

Retrospective Analysis of the Experience in Diagnostics and Surgical Treatment of Rare Cardiac Tumors-Lipomas

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Abstract

The aim of this study is to determine the optimal treatment tactics for cardiac lipomas by performing a retrospective analysis of the features of the clinical course, diagnostics and specifics of surgery for this pathology. At Amosov NICVS, in the period from 1969 to 01.01.2020, 968 patients with various types of cardiac tumors underwent surgical treatment, of which 36 patients were with non-myxomas benign tumors. Cardiac lipoma diagnosed in three cases (0.3%). The described cases demonstrate a significant risk of heart damage by benign neoplasms (lipoma), the operability of neoplasm is largely determined by the localization and volume of myocardial involvement. In the two cases described, a lipoma due to the localization in the left ventricle and right ventricle walls and transmyocardial penetration of the neoplasm led the risk of rupture of the penetrated walls of the ventricles and to almost incurable arrhythmias. Surgical tactics for these neoplasms should be based on the size of the tumor, its location and the presence of obvious hemodynamic disturbances due to the obstructive form of the neoplasm.

Keywords: Benign heart tumors, lipoma, surgical treatment



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Introduction

Benign neoplasms account for 75-80% among cardiac tumors, of which myxomas are detected in 75-80% of cases⁽¹⁻⁴⁾. Non-myxomas benign cardiac tumors (NBCTs) account for up to 3.5% of all primary heart tumors⁽⁵⁻⁷⁾. Cardiac lipoma is a very occasional variant among primary benign cardiac tumors; we can see rare mentions of this pathology in literary sources⁽⁸⁻¹⁰⁾. Cardiac neoplasms lead to clinical manifestations such as heart failure, embolic complications, arrhythmias and dysfunction of the heart valves, which, in some cases, can be life-threatening. The clinical picture in this pathology is very variable. Despite modern diagnostic methods, it can be challenging to identify a cardiac tumor. Moreover, determining the adequate treatment tactics (especially preoperative management and planning) is of a particularly difficult task for heart team.

Since 1969 to 2020 there were 36 patients with NBCTs, who undergone surgery in Amosov National Institute of Cardiovascular Surgery of the Academy of Medical Sciences of Ukraine (Amosov NICVS). Three of these patients had cardiac lipomas (8.3%). Clinical and pathological aspects, as well as the tactics of surgical intervention are of special interest to cardiac surgeons and cardiologists due to the rare occurrence of this type of tumor.

The aim of this study is to determine the optimal treatment tactics for cardiac lipomas by performing a retrospective analysis of the features of the clinical course, diagnostics and specifics of surgery for this pathology.

Materials and Methods

As of 01.11.2019, 968 patients with primary cardiac tumors were observed in Amosov NICVS. In the vast majority of cases (862) myxomas of the heart were detected, in the rest (36) there were other benign neoplasms. Cardiac lipoma was diagnosed only in three cases, which amounted 0.3% among all primary cardiac tumors.

Among patients with NBCT there were 13 men (36.1%) and 23 women (63.9%). The average age of patients was 37.6±24.6 years (range: 1-56). The duration of the disease averaged 4.5±2.3 months (1-16), (according to the first clinical manifestations).

Clinical manifestations included heart pain - 6 (16.7%), shortness of breath - 8 (22.2%), fatigue - 7 (19.4%), fever 5 (13.9%), weight loss 4 (11.4%), heart rhythm disturbances - 5 (13.8%) and limb plegia as a consequence of cerebral vascular embolism - 2 (5.6%). Localization of different variants of NBCT determined the type of clinical manifestations (Table 1).

