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CLINICAL STUDY

Postpericardiotomy syndrome – post-cardiac injury syndrome

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Abstract: *Introduction:* Postpericardiotomy syndrome is a non specific belated reaction of pericardium, epicardium and pleural cavity after cardiac or pericardial injury. It is concidered to be a common complication in cardiosurgery with occurence of 3 to 30 percent. Most likely, the primary cause is a common immunopathic proces. It develops within days or even up to six months after either cardiac or pericardial injury or both.
Aim: Echocardiography is the leading method in determination of postpericardiotomy syndrome due to the frequency of occurance, non- specific clinical symptoms (fever, chest pain, cough, dizziness), innacurate interpretation of examination methods (ECG, X-ray, laboratory tests). We would like to show how to determine the exactly diagnose, how to treat it and what is prognosis of this illness.
Results: We have performed a retrospective analysis of 1344 patients, who underwent cardiac surgery in the year 2009. The incidence of post- cardiac surgery syndrome was 12.4 %. In 2.6 % of the studied cases, surgical intervention was needed due to a cardiac tamponade. Int other cases similar to acute pericarditis, symptomatic treatment in duration of several weeks or months with non-steroid antireumatics, salicylic acid or colchicine is sufficient. Therapeutic options in refractory forms are long term oral corticoids or pericardiectomy. During our follow-up, pericardiectomy was necessary to perform in one patient.
Conclusion: Postpericardiotomy syndrome, which occurs in early postoperative period, prolongs hospitalisation. In spite of non specific symptoms huge pericardial effusion might be present and can cause cardiac tamponade with haemodynamic failure in later periods. Transthoracic echocardiography is the golden standard in determination of accurate diagnosis *(Fig. 6, Ref. 15)*. Full Text in PDF *www.elis.sk.*
Key words: postpericardiotomy syndrome, pericarditis, heart operation, pericardial effusion, etiology, diagnose.

Postpericardiotomy syndrome is non specific belated reaction of pericardium, epicardium and pleural cavity like a result of mechanical injury of cardiac or perikardial injury or both (1, 2). It is concidered to be a common complication in cardiosurgery with occurence of 3 to 30 percent. More frequent incidence of postpericardiotomy syndrome is in patients after correction of congenital heart disease, after aortic valve replacement, in patients with blood group B RH negative, in history of pericarditis or during contemporary treatment with corticoids (3). Cardiac tamponade after open heart sugery is more common following valve surgery (73 %) than coronary artery bypass grafting alone (24 %) and may be related to the preoperative use of anticoagulants (4). Most likely, the primary cause is an immunopathic process (5). It develops within days or even up to six months after either cardiac or pericardial injury or both. It does not occure in children under two years of age and the incidence decreases also in eldery.

Based of the above mentioned information, one could suggest two theories of origin of this syndrome. Presence of antiobodies against contractile proteins actin and myosin (AMA) and circulate immunocomplex gives evidence supporting the autoimmune etiology, propably related to more extensive release of antigenic material. Some authors (6) described the presence of specific auto-antibodies- AMA-, which experienced fourfold increase in postoperative period. It is suggested that the titer corellates with seriousness of postpericardiotomy syndrome. Evidence supporting immunopathological process is the latent period in duration of several months after surgery, presence of anticardiac antibodies and quick answer to the steroid therapy (7). The second theory is a viral etiology with recent or reactivated viral infection. Concomitant mechanical injury of pericardium is necesary in both theories.

Clinical symptoms depend on the rapidity of accumulation of pericardial fluid, biomechanical quality of fluid and quantity of fluid in pericardial sac. The volume of fluid causing tamponade varies inversely with both parietal pericardial stiffness and thickness. In early postoperative period, even 80 ml of fluid can cause an emergent situation. Symptoms, except for retrosternal or left precordial chest pain that worsens with recumbency and is relieved by leaning forward, are unspecific: fatigue, malaise, anorexy, non productive cough, artralgia and myalgia.

