmitted. 2 cases readmitted with severe headache were initially considered as brain lesion, but emergency brain CT basically ruled out organic brain disease, and then the detailed examination revealed it to be DLPE. 38 patients were confirmed as DLPE after careful physical examination combined with clinical symptoms. Another 20 cases were misdiagnosed as heart failure due to inexperienced initial diagnosis and careless observation, so they were administrated cardiac diuretic medications while the effects were ineffective; later, they were suspected as DLPE and confirmed after performed emergency cardiac ultrasound. All cases were finally confirmed by ECG and chest CT.

Overall treatment outcome

Forty-eight patients succeeded in the drainage. 14 cases were sent to emergency operating room for open surgery under general anesthesia due to not being able to tolerate pericardiocentesis under local anesthesia or the drainage was unsmooth, among which 12 cases were performed with subxiphisternal pericardial fenestration. After removing partial suture along the lower section of the original incision, the xiphisternal adhesions were then isolated with fingers, and blood or fluid was then absorbed clearly. 2 cases occurred with cardiac arrest during anesthesia, so they were emergently performed with re-thoracotomy from the original incision and intrathoracic cardiac massage; 1 case was successfully rescued while 1 case died. The pericardial effusion was sucked clearly during the surgery, and No. 32 chest tube was placed and connected to one water-sealed bottle postoperatively for the drainage. After the treatment, the postoperative symptoms in all the patients were significantly mitigated.

Amount of pericardial effusion by draining

A total of 800 ± 180 ml of pericardial effusion was drained on the surgery day, and the total amount was 1800 ± 300 ml at the end to treatment. 36 cases exhibited dark red fluid, 14 cases exhibited dark yellow fluid, 8 cases exhibited pale yellow fluid, and 4 cases exhibited the mixture of blood and a small amount of clots.

Comparison of heart rate, blood pressure and blood oxygen saturation before and after treatment

The heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure, mean pulmonary artery pressure and blood oxygen saturation before and after surgery were compared. There was significant difference of heart rate,

systolic blood pressure, mean blood pressure and mean pulmonary artery pressure between before and after treatment ($P<0.05$), with no significant difference of diastolic blood pressure or blood oxygen saturation ($P>0.05$) (Table 1).

Follow-up results

The postoperative 1-month ECG prompted no pericardial effusion in 57 cases, with small amount of pericardial effusion in 4 cases. The postoperative 6-month and 1-year follow-up revealed no pericardial effusion in all patients.

Table 1. *Comparison of heart rate, blood pressure and blood oxygen saturation before and after treatment.*

Index	Before treatment	After treatment	P
HR (beat/min)	115.11 ± 13.23	82.78 ± 8.44	<0.05
SBP (mmHg)	108.23 ± 12.88	120.92 ± 15.87	<0.05
DBP (mmHg)	74.45 ± 9.58	76.12 ± 6.43	>0.05
MBP (mmHg)	80.23 ± 6.33	110.34 ± 9.78	<0.05
MPAP (mmHg)	41.01 ± 5.91	19.05 ± 2.27	<0.05
SpO_2 (%)	98.04 ± 10.28	99.23 ± 11.71	>0.05

HR; Heart Rate; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; MBP: Mean Blood Pressure; MPAP: Mean Pulmonary Artery Pressure; SpO_2: Oxygen Saturation.

Discussion

Although the incidence of post-CS-DLPE is low, once it occurs, it may be easily mis-, miss-, or delay-diagnosed; most patients show severe illness and rapid development, and it could lead to severe hemodynamic abnormalities. If the diagnosis is not timely and clear, such severe conditions as acute cardiac tamponade caused cardiac arrest and sudden death might occur. Therefore, improving the awareness towards post-CS-DLPE to realize early diagnosis and early treatment is essential.

The reasons for post-CD-DLPE are many, and the most common one is to perform anticoagulation immediately after removing the drainage tube or excessive anticoagulation [7,8]. Among the 62 patients diagnosed in our department, 36 cases occurred after the valve replacement or valve replacement plus bypass, accounting for 58%, and this also showed that because of the routine use of warfarin, patients with valve surgeries might more likely occur post-CS-DLPE, and the patients appearing improved post-valve replacement conditions while such similar symptoms as severe heart failure after having removed the chest tube should be highly precautious about the occurrence of post-CS-DLPE [9]. Careful physical examination towards these patients could find such signs as accelerated heart rate, low-blunt or distant heart sound, filled or engorged jugular vein, increased liver, or paradoxical pulse in most cases. At this time, chest radiography, chest CT, and ECG would be performed actively, among which chest radiography normally exhibits flask-like heart, and chest CT and ECG could confirmed the diagnosis and provide important reference for the treatment [10].

