**SURGICAL APPROACH FOR PERICARDIAL
FENESTRATION NAME CHANGE PROPOSAL
FROM SUBXIPHOID TO SUBSTERNAL**

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Abstract

Various surgical approaches for pericardial fenestration are described in the medical literature and are used in practice. Each of them has its advantages and disadvantages depending on the cause suggesting the need of pericardial fenestration. The purpose of this study is to demonstrate whether the substernal approach after resection of the xiphoid process is a safe and effective approach to the surgical treatment of pericardial tamponade. From 2000 to 2017 in the Clinic of Thoracic Surgery at the University Hospital "Prof. Dr. St. Kirkovich" – Trakia University, Stara Zagora, Bulgaria, and in the Clinic of Thoracic Surgery at the University Hospital for Active Treatment of Pulmonary Diseases "St. Sophia", Faculty of Medicine, Medical University – Sofia, Bulgaria, a total of seventy-one patients were diagnosed with pericardial effusion, respectively pericardial tamponade, and due to this underwent surgery. In thirty-two of them, the pericardial effusion was accompanied by a malignant pleural effusion (MPE). The VATS – Fenestratio pericardii procedure was performed on 29 patients while substernal pericardial fenestration was performed on the remaining 42 patients. Operative and perioperative mortality was not reported. Operative complications such as bleeding, damage to the coronary artery or myocardium did not occur. The average operating time was 38 min and the average length of hospital stay was 5 days. After resection and removal of the xiphoid process, the surgeon has sufficient and comfortable working space. The substernal approach after resection of the xiphoid process is a safe and effective approach to the surgical treatment of pericardial tamponade.

Key words: pericardial tamponade, subxiphoid, substernal, xiphoid process, MPE

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Introduction. Pericardial fenestration is a surgical procedure which is performed to evacuate pericardial fluid from the pericardial cavity. The causes leading to collection of fluid in the pericardial cavity are numerous and varied. Those include pericardial carcinomatosis or direct infiltration of a neighbouring tumour process, as well as the combination of the pericardial effusion with MPEs (malignant pleural effusions). There is a correlation between the rate of pericardial fluid accumulation, the pericardial fluid volume and the resulting cardiac tamponade.

When the pericardial effusion is acute, only a small volume of the fluid can increase the intrapericardial pressure, resulting in clinical symptoms. Here, the structure and the function of the pericardium should also be taken into account, i.e. inflammatory processes, adhesions, fibrous transformation. These cause thickening and rigidity of the pericardium, and hence, a smaller volume of the pericardial fluid is able to cause cardiac tamponade. The usual fluid volume associated with cardiac tamponade is 150–2000 ml.

Various surgical approaches for pericardial fenestration are described in the medical literature and are used in practice. Each of them has its advantages and disadvantages depending on the cause suggesting the need of pericardial fenestration.

In chronic health conditions with no symptoms of tamponade any of the described surgical techniques can be equally easy to apply. In the case of symptomatic cardiac tamponade with collapse of the right atrium and right ventricle as well as elevated central venous pressure, priority is given to those approaches which allow rapid access to the pericardium and which are suitable to perform under local anaesthesia and sedation.

Material and methods. From 2000 to 2017 in the Clinic of Thoracic Surgery at the University Hospital “Prof. Dr. St. Kirkovich” – Trakia University, Stara Zagora, Bulgaria and in the Clinic of Thoracic Surgery at the University Hospital for Active Treatment of Pulmonary Diseases “St. Sophia”, Faculty of Medicine, Medical University – Sofia, Bulgaria, a total of seventy-one patients were diagnosed with pericardial effusion, respectively pericardial tamponade, and due to this underwent surgery. In thirty-two (45%) of them the pericardial effusion was accompanied by a malignant pleural effusion (MPE). In thirteen (40.6%) of the cases of pericardial tamponade in combination with an MPE, there was histological evidence for malignancy in the pericardial specimen collected at the time of fenestration or the cytological test of the pericardial fluid. The malignant pleural effusion was found more often in the left pleural cavity than in the right one. In twenty-four (75%) cases the combined MPE was found in the left pleural cavity, in six (18.75%) cases – in the right pleural cavity and in two (6.25%) – bilaterally.

The VATS – Fenestratio pericardii procedure was performed on 29 patients, in whom the pericardial effusion was accompanied by an MPE. In these cases the pericardial fenestration was in combination with VATS talc pleurodesis. The

procedure was performed under general anaesthesia on patient able to tolerate it. A substernal pericardial fenestration with drainage of the pericardial effusion after resection of the xiphoid process was performed on the other 42 patients, as in 34 of them this procedure was carried out under local anaesthesia and sedation, while in the remaining 8 patients this procedure was carried out under thoracic epidural anaesthesia at the Th 6–8 intercostal space.

Surgical technique: for a new name of the surgical approach, i.e. from subxiphoid to substernal.

Patient's position on the operating table: the patient lies on his back with a support underneath, so that the sternum is positioned higher than the anterior abdominal wall.

The operating surgeon stands on the right side of the patient. A small midline longitudinal incision 5–7 cm in length is performed, starting 1 cm above the upper end of the xiphoid process and finishing 1 cm below its tip (lower end). The skin and subcutaneous tissue are incised to expose the xiphoid process.