Objective symptoms are temperature above normal, pericardial friction rub occuring in three phases corresponding with atrial systole, ventricular systole and ventricular diastole, pleural rub, tachycardia, tachypnoe, attenuate sound, hepatomegaly and compression of the base of the lung results in a dullness under the left scapula (Bamberg-Pins-Ewart´s sign). Cardiac tamponade is a decompensated phase of cardiac compression caused by effu-

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sion accumulation and the increased intrapericardial pressure. The symptoms of imminent tamponade are hypotension, pulsus paradoxus, hypotension, tachycardia, dyspnoe or tachypnoe with clear lungs and elevated and increased filling of jugular or systemic venous pressure.

The most feasibile, the quickest and the most sensitive method in detection of pericardial effusion is *echocardiographic* examination. Pericardial effusion is present in almost 85 % of patients after heart surgery. However, the postpericardial syndrome is the causal cause in only 10 to 30 % percent. The fluid has less echo reflection than back wall of left ventricle. That´s why transudate is seen like an echo free space, while exudate is opacitated with fibrate streaks. Transthoracic two dimensional echo gives the information about the type of the fluid (fibrin, clot, tumour, air), but the definite type of fluid can be determined by an analysis of pericardial fluid. Pericardium must be examined at least from three projections. The parasternal long axis position is the basic representation, because the pericardial fluid is located first of all behind the posterior wall of left ventricle. Parasternal short axis gives the information regarding medial and lateral segments and the apical four-chamber projection the view to the apex. Subcostal projection shows the lateral wall of the right ventricle and right atrium and is important in detection of compression of right ventricle and right atrium of heart. In case of the rising the amount of pericardial fluid above physiological quantity, the separation of both leaves of pericardium could be seen not only in systole, but also in diastole and we can see the flattening of parietal leaf of pericardium. It is necessary to examine both atrioventricular ostiums by Doppler echo. Transesophageal echo is very important in low echogenicity, e.g. in early postoperative period in intubated patients.

The current substantial problem is the quantification of pericardial effusion, because of iregular distribution of fluid where mathematical models could not be used (8). Currently, semikvantitative quantification is used in clinical practise. Effusion of small amount (into 100 ml) can be seen above posterior wall of left ventricle (Fig. 1). In a mild amount of effusion (100–500 ml), effusion can be detected above posterior, lateral and anterior

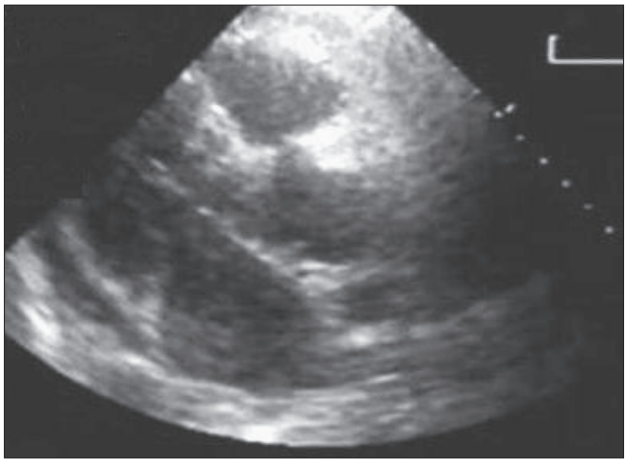

Fig. 1. Small pericardial effusion.

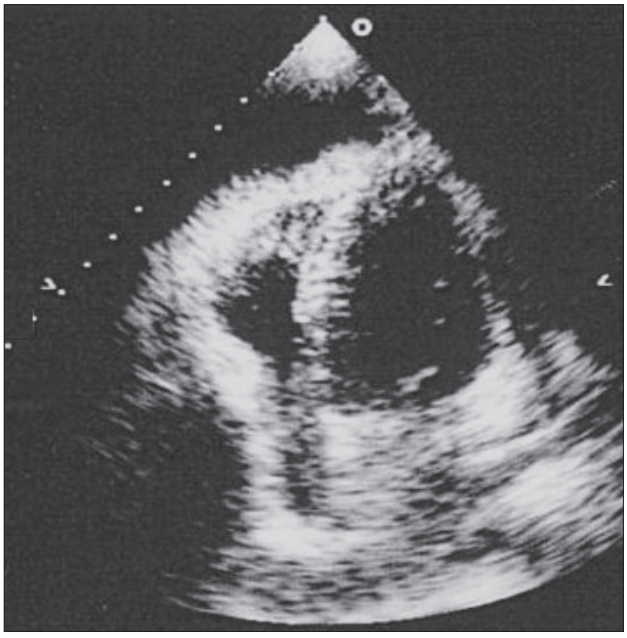

Fig. 2. Tamponade of pericardium.