Table 1. Localization of non-myxomas benign cardiac tumors

| Type of NBCT | Localization | | | | Total | | |
|-------------------------|--------------|----|----|------|-------|-------|-------|
| | LA | LV | RA | RV | n | % | |
| Leiomyofibroma | - | - | 2 | 1 | 3 | 8.3 | |
| Fibroma | 1 | 2 | - | 1 | 4 | 11.1 | |
| Rhabdomyoma | - | 1 | - | 7 | 8 | 22.2 | |
| Lipoma | - | 1 | 1 | 1 | 3 | 8.3 | |
| Hemangioma | 21 | 1 | 2 | 3 | 8 | 22.2 | |
| Papillary fibroelastoma | 5 | 4 | - | - | 9 | 25 | |
| Immature teratoma | 1 | - | - | - | 1 | 2,7 | |
| Total | n | 9 | 9 | 5 | 13 | 36 | 100.0 |
| | % | 25 | 25 | 13.9 | 36.1 | 100.0 | - |

NBCT: Non-myxomas benign cardiac tumors, LA: Left atrium, LV: Left ventricle, RV: Right ventricle, RA: Right atrium, n: Number

In one patient cardiac lipoma was identified in the right atrium (RA), in the second and the third patient lipomas were detected in right ventricle (RV) and left ventricle (LV). In all three cases, there were fatigue at light exertion and shortness of breath. Examinations of these patients revealed an enlargement of the cardiac silhouette on a frontal chest X-ray in two patients (in case of LV and RV lipomas), one patient had sinus tachycardia, two patients had atrial fibrillation. Such imaging techniques as echocardiography and computed tomography (CT) allowed us to identify a mass, differentiate it from vegetations and thrombi, determine its attachment point, mobility, structure, the extent of involvement of cardiac structures, as well as the degree of hemodynamic disturbances.

Results

We present the results of three clinical observations of patients with heart lipomas in Table 2.

1. The first case is of the RA lipoma. A thirty years old female patient was hospitalized to Amosov NICVS on 01.30.1985 with a diagnosis of mitral-tricuspid insufficiency. The complexity of the diagnosis was that there was no technical possibility to perform echocardiography at that time at Amosov NICVS. The ECG examination revealed atrial fibrillation, impaired intraventricular conduction, RV hypertrophy and diffuse changes in the myocardium. Cardiac catheterization demonstrated filling defect in a significantly enlarged RA.

During surgery, a 20×15 cm lipoma was detected, which was removed with the wall of the RA in the area of the atrial fissure. The defect in the RA wall was sutured using Teflon patches. In early post-operative period normal sinus rhythm was recorded. However, atrial fibrillation resumed 6 months later. Sudden death because of fatal arrhythmia (ventricular fibrillation) happened in this patient 11 years later (according to the report of cardiologist at the place of patients' residence).

2. The second case is of RV lipoma. A 34 years old male patient was hospitalized on 22.09.2003 to Amosov NICVS with complaints on shortness of breath, intermittent chest pain. There were no signs of congestive heart failure and there were no pathological changes in other organs and systems, as well as in laboratory test. There was atrial fibrillation with a frequency of 57 beats per minute detected on the electrocardiogram (ECG).

According to transthoracic echo (TTE) data, the tumor was detected in RV cavity as an echopositive, sedentary mass with indistinct contours. Transesophageal echo was performed due to the low informativeness of TTE to clarify the place of attachment of the tumor, the width of its base and its location relative valve apparatus (Figure 1). In the area of RV apex, an irregularly shaped mass, without clear contours was detected, with the tumor size 4.1x3.2 cm, which did not cause obstruction to the tricuspid valve and to RV outflow tract. Tumors place of attachment was the interventricular septum, RV apex and RV free wall were, which indicated a significant area of tumor invasion to the RV walls. Patency of the tricuspid valve was maintained

Table 2. Clinical manifestations and research data of cardiac lipomas

| No | Sex | Localization | Clinical symptoms | Heart failure | Increased cardiac shadow | Arrhythmia | Surgical treatment |
|----|-----|--------------|-------------------|---------------|--------------------------|------------|--|
| 1. | F | RA | + | + | ++ | +(AF) | Radical resection |
| 2. | M | RV | + | + | + | +(AF) | Partial resection |
| 3. | F | LV | + | + | - | + | Surgical biopsy; heart transplantation |

