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Original Article

Safety Pericardiocentesis with Fluoroscopy Following Cardiac Surgery

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Purpose: In the treatment of the postsurgical pericardial effusions via pericardiocentesis, determination of the puncture site might be difficult. Contrast echocardiography may not be efficient due to surgical artefacts and pulmonary problems and therefore may lead to inaccurate evaluation. Alternative imaging methods might be helpful to perform the pericardiocentesis with decreased complications.
Methods: We retrospectively analyzed the patients who had undergone pericardiocentesis in our department from January 2008 through April 2018. The procedure was performed in slightly semi-seated position with the guidance of the echocardiography and fluoroscopy. Following the catheterization, percutaneous drainage was performed.
Results: There were 63 patients needed intervention due to pericardial effusion. 67% of the patients were using warfarin and the next patients were using acetyl salicylic acid and/or clopidogrel. All effusions were in the posterolateral localization. The mean volume of aspirated pericardial fluid was 404 ± 173 mL (150–980 mL). Control echocardiograms showed that almost all fluid was drained in all patients and there were no procedural or follow-up complications.
Conclusion: In the treatment of postoperative pericardial effusion, fluoroscopy is an alternative method to locate the catheter accurately in challenging situations following cardiac surgery. Thus, procedural risk minimizes and drainage of pericardial fluid is performed safely.

Keywords: pericardial effusion, fluoroscopy, pericardiocentesis

Introduction

Pericardial effusion commonly develops postoperative 0–56 days of the cardiac surgery with the rate of 1.5%.[1,2] Most of the pericardial effusions are not clinically important and only less than 1% needs pericardiocentesis.[1] Insignificant effusions might be diagnosed with routine postoperative echocardiographic examinations unless they are asymptomatic. Effusions smaller than the 2 cm might be treated medically; however, clinically symptomatic or wider than 2 cm pericardial effusions necessitate interventional approach.[3] Echo-free space during diastole >25 mm, early diastolic collapse, compression of heart chambers, plethora of inferior vena cava, and ventricular independence have been reported the indications of postoperative pericardial drainage.[4]

Sub-xiphoid incision had been used for pericardial drainage. In wide circumferential effusions (especially in anterior and apical collections), pericardiocentesis with sub-xiphoid approach by the guidance of echocardiography is a safe alternative.[5] Postoperative pericardial effusions

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following cardiac surgery are usually localized and posterior positioned, therefore determining the puncture site is difficult since echocardiographic imaging can be distorted due to surgical artefacts.[6] Also, differentiating pericardial hemorrhagic fluid from intravascular blood in the patients under the treatment of anticoagulants, which are strong triggering factor of pericardial effusion, is difficult.[2,6] In such cases, alternative imaging methods can be a solution to reduce procedural complications.

Although technical aspects of the procedure have been detailed in the literature, few reports of case series were published. Recently, 99% technical success of 93 patients via pericardiocentesis was reported. In these patients, pericardial fluid was caused by malignancy, uremia, infection, collagen vascular disease, and trauma.[7] In this study, we are reporting our clinical experience of postoperative pericardiocentesis with the guidance of echocardiography and fluoroscopy. To our knowledge, this is the first study to report postoperative pericardiocentesis experience and its technical details after the cardiac surgery.

Materials and Methods

We retrospectively analyzed the patients who had undergone cardiac surgery at Sultan Abdulhamid Han Training Hospital from January 2008 through April 2018 to evaluate the patients who had undergone pericardiocentesis due to pericardial effusions. We included all patients with pericardial effusions who had undergone pericardiocentesis. The data of pre-procedure echocardiographic examinations, procedure, and follow-up were gained from the medical records.

All procedures were performed in the hybrid operating room. After monitoring the patients, the procedure was performed in a slightly semi-seated position. In the evaluation of echocardiographic examination, contrast echocardiographic imaging was suboptimal due to surgical artefacts, especially in the anterior and free wall of right ventricle, wherein the quality of the image should be the best. We used fluoroscopy to improve reliability of pericardial space during the procedure.