Among these 62 patients, 22 patients occurred after congenital heart disease or left atrial myxoma surgery. Although such patients need no postoperative anticoagulation, its occurrence might be related to the slow bleeding inside the pericardial cavity after removed the chest tube postoperatively, or poor cardiac function or hypoalbuminemia caused by chronic exudate accumulation, etc. [11]. Removing the leads of the temporary epicardial pacemaker might also be one of the causes [12]. Because the pacemaker leads are sutured and fixed on the heart surface, removing the leads might cause epicardial tearing and lead to bleeding. Postoperative anticoagulation might more likely to cause large amounts of pericardial effusion. If the leads are not easily removable, we advocated cutting them along the surface, and this could play a preventive role. Furthermore, we removed the drainage tube when the drainage was less than 50 ml within 24 h after surgery, but some patients with large early postoperative drainage might be applied a large number of hemostatic agents. They might generate blood clots and block the drainage tube, so if some patients exhibit drainage tube blockage when extubating, the phenomenon that the pericardial effusion could not be drained after extubation might cause the occurrence of post-CD-DLPE, and this situation should also be vigilant.

The occurrence of DLPE in simple coronary bypass surgery is less [13,14], which might be related to that most patients with coronary artery bypass need to open the left chest to facilitate the access to the internal mammary artery, so the pericardial effusion could flow into the chest; therefore, there might exist the possibility of postoperative pleural effusion instead of large pericardial effusion. In recent years, some scholars advocated to prevent the occurrence of post-CS acute and delayed cardiac tamponade using simultaneous pericardial fenestration [15,16]. The principle was to introduce the excessive pericardial effusion into the chest [17,18]. However, this method was not conducive to observe the perioperative drainage amount, so it would delay ICU medical staff's judgment towards hypovolemic shock. Furthermore, maintaining the integrity of the closed chest could facilitate postoperative pulmonary management and reduce the incidence of lung infections and other lung complications. Therefore, we believed that if no intraoperative pleural rupture occurred, the mediastinal and pericardial drainage tubes should be routinely placed, and no pericardial fenestration and latero-chest tube should be placed deliberately.

Sometime, the symptoms of post-CS-DLPE might not be typical. The two patients in our department, for example, only exhibited severe headache as the main symptoms when readmitted instead of severe palpitation or oppression in chest. Therefore, the initial diagnosis when admitted was considered as brain lesions; however, the emergency brain CT revealed no positive findings, so organic brain disease was excluded and DLPE was only diagnosed after detailed examination was performed. Therefore, at any time, we should pay high attentions to acquire the disease history in details and to

perform careful physical examination. The headache in these 2 patients was quickly relieved after pericardiocentesis. Therefore, we believed that the reason of the headache was caused by poor brain blood returning because large pericardial effusion caused the venous pressure to be increased too high.

Once diagnosed, immediate actions should be taken towards post-CS-DLPE; pericardiocentesis-drainage is the most simple and effective method [19]. In order to avoid the risk of pericardiocentesis, we generally used bedside ultrasound guidance during pericardiocentesis. Most patients might exhibit relieved symptoms when some effusion was drained. However, a small number of patients with severe disease conditions might not be able to tolerate pericardiocentesis and drainage, or the sticky pericardial effusion might cause poor drainage, they should be sent to emergency operating room for surgeries immediately. In most cases, subxiphisternal fenestration and drainage could be performed. If there is difficult in separating adhesions, active bleeding still exists, or blood clot oppression is considered, re-thoracotomy should be performed from the original incision to completely remove blood clots and fluid. We also encountered two cases of cardiac arrest during anesthesia and performed emergency thoracotomy and thoracic cardiac massage for the rescue and treatment.

Patients with post-CS-DLPE should also be applied cardiotonics, diuretics, or nutritional support according to their different cardiac functions and general conditions as well as antibiotics to prevent infections. Furthermore, if excessive anticoagulation occurs, we advocated to temporarily stop the medication of anticoagulant drugs and use vitamin K1 and other drugs to improve blood clotting mechanism when necessary [20].

In conclusion, the post-CS-DLPE is easily mis-, miss-, or delay-diagnosed, so the early diagnosis is crucial. The increasing the understanding of post-CS-DLPE as well as realizing early diagnosis and prompt treatment can significantly reduce the mortality rate of these complications.

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