RV: Right ventricle, RA: Right atrium, AF: Atrial fibrillation, F: Female, M: Male

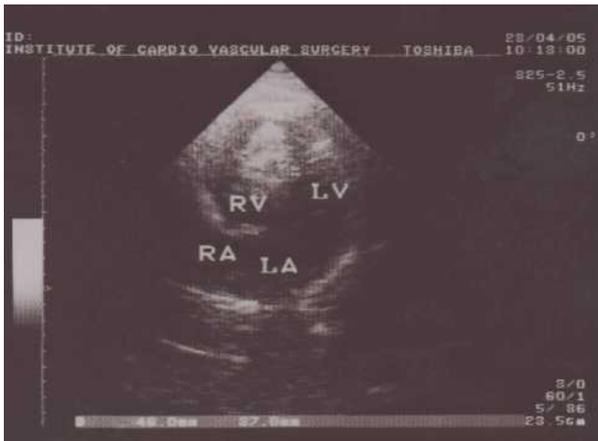


Figure 1. Transthoracic ECHO of patient B. Tumor in the RV apex

RV: Right ventricle, ECHO: Echocardiogram

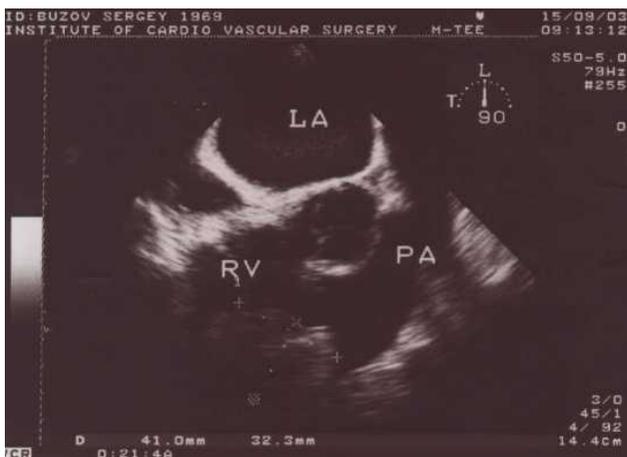


Figure 2. Transesophageal ECHO of patient B. Tumors place of attachment was the interventricular septum, RV apex and RV free wall were, which indicated a significant area of tumor invasion to the RV walls

RV: Right ventricle

(Figure 2).

Endovascular biopsy was unsuccessful. During angiography an additional sedentary, with a large tuberous surface neoplasm was identified in RV cavity. The mass was attached to trabecular section of the RV and occupied most of the ventricular cavity. RV inflow and outflow tracts had no obstruction.

However, the patient, at his request, underwent surgery only in a year and a half, on the background of atrial fibrillation and recurrent ventricular fibrillation. The newly performed cardiac ventriculography revealed an increase of the filling defect in the RV cavity, also the neoplasm's spread in the direction to tricuspid valve was noted, with the threat of its subsequent obstruction.

Partial resection of the tumor from the RV cavity in condition of artificial blood circulation was performed on 05.11.2005. During surgery a yellow mass, with a dense-elastic consistency was found in the apex of the significantly enlarged RV, towering above its surface in the form of a mushroom with a round base with the tumor



Figure 3. RV lipoma, localized in its apex, extending into the RV cavity. Coronary vessels pass on both sides of the neoplasm, tightly adjacent to the tumor

RV: Right ventricle

size 5.5x5.5 cm (Figure 3). Coronary vessels passed on both sides of the neoplasm and were tightly adjacent to the tumor. The tumor spread to the interventricular groove and the LV apex under the epicardium. The RV was revised by access through the RA and tricuspid valve. Similar yellow color dense elastic mass blocked most RV cavity, tightly fused within the RV walls and caused involvement of the papillary muscles and partially the tricuspid valve chordae. RV inflow and outflow tract were patent. Thus, the detected neoplasm replaced the RV wall over a large area, deforming its cavity and rising above the surface of the heart.