Under local anesthesia, the needle (9 cm-18 gauge) was advanced to the pericardial cavity with sub-xiphoid approach. Following the initial puncture, a 0.35 inch guidewire was advanced through the needle, then a 40 cm 9F pigtail pericardiocentesis catheter was safely placed into intrapericardial space with the guidance of echocardiography (**Fig. 1**). When we drain the pericardial fluid, we test it to evaluate whether it is pericardial fluid or

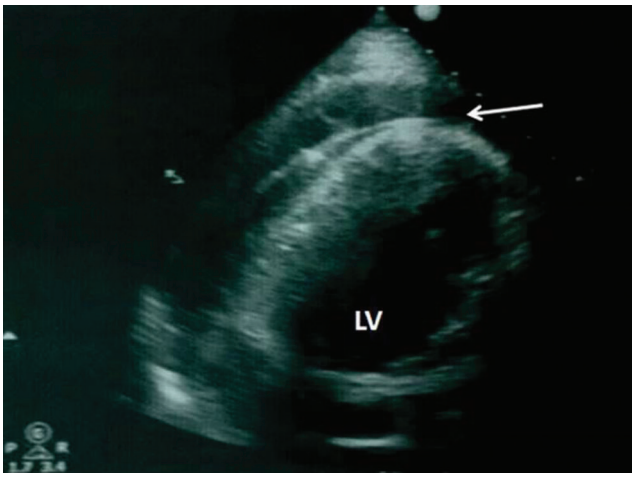

Fig. 1 Echocardiographic imaging of pericardial effusion during the procedure.

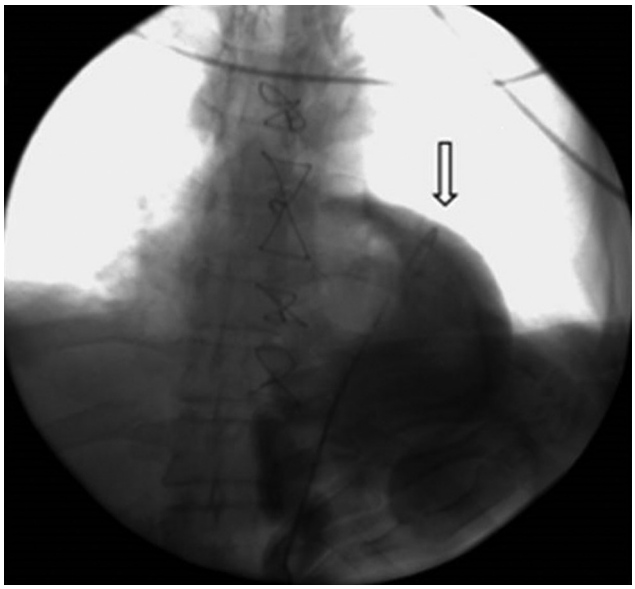

Fig. 2 Fluoroscopic view of pericardial effusion after the catheterization.

blood. However, anticoagulation treatment made it difficult to differentiate pericardial hemorrhagic fluid from intravascular blood. Therefore, 10 mL of contrast agent was injected through the catheter to make sure that the end of the catheter was placed inside pericardial effusion (**Fig. 2**). Following the catheterization, percutaneous drainage was performed. After the procedure, we follow-up the patients with the ibuprofen treatment and routine echocardiographic examinations.

Results

From January 2004 to June 2018, a total of 2684 patients had cardiac surgery and 144 of these patients

Table 1 Distribution of the patients with pericadial effusion according to the operation and anticoagulant/antiagregant regimen

Type of cardiac surgery	Number of patients (%)	Warfarin (n)	ASA (n)	ASA + clopidogrel (n)	ASA + Warfarin (n)
Valve surgery	81 (56.3)	81	-	-	-
CABG	51 (35.4)	-	-	45	6
Adult congenital	12 (8.3)	3	9	-	-
Total	144 (100)	84	9	45	6

ASA: asetilsalisilic acide; CABG: coronary artery bypass grafting

Table 2 Distribution of the patients who had undergone pericardicentesis

Type of cardiac surgery	Number of patients (%)	On warfarin	On ASA	On ASA + clopidogrel	Volume of drainage (mL)
Valve surgery	39 (61.9)	39	-	-	433 ± 187
CABG	16 (25.4)	-	-	16	381 ± 126
Adult congenital	8 (12.7)	3	5	-	278 ± 109
Total	63 (100)	42	5	16	404 ± 173

ASA: asetilsalisilic acide; CABG: coronary artery bypass grafting

had diagnosed with postoperative pericardial effusion. The primary operations were valve surgery (n = 81), coronary artery bypass surgery (n = 51), and adult congenital cardiac surgery (n = 12) (**Table 1**). The 63 of these patients necessitated pericardiocentesis due to cardiac compression and/or diameter of pericardial fluid (≥2 cm). In all, 42 of 63 patients were on warfarin treatment and the next 21 were under the treatment of acetylsalicylic acid (ASA) or combination of ASA and clopidogrel (**Table 2**).

