Subject Reviews

The Essentials of Pericardial Diseases

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Abstract:

Generally, diseases of the pericarcium is uncommon, i.e. pericardial effusion, cardiac tamponade, pericarditis, and peicardial neoplasms (tumours). However, cardiac tamponade is one of the important cause of sudden death. A good understanding of the aetiologies of pericardial abnormalities can lead to improve the patient's care throughout diagnosis and treatment.

Keywords: ● *Pericardial effusion* ● *Cardiac tamponade* ● *Pericarditis* ● *Peicardial neoplasms*

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บทความฟื้นวิชา

สาระสำคัญเกี่ยวกับโรคของเยื่อหุ้มหัวใจ

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บทคัดย่อ

โดยทั่วไปแล้วโรคของเยื่อหุ้มหัวใจเป็นโรคที่พบได้ไม่บ่อยนัก ได้แก่ ภาวะน้ำในช่องเยื่อหุ้มหัวใจ ภาวะบีบรัดหัวใจ เยื่อหุ้มหัวใจอักเสบ และ เนื้องอกของเยื่อหุ้มหัวใจ อย่างไรก็ตามภาวะบีบรัดหัวใจเป็นสาเหตุหนึ่งที่นำไปสู่เสียชีวิตอย่างเฉียบพลันได้ ดังนั้นการเข้าใจอย่างดีถึงสาเหตุของความผิดปกติของเยื่อหุ้มหัวใจจะช่วยให้สามารถดูแลผู้ป่วยได้ดียิ่งขึ้นทั้งในด้านการวินิจฉัยและการรักษา

คำสำคัญ: ● *ภาวะน้ำในช่องเยื่อหุ้มหัวใจ* ● *ภาวะบีบรัดหัวใจ* ● *เยื่อหุ้มหัวใจอักเสบ* ● *เนื้องอกของเยื่อหุ้มหัวใจ*

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Introduction

Clinically, pericardial disease is one of uncommon heart conditions, but it has typical morphological features. This review focuses on the aetiologies of four most important pericardial diseases, i.e. pericardial effusion, cardiac tamponade, pericarditis, and peicardial neoplasms (tumours). Cardiac tamponade is a medical emergency and may result in sudden death. Hence, a good comprehension of how pericardial abnormalities develop can lead to more improved diagnosis and treatment.

Normal Pericardium

The normal pericardium is a flask-shaped sac that encloses the heart and the roots of the great vessels. The pericardium (pericardial sac) consists of 2 parts: (I) an external inelastic fibrous tissue called the *Fibrous pericardium*; and (II) an internal transparent serous membrane called the *Serous pericardium*[1]. The fibrous pericardium protects the heart against acute dilatation[2]. The serous pericardium is comprised of the delicate mesothelial-lining *Parietal* and *Visceral layers*. The parietal layer of the serous pericardium (the parietal pericardium) is attached to the inner surface of the fibrous pericardium. The visceral layer of the serous pericardium (the visceral pericardium) envelops the heart and is also called the *Epicardium*[1,3] containing variable amounts of adipose tissue, the coronary arteries and veins, lymphatic vessels, autonomic nerves, fibroblasts, and macrophages[3]. The *Pericardial cavity* is the potential space between the parietal and visceral layers of the serous pericardium[4]. It normally contains up to 50 millilitres (mL) of straw-coloured physiologic serous fluid[3,5] that enables the heart to move and beat in a minimal friction environment[2].

A Concisely Medical History of the Pericardium

Hippocrates, an ancient Greek physician (460 BC-375 BC), described normal pericardium as the following statement: the pericardium is a smooth mantle surrounding the heart and containing a small amount of fluid resembling urine. Aelius Galenus (Claudius Galenus or Galen of Pergamum), a Greek physician (AD 129-200), considered that the pericardium is the protective structure of the heart. In addition, he firstly encountered (I) pericardial effusion from anatomical dissection of a monkey; (II) partial pericardial removal in a young man with probably infective anterior mediastinitis; and (III) a cartilaginous tumour in the pericardial carvity from anatomical dissection of a cock (*an adult male chicken*).

Since the Renaissance (the period in Europe during the 14th-16th centuries) period led to dissemination of anatomical dissection (mostly illegal), there is an increase in knowledge about the heart and pericardium. Richard Lower (1631-1691), a British physician, clearly explained the reasonable mechanism of cardiac tamponade and of constrictive pericarditis based on the clinical information and the pericardial necrosy specimens derived from a 30-year-old woman with progressive dyspnoea, weakness, fainting, chilliness of the limbs, and intermittent and very weak pulse. Jean-Baptiste de Sénac, a French physician (1693-1770) and a personal physician to King Louis XV from 1752 until 1770, showed that pericarditis is related to the other thoracic inflammations such as pneumonia, pleuritis, and mediastinitis. He also publicly performed parasternal pericardiocentesis for patients suffering from pericardial effusion or hydropericardium. Nevertheless, pericardiology importantly appears in the 17th-18th centuries[6].