The tumor was partially removed from the RV and sent for histological examination. The tricuspid valve remained intact. Partial mobilization of the anterior interventricular artery in the most suspicious place for its possible deformation by the tumor was done. Further surgical manipulations on the heart were considered dangerous



Figure 4. CT scan of the heart of a 19-year-old patient presented in 2011. The short axis of the CT of the heart shows a gigantic, well-defined mass with a fat density (-110 H.U), which replaces and splits the myocardium of the inferior and inferolateral left ventricular segments at the basal and mesoventricular level
CT: Computed tomography

and unpromising. An ECG in early postoperative period showed the presence of an acute complete right bundle branch block, subendocardial hypoxia of the myocardium, migration of driver of rhythm with a transition to atrial fibrillation, frequent ventricular ectopy extrasystole. In the further postoperative observation, there was a repeated alternation of atrial fibrillation and sinus rhythm. In the long-term period, the patient had atrial fibrillation. From the questionnaire, it has known that the rhythm disturbance led to the sudden death of the patient 13 years after the surgical treatment.

3. The third case is of LV lipoma. Twenty-seven years old female patient, was hospitalized on 22.03.2019 to Amosov NICVS with a diagnosis of a LV tumor. From the anamnesis, it is known that since 2011 the patient had been suffering from cardiac arrhythmia (paroxysmal tachycardia attacks). On CT transmural LV tumor (presumably lipoma) was identified in lateral segments (Figure 4). The clinical condition of the patient was quite satisfactory, and therefore surgical treatment at that time considered inappropriate.

However, rhythm disturbances continued and, during pregnancy in 2018, their frequency increased. The defibrillator was implanted in the patient in 2018 because there were attacks of ventricular tachycardia. With repeated echo, a motionless mass associated with its lateral wall was detect in the LV. Physical examination and laboratory tests did not reveal any pathological abnormalities. There was sinus rhythm on the ECG, the heart rate was 80 beats per minute.

Because of ongoing bouts of arrhythmia, that did not respond well to therapeutic treatment, the patient was sent to the intensive care unit after delivery by Cesarean section in the Amosov NICVS. There were recorded the daily defibrillator responses.

At CT study, which was performed on 2019, a tumor rupture was detected. This was probably due to the reduced resistance of adipose tissue compared to the myocardium to high pressure in the LV cavity (Figure 5). Also, involvement of papillary muscles by cardiac lipoma was

noted. These data were regarded as a threat of rupture of the heart wall. Multiplanar reconstructions demonstrated the localization of tumor, the degree of involvement by lipoma of LV walls and papillary muscles, which did not leave any hope for removal of the neoplasm (Figure 6). In this regard, it was decided to perform a biopsy of the tumor tissue to clarify its histological type with a further decision on the issue of heart transplantation.

After performing left thoracotomy on 04.01.2019 (aimed at removing a neoplasm fragment for histological examination), the pericardium was opened. The pale-yellow color neoplasm of dense-elastic consistency, with smooth contours up to 5.5 cm in diameter, was located on the lateral surface of the LV, starting from the circumflex artery (Figure 7).

Visual and palpation examinations made it possible to preliminarily determined the massive lipoma penetrating the LV wall by the infiltration area up to 5 cm, the radical

removal of which could lead to irreversible damage of the heart structures and coronary arteries. The diagnosis of lipoma was confirmed by histological examination. In