Linea alba is incised inferiorly to the xiphoid process. Kocher clamp forceps is used to get a grip of the exposed part of the xiphoid process and pull it out forward and upward. An electric knife is then used to peel the loose tissue off the xiphoid process completely (front and back) reaching its base (sternoxiphoidal junction). Resection of the xiphoid process follows with the help of bone cutters. With a retractor, the lower part of the sternum is retracted, while a gauze swap is used to press and take down the preperitoneal adipose tissue towards the inferior end of the incision.

After the resection, the surgeon penetrates deeply into the loose fatty tissue of the anterior inferior mediastinum following an upward, inward and leftward direction, and reaching the pericardium in front of the right ventricle. Prior to opening the pericardial window and the pericardiotomy, the pericardium is punctured using an abbocath catheter to evacuate some 50–100 ml fluid, facilitating its subsequent grip and safe opening.

There are no major blood vessels or major anatomical structures that the surgeon may encounter and which may delay or hinder the surgeon's access to the pericardium.

In practice, when the improved surgical technique is used, at first, resection of the xiphoid process is performed and then the substernal region is penetrated into as deep as 2–5 cm following an upward, inward and leftward direction. A declivous position as close to the angle between the pericardium and the diaphragm is the most suitable site for performing the pericardial fenestration. After making the pericardial window, through the opening into the pericardial cavity, catheter G18 is inserted upwards, drawn out and fixed through a separate incision. The lower mediastinum is drained using another catheter G18 drawn out and fixed to the left. Each catheter has its own gravity drainage bag. Experience with the substernal access shows that after resection and removal of the xiphoid process,

the surgeon has sufficient and comfortable working space to reach the anterior inferior pericardium in front of the right ventricle.

Making a large enough window (4×4 cm) close to the angle between the pericardium and the diaphragm allows direct observation of a part of the pericardial cavity and the myocardium. Possible and required is a video-assisted visualization of the inner surface of the pericardium and the myocardium. Samples are collected from the pericardial fluid for cytological, microbiological and biochemical analyses. Resected pericardium specimen is sent for pathomorphological assessment.

Results. In forty-two patients with cardiac tamponade the substernal approach was performed after resection of the xiphoid process as in 34 of them this procedure was carried out under local anaesthesia with lidocaine 1% and intravenous sedation, while in the remaining 8 of the patients, this procedure was carried out under thoracic epidural anaesthesia at the Th 6–8 intercostal space. Operative and perioperative mortality was not reported. Operative complications such as bleeding, damage to the coronary artery or myocardium did not occur. The average operating time was 38 min and the average length of hospital stay was 5 days. The pericardial and the mediastinal catheters remained in place for 4 days on average.

Discussion. The subxiphoid pericardial fenestration approach was described by LARREY [1] in 1829. Later in 1900, OGLE and ALLINGHAM [2] began to popularize the procedure. In 1970 FONTENELLE et al. [3] started using the subxiphoid approach (after resection and removal of the xiphoid process) to open a pericardial window. Since then, in the work of many authors, this approach has been considered one of the main ones for performing pericardial fenestration. The only modification that took place over the years is the resection and removal of the xiphoid process to facilitate access to the pericardium [4]. Initially, in the operative protocols the procedure was registered in the same way as it is commonly known in the global cardio-thoracic community, i.e. subxiphoid pericardial window. For accuracy and surgical clarity, after resection and removal of the xiphoid process, the approach to the lower anterior mediastinum and the pericardium is substernal. The author's opinion is that changing the name of the approach will not diminish or undermine the reputation and the uniqueness of the surgical technique described 190 years ago by Larrey and used ever since. Another technique allowing direct access to the pericardium and possibility for pericardial fenestration is the "*Left Paraxiphoid Approach to Drainage of Pericardial Effusions*", described and used by MOTAS et al. [5]. This approach provides a rapid access to the pericardium and a possibility for decompression of the cardiac tamponade. The fact that the approach is performed through the left sternocostal triangle (sharp angle, especially in the case of asthenic habitus) limits the possibility for an adequate intervention if complications occur during fenestration. This approach follows Larrey's point for pericardial puncture and provides the fastest access to the pericardium. The pericardial fenestration performed by this tech-

nique is equally effective. Here, the drain catheter is placed in the most declivous position. The same approach for opening a pericardial window is also used by FIGUEROA et al. [6] in patients with renal failure requiring chronic hemodialysis. The anterior parasternal minithoracotomy proposed by ALTMAN et al. [7] is more suitable for patients without cardiac tamponade. Its combination with a general intubation anaesthesia is recommended. After performing this procedure some postoperative complications have been reported affecting the pleural cavity and the lungs such as respiratory failure, pneumonia, and atelectasis. This surgical approach is slower with an average operating time of 73 min, making it less suitable for patients with cardiac tamponade. When discussing the surgical techniques for pericardial fenestration in patients with cardiac tamponade, it should be noted that all of them are applicable after performing a pericardial puncture and decompression of the cardiac tamponade. When the pericardial effusion is accompanied by an MPE, and the preliminary assessment is that the patient can tolerate the general anaesthesia, the preferred approach is VATS pericardial fenestration and talc pleurodesis.

Conclusion. After resection and removal of the xiphoid process, the surgeon has sufficient and comfortable working space. The substernal approach after resection of the xiphoid process is a safe and effective approach to the surgical treatment of pericardial tamponade.

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