

## ORIJINAL MƏQALƏ

## AÇIQ GİRİŞ (OPEN ACCESS)

# Davamlı Drenajsız üsulla aparılan perikardiosintezin etibarlıq və effektivliyinin dəyərləndirilməsi

Uzm.Dr. Farid Aliyev<sup>1</sup>, Uzm.Dr. Evin Bozçalı<sup>2</sup>, Uzm.Dr. Ali Can Hatemi<sup>3</sup>, Uzm.Dr. Firdovsi İbrahimov<sup>1</sup>, Uzm.Dr. Kamran Musayev<sup>4</sup>

**Aim:** In this study we aimed to evaluate effectiveness and safety of pericardicentesis protocol and procedure employed at our Institutions.

**Methods:** This study enrolled patients with pericardial effusion, which were admitted to hospital during the period from July 2005 through February 2009. Enrollment criteria included presence of at least 1.5 cm of circumferential pericardial effusion or combination of clinical and echocardiographic signs of cardiac tamponade. Effectiveness and safety of technique of pericardial drainage with 6 French dilatator and subsequent removal of catheter without long term drainage was evaluated here.

**Results:** A total of 61 patients were enrolled. Technique was successful in all patients (100%). Reaccumulation of fluid and need for a second procedure was observed in two patients (3.2%). There were no major complications. Four cases suffered minor procedure related complication (chest pain in one patient and severe bradycardia in 3 patients). The most frequent final diagnosis was tuberculosis in 65 % and malignancy in 16% of study patients.

**Key words:** fluid, pericardiosynthesis, technique

## Abstrakt

**Məqsəd:** Mərkəzlərimizdə aparılan perikardiosintez protokolunun etibarlılıq və effektiv

liyinin dəyərləndirilməsi

**Xəstə və üsullar:** Perikardial maye diaqnozu ilə 2005 oktyabr və 2009 noyabr tarixləri arasında xəstəxanaya gələn xəstələr tədqiqata daxil edildi. Ən az 1.5 sm ölçüsündə dairə şəkilli perikard mayesinin varlığı, klinik və ya exokardioqrafik tamponada əlamətləri tədqiqata daxil edilmə kriteriyaları olaraq müəyyənləşdirildi. 6 Frenç qalınlığında dilatator ilə uzun müddətli drenaj ilə icra edilən perikardiosintez proseduru etibarlılıq və effektivlik baxımından dəyərləndirildi.

## Yazışma üçün əlaqə:

Uzm.Dr. Farid Aliyev<sup>1</sup>, Uzm.Dr. Evin Bozçalı<sup>2</sup>,

Uzm.Dr. Ali Van Hatemi<sup>3</sup>, Uzm.Dr. Firdovsi

İbrahimov<sup>1</sup>, Uzm.Dr. Kamran Musayev<sup>1</sup>

<sup>1</sup> Mərkəzi Klinik Hastanesi, Kalp Mərkəzi,

Kardioloji Bölmesi, Bakı, Azərbaycan

<sup>2</sup> İstanbul Üniversitesi Kardioloji Enstitüsü,

Kardioloji ABD. Haseki-Fatih, İstanbul,

Türkiye.

<sup>3</sup> İstanbul Üniversitesi Kardioloji Enstitüsü,

Kalp Damar Cərrahisi ABD. Haseki-Fatih,

İstanbul, Türkiye.

Email: drfaridaliev@yahoo.com.tr

**Nəticələr:** Topamda 61 xəstə tədqiqata daxil edildi. Aparılan müalicəvi üsulun xəstələrin tamamında uğurlu nəticələndiyə gözləndi. İki xəstədə (3.2%) yenidən perikardial maye yığılması səbəbi ilə bir prosedura daha ehtiyac oldu. Tədqiqata daxil edilən xəstələrdə ən çox qoyulan diaqnoz vərəm (65%) və onkoloji xəstəliklər idi (16%).

**Yekun:** Bu üsulun etibarlılıq və effektivlik dərəcəsinin yüksək olması ilə yanaşı ağırlaşma riskinin azlığı və təkrar proseduraya ehtiyacın az olması aydınlaşdı.