Pericardial Effusion

Pericardial effusion is defined as the accumulation of an abnormally large amount of fluid, including an exudate (*fluid, which has escaped from blood vessels, usually as a result of inflammation, shows a high content*

of protein, cells, or cellular debris) or a transudate (*fluid, which has passed through a membrane or been extruded from a blood vessel, as a result of hydrodynamic forces or probable inflammation, shows a low content of protein, cells, or cellular debris*), in the pericardial cavity[7]. A pericardial effusion can be acute or chronic (longer than 6 months) and there are various types of fluid, including serous, serosanguineous, sanguinous, purulent, or chyle, based on each individual cause (Tables 1, 2).

Serous effusion is usually related to a decreased return of pericardial fluid or to decreased serum osmolality such as hypoproteinaemia. Serosanguineous effusion is mostly associated with pericardial inflammation and purulent exudation is commonly present. Either sanguinous or haemorrhagic effusion is usually related to myocardial rupture secondary to trauma or myocardial infarction, maliganant neoplasms, and uraemic pericarditis[8]. Regarding haemopericardium, the pericardium contains the large volumes of dark blood in the cavity resulting from myocardial and/or coronary artery rupture (s). In addition, this condition is usually related to penetrating trauma or massive blunt force trauma to the chest (often from the steering wheel). A haemopericardial effusion could lead to cardiac tamponade. A pericardiocentesis is able to use as a diagnostic procedure[9].

Chylopericardial effusion is a rare condition. In 2008, Kamada and colleagues reported a 20-month-old girl presenting with fatal pulmonary lymphangiectasia, chylopericardium, and chylothorax. A chest radiograph showed cardiomegaly and pulmonary congestion. Computed tomographic (CT) scanning of her chest with intravenous administration of contrast material showed pericardial effusion and pulmonary congestion. Pericardiocentesis (*surgical puncture of the pericardial cavity for the aspiration of fluid*) produced 150 mL of milky fluid which confirmed a diagnosis of chylopericardium because of a high triglyceride concentration with positive Sudan III staining and a predominance of lymphocytes (95%) in cellular components[10].

Table 1 Characteristics of acute pericardial effusion[8]. Haemorrhagic effusion (haemopericardium) is bloody liquid that has a haematocrit virtually identically to that of blood. Minoxidil is a drug used in the treatment of either hypertension or hair loss. Purulent effusion is fluid containing pus which is a liquid inflammation product made up of leucocytes, cellular debris, and a thin protein-rich fluid. Sanguinous effusion is fluid containing excessive blood. Serosanguineous effusion is fluid containing both serum and blood.

Cause	Possible type of fluid						
	Clear straw-coloured	Serous	Bloodtinged	Serosan-guineous	Sanguinous	Haemor-rhagic	Purulent
Cardiac causes							
Congestive heart failure	Yes						
Myocardial (free wall) rupture					Yes		
Post-myocardial infarction (MI)		Yes	Yes			Yes	
Acute infections							
Bacteria				Yes			Yes
Virus		Yes		Yes	Yes		
Trauma				Yes	Yes		
Drugs							
e.g. Minoxidil		Yes					

Table 2 Characteristics of chronic pericardial effusion [adapted from ref.8]. Chyle is fluid consisting of lymph (a liquid portion mixed with mostly lymphocytes) and droplets of triglyceride fat (chylomicrons) in a stable emulsion. Chylopericardium is accumulation of chylous fluid in the pericardial cavity. Cor pulmonale is characterised by hypertrophy or failure of the right ventricle secondary to involvement of the pulmonary circulation by lung disease. Idiopathic is defined as arising spontaneously or from an unknown cause. Myxoedema is hypothyroidism in adults. Procainamide is a drug used in the treatment of cardiac arrhythmias. Sanguinous effusion is fluid containing excessive blood. Serosanguineous effusion is fluid containing both serum and blood.

Cause	Possible type of fluid			
	Serous	Serosanguineous	Sanguinous	Chyle
Cardiac cause				
Congessive heart failure	Yes			
Cor pumonale	Yes	Yes		
Left ventricula hypertrophy	Yes			
Myocarditis	Yes	Yes		
Obstructive cardiomyopathy	Yes			
Post-heart transplantation	Yes	Yes		
Post-myocardial infarction (MI) syndrome	Yes	Yes		
Rheumatic heart disease		Yes		
Chronic infections				
Fungus	Yes	Yes		
Parasites	Yes	Yes		
Acquired immunodcficiency syndrome (AIDS)				
Infection	Yes	Yes		
Kaposi sarcoma			Yes	
Idiopathic pericarditis	Yes	Yes		
Collagen vascular diseases	Yes			
Chronic renel disease		Yes		
Clotring disorders				Yes
Myxoedema	Yes			
Trauma			Yes	
Chylopericardium				
● Primary (Idiopathic)				Yes
● Secondary				Yes
● Surgery,traumatic injury to the thoracic ductt				Yes
● Lymphatic occlusion by parasites or metastatic tumour				Yes

