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THE SURGICAL MANAGEMENT OF PERICARDIAL EFFUSIONS IN CANCER PATIENTS

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Pericardial effusion may appear in any malignancy, but most commonly in lung, breast cancer and lymphoma. Patients in these cases are usually with advanced malignancy and have an overall poor prognosis. The pericardial effusions may be malignant – malignant cells present in the fluid or in the pericardium or epicardium, or nonmalignant. Difference in survival between the two groups is important. The long term prognosis is closely linked with the type of cancer. Clinical manifestations can vary from no symptoms to cardiac tamponade with fatal prognosis, depending on the amount of fluid and the installation interval. Most treatment options aim for rapid improvement of symptomatology. The purpose is to colect fluid and/or tissue to make a diagnosis and obtain a lasting effect with a low chance of recurrence. The procedures used to drain pericardial effusions include: pericardiocentesis, balloon pericardiotomy, subxiphoidian window, left paraxiphoidian window (Motas), pericardo-pleural and pericardo-peritoneal window, pericardiectomy via sternotomy or thoracotomy, and may be followed by sclerotherapy. Despite the efficient treatment of the pericardial effusions, the final outcome remains poor for these patients.

Key words: pericardial effusion, cancer, cardiac tamponade, surgical procedures, sclerotherapy

INTRODUCTION

Malignant pericardial effusion is an accumulation of fluid in the pericardial sac, and usually represents a challenging problem. The pericardium surrounds the heart and the great vessels and it is composed of a thin visceral membrane, a fibrous parietal membrane, and the pericardial space between them. Normally, the space contains less than 50 ml of plasma ultrafiltrate.[1]

The pericardium elasticity results in a nonlinear pressure-volume curve. Lower quantities of pericardial fluid does not modify the pericardial pressure, but large or sudden effusions can lead to tamponade, by increasing the pressure[2,3]. In cancer patients the pericardial effusions usually increases slowly. When the pericardial fluid volume exceeds the limit of the membrane stretch, it results in cardiac tamponade[3].

Malignant pericardial effusion are characterized by the presence of malignant cells in the pericardial fluid, the pericardium, or epicardium. But in cancer patients malignancy associated pericardial effusion may appear, which do not include malignant cells. Approximately half of the pericardial effusions in cancer patients are benign[2,4].

The symptoms of pericardial effusion include dyspnea (85%), cough (30%), orthopnea (25%) and chest pain (20%). The signs are paradoxical pulse (45%), tachypnea (45%), tachycardia (40%), hypotension (25%) and peripheral edema (20%)[4].

Cardiac tamponade can be recognized clinically by Beck's triad: hypotension, tachycardia, and muffled heart sounds[2,3]. Pericardial effusion can be accompanied by a pleural effusion in 50% of the cases.

The chest radiograph shows an enlarged cardiac silhouette (figure 1)[2,4].

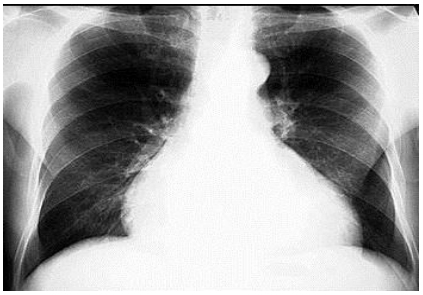

Figure1 Water bottle sign on chest x-ray.

The patient's EKG may be normal, or may illustrate a low QRS voltage, nonspecific ST or T wave changes, or electromechanical dissociation[2]. Pericardial effusion is most commonly associated with low QRS voltage.

MATERIAL AND METHODS

Echocardiography is an accurate, noninvasive method for detection of effusion, and has clarified the definition from pericarditis to pericardial effusion, a standardized entity[5].
The echocardiography is the most useful study for determining the presence, location and hemodynamic effect of the pericardial effusion: collapse of the right atrium at end of the diastole, and of the right ventricle in early diastole (figure 2)[3].