Pericardial effusions revealed in the routine postoperative echocardiographic evaluation. It was diagnosed at postoperative 15.7 ± 6.5 day (7–24 days). All patients, who had undergone pericardial drainage, had ≥2 cm pericardial effusions and most of them had the complaints of fatigue. However, none of them had the symptoms of cardiac tamponade.

The success of the procedure was 100% and control echocardiographic examinations showed that nearly all of the fluid was drained in all patients. The mean volume of aspirated pericardial fluid was 404 ± 173 mL with the range of 150–980 mL. There was no complication and patients were discharged from the hospital postprocedural second day.

Discussion

In this study, we are presenting our experience of pericardiocentesis with the guidance of echocardiography and fluoroscopy. In the evaluation of 63 patients with pericardial effusions, there was no need for conversion to surgery and we successfully drained pericardial fluid without any complications.

In the postoperative period of the cardiac operations, most of the patients might use anticoagulant or antiagregant treatment. Anticoagulants have shown to be the main factor for both the first 7 days (86% of the patients), and late pericardial effusions (65% of the patients).[6] In the evaluation of 21416 patients, Ashikhmina et al.[2] reported the rate of pericardial effusion after cardiac surgery as 1.5%. Although 42% had clinical features of tamponade, 86% of these patients had nonspecific symptoms.[2] In another study, pericardiocentesis-required pericardial effusion following a cardiothoracic surgery has been reported as 0.8%.[6] Follow-up of the patients who had cardiac surgery is important to avoid pericardial effusion and its complications. Although the rate of pericardial effusion is low, it is important since untreated pericardial effusions might be the cause of life-threatening cardiac tamponade. We routinely perform echocardiographic examinations of the patients in the postoperative period (postoperative 4th day, pre-discharge, and control examination in the first week). In suspected clinical condition, we follow-up patients with weekly echocardiographic examinations. As an advantage of routine echocardiograms, we diagnosed and treated asymptomatic pericardial effusions in early period.

Percutaneous drainage is a practical approach in the treatment of pericardial effusion. It is also less stressful and more comfortable for the patients. Intracardiac