Table 2 (Continue)

Cause	Possible type of fluid			
	Serous	**Serosanguineous**	**Sanguinous**	**Chyle**
Lymphopericardium e.g. Pericardial lymphangioma, Lymphangiectasia	Yes (Lymph)			
Neoplasms				
● Benign: Atrial myxoma	Yes			
● Malignant				
● Primary, e.g. Mesothelioma, Atrial angiosarcoma	Yes	Yes		
● Secondary				
● Metastatic cardinoma from solid organs, e.g. breast, lung		Yes	Yes	
● Leukacmia/Lymphoma	Yes	Yes		
Drugs				
e.g. Procainamide	Yes			
Radiotherapy	Yes			
Pregnancy	Yes (Usually self-limiting)			
Unknown	Yes (Usually)			

Cardiac Tamponade

Cardiac tamponade is a haemodynamically significant compression of the heart resulting from acute accumulation of fluid or blood in the pericardial cavity (at least 100 mL) that increase intra-pericardial pressure sufficiently to produce a progressive reduction in diastolic ventricular filling and a consequent decrease in stroke volume (the volume of blood pumped from the right or left ventricle of the heart in one beat) and cardiac output (the volume of blood pumped from the right or left ventricle of the heart in one minute)[8,11,12].

Pericarditis

Pericarditis is inflammation of the pericardial sac and may be caused by the following:[8,13-15]

1. **Idiopathic cause** (non-specific, probably viral)

2. **Infectious causes**

2.1 Viruses, i.e. coxsackievirus A and B, hepatitis viruses, human immunodeficiency virus, measles virus, mumps virus, and varicella virus.

2.2 Bacteria, i.e. gram-negative (Escherichia coli, Haemophilus influenzae, Klebsiella pneumoniae, Neisseria species, and Pseudomonas aeruginosa) and gram-positive (pneumococci, staphylococci, and streptococci) organisms, and Mycobacterium tuberculosis. Pericarditis associated with bacterial infections usually leads to the development of purulent effusion (turbid yellow exudate) in the pericardial cavity. This condition is called purulent pericarditis[16].

2.3 Fungi (most common in immunocompromised patients), i.e. Blastomyces dermatitidis, Candida species, and Histoplasma capsulatum.

2.4 Parasites, i.e. Echinococcus granulosus, Entamoeba histolytica, Toxoplasma gondii, and Trypanosoma cruzi.

3. Non-infectious causes

3.1 Trauma, i.e. Non-penetrating or penetrating injury.

3.2 Cardiovascular diseases, i.e. acute myocardial infarction, aortic dissection, and Takayasu's arteritis.

3.3 Systemic illness, i.e. hypothyroidism, inflammatory bowel disease, renal failure, rheumatic fever, rheumatoid arthritis, sarcoidosis, scleroderma, spondyloarthropathies, systemic lupus erythematosus (SLE), and Wegener's granulomatosis.

3.4 Drugs (in relative order of frequency), i.e. hydralazine, procainamide, phenytoin, isoniazid, rifampin, phenylbutazone, dantrolene, doxorubicin, methysergide, penicillin, and mesalamine.

3.5 Iatrogenicity (unintentional and preventable induction of disease or complications by a physician or surgeon or by the medical treatment or diagnostic procedures), i.e. cardiac catheterisation, cardiovasclar surgery, pacemaker implantation, pericardiocentesis, and radiation therapy for breast or lung cancer.

3.6 Malignant neoplasms, i.e. breast cancer, Hodgkin's lymphoma by local invasion, leukaemia, and lung cancer.

Based on pathophysiologic process, pericarditis is classified as acute (*less than 6 weeks*), subacute (*6 weeks - 6 months*), and chronic (*longer than 6 months*)[14]. The histopathological features of acute pericarditis consist of infiltration of acute inflammatory cells with fibrinous exudate and increased pericardial vascularity. Many cases of pericarditis resolve without residual lesions. However, fibrous adhesions might be formed between pericardium and epicardium and between pericardium and adjacent sternum and pleura. Additionally, pericardial fibrosis and thickening could be appeared as white patches on the epicardial surface[8].

Pericardial Neoplasms (Tumours)

Primary pericardial neoplasms (tumours) are rare, but secondary (metastatic) tumours are more common. For benign tumour, pericardial (mesothelial) cyst is the most common. Other benign tumours include angioma, lymphangioma, fibroma, teratoma, and lipoma. Malignant pericardial tumours are generally sarcomas[8]. Grossly, metastatic tumour of the pericardium presents with multiple whitish tan nodules on the epicardial surface of the heart. This condition could lead to the development of haemorrhagic pericarditis[16].

Conclusion

Diseases of the pericardium are classified according to clinical, aetiologic, and morphologic features. Hence, the diagnostic approach and treatment should be individualised for each patient.

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