Figure 2 Echocardiographic imaging of pericardial effusion

The computed tomography and magnetic resonance imaging are useful in determining the quantity, the distribution of the pericardial fluid, and if the fluid is loculated (figure 3)[2].

Figure 3 Computer tomographic imaging of pericardial effusion

In order to treat pericardial effusion in cancer patients, we need to evaluate the cardiovascular status, and consider the prognosis of the underlying malignancy.
Stable patients, without evidence of tamponade can be managed by careful monitoring, and therapy of the underlying cause. Patients with tamponade should be given volume resuscitation if systolic blood pressure is below 100 mmHg, and the central venous pressure must be kept higher than the pericardial pressure in order for the heart to fill[3].
The goals of the treatment are to relieve symptoms, to obtain fluid and tissue for diagnosis, and to insure a low recurrence[4].

There are different surgical procedures: pericardiocentesis, baloon pericardiotomy, subxiphoid and paraxiphoid window (Motaş), video-assisted thoracic surgery and by thoracotomy pericardial window, pericardial-peritoneal window, and pericardiectomy via sternotomy or thoracotomy.
Pericardiocentesis is the only rapid procedure that can be done in case of sudden hemodynamic colapse. It can be done using only anatomic landmarks and local anesthetic.[3] The help of echocardiography (figure 4) and fluoroscopy can increase the accuracy of the procedure[1,6].

Figure 4 Pericardiocentesis guided by echocardiography

Major complications include ventricular perforation and cardiac arrest, heart chamber laceration, ventricular tachycardia, pneumothorax. The recurrence rate may be higher than 50% (90% by some authors)[5,7]. In order to lower the risk of recurrence, sclerotherapy agents can be used: tetracycline or doxycycline, cisplatin, bleomycin and thiotepa.
Baloon pericardiotomy involves pericardiocentesis followed by a catheter - based balloon inflation, resulting in a tearing in the pericardium and creating a communication between the pericardial and pleural or peritoneal cavities.
Subxiphoid pericardial window is a very common procedure, used in pericardial effusions. It is performed via an upper midline abdominal incision, with the retraction or removal of the xiphoid process. It may be performed under local anesthesia and fluid and tissue sample can be collected.
Left paraxiphoidian pericardial window involves a median incision above the xiphoid process, de-insertion of the left rectus abdominal head form the xiphoid process, with access above the diaphragmatic cupola, close to the maximal pericardial bulge area (figure 5)[7].

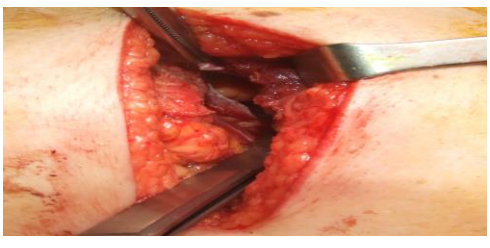

Figure 5 Left paraxifoidian window

A pericardial-mediastinal window is created. The procedure can be done under local anesthesia, not having to resect the xiphoid process and is far from the pleural space, with no risk of pneumothorax[8]. It offers the possibility of collecting fluid and tissue sample.

Video-assisted thoracic surgery pericardial window represents a minimally invasive alternative to anterolateral thoracotomy or subxiphoid window. It has the possibility to approach concomitant pleural or pulmonary disorders, and to perform pleurodesis. Loculated pericardial effusions are better resolved with this technique, under direct visualization[7]. The disadvantage of this procedure is the need for general anesthesia with single lung ventilation, which can be a problem in patients with tamponade. However, VATS pericardial window has been done successfully with local anesthetic and sedation[4].

Pericardiectomy can be performed via sternotomy or anterior thoracotomy, but represents a very invasive procedure. The procedure can have up to 67% mortality, compared with subxiphoidian window (10%)[4].

Pericardial-peritoneal window is a simple, safe, and effective procedure. It is applicable to most patients with pericardial effusion, including those with tamponade[9]. No drainage tubes are needed, pericardial fluid is absorbed by the peritoneum, and the subxiphoid incisions are small and almost painless[9,10].

