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A New Approach for Pericardiocentesis-Right Parasternal

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Abstract
Pericardiocentesis is the most useful therapeutic procedure for the early management or diagnosis of large, symptomatic pericardial effusion and cardiac tamponade. The first description of cardiac decompression was in 1653, when Riolanus suggested sternal trephination to relieve pericardial pressure. In 1911, Marfan first described the subxiphoid approach, which had been used for the blind pericardiocentesis procedure for decades, despite the significant morbidity and mortality rates (50% and 6%, respectively). In subsequent years, the techniques recommended for safe and successful pericardiocentesis have changed considerably, particularly with the introduction of fluoroscopic, electrocardiographic and, finally, echocardiographic guidance, and with the description of approaches other than the substernal one (apical and parasternal). Here, we introduce a new puncture site: right parasternal in cardiac tamponade.

Keywords: Pericardial Effusion, Tamponade, Right Parasternal Approach, Pericardial-Pleural Windows, Phan Thai Hao Approach

Introduction

Cardiac tamponade is a life-threatening accumulation of pericardial fluid leading to compression on the heart and compromise of cardiac output. In hemodynamically unstable patients, an emergency pericardiocentesis is the cornerstone of therapy because the removal of fluid allows for normal ventricular filling and restores adequate cardiac output [1, 2, 3]. In case of pericardial effusion without hemodynamic compromise, pericardiocentesis is indicated for diagnostic purposes as well as symptomatic relief in moderate to large effusion nonresponsive to medical therapy or when tuberculous, bacterial, or neoplastic pericarditis is suspected. Clinically, cardiac tamponade is defined as the decompensated phase of cardiac compression, resulting from increased intrapericardial pressure. Clinical symptoms and signs include dyspnoea, elevated jugular venous pressure, hypotension, tachycardia, and pulsus paradoxus. At least one of these is present in over 75% of cases [4]. The effect of pericardiocentesis is often immediate: the drainage of a few millilitres of the effusion significantly increases stroke volume, reduces intrapericardial and atrial pressures, and permits separation between right and left filling pressures. Tachycardia and dyspnoea decrease, whereas arterial pressure increases and pulsus paradoxus disappears [5]. Three main approaches can be used for pericardiocentesis: the apical, the subcostal or the parasternal approach.

Traditionally, a subcostal approach has been preferred, largely because it was considered the safest route without image guidance. However, pericardial effusion is not always circumferential and equally distributed; consequently, an ultrasound evaluation of the ideal entry site for drainage is fundamental for procedural success. The Mayo Clinic advocates selecting the approach based purely on echocardiographic findings and defines the optimal entry site as the point where the pericardial space is closest to the probe and the fluid accumulation is maximal, with no intervening vital organs. This site is more often para-apical than subcostal [1]. Furthermore, an observational series on echo-guided pericardiocentesis demonstrated a greater success rate and a minor complication rate when the entry site was echocardiographically selected rather than when the subxiphoid approach was routinely used [1].

Case Report

A 48-year-old male patient was diagnosed with pericardial and pleural metastatic lung cancer and had a pericardial-pleural window opened. On admission, the patient had difficulty breathing, had accessory respiratory muscle contractions, cold hands and feet, sweating, Blood pressure: 100/60mmHg, Pulse: 160 bpm, spO2 88%. The heart is fast and steady, the lungs were clear and decreased at two lungs bases. Abdomen was normal. Fluid through the left pleural drainage tube released very little

red blood fluid in 24 hours. Suspected that the patient had a blocked pericardial-pleural shunt causing tamponade. The patient had a bedside echocardiogram which showed a lot of pericardial fluid with a maximum diameter of 52.7mm and signs of right atrial and right ventricular collapse (Fig 1) and **video clip**, especially on the right side of the sternum. We decided to do the puncture at a different location than the basic punctures: the left sternal edge, the cardiac apex and the subcostal line. We inserted the 16 gauge, 9 cm needle needle at the IV intercostal margin of the right sternum and withdrew 400ml of uncoagulated red fluid (Fig 2). After pericardiocentesis, the patient had less difficulty breathing, his pulse was 145 times/minute, his blood pressure was 110/60mmHg, and his SpO2 was 92%.