**Açar sözlər:** maye, perikardiyosintez, texnika

### Introduction

Pericardiocentesis performed either using percutaneous or surgical approach is a well-established treatment of pericardial tamponade and massive pericardial effusions. Establishment of etiologic diagnosis in patients with pericardial effusion is another aim of pericardiocentesis (1). Although surgical approach (2, 3) is preferred in patients with small amount of pericardial effusion, it is also affected by operator experience in percutaneous techniques. Advantage of surgical approach is possibility of removing of small, and localized pericardial effusions. Percutaneous pericardiocentesis method was applied effectively since 1840 (4), although it may lead to serious complications such as death, cardiac arrest, cardiac perforations, cardiac arrhythmias, arterial bleeding, pneumothorax, infection, and vagal reaction (5, 6).

Pericardiocentesis under two-dimensional echocardiographic guidance is safer and easier rather than blind approach. Two-dimensional contrast echocardiography is helpful in locating needle position; thereby significant complications can be precluded (7, 8). Prolonged drainage of pericardial fluid is generally performed to avoid reaccumulation of pericardial fluid.

Herein we report treatment and complication rates of 61 cases of pericardial effusions with different etiologies, treated by percutaneous echocardiographically guided pericardiocentesis without prolonged pericardial drainage, and describe our technique.

### Patients and Methods

#### Patient Selection

Patients with pericardial effusion, which were admitted to hospital during the period from July 2005 through February 2009 were enrolled. Study was approved by the ethical board. Enrollment criteria included presence of at least 1.5 cm of circumferential pericardial effusion or combination of clinical and echocardiographic signs of cardiac tamponade. Diagnosis of cardiac tamponade was established based on combination of several clinical and echocardiographic findings in the presence of pericardial effusion. Moderate to severe dyspnea, orthopnea, decrease in systolic blood pressure, decrease in urine output, elevated central venous pressure and presence of pulsus paradoxus were considered as clinical signs of cardiac tamponade. Right atrial diastolic collapse, right ventricular collapse, more than 25% decrease in transmitral E wave amplitude on inspiration and failure to decrease proximal diameter of inferior vena cava on deep inspiration were considered as echocardiographic signs of cardiac tamponade. Patients who developed pericardial effusion due to trauma, thoracic surgery and patients who had coagulation abnormality, thrombocytopenia ( $<100\ 000$ ), and those anticoagulated with warfarin were excluded from the study. The procedure was not performed in patients with suspected aortic dissection, until exclusion of this condition was performed with appropriate diagnostic imaging tools. Informed consent was obtained from all patients before the

procedure. Complete blood count and coagulation parameters were assessed and general physical examination was performed before the procedure.

Description of the technique  
Pericardiocentesis was performed in the coronary care unit setting, under continuous ECG (electrocardiogram), pulse oxymetry and blood pressure monitoring.

Echocardiographic evaluation: Complete two-dimensional and Doppler echocardiographic evaluation was performed before the procedure. During echocardiographic study it was aimed to evaluate location and size of effusion, presence or absence of echocardiographic signs of tamponade, to determine the presence of loculation, to evaluate stranding, and to determine the optimal site of puncture (subxiphoidal or apical). Other important information, obtained during echocardiographic examination was measurement of distance from parietal pericardium to the optimal site of puncture (measured on 2-D echocardiography device monitor as a distance from the apex of triangle to the pericardium). This distance was measured in near sitting position at 45-60° angle in which procedure was planned to be performed for patients considered to undergo a subxiphoidal approach and in semi-left decubitus position for those considered for intervention from apical approach.

In cases requiring echocardiographic guidance during the procedure, assisting operator placed the probe into the sterile glove filled with ultrasonic transmission gel and surface of skin was cleaned with povidone-iodine solution to allow the transition of ultrasonic waves.

Before procedure two routes of intravenous access on both arms were obtained. 500 ml of 0.9% NaCl solution was infused over the period of 15 minutes before procedure, and was continued to up for 1000 ml during and

following the procedure.