Along with the continued pericardial drainage until the quantity of fluid is minimal through the tubes, also instillation of sclerosing agents helps to prevent recurrences: cisplatin, thiotepa, bleomicin, tetracycline, doxycycline, minocyline[11].

Radiation therapy is very effective in controlling malignant pericardial effusion in patients with radiosensitive tumors such as lymphomas and leukemias[11].

RESULTS AND DISCUSSIONS

Primary tumors of the pericardium are 40 times less common than metastatic ones. Mesothelioma, the most frequent of the primary tumors, is almost always incurable[12].

Pericardial effusions are detected with increasing frequency in patients with malignancy.[13] Metastases to the heart and pericardium are observed postmortem in about 15-20% of cancer patients. Cardiac metastasis manifest by pericardial effusion in 5-15% of patients with cancer. Nonmalignant pericardial effusion may be found in 7% of patients with cancer at autopsy[13].

Pericardial effusions may appear in the course of any malignancy, but most commonly in lung cancer, breast cancer and lymphoma[2,4,8].

Pericardial effusion less than 1 cm usually does not progress[13]. Asymptomatic patients should be managed with close follow up and treatment of the underlying malignancy. Noninvasive treatment strategy in these patients does not to increase mortality or lengthen hospital stay[13].

Studies of different surgical procedures of the pericardial effusions showed that the most effective technique with the lowest rate of recurrence is thoracoscopic pericardial-pleural window. Pericardocentesis may have up to 90% recurrence, accompanied by injection of sclerosing agents 25% recurrence, subxiphoidian window 14%, thoracoscopic pericardio-pleural window 5%, pericardio-pleural window by thoracotomy 10% and pericardio-peritoneal window 10% recurrence at 3 months[7].

The most aggressive surgical method remains the pericardiectomy done by thoracotomy or sternotomy.

Drainage tubes placed in the pericardium are maintained on suction by the water seal drainage systems until drainage is less than 50 ml in 24 hours.

Studies of therapeutic efficacy revealed that a low rate of recurrence can be obtained by complete drainage of the pericardial fluid and the use of continued pericardial drainage until adhesion between epicardium and pericardium appears[14].

Pericardioscopy represent the endoscopic inspection of the pericardium[16]. By pericardioscopy visualization and extensive pericardial sampling is possible[15,16].It improves the diagnostic value of pericardial biopsy. Sampling efficiency is higher (86%), compared to fluoroscopic procedures (43.7%)[17].

There are no randomized trials comparing the efficacy and safety of different therapeutic modalities in neoplastic pericardial effusion. Prevention of recurrence, observed in 40-70% of patients with large malignant pericardial effusion, can be improved by intrapericardial instillation of sclerosing agents, systemic tumor therapy, radiation therapy and surgical methods[11].

Depending on histological type of the tumor: in case of adenocarcinoma of the lung and breast cancer, intrapericardial instillation of cisplatin is effective in 83-93% of cases; thiotepa is effective in 83-89% of cases; tetracycline is a sclerosing agent effective in 85% of cases, but has frequent side effects: fever, chest pain, atrial arrhythmia; doxycycline, minocycline, and bleomicin also provides an effective procedure[11].

The use of sclerotherapy is used cautiously due to the potential of pain caused by introduction of the agents and concern for later development of constrictive pericarditis. This is a relatively problem, considering the life expectancy in these patients, which is low.

CONCLUSIONS

The surgical procedure is chosen by the surgeon considering the cardiovascular and medical condition of the patient, and the long-term live expectancy of the underlying malignancy. We must appreciate if the patient is stable and can sustain a general anesthesia, and if pleural effusion is associated.

If the conditions approve, pericardial windows made under local anesthesia (subxifoidian or left paraxifoidian window) or general anesthesia (thoracoscopic pericardial-pleural window) offer a better efficiency on

short and middle term than pericardiocentesis, and a lower chance of recurrence.

