

Regularities of structural organisation of the heart myxomas in patients with Karney complex

Larysa Fedoniuk

Doctor of Medical Sciences, Professor, Head of Department
I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine
46001, 1 Maidan Voli, Ternopil, Ukraine
<https://orcid.org/0000-0003-4910-6888>

Olena Rudenko

PhD in Medical Sciences, Senior Research Fellow
M.M. Amosov National Institute of Cardiovascular Surgery
02000, 6 Mykola Amosov Str., Kyiv, Ukraine
<https://orcid.org/0000-0003-3640-566X>

Olena Ruzhytska*

PhD in Biological Sciences, Assistant
I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine
46001, 1 Maidan Voli, Ternopil, Ukraine
<https://orcid.org/0000-0001-6846-888X>

Abstract. Myxomas of the heart are one of the most common primary heart tumours, which most often develop in the left atrium, are characterised by a benign nature and no relapses after surgical removal of the tumour. Karney complex is an autosomal dominant disease characterised by numerous tumours, in particular, myxomas of the heart. Insufficient coverage of this pathology in the literature leads to an erroneous diagnosis, progression of the disease and inadequate treatment. The purpose of the study was to determine the morphological features of heart myxomas in patients with Karney complex. Using light microscopy, a morphological examination of the heart myxomas was performed, which were removed during 7 operations. Histological sections were made from the operating material, which were stained with hematoxylin and eosin, according to Van Gieson, fuchselin, and Masson's Trichrome Stain in the Zerbino-Lukasevich modification. A comparison of the group of heart myxomas of patients with the Karney complex (16 tumours) with a group with myxomas of the heart that occur sporadically (278 tumours) was made to identify morphological features. It was established that myxomas of the heart are multiple, they were detected with the same frequency in the right and left chambers of the heart. It was generalised that in myxomas of the heart, signs of both alteration and high proliferative activity of endotheliocytes and fibrous connective tissue cells are noted. Secondary myxomas of the heart in patients with the Karney complex have the same structural organisation as primary tumours, but most often they are not relapses, more often they are multiple and do not have a predominant localisation in the left atrium. The analysis established an identical cellular composition of both groups of heart myxomas, which suggests the same source of tumour growth, but the presence of more complex cell formations in sporadic myxomas and the predominance of single cells in Karney heart myxomas indicate the existence of differences in their morphogenesis

Keywords: benign tumours; morphology; mitral valve; Carney syndrome; light microscopy

INTRODUCTION

According to statistics, among the pathologies of the cardiovascular system, benign heart tumours are detected with a frequency of 0.0017-0.02%. They pose a substantial problem in their detection and occupy a leading place among

Suggested Citation:

Fedoniuk L, Rudenko O, Ruzhytska O. Regