Pneumopericardium after pneumonectomy and lobectomy

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ABSTRACT Pneumopericardium is a rare condition, most frequently reported in connection with prolonged artificial ventilation in infants with hyaline membrane disease. No reports of pneumopericardium after pulmonary surgery have been published. Two cases of pneumopericardium are reported, one of tension pneumopericardium after pneumonectomy and artificial ventilation and one that followed radical lobectomy and artificial ventilation. The radiographic findings included pneumopericardium and subcutaneous emphysema and the patient who had had a pneumonectomy had severe symptoms of cardiac tamponade. Prolonged artificial ventilation in patients after pulmonary surgery and in the presence of an intrathoracic air leak may be a hazard. The importance of prompt surgical intervention in cases of tension pneumopericardium is underlined; the treatment of choice is thoracotomy with pericardiotomy.

Many complications of pulmonary surgery are well known and described and most can be detected from the clinical state of the patient and the chest radiograph. Pneumopericardium occurring shortly after lobectomy or pneumonectomy for cancer is rare, however, and the purpose of this paper is to report two cases of postoperative pneumopericardium, one with and one without tension.

Case reports

CASE 1

A 65 year old man was treated by right middle and lower lobectomy for a squamous carcinoma located in the right bronchus intermedius. During the first postoperative day he developed total atelectasis of the remaining upper lobe, which was relieved by a therapeutic bronchoscopy. On the second day an emergency thoracotomy was performed for suspected bleeding. This operation disclosed no bleeding but recurrence of the atelectasis and a fistula in the bronchial stump. The bronchus was resutured with interrupted polyglycolic acid (Dexon) sutures. The proximal part of the pulmonary artery and the peri-

cardium were not dissected at either of these operations.

Artificial ventilation with positive end expiratory pressure (PEEP) of 5 cm H₂O was required after operation. On the sixth postoperative day the chest radiograph showed a pneumopericardium, which increased slowly over five days without any symptoms of cardiac tamponade (fig 1). The pneumopericardium disappeared spontaneously as the patient was weaned from artificial ventilation over a period of seven days. The electrocardiogram showed low voltage complexes. Subsequent recovery was uneventful and the patient was discharged from hospital on the 43rd postoperative day.

CASE 2

A 37 year old woman had a right pneumonectomy for a large cell carcinoma situated in the angle between the right pulmonary artery and the right main bronchus. The latter was transected close to the carina and closed with interrupted Dexon sutures, and the right pulmonary artery was transected near the main trunk. Both the transected bronchus and the artery were covered with mediastinal pleura, which was sutured with an over and over Dexon suture. The chest wall was closed without pleural drainage.

On the third postoperative day the patient developed respiratory insufficiency due to a left sided pneumonia and artificial ventilation was necessary. The oxygen saturation was kept at 100% by means of

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Fig 1 Case 1: Chest radiograph on the ninth postoperative day, with the patient in supine position, showing a large pneumopericardium and fully expanded right upper lobe.

PEEP (10 cm H₂O) and an inspiratory pressure of 50 cm H₂O. A *Klebsiella* septicaemia was treated with appropriate antibiotics. On the 10th postoperative day she developed severe shock immediately after endotracheal suction, which had provoked a violent bout of coughing. The condition did not respond to emergency pleural drainage (for a suspected fistula) or to treatment with intravenous fluids. Chest radiographs showed a pneumopericardium (fig 2), which increased rapidly within 30 minutes. The systolic blood pressure was 60 mm Hg and the central venous pressure 26 cm H₂O, and the ECG showed sinus tachycardia and low voltage complexes.

Emergency thoracotomy revealed a pericardium distended with air and frothy fluid. When the pericardium was opened the blood pressure and central venous pressure restored immediately to normal values. The mediastinum showed surgical emphysema up to the root of the neck. A direct communication from a small fistula in the bronchial stump via the bed of the right pulmonary artery to the pericardial sac was found to have caused the condition. The right main bronchus was resutured, the mediastinal pleura and the pericardium were left open, and a pleural tube was inserted.

After the second operation the patient was septicæmic and required artificial ventilation for some weeks. During this time she had a moderate air leak through the pleural tube, suggesting a small bronchopleural fistula. This leak ceased a week after artificial ventilation was stopped. The pleural tube

Fig2 Case 2: Chest radiographs of the patient in the supine position (a) immediately after she had developed severe shock, showing pneumopericardium and fluid in the right pleural cavity; and (b) 30 minutes later, showing an increased pneumopericardium.

was removed. The patient did not develop empyema or recurrence of the pneumopericardium and was discharged in good condition after two months.

Discussion

Pneumopericardium was first diagnosed by Brichteau in 1844¹ and Meyer² in 1948 identified three main causes—namely, trauma, perforations from neigh-

bouring organs, and infections.