The long-term prognosis of cancer patients with pericardial effusions is not influenced by age or sex, and is not affected by the surgical technique used. It is closely linked with the type of cancer of the patient. The longest survival rate can be found in lymphomas (20.4 months) compared with other malignant tumors. From these, malignant effusions associated with breast cancer has the best chance of long-term survival (8.3 months)[4,8].

Despite the efficiency of treatments for the pericardial effusion, the overall prognosis for these patients remains poor.

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REFERENCES

1. Roberts J.R.; Kaiser L.R., „Pericardial Procedures" Mastery of Cardiothoracic Surgery 2nd edition, Lippincott Williams & Wilkins, Philadelphia, 2007, 254-261
2. Horvat T.; Ciuche A., „Pericarditele Maligne" Tratat de Chirurgie volumul IV, Editura Academiei Române, Bucureşti, 2008, 347- 357
3. Petrofsky M., J Adv Pract Oncol., 2014; Management of Malignant Pericardial Effusion, 5(4), 281-289
4. Singh D.; Katlic M. R., „Malignant Pericardial Effusions" General Thoracic Surgery 7th Edition, Lippincott Williams & Wilkins, Philadelphia, 2009, 885-890
5. Levy P.Y.; Habib G.; Collart F.; Lepidi H.; Raoult D., Future microbiol. 2006; Etiological Diagnosis Of Pericardial Effusion, 1(2),229-239
6. Karatolios K.; Alter P.' Maisch B., Herz, 2009, Differention Of Malignant From Nonmalignant, Inflamatory Pericardial Effusions With Biomarkers, 34(8), 624-633
7. Ciuche A,; Nistor C.; Motaş C.; Horvat T., Chirurgia, 2012; Chirurgia Miniinvazivă În Tratamentul Pleuro-Pericarditelor Maligne, 2, 206-212
8. Motaş C.; Motaş N.; Rus O.; Horvat T., ICVTS, 2009, Left Paraxifoidian Aproach For Drainage Of Pericardial Effusions, 10, 4-6
9. Olson J. E.; Ryan M. B.; Blumenstock D. A., Ann Surg Oncol, 1995, Eleven Years' Experience With Pericardial-Peritoneal Window In The Management Of Malignant And Benign Pericardial Effusions, 2(2), 165-169
10. Kallianpur A. A.; Samra S. S.; Nimbran V.; Gupta R.; Akkarappatty C.; Gupta N.; Gupta G., Indian J Palliat Care, 2013, Pericardial-Peritoneal Window: A Novel Palliative Tratement For Malignant And Recurrent Cardiac Tamponade, 19(2), 116-118
11. Maisch B.; Ristic A. D., Heart, 2003, Practical Aspects Of The Management Of Pericardial Disease, 89, 1096-1103
12. The Task Force on the Diagnosis and Management of Pericardial Diseases of the European Society of Cardiology, European Heart Journal, 2004, Guidelines on the Diagnosis and Management of Pericardial Diseases, Executive Summary, 25, 587-610
13. Laham R. J.; Cohen D. J.; Kuntz R. E; Baim D. S.; Lorell B. H.; Simons M., Heart, 1996, Pericardial Effusion In Patients With Cancer: Outcome With Contemporary Management Strategies, 75, 67-71
14. Sugimoto J. T.; Little A. G.; Ferguson M. K.; Borrow K. M.; Vallero D.; Staszak V. M.; Weinert L., Ann Thorac Surg, 1990, Pericardial Window: Mechanisms of Efficacy, 50, 442-445
15. Millaire A.; Wurtz A.; de Groote P.; Saudemont A.; Chambon A.; Ducloux G., Am heart J, 1992, Malignant Pericardial Effusions: Usufulness of Pericardioscopy, 124(4), 1030-1034
16. Seferovic P. M.; Ristic A. D.; Maksimovic R.; Simeunovic D.; Petrovic P.; Maisch B., Herz, 2000, Flexible Percutaneous Pericardioscopy: Inherent Drawbacks And Recent Advances, 25(8), 741-747