wall of left ventricle. In large effusion (above 500ml), there is a great separation of leaves of pericardium above posterior, lateral and anterior wall – circuit (9). The separation of leaves is more than 10 mm. In the threat of tamponade, early diastolic collaps of right atrium and anterior right ventricle free wall apears, which represent almost 80 % of sensitivity. Collapse of right atrium appears sooner than right ventricle and is more sensitive, but less specific (Fig. 2). Sensitivity and predictive value of collapse of right atrium reached almost l00 %, if lasted more than 1/3 of the heart cycle (10). In large effusions, there can be seen a special motion of heart in pericadial sac in antero-posterior, or medio-lateral direction so called "swinging heart". Pseudoprolaps and pseudo SAM (systolic anterior motion) of mitral valve, enlargement of the right ventricle and reduced size of the left ventricle in inspirium, or even the compression of the right ventricle can apear. Left atrium and very rarely also left ventricle collaps, increased left ventricle diastolic wall thickness „pseudohypertophy", vena cava inferior dilatation (no collaps in inspiration). Tricuspid flow increases and mitral flow decreases during inspiration (reverse in expiration). The filling pressure in left atrium is decreased in inspirium and the decrease of peak speed of E wave (approximately 43 %) and wave A (approximately 25 %) can be detected. The relaxation time of left ventricle is growing. Systolic and diastolic flow is reduced in systemic veins in expiration anda reverse flow with atrial contraction is increased. Distinguishing between pleural and pericardial effusion is very important (11). Small and middle pleural effusion never reached behind left atrium (in parasternal long axis). In large and circuit effusions is necessary to orientate by the position of descending part of thoracic aorta. The descending part of thoracic aorta behind posterior wall of left ventricle near the atrioventricular incision can be seen. Pericardial effusion interferes within posterior wall of left atrium and moves descend-

ing aorta from its position, which is normally behind the posterior wall of left ventricle. It is necessary to distinguish between subpericardial fat, cyst, tumour, haematoma, hiatal hernia, gigant left atrium, vena cava inferior, coronary sinus, thoracic aorta and pseudoaneurysm of left ventricle.

The electrocardiogram is very useful in the diagnosis of postpericardiotomy syndrome. Characteristic manifestation includes a diffuse ST-segment elevation (12) (Fig. 3). Changes depend on the stage of a disease. In the first stage, anterior and inferior concave ST segment elevation and PR segment deviations opposite to P polarity (besides V1 and aVR) could be found. In early second stage, ST junctions return to the baseline and PR deviates and in late second stage, T wave progressively flattens and inverts. In the third stage, generalisated T waves are inversions what can persist even several weeks. In the fourth stage, ECG returns to prepericarditis stage. Occasionally stage four does not ococcur and there are permanent T wave inversionsand flattening. Low voltage is present many times and in case of imminent tamponade electrical alternans is present. In agonal phase we can see electromechanical dissociation. Acute myocardial infarction, early repolarization, pulmonary embolism, hypercaliemia, subepicardial haemorhagy, myocarditis, aneuryzm of left ventricle have to be excluded (Fig. 4). In the third stage, it is necessary to exclude diffuse myocardial demage, biventricular strain and myocarditis. Pericarditis is probably present, if J point in V6 is more than 25 % of height of the T wave apex (using the PR segment as a baseline). ECG in early repolarisation is similar to the first stage of pericarditis, but this finding is without development. Elevation of J point is accompanied by oscilation at the end of QRS complex in front of and inside of J point and high R and T wave are present.

Positive markers of inflammation (ESR, leukocytes, CRP, procalcitonin) and markers of myocardial lesions can be found in *laboratory results*. Cardiospecific enzymes are necessary to examine

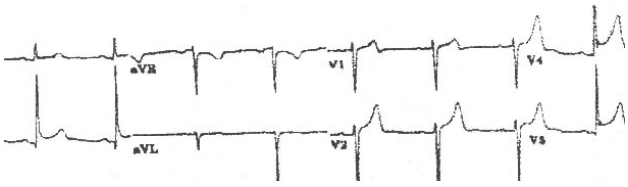

Fig. 3. Characteristic manifestation includes a diffuse ST-segment elevation.