Following a sterile preparation and draping of procedure field, approximate area of puncture was infiltrated with 20 ml of 2% prilocaine (400 mg). Puncture was performed with 18-gauge needle (5-8 cm length) under continuous negative aspiration, until the approximate distance from skin to parietal pericardium measured by echocardiography was exceeded by 1 cm. In this situation approximate direction of needle was reevaluated by echocardiography, and puncture was performed in another appropriate direction. After entering the pericardial space, a small amount of fluid (50 ml) was aspirated into the syringe and stored for further diagnostic work up. Then the syringe was removed, and 0.038-inch J-tipped guide wire (length 45.5 cm) was advanced through the needle. Once the guide wire had been advanced safely into the pericardial space, the needle was removed and dilator of 6F sheath (Input Introducer Sheath, Medtronic, Minneapolis, USA), which length is 17 cm, was advanced into the pericardial space and the guide wire was removed thereafter. Sheath was not advanced into the pericardial space, and was not used by any means during the procedure. Once the dilator was completely introduced into the pericardial space over-the-wire, fluid was aspirated until it stopped to flow into the syringe. Then the catheter was slightly withdrawn, aspiration continued at each point until it was not possible to aspirate at that position. This procedure was repeated continuously, until the dilator catheter was completely withdrawn from the pericardial space. During pericardiocentesis procedure, we aimed to remove pericardial fluid as completely as it was possible. Echocardiographic assessment was repeated before complete withdrawal of dilator from pericardial space. In patients with significant amount of residual

pericardial fluid ( $> 1$  cm), guide wire was advanced into pericardial space, dilator was further readvanced and residual fluid was aspirated. After removal of catheter, puncture site was covered with sterile closure band. In cases with hemorrhagic pericardial effusion and in those with clinical suspicion or history of underlying tuberculosis, antituberculosis treatment was started immediately, and continued until the diagnosis of tuberculosis was excluded. We believe that this approach may result in decrease of re-accumulation of pericardial fluid in subgroup of patients with underlying tuberculosis.

Echocardiographic evaluation was performed several hours (3-6) after initial procedure and repeated every day during hospitalization. Final evaluation was performed on the day of discharge from the hospital.

## Results

### Patient Characteristics

61 patients were enrolled in to the study. Data of the patients, including demographic characteristics and final diagnosis established at the time of the procedure or during subsequent diagnostic work-up is presented in Table 1.

Procedure related complications and outcome procedure was successfully performed in all patients. There were no major complications, such as death, hemodynamic compromise, or requirement for urgent cardiothoracic surgery during the procedure or subsequent follow-up.

Procedure was performed via subxiphoidal approach in 59 patients and via apical approach in 2 patients. We observed only four minor complications, such as severe chest pain in one patient and severe bradycardia responsive to administration of atropine in three patients. Chest pain was suggested to be a consequence of irritation of intercostal nerves during an apical

approach and bradycardia due to either insufficient local anesthesia or irritation of the vagal fibers of diaphragm, pericardium or right ventricular wall. Re-accumulation of pericardial fluid within pericardial space, requiring second intervention was observed in two patients: one with hypothyroidism and one during serous stage of pericarditis secondary to tuberculosis. Accumulation of pericardial fluid within left pleural space was observed in 7 patients, which was suggested to be secondary to the formation of connection between pericardial and pleural spaces. Two of these patients had undergone apical and five of them subxiphoidal approach, and pericardial effusion had serous character in all of these patients. None of the patients with hemorrhagic effusion had transition of fluid in to the pleural space. These cases were successfully managed without need for left-sided thoracentesis. This fluid disappeared during the follow-up in all patients.

Another important observation was made in one patient who developed pericardial effusion after percutaneous coronary intervention (PCI). This patient was managed with pericardiocentesis and intrapericardial administration of tranexamic acid, which resulted in rapid cessation of hemorrhage. We suggest that this finding needs further investigation in patients with post-PCI pericardial effusion, because local administration of antifibrinolytic agents may help to avoid thrombotic complication when compared to administration of these agents into the central circulation.

Echocardiographic measurement of distance between skin and pericardial fluid at puncture site, was found to be highly correlated with needle depth required to achieve pericardial space ( $r=0.953$ ,  $p<0.0001$ ). This measurement may help to avoid traumatic complications associated with pericardiocentesis procedure.

Total volume of pericardial fluid aspirated in this study cohort was  $1370 \pm 920$  ml (250 - 2700 ml).

