

A clinical case of metastatic osteosarcoma in the heart cavity

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Tumors of the heart are catalogued as a poorly studied area of clinical oncology because of an extreme rarity of this pathology, absence of pathognomonic symptoms, a large variety of clinical manifestations, and diagnostic complexity. In order to achieve diagnostic and therapeutic adequacy, clinicians need to be aware of cancer heart diseases and their frequently atypical clinical manifestations. The report presents a clinical case of tumor spreading through the vascular system and malignant lesions of the right atrium of the heart in a patient with osteosarcoma of the humerus, where osteosarcoma metastases are resected and plasty of the right atrium is performed by using a pericardial patch.

Keywords: heart neoplasms; metastasis; osteosarcoma

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Introduction

Many malignant tumors might spread into the heart. Secondary cardiac tumors are detected 13–40 times oftener than primary ones. According to various authors, metastasizing in the heart and tumor invasion in the myocardium and pericardium are identified in 0.3–27% of those died from malignant neoplasms [1]. K.Y. Lam et al analyzed 7 cases of primary and 154 secondary cardiac tumors during autopsies performed at Queen Mary Hospital, Hongkong over a period of 20 years [2]. In this study the incidence of primary and secondary heart tumors in 12,485 autopsies accounted for 0.056 and 1.23% respectively [3]. Depending on the type

of primary tumors, cardiac metastases are more frequent in patients with melanoma, and rare in those suffering from leukosis and lymphomas. Most secondary tumors of the heart belong to carcinomas, sarcomas are rarely observed in secondary heart malformations [4]. Cardiac metastases are highly likely met at an advanced stage of the disease and combined with primary neoplasms or metastases within the thoracic cavity. Metastases are typically small dense nodes in some neoplasms, particularly in sarcomas and hematological malignancies, diffuse tumorous infiltration of the heart is also recorded [5]. Symptoms depend on the location and size of metastases rather than on their origin.



Metastasizing in the pericardium is accompanied by the formation of a hemorrhagic pericardial effusion and cardiac tamponade symptoms. In the case of intramural myocardial metastasizing, atrial/ventricular arrhythmias including atrial flutter/fibrillation and conduction disorders tend to occur. Large metastases in the endocardium contribute to the formation of intracavitary obstruction [6]. Echocardiography is the most sensitive tool for identifying metastatic lesions of the heart.

Therapy when treating metastatic cardiac tumors depends on the origin of a neoplasm and includes systemic chemotherapy or palliative procedures. Surgery is indicated for isolated intracavitary cardiac metastases only and results in resection of the chambers and the valve [7].

Clinical case

On 18 January 2017 the specialists of Department of Pediatric Cardiology and Cardiac Surgery of V. Gusak Institute of Emergency and Resuscitation Surgery (Donetsk) consulted a mother with an 11-year-old child complaining of retrosternal pain, dyspnea, nasolabial triangle cyanosis. The medical history read that the child had undergone left interscapular-thoracic amputation and right thoracotomy. His right lower lobe of the lung had been resected because of left humerus osteosarcoma and he had been diagnosed with American Joint Committee on Cancer (AJCC) T2N0M1a, IVA stage, Enneking III stage and metastatic lung lesions. He had received 18 blocks of polychemotherapy (doxorubicin, cisplatin, methotrexate). During follow-up a floating thrombus had been observed in the right brachiocephalic vein, which had been resolved in the process of therapy.

According to examination data repeated in 2016 (ultrasound examination of the vessels and heart, chest computed tomography), no thrombi and pathological formations had been identified.

At admission, skin/mucosae pallor, nasolabial triangle cyanosis and petechial skin rash on the anterior abdominal wall and calves were observed. Harsh breathing by auscultation, crepitant rales below the right scapula, breathing rate 22/minute. The borders of relative heart dullness were expanded edgewise. The heart's

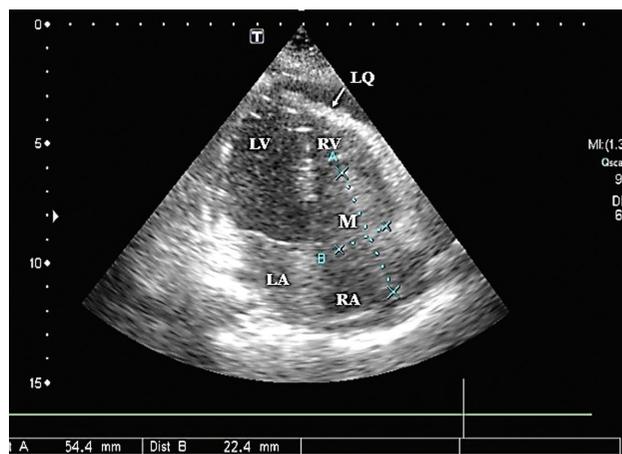


Fig. 1. Echocardiography as of 19.01.17 in apical four-chamber position: a large-sized neoplasm is observed in the right atrium cavity bulging into the right ventricle and nearly blocking the tricuspid valve. M, metastasis; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle; LQ, exudate in the pericardial cavity

function was regular, pulse 140/minute, blood pressure 95/60 mm Hg. Heart sounds were muffled, apical systolic murmur on the left edge of the sternum. Liver enlarged by two cm. Edema of calves and feet.