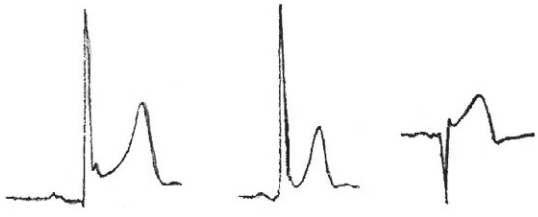

Fig. 4. QRS complex – pericardium, syndrome of early repolarisation and acute myocardial infarction (from left side).

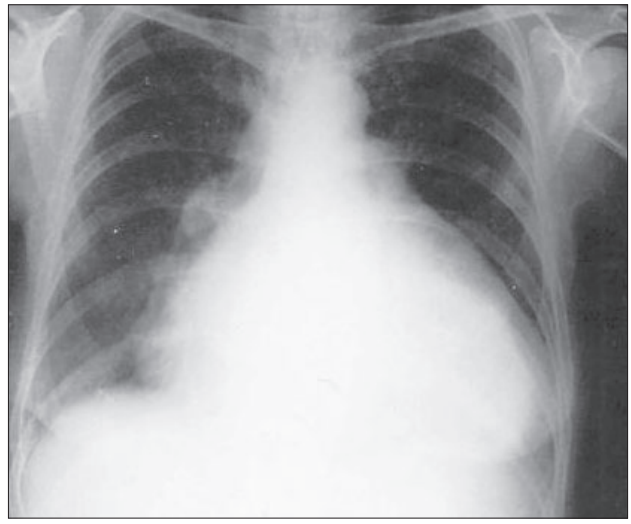

Fig. 5. Shadow of water battle.

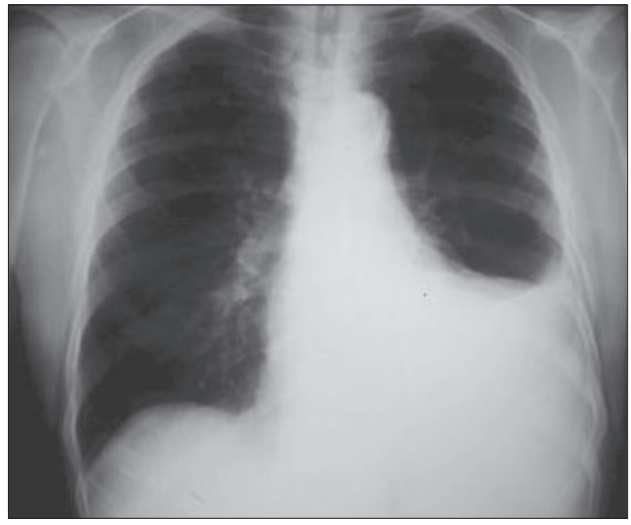

Fig. 6. Pleural effusion.

to exclude acute coronary event. Cardiac troponin I is detectable in 32.2–49 % of patients, more frequently in younger, male, with ST segment elevation and pericardial effusion at presentation. An increase beyond 1.5 ng/ml is rare (7.6–22 %) and associated with CK-MB elevation. Troponin I increase is not a negative prognostic marker regarding the incidence of recurrences, constrictice pericarditis, cardiac tamponade or residual left ventricle dysfunction. Biochemical analysis can be spread with immunologic examination of antibodies and cell imunity and antiviral antibodies (ECHO, Coxsackie A, B, herpetic virus, adenovirus, Ebstein Barr virus, cytomegalovirus, influenza and mycoplasm).

In X-ray is present a bilateral enlarged cardiac silhouette (enlargement of shadow of heart with sharp edge, shadow of "water bottle") with clear lungs (Figs 5 and 6). In the present times, X-ray examination brings only limited results, therefore

it is necessary to make deeper analysis of cause of cardiomegaly by echocardiography, or computer tomography, or nuclear magnetic resonance. These examination methods are sometimes necessary for orientation in the surrounding structures and characteristics of fluid.