### Discussion

Pericardiocentesis via the subxiphoidal approach was reported as a safest method to avoid procedure related complications (9). Two-dimensional echocardiography helps to improve procedural outcome via the perception of spatial orientation, while pericardial contrast injection provides

optimal identification of the needle tip (8, 10, 11). Morbidity and mortality rates with blind pericardiocentesis via subxiphoidal approach, was reported as high as 50% and 6%, respectively. Otherwise, echo-guided pericardiocentesis was associated with fewer complication rates (12-14). First of all, technique of pericardiocentesis presented here is very cost effective and safe irrespective of

**Table 1.** Demographic characteristics of study patients, final diagnosis and procedural outcome. (PCI: percutaneous coronary intervention)

Characteristics	N, (%)
<b>Diagnosis</b>	
<i>Tuberculosis</i>	39 (64.0%)
<i>Idiopathic/viral</i>	9 (14.0%)
<i>Hypothyroidism</i>	2 (3.20%)
<i>Malignancy</i>	10 (16.0%)
<i>Post-PCI</i>	1 (1.60%)
<i>Total</i>	61 (100.0%)
<b>Characteristics of pericardial fluid</b>	
<i>Transudative</i>	9 (15%)
<i>Exudative</i>	52 (85%)
<b>Mean age (years)</b>	$35 \pm 21$
<b>Sex, males (%)</b>	37 (60.6%)
<b>Procedural success</b>	61 (100.0%)
<b>Approach</b>	
<i>Subxiphoidal</i>	59 (96.7%)
<i>Apical</i>	2 (3.2%)
<b>Complications</b>	
<i>Minor complications</i>	4 (6.5%)
<i>Chest pain</i>	1 (1.6%)
<i>Bradycardia</i>	3 (4.9%)
<i>Major complications</i>	0 (0.0%)
<i>Death</i>	0 (0.0%)
<i>Perforation</i>	0 (0.0%)
<b>Requirement for repeat intervention due to reaccumulation of pericardial fluid</b>	2 (3.2%)
<i>Percutaneous</i>	1 (1.6%)
<i>Surgical</i>	1 (1.6%)

underlying disease. Cost of procedural equipment is about 10 US dollars, and this price is significantly lower when compared to use of specially designed catheters for pericardiocentesis or standard angiographic pig-tail catheters. Although, Tsang et al. was reported that extended catheter drainage in patients who underwent echo-guided pericardiocentesis, offered decrease in recurrence (14), based on our observation we suggest that extended drainage of pericardial fluid is not necessary in significant proportion of patients. Although, it is well known that patients with tuberculosis pericarditis and those who have serous effusions secondary to hypothyroidism or hypoalbuminemia have higher effusion recurrence rates, in our opinion initiation of antituberculosis treatment immediately after the procedure in all patients with suspicion of this disease, may decrease fluid re-accumulation rates and need for long-term pericardial drainage. However this hypothesis needs further prospective investigation.

We preferred use of dilator instead of sheath, because of several reasons: distal edge of sheath may result in myocardial damage, and sheaths are prone to kinking within pericardial space. However dilator is much more stiff than sheath and is not prone to kinking. It can be speculated that its distal edge may also result in myocardial damage, but we have noted in methods section that dilator was only withdrawn and in case of need for further readvancement dilator was advanced over the guide wire.

Another important finding of this study, is observation of correlation between real and echocardiographically measured distance from skin to pericardium. This approach may help to reduce procedure related traumatic complications. In addition we and other investigators recommend that the puncture site of pericardiocentesis should be

determined with two-dimensional echocardiography (15). Absence of major complications, only three minor complications in this study, may be explained by operator experience, however we suggest that technique described here is very safe and effective even in inexperienced hands. Selection of either apical or subxiphoidal approach depends on the location of pericardial fluid. And we suggest that puncturing the site where pericardial effusion leads to increase between parietal and visceral pericardium, may help to decrease procedure related major complications.

Low rate of re-accumulation of pericardial effusion depends on several factors. First of all, significant proportion of patients enrolled in the study had hemorrhagic pericardial effusion, with excessive stranding, and we suggest that, complete removal of fluid results in adhesion between visceral and parietal pericardium, and by this way prevents re-accumulation of pericardial fluid. Second factor, is very high rate of tuberculous pericarditis. Also need for repeated pericardiocentesis is high for patients with tuberculosis; we routinely start empirical treatment with antituberculosis agents in all patients with hemorrhagic pericardial effusion and as it was mentioned before this issue may explain low incidence of fluid reaccumulation in our cohort. Although, hemorrhagic pericardial effusions due to tuberculosis are uncommon in developed countries (16), in our country the incidence of tuberculosis and tuberculosis pericardial effusions is higher and similar to African and Asian countries (17, 18).