Westaby³ reported three cases of pneumopericardium with tension after non-penetrating chest injuries; all were treated with surgical drainage of either the pleural space or the pericardial sac. Rosen⁴ reported a case of spontaneous pneumopericardium following a car accident in which no active treatment was required. Penetrating trauma from stab and ballistic wounds are known to cause pneumopericardium² and are reported to have a poor cure rate if the condition is complicated by infection. Ackerman⁵ reported a clinically insignificant case of pneumopericardium that followed sternal bone marrow aspiration, and Khan⁶ reported a non-fatal case of tension pneumopericardium occurring as a complication of a subtotal pericardiectomy.

Pneumopericardium is seen in connection with acute asthma⁷ and without any concomitant disease,⁸ in both cases probably as a result of a pleuropericardial laceration in the presence of a tracheo-bronchial or pulmonary air leak.³ Prolonged artificial ventilation of infants may also cause tension pneumopericardium,^{9,10} especially if the inspiratory pressure is kept above 25 cm H₂O.

A fatal case of pneumopericardium secondary to pneumonic cavitation of tuberculous origin was reported by Patel.¹¹ Meyer² stated in his original paper that spontaneous development of gas in the pericardial sac is extremely rare; it is more frequently seen in combination with a general infection such as pneumonia.

The two cases we present are likely to be due to a combination of surgical trauma and prolonged artificial ventilation. In both cases the addition of positive end expiratory pressure to the artificial ventilation may have played an important part in the development of pneumopericardium and especially tension pneumopericardium.

In a review by Cummings¹² 83% of cases with tension pneumopericardium occurred in patients who were having positive pressure support ventilation. This is believed to cause increased intra-alveolar pressure causing leaks, with subsequent dissections containing air along the perivascular and peribronchial sheath into the pericardium, where a valve mechanism may develop, allowing continued inflation of the pericardial sac without notable deflation.³

Positive end expiratory pressure may also have been one reason for the development of a fistula in our

patients, since in case 1 the pneumopericardium disappeared shortly after the patient had been taken off assisted ventilation.

In case 2 the use of polyglycolic acid suture (Dexon) and a severe bronchopulmonary infection may also have contributed to the fistula, although Dexon has been shown to be associated with fewer bronchopleural fistulas than chromic catgut.¹³

Aspiration of the pericardium to release air or blood is technically easy, but many cause arrhythmias, and we have seen sudden death due to this manoeuvre. In the second case we preferred therefore to proceed to immediate reoperation, which was accomplished without appreciable delay, rather than to use a preliminary aspiration of the pericardium.

References

- 1 Bricheteau M. Observation d'hydro-pneumo-pericarde, accompagnée d'un bruit de fluctuation perceptible à l'oreille. *Arch Gen Med* 1844;4:334-9.
- 2 Meyer HW. Pneumopericardium. *J Thorac Surg* 1948;17:62-71.
- 3 Westaby S. Pneumopericardium and tension pneumopericardium after closed-chest injury. *Thorax* 1977;32:91-7.
- 4 Rosen A, Vaudagna J, Jamplis RW. Spontaneous pneumo-pericardium. *Am Rev Respir Dis* 1963;87:764-5.
- 5 Ackerman JL, Alden JW. Pneumopericardium following sternal bone marrow aspiration. A case report. *Radiology* 1958;70:408-9.
- 6 Khan RMA. Air tamponade and tension pneumopericardium. An unusual complication of subtotal pericardiectomy. *J Thorac Cardiovasc Surg* 1974;68:328-30.
- 7 Toledo TM, Moore WL, Nash DA, North RL. Spontaneous pneumopericardium in acute asthma. Case report and review of the literature. *Chest* 1972;62:118-20.
- 8 Diemer NH, Egvad K. Pneumopericardium. *Ugeskr Laeger* 1973;135:1751-2.
- 9 Cohen S, Lockhart CH. Pneumopericardium: A complication of prolonged ventilation. *Anesthesiology* 1970;32:465-7.
- 10 Sagel SS, Wimbuxh P, Goldenberg DB. Tension pneumopericardium following assisted ventilation in hyaline membrane disease. *Radiology* 1973;106:175-8.
- 11 Patel CV, Anand AL. A fatal case of pneumopericardium. *Radiology* 1966;74:626-7.
- 12 Cummings RG, Wesly RLR, Adams DH, Lowe JE. Pneumopericardium resulting in cardiac tamponade. *Ann Thorac Surg* 1984;37:511-8.
- 13 Høier-Madsen K, Schulze S, Pedersen VM, Halkier E. Management of bronchopleural fistula following pneumonectomy. *Scand J Thorac Cardiovasc Surg* 1984;18:263-6.