It is important to detect the curable causes of pericarditis. There exists infective pericarditis (viral, bacterial, fungy, parasitic), autoimmune diseases (lupus, sclerodermy), autoimmune process (reumatic fever, Dressler syndrome after myocardial infarction), metabolic disease (uremia, myxedem, Addison disease, hyperlipoproteinemy, diabetes mellitus, hypothyreosis, gravidity), posttraumatis laesion (chylopericardium, pneumopericardium, postiradiac), neoplastic disease (tumours primary and methastasic), consequence of adverse events of medicaments (hydralazin, doxorubicin, isoniazid). It is necessary to exclude also the acute dissection of aneurysm of aorta with rupture, pericarditis epistenocardiaca, hydropericardium in heart failure, pulmonary embolism, recent or postpone bacterial endocarditis, thrombosis of arteficial prostesis of valve orificium and oesophagus disease. Postoperative febrility can be often present due to wound, respiratory or urinary infection. Paresis of diafraghm as a consequens of chill injury of nervus phrenicus has to be excluded.

Therapeutic approach follows of seriousness of clinical syndromes in accordance to the guidelines on the Diagnosis and Management of Pericardial Diseases of the European Society of Cardiology (13). In case of imminent pericardial tamponade it is necessary to perform the drenage of pericardium as soon as possible. *Pericardiocentesis and pericardial drainage* under echo or fluoroscopic control is indicated in case of tamponade or pericardial effusion more than 20 millimeters in diastole. The second choice is surgical pericardiotomy and drenage. *Pericardiectomy* is indicated in case of a repetitive effusion, or constriction of pericardium. It is necessary to drenage also the great pleural effusion. Effusion after drenage must be examined by pericardial fluid cytology, cultures, PCRs and histochemistry for determination of infestion or neoplasia. *Conservative method* is indicated in a case of a mild pericardial effusion. Nonsteroid therapy (NSAID) is the drug of first choice (14). It has antipyretic, antiflogistic and analgetic effects, which are caused by supression of synthesis of prostaglandin and other inflammation mediators. Generally is used ibuprofen three or four times daily 400–600 mg or diclophenac three or four times daily 50 mg. Acid acetylosalicylic four times daily 400–650 milligram in short duration therapy two to five days is also recommended. Both pharmacologic regimens need a gastric antisecretoric therapy with inhibitors of protone pump or H2 blockers. Colchicum has also cytotoxic efficacy and inhibits migration of leucocytes, fagocytosis and formation of some leucotriens (15). It inhibits mitosis in nuclear cell and it binds to tubulin and interferes with transcellular transference of collagen. Recommended dose is 2 milligram daily for 48 hours and later l mg daily. Colchicum can be used in monotherapy or in combination therapy with nonsteroid drugs in dose twice daily 0.5 milligram. In case of large effusion or in case of repeated effusion, corticosteroid therapy in peroral form in dose l–l.5 milligram for kilogram of weight could be used or combination of NSAID and parenteral corticosteroids in short duration. When the corticosteroid therapy is finished, it is necessary to continue the NSAID therapy or colchicum. In the resistant cases, immunosupressive therapy (methotrexat, cyclofosfamid, azathioprin) is indicated. Nonsteroid antireumatic drug indometacin is contraindicated because of emergency of premature closure of vein graft.

Prognosis of disease is very good and mostly is restitution ad integrum. Pericardectomy is indicated in case of recidive pericarditis, or later because of constriction of pericardium. In the Department of Heart Surgery of National Institute of Cardiovascular Diseases in Bratislav, the yearly incidence of postpericardiotomy syndrome was 12.4 %

(166 patients) with 2.6 % (36 patients) requirement of surgery intervention due to the heart tamponade. In other cases, conservative method was used with peroral nonsteroid drugs in lenght of several days to several weeks (fourteen days to 16 weeks). In 6.25 % (84 patients) we applied a short durated parenteral corticotherapy with Hydrocortison twice daily 50–l00 milligramg in lenght from 3 to 7 days. In 0.37 % of cases (5 patients), subjects were threated by peroral corticoid therapy by Prednison in introduction dose of one milligram for kilogram of weight. One patient underwent a pericardiectomy due to recurrence of pericarditis with large production of effusion. For determination of diagnosis of postpericardiotomy syndrome, the presence at least two of the following criteria was necessary: chest pain in exclusion of wound pain, subferilits, leucocytosis with negative cultivations and contemporary ECG signs of pericarditis, or presence of pericardial friction rub, or pericardial effusion.