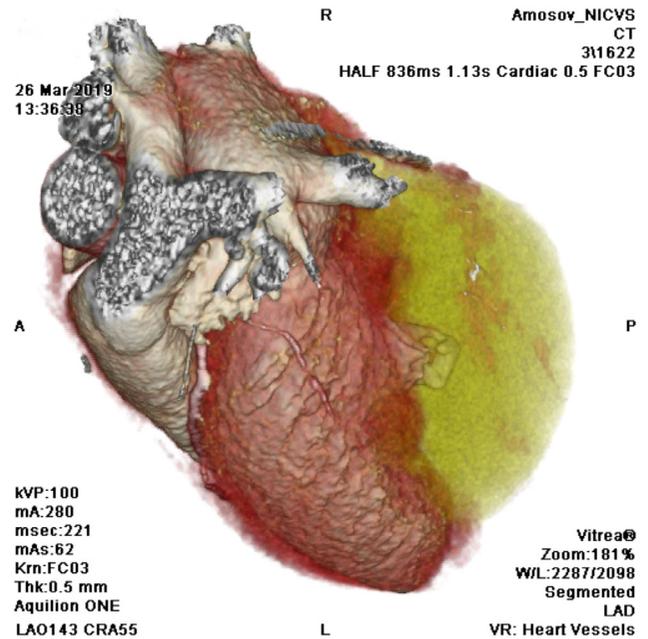


Figure 6. Three-dimensional reconstruction of a cardiac CT study demonstrates the leak of contrast medium into a giant tumor of the LV with a fat density (marked in yellow)
CT: Computed tomography, LV: Left ventricle, LAD: Left anterior descending artery



Figure 5. CT scan of the heart of 27 years old patient, performed a week after the Cesarean section in 2019. The short axis of the CT scan of the heart shows a contrast leak into the giant tumor of the LV. Implantable cardioverter-defibrillator diverted to the RV
CT: Computed tomography, LV: Left ventricle, RV: Right ventricle

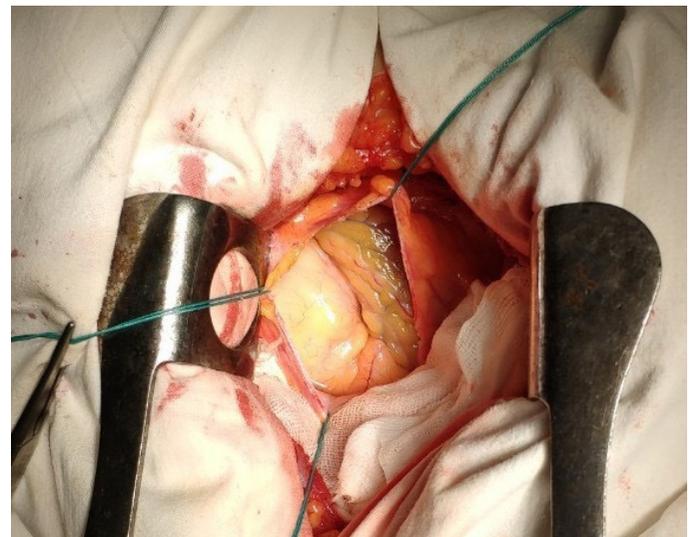


Figure 7. Lipoma of the LV, localized in the region of its lateral wall, extending into the cavity of the heart
LV: Left ventricle

the postoperative period, the patient was in intensive care unit because of ongoing frequent attacks of ventricular tachycardia, which relieved by discharges of the implanted defibrillator.

On the 10th day after the operation the patient was discharged and sent to the specialized heart surgery center, where a heart transplant was subsequently performed. In the long-term postoperative period (1.5 years after heart transplantation), the patient's condition was satisfactory.

Thus, analysis of all three cases of heart lipomas showed, that cardiac arrhythmias were the leading clinical manifestation of the disease, which was refractory to drug treatment. All three patients underwent surgical treatment: in the first and second cases - with the use of cardiopulmonary bypass, in the third case – as a first step a biopsy was performed by surgery, and then heart transplant was performed.

In the long-term postoperative period, arrhythmias were fatal in the first and second patients 11 and 13 years after surgery, respectively. With a high degree of probability, it can be judged that in these cases, the removal of the tumor (lipoma) was not performed radically. Subsequently the neoplasm continued to affect the conducting system, causing persistent arrhythmias. This complication was avoided by performing a heart transplant in the latter case.