According to complete blood count, thrombocytopenia 63 g/l, prothrombin index decreased down to 50% and international normalized ratio down to 1.52. Activated partial thromboplastin time increased up to 57 s. According to echocardiography data as of 19.01.2017, a neoplasm 1.9 x 3.9 x 4.8 cm in size was identified, which prolapsed into the right ventricular cavity and practically completely blocked the tricuspid valve (TV). Pressure gradient (Δp) on TV was 8.7 mm Hg. Pericardial layers along the posterior wall of the left ventricle were separated by 0.88 cm, while along the anterior wall by 0.44 cm, which corresponded to about 125 ml of effusion (see Fig. 1).

The child underwent X-ray chest examination (19.01.2017). A peripheral, clearly outlined formation up to 2 cm in diameter was discovered on the left at a rib IV level. Consolidated fracture of rib VI on the right. The roots were structured. According to multislice computer tomography (20.01.2017), a subpleural locus up to 17 mm in diameter was observed in S4 upper left pulmonary

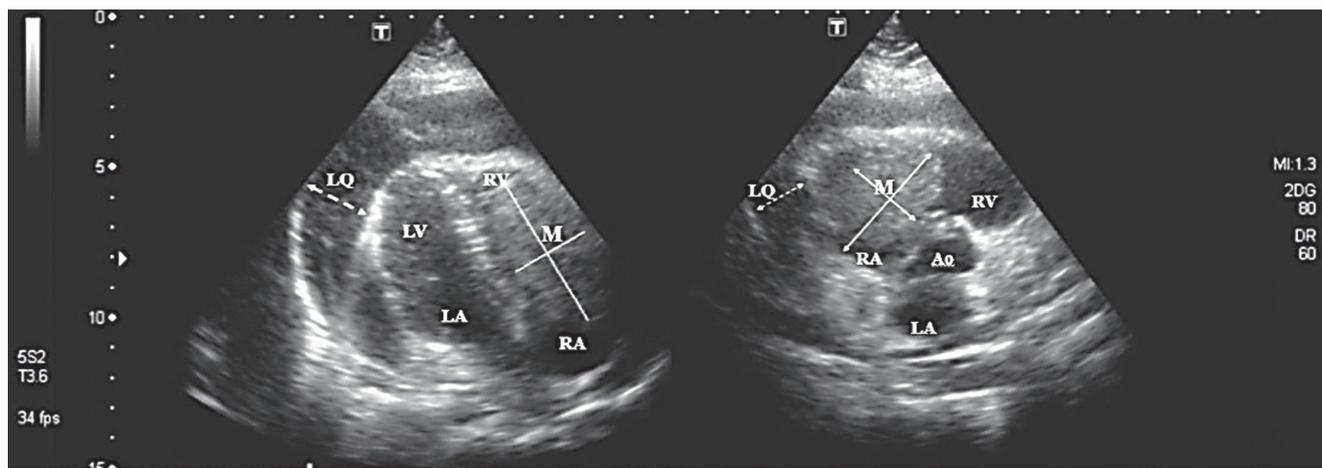


Fig. 2. Echocardiography at 7 days of hospital stay. M, metastasis; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle; LQ, exudate in the pericardial cavity; Ao, aorta

lobe, possibly spreading onto the paracostal pleura. In the pericardial sac there was liquid content with the pericardial layers dissected to a maximum in projection of the left ventricle up to 12 mm. To precisely determine the location and verify the formation in the right atrial cavity, as well as to exclude thrombosis of the superior vena cava, intravenous angiography was used (20.01.2017). Free contrast flow along the subclavian vein and superior vena cava, adequate to the volume and rate of agent administered; enhanced right atrium, right ventricle, pulmonary artery. To exclude mural thrombosis in the superior vena cava was impossible.

Echocardiography was repeated and it again showed a neoplasm $4.9 \times 2.4/3.6$ cm in size (slightly increased dimensions, enlarged TV obstruction, TV pressure gradient 12.3 mm Hg). A slight increase in the pericardial effusion (1.1–1.2 cm). 1.5 cm opacity in the superior vena cava ostium.