Postpericardiotomy syndrome in the early postoperative period prolongs the duration of hospitalisation. Sometimes even non specific subjective and objective symptomes of postpericardiotomy syndrome can be the cause of false or late diagnosis of tamponade of pericardium and can cause life threatening situation due to circulatory colaps. Every patient after cardiosurgery procedure must have a regular echo examination, at least at the time of discharge from the hospital. In case of establishing the diagnosis of postpericardiotomy syndrome, we recommend an exact date of echocardiographis examination by cardiologist to be put in place. Despide of this fact, small amount of effusion can cause an uncontrolled rise into life threatening dimension. That is why in history of heart surgery, event in non specific clinical signs, it is necessary to provide immediate echocardiographic control. *Transthoracic echocardiography examination is the golden standard.*

References

1. Spodick DH. Pericardial disease. In: Braunwald E, Zippes DP, Libby P (Eds). Heart Disease. 6th ed. Philadelphia–London–Toronto–Montreal–Sydney–Tokyo: W.B. Saunders, 2001, 1823–1876.

2. Maisch B, Berg PA, Kochsiek K. Clinical significance of Immunopathological findings in patients with post-pericardiotomy syndromes. I. Relevance of antibody pattern. Clin Exp Immunol 1979; 38: 189–197.

3. Buckman RF, Buckman PD. Vertical deceleration trauma: priciples of management Surg Clin North Am 1991; 71: 331–340.

4. Kuvin JT, Harati NA, Pandian NG et al. Postoperative cardiac tamponade in the modern surgical era. Ann Thorac Surg 2002; 74: 1148–1153.

5. Asensio JA, Berne JD, Demetriades D et al. Penetrating cardiac injuries: a prospective study of variables predicting aoutcomes. J Am Coll Surg 1998; 186: 24–34.

6. Morton MJ, DeMots HL. Complications of transseptal cathetrization and transthoracic left ventriculare puncture. In: Kron J, Morton MJ, editors. Complications of cardiac cathetrization and angiography. New York: Futura, 1989, 77–103.

7. Engle MU, McCabe JC, Ebert PA et al. Postpericardiotomy syndrome and antiheart antibodies. Circulation 1974; 9: 401.

8. Levine MJ, Lorell BH, Diver DJ et al. Implications of echocardiographically of echocardiographically assisted diagnosis of pericardial tamponade in contemporary medical patients; detection before hemodynamic embarrassment. J Am Coll Cardiol 1991; 17: 59–65.

9. D´Cruz IA, Hoffman PK. A new cross sectional echocardiographic method of estimating the volume of large – pericardial effusion. Br Heart J 1991; 66: 448.

10. D´CruzIA, Cohen HC, Prabhu R et al. Diagnosis of cardiac tamponade by echocardiography. Changes in mitral valve motion and ventricular dimensions, with special reference to paradoxal pulse. Circulation 1975; 52: 460–5.

11. Haaz WS, Mintz GS, Kotler MN, Parry W et al. Two-dimensional echocardiographic recognition of the descending thoracic aorta value in differentiating pericardial from pleural effusion. Am J Cardiol 1980; 46: 739.

12. Marinella MA. Electrocardiographic manifestation and differential diagnosis of acute pericarditis. Amer Fam Phys 1998; 57: 532.

13. Guidelines on the Diagnosis and Management of Pericardial Diseases. Full Text: The Task Force on the Diagnosis and Management of Pericardial Diseases of the European Society of Cardiology. Eur Heart J 2004; 15: 1–28.

14. Horneffer PJ, Miller RH, Pearson TA, Rykiel MF, Reitz BA, Gardner TJ. Effective treatment of postpericardiotomy syndrome after cardiac operations: J Thorac Cardiovcasc Surg 1990; 100: 292–296.

15. Filkenstein Y, Shemesh J, Mahlab K et al. Colchicine for the prevention of postpericardiotomy syndrome. Herz 2002; 27: 791–794.

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