Discussion

A retrospective analysis of these cases demonstrates the possibility of diagnosing of cardiac tumors. In 1985 there were not standard diagnostic methods as echo or CT in the Amosov NICVS. Diagnosis was based on physical findings, ECG and angiography. Most authors recognize ultrasound as the basis for diagnosing this pathology (2-8). Two subsequent cases, when echo was used, supplemented by CT to clarify the extent of tumor spread and determine the treatment plan, confirmed this, which is also affirmed in the study by Lestuzzi et al.⁽⁷⁾ Echo is decisive for differential diagnosis of lipomas (0.3%) with the most common cardiac tumors - myxomas. In the differential diagnosis it is important to take into account:

1) tumor localization - in 752 (87.8%) cases myxomas were located in the LA; 2) the mobility of the neoplasm detected on echo in 587 (68.1%) during the cardiac cycle; 3) variability of the auscultatory picture when changing the position of the body, as well as fainting conditions, which occurred in 185 (21.5%) of patients, were typical clinical symptoms of myxoma.

In their study, Pacini et al.⁽¹¹⁾ indicates that the improvement of echo methods contributes to more detailed and accurate information, which allows cardiologists and cardiac surgeons to better assess the condition of patients in the long term. According to Oliveira et al.⁽¹²⁾ early diagnosis of cardiac tumors, and, accordingly, patient survival, depends on an increase in the frequency of use of imaging research methods - echo and CT, while early, sometimes - accidental detection of these neoplasms can facilitate treatment with better results than in situations where the diagnosis is based primarily on the presence of symptoms.

The optimal tactics for surgical treatment of cardiac tumors is radical removal of the neoplasm⁽¹⁻⁵⁾. However, in certain situations, when there is a large volume of penetration of the pathological process into the myocardium, such removal of the tumor can have fatal consequences, and is limited to hemodynamic correction and reconstruction of lesions of the valve structures.

In the analysis of literature data, one can see single mentions of lipomas among cardiac neoplasms. Thus, in a study by Li et al.⁽⁹⁾ describes 2 cases out of 399 operations for cardiac tumors, Isogai et al.⁽¹⁰⁾ - three of 914 cases, Hoffmeier et al.⁽⁸⁾ mention one out of 181 cases of this pathology. Analysis of the experience of Amosov NICVS demonstrates a significant danger of heart damage by such neoplasms as lipomas. The operability of neoplasm is largely determined by the localization and volume of myocardial involvement. A histologically benign tumor - lipoma due to the localization and transmural penetration of the neoplasm (into LV and RV walls) led to almost incurable arrhythmias in all described cases. Moreover, due to the threat of the penetrated by tumor



ventricular walls rupture, patients had direct indications for urgent heart transplantation. The case of atrial localization of the lipoma was also distinguished by its aggressive course and, despite the resection of the neoplasm (probably, partial removal), there was fatal arrhythmia 11 years after the surgery. Analyzing retrospectively, we can come to the conclusion that the need for heart transplant could have taken place in all three cases.

Conclusion

1. Diagnosis of benign heart tumors, and in particular lipomas, is extremely difficult, due to the absence of pathognomonic signs of the disease and, often, an asymptomatic course. In addition, in some cases, there may be no noise manifestations of the disease (on auscultation), even with a high degree of cardiac involvement. In most of the cases different arrhythmias are the only manifestation of the disease.

2. Surgical tactics for these neoplasms could be based on the size of the tumor, its location and the presence of obvious hemodynamic disorders due to the obstructive form of neoplasm. Despite the fact that a lipoma is a benign tumor, the nature of its growth with frequent intramural localization does not allow for its complete resection, and the natural course can manifest itself as fatal cardiac arrhythmias. The only method of radical treatment for such patients may be a heart transplantation.

Ethics

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: R.M.V., V.V.I., D.M.D., Concept: R.M.V., V.V.I., Design: D.M.D., V.F.O., Data Collection or Processing: V.V.I., V.F.O., M.A.T., Analysis or Interpretation: D.M.D., M.A.T., I.V.M.,

O.A.P., Literature Search: D.M.D., I.V.M., M.A.T., O.A.P., Writing: R.M.V., V.V.I., D.M.D.

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