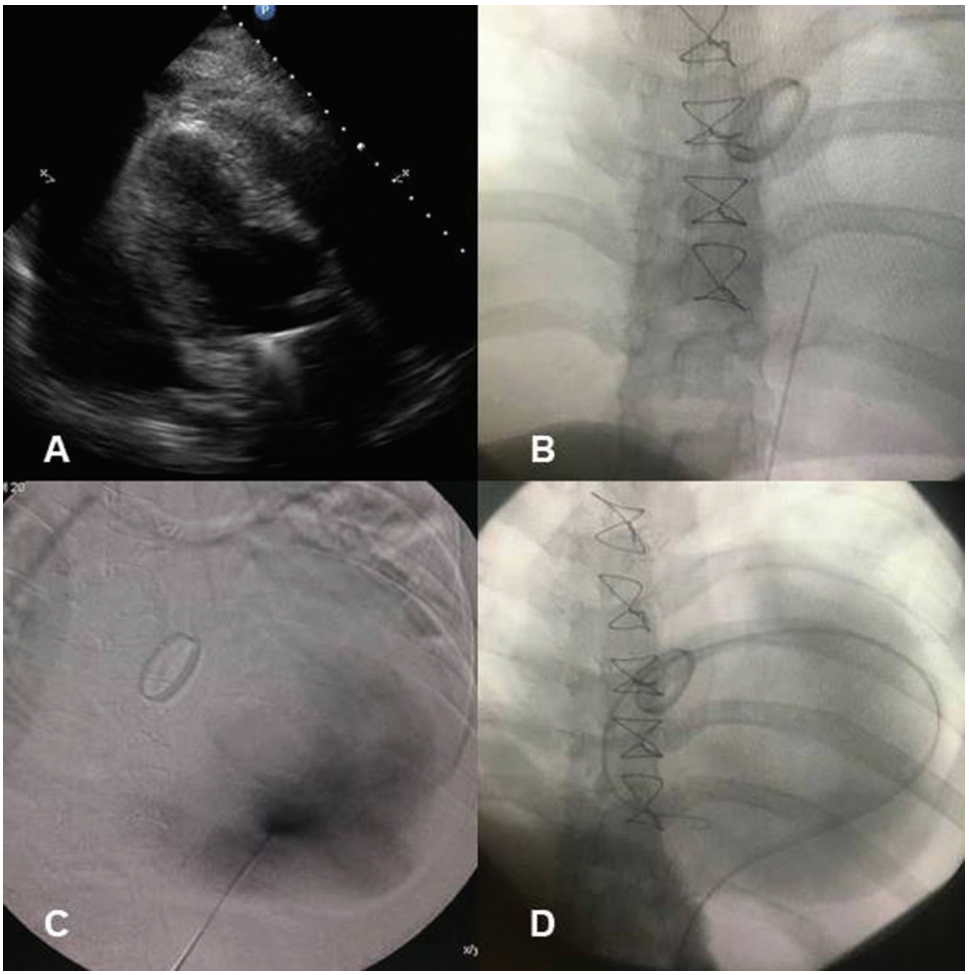

Fig. 3 (**A**) Four-chamber echocardiographic view of posterior pericardial effusion and minimal pericardial fluid at the apex. (**B**) View of the needle in the right ventricle. (**C**) View of pericardial effusion with fluoroscopy. (**D**) Placement of the catheter into the posterior pericardium.

catheterization which needs urgent surgery is rare but most important complication of percutaneous drainage. Catheter-based pericardial drainage is contraindicated in the cases with little fluid at needle entry side or loculated pericardial hematoma.[8] Postoperative pericardial effusion usually develops in the posterolateral side of the left ventricle. Posterior effusions usually treated with surgical approach due to difficulty in the pericardiocentesis.[9] In the effusions that localized at a difficult position to reach percutaneous drainage (e.g., posterior location), patients may be observed conservatively and may be re-operated with re-sternotomy in the emergent conditions.[2] Right ventricular injury risk increases in the sub-xiphoid approach when fluid was less in the apical and anterior area.[9] Right ventricle injury risk at inferior surface increases especially in the blind sub-xiphoid approach.[10] 2D echocardiography is reported as an effective method during the pericardiocentesis.[1,6,11,12] Ashikhmana et al.[2] treated postoperative pericardial effusions of 327 patients by echocardiography-guided pericardiocentesis, surgical drainage and conservatively with the rates of 52%, 25%, and 20%, respectively. In the evaluation of 5818 patients with cardiac surgery, Pomplio et al.[4] reported the rate of postoperative pericardial effusion in 117 patients with the rate of 2% and they treated pericardial effusion by surgical drainage (56%) or echocardiographic-guided pericardiocentesis (44%). However, surgical artefacts which are localized in the puncture site and lung problems causes suboptimal imaging during transthoracic echocardiographic evaluation. Even agitated saline might not enough to identify position and leave us in doubt even contrast study.

It can be difficult to distinguish hemorrhagic pericardial fluid from the thinned blood of the patient who is

already on anticoagulants treatment. In this condition, fluoroscopy is helpful for the success of the procedure. Fluoroscopic examination with contrast agent is important to ensure the place of catheter and continue to the procedure. In our patients, we can easily revealed pericardial space with the guidance of fluoroscopy and echocardiography.

Presence of a limited diameter fluid in the apical space and localization of the fluid in the posterolateral segment are challenges for pericardial drainage with sub-xiphoid approach. Pericardiocentesis should be performed in the hybrid operating room to convert to urgent surgery if necessitated. In experienced centers, it is possible to perform pericardiocentesis even in the patients with 0.7 mm pericardial space around the apex. Also, pericardiocentesis might be done to early diagnosis of the cardiac injury after the trauma, and patient might undergo operation.[13] In some cases, the needle might enter the heart cavity during the puncture. It is important to manage this situation in a cold-blooded manner since there may not too much bleeding to develop cardiac tamponade with 18-gauge needle. The needle was entered into the right ventricle and we confirmed it with fluoroscopy in two patients with 0.7 mm pericardial space around the apex. In these patients, we pulled the needle back and insert it posterolateral neighborhood of the heart. To avoid any complication causing from the bleeding from the needle side, we did serial echocardiographic examinations first 2 hours and drained the pericardial fluid with success without any complication (**Fig. 3**).

The limitation of the study is its retrospective nature. We gained all information from the medical records. All of the effusions were wider than >2 cm. However, we do not have any detailed information about diastolic collapse or other echocardiographic findings. None of the patient underwent urgent surgery or pericardiocentesis. This might be related with the advantage of the routine echocardiographic examination and we can say that we diagnosed the patients with pericardial effusion before significant symptoms had been developed.

Conclusion

Echocardiographic-guided pericardiocentesis has become the primary interventional approach in the treatment of pericardial effusion. However, postoperative pulmonary problems, artefacts, and antiagregant/anticoagulant usage affect the safety of the procedure. Additional fluoroscopic imaging encourages surgeons in the subject of catheter placement and increases the efficiency of the procedure.

Disclosure Statement

Authors certify that we have no conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript.

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