Fig 1: Pericardial Effusion (PE)

Fig 2: The puncture site was at the IV intercostal space of the right parasternal

Discussion

Pericardiocentesis via the apical approach is classically performed under echocardiographic guidance. The echocardiographic-guided approach allows one to simultaneously define the position of the effusion, the ideal entry site, and the needle trajectory. The ideal puncture site will have no intervening organs and the minimum distance from the ultrasound probe to the maximal fluid accumulation within the pericardium (primarily apical) [2]. Because ultrasound does not penetrate air, echocardiographic guidance ensures avoidance of the lung and the shortest path to reach the pericardium.

Pericardiocentesis via the left parasternal: the needle insertion site is in the fifth left intercostal space close to the sternal margin. Advance the needle perpendicular to the skin (at the level of the cardiac notch of the left lung). Risk of pneumothorax and puncture of the internal thoracic vessels (if the needle is inserted more than 1 cm laterally). Echocardiographic guidance, also with phase array probe, provides a good visualisation of pericardial structures.

In 1911, Marfan described the subxiphoid approach as a variation of the blind procedure, and this quickly became the standard route. The greatest risk in the blind procedure is laceration of the heart or coronary arteries by a steel needle [1].

Our new approach with ultrasound-guided right parasternal needle puncture was quite safe for patients with suspected pericardial-pleural window obstruction.

Four different Pericardiocentesis Approaches were summarized in Table 1.

Table 1: Characteristics of the Different Pericardiocentesis Approaches [6]

Place of Puncture	Description	Disadvantages	Advantages
Apical	The needle insertion site is 1-2 cm lateral to the apex beat within the fifth, sixth or seventh intercostal space. Advance the needle over the superior border of the rib to avoid intercostal nerves and vessels.	Risk of ventricular puncture due to the proximity to the left ventricle. Increased risk for pneumothorax for the proximity to the left pleural space.	The thicker left ventricle wall is more likely to self-seal after puncture. Due to ultrasound not penetrating air, using echocardiographic guidance ensures avoidance of the lung. The path to reach the pericardium is shorter.
Left Parasternal	The needle insertion site is in the fifth left intercostal space close to the sternal margin. Advance the needle perpendicular to the skin (at the level of the cardiac notch of the left lung).	Risk of pneumothorax and puncture of the internal thoracic vessels (if the needle is inserted more than 1 cm laterally).	Echocardiographic guidance, also with phase array probe, provides a good visualisation of pericardial structures.
Subxiphoid	The needle insertion site is between the xiphisternum and left costal margin. Once beneath the cartilage cage, lower the needle to a 15-to-30-degree angle, with the abdominal wall directed towards the left shoulder.	A steeper angle may enter the peritoneal cavity, and a medial direction increases the risk of right atrial puncture. In some cases, the left liver lobe may be transversed intentionally if an alternative site is not available. The path to reach the fluid is longer.	Lower risk of pneumothorax.
Right Parasternal (Phan Thai Hao approach)	The needle insertion site is in the fourth right intercostal space close to the sternal margin. Advance the needle perpendicular to the skin	Risk of pneumothorax and puncture of the internal thoracic vessels (if the needle is inserted more than 1 cm laterally).	Echocardiographic guidance, also with phase array probe, provides a good visualisation of pericardial structures. especially for patients with pericardial-pleural windows

Conclusion

Pericardiocentesis can be a potentially life-saving procedure that carries a high risk of complications. In this regard, imaging support and the careful planning of the proper entry site are fundamental for a safe and successful procedure. A new approach for pericardiocentesis-right parasternal (Phan Thai Hao approach) quite safe, especially for patients who have the pericardial-pleural window.

Conflict of interest

None.

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