Another important factor is formation of pleuro-pericardial connections after removal of catheter, which results in flow of pericardial fluid to pleural space. All patients who had developed left sided pleural effusion following pericardiocentesis, had

serous effusions and were managed without need for thoracentesis. It is not surprising that none of these patients had hemorrhagic effusions and we suggest that fibrin strands prevent formation of pleuro-pericardial connections in patients with hemorrhagic effusions. Increased pleural capability of fluid absorption obviates need for further interventional procedures such as thoracentesis.

One of the important points that we would like to mention here is periprocedural bradyarrhythmia, which can sometimes be disastrous complication. This may be prevented by sufficient local anesthesia. Inexperienced operators, prefer to abort procedure and initiate resuscitation in cases of periprocedural bradyarrhythmias/hypotension as a consequence of vasovagal reaction. However, we strongly recommend continuing procedure with simultaneous administration of atropine, fluid and vasodepressors when necessary, and especially in patients with cardiac tamponade and massive pericardial effusion. This argument is based on the fact, that cardiopulmonary resuscitation is not effective in restoration of circulation in the setting of cardiac tamponade (19). Rapid pericardiocentesis, with even very small amount (20-50 ml) of fluid removal is life saving in this setting, because of the very high mortality associated with cardiac tamponade and cardiac arrest (1, 20, 21). We routinely administer a large amount of intravenous fluid before and during the procedure as described in methods section, and this helps to support filling pressures, even during severe bradyarrhythmias. In addition, intravenous fluid administration may prevent 'decompressive syndrome', which may be seen after removing of large amount (>500 ml) of pericardial fluid (21). Although, cases of acute pulmonary congestion and acute transient left

ventricular systolic failure after large volume pericardiocentesis have been reported (22), we did not observed this kind of complication in our patients. Thus, we strictly advise pre- and perioperative administration of intravenous fluid without concomitant treatment with vasopressor agents to avoid hemodynamic compromise.

### Conclusion

Here we presented very simple, effective and safe technique of pericardiocentesis. Although we understand that this issue needs further prospective evaluation, we suggest that early administration of antituberculosis treatment in countries with high incidence of this disease seems to be an effective approach toward decreasing the rate of fluid reaccumulation.

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## **Additional Information.**

### **Contribution of authors.**

Conception and design, Acquisition, analysis or interpretation of data, Drafting of the manuscript, Critical revision of the manuscript for important intellectual content, Statistical analysis, Data management, Research, Obtained support, funding and supervision: all authors equally. The authors read and approved the final manuscript.

### **Financing.**

No external funding was received for the analysis and research conducted for the purpose of preparing the article. No other entity or sponsoring organization was involved in the design and conduct of the study or research or analysis; had no role in data collection, management, analysis, data interpretation, or manuscript preparation, review, or approval; did not



participate in making decisions about submitting the manuscript for publication.

**Availability of information and materials.**

The information (data) used and/or analyzed during the analysis can be obtained by contacting the authors or the editors of the journal.

**Declarations.**

**Ethics Committee approval and informed consent.**

Written or oral informed consent was obtained from each participant. The Ethics Committee (ACS, Azerbaijan) and the Scientific Committee of the Congress approved this analysis.

**Consent to publish.**

Not provided.

**Conflict of interest.**

The author(s) declared no conflict of interest.

**Details about the authors.**

1 Mərkəzi Klinika Hastanesi, Kalp Mərkəzi, Kardioloji Bölümü, Bakı, Azərbaycan

2 İstanbul Üniversitesi Kardioloji Enstitüsü, Kardioloji ABD. Haseki-Fatih, İstanbul, Türkiye.

3 İstanbul Üniversitesi Kardioloji Enstitüsü, Kalp Damar Cerrahisi ABD. Haseki-Fatih, İstanbul, Türkiye.

Email: drfaridaliyev@yahoo.com.tr

**Sent:** April 4, 2023. **Received:** April 4, 2023.

Electronic publication: October 5, 2023.