During follow-up the lab data would demonstrate an increase in thrombocytopenia up to 32 g/l, hypocoagulation (prothrombin index up to 57%, prothrombin time 23 s, international normalized ratio to 1.8, activated partial thromboplastin time 38 s, fibrinogen 2.75 g/l, Duke's bleeding time 1 min). Soluble fibrin complex increased to 19 mg/% at $n = 3-4$ mg/%. Disseminated intravascular coagulation syndrome (DIC

syndrome) was diagnosed, hypocoagulation stage. Given DIC syndrome, therapy was complemented by transfusion of fresh-frozen plasma of the same type 10 ml/kg/day, to reduce the size of the neoplasm, heparin 10 units/kg/hr was administered, with coagulation controlled by means of Lee – White method.

At 7 days (from 15.00, 24.01.2017) of inpatient stay the child's state deteriorated. Complains of faintness, shortage of air. Critical general state because of increased cardiorespiratory insufficiency. Stuporous state. Adynamia events. Blood pressure tended to decrease from 90/60 to 80/50 mm Hg, sinus tachycardia up to 150 per minute, paradoxical pulse, dyspnea increased up to 30–40 per minute. Oxygen saturation against the background of humidified oxygen insufflation reduced down to 82%.

According to echocardiography data, the pericardial layers kept on separating along the anterior wall of the right ventricle up to 2.8 cm, in the apical region up to 2.1 cm and along the posterior wall of the left ventricle up to 2.0 cm. Observed in the right atrium was a neoplasm $4.9 \times 2.9 \times 9.6$ cm bulging into the right ventricular cavity and nearly blocking the tricuspid valve. Pressure gradient on TV was 11.0 mm Hg. The inferior vena cava and superior vena cava were not collapsed (see Fig. 2).

Taking into account dramatically progressing cardiorespiratory disorders caused by TV occlusion, a

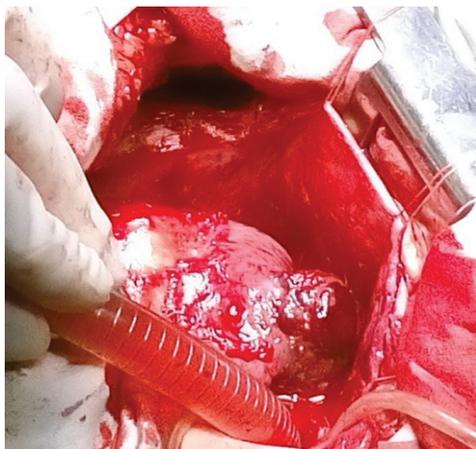


Fig. 3. Right atrium covered with metastatic tissue

mass neoplasm in the right atrium and heart tamponade combined with increased exudate in the pericardium, the neoplasm was removed and an autologous pericardial patch was used to perform on-pump right atrial plasty.

Heart surgery: median sternotomy. Tense pericardium. Marks of chronic inflammation process of the anterior mediastinum. When opening the pericardium, about 400 ml of hemorrhagic effusion was removed. As a result, hemodynamic parameters got stabilized. Pericardium thickening was observed. Upon inspection: anterior lateral surface of the right atrium from the superior vena cava ostium (upwards of sulcus terminalis) to the right atrial appendage was covered with tuberous dense-by-touch tissue (see Fig. 3) penetrating through the atrial wall into the cardiac cavity.

The pump was connected and turned on routinely. The atrial wall connected through the intima with the neoplasm (10 x 5 cm in size), which bulged from the wall into the right ventricular cavity, was dissected within the limits of visually unchanged tissues (see Fig. 4).

Tricuspid valve inspection: the valve is competent. Plasty of the right atrial wall defect with an autologous pericardial patch 6 x 4 cm in size. Careful hemostasis. Placement of two drain tubes and electrodes to the right ventricle. Layered closure of the wound. Aseptic bandage. Intraoperatively, the child received platelet concentrate to prevent the development of thrombocytopenia as

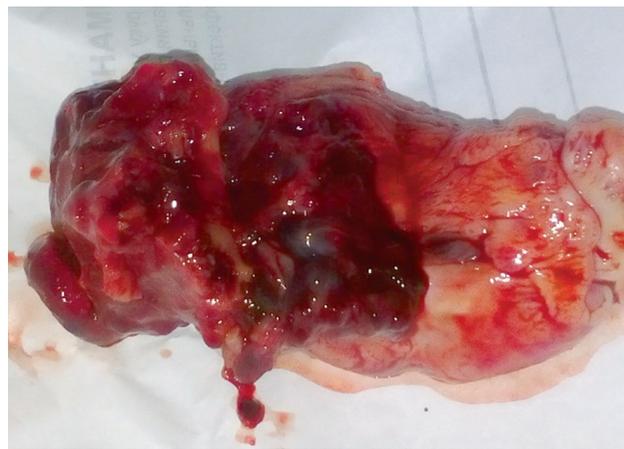


Fig. 4. Gross specimen of osteosarcoma metastases resected from the right atrium

a component of DIC syndrome. Following the 1st day of surgery the child's state improved, cardiac-respiratory defects regressed, no fever. The skin was pale, with evanescent components of punctate petechial rash on the anterior surface of the abdominal wall and calves.

Slight edema of the calves and feet remained. Vesicular resonance over the lungs, harsh breathing by auscultation suppressed in the lower parts of the lungs, crepitant rales in the root area. SpO₂ 96% against the background of humidified air insufflation. Heart tones remained muffled, however, their richness increased.

Stable hemodynamics, blood pressure 128/63 mm Hg, sinus rhythm with a rate of 88/min. Symmetric and soft abdomen, painless in all parts; soft gastric peristalsis. Urine passes through catheter. 90 ml of hemorrhagic fluid with hemoglobin 15 g/l by drain tubes. According to complete blood count: moderate anemia (RBC 2.68 x 10¹²/l, Hb 91 g/l, thrombocytopenia (Tr) 147 g/l). According to echocardiography data, right chambers dilatation remains, III grade TV insufficiency (20.5 mm Hg).

Pulmonary artery pressure 26 mm Hg. Sclerosis of a free wall of the right atrium 0.7 x 1.5 cm, TV pressure gradient 4.1 mm Hg. No effusion in the pericardium.

Histological examination showed that the material had some elements of immature connective-tissue tumor, probably, osteosarcoma (see Fig. 5).

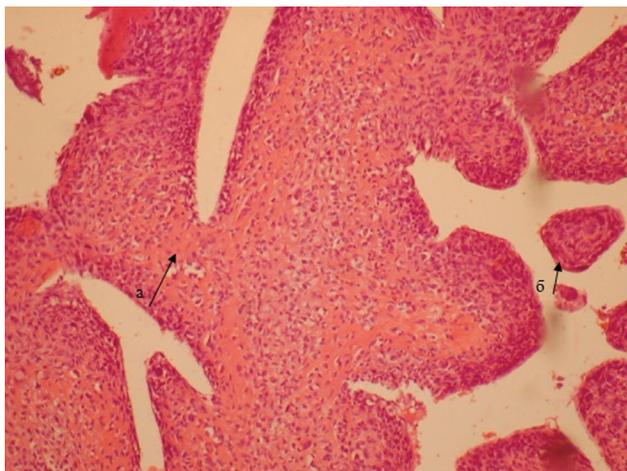


Fig. 5. Microslide of osteosarcoma metastases: A, osteoid substance; B, generation of villous structures by immature cells. Dyed with hematoxylin and eosin. 100x magnification

In the course of treatment, the child's state improved, his cardiac-respiratory disorders regressed fully, blood parameters gradually returned to normal, he subjectively felt well, the postoperative wound healed by primary intention. Given the histological examination data, the patient was transferred to the oncology department to receive special therapy at 7 days.

Discussion

This case is the example of a secondary transvenous metastatic lesion of the heart. Due to red cells activation, synthesis of fibrinolysis inhibitors and procoagulants by tumor cells, the coagulation and vascular/platelet components of the blood coagulation system get activated in the organism. In this process, the circulating tumor cells might also adhere to endothelium of the venous vessels, thus forming a nest for thrombus formation. A tumor thrombus can grow in an upstream blood flow direction towards the right atrium and in a number of cases reaches the right ventricle and pulmonary artery. Some authors suggest that the risk of venous thromboembolism depends on a tumor grade, the highest risk is registered in patients with bone system tumors (37.7 cases per 1 thousand patients) [8].

In our case a floating thrombus in the right brachiocephalic vein detected in the child following left interscapular-thoracic amputation could have been a tumor metastasis and its dislocation into the superior vena cava ostium might have resulted in tumor cell growth in the atrium. Damaging the atrial endocardium during catheter manipulations might have also caused the occurrence of tumor cells. The case in question attests to the fact that in order to identify metastatic foci, there should be a more precise approach to examination of patients with malignant oncopathologies in the postoperative period.

Conclusion

In our case, despite a high risk of surgery, resection of the tumor from the right atrial cavity was the only chance to save the child's life, because penetration of the tumor into the tricuspid valve blocked the venous outflow pathway and again caused effusion accumulation in the pericardial sac and heart tamponade. AJCC estimates that a 5-year survival of patients, notwithstanding the tumor type, accounts for 16%. According to prognoses, 4% of patients with cardiac metastases will live for more than 5 years, 22% of patients for 3 years, and 20% of patients for 2 years [9]. If it is possible to perform complete resection of the tumor, provided other organs are intact, the prognosis is positive. Unfortunately, it happens in very rare cases, while partial resection results in a high mortality rate.

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Conflict of interest

Authors declare no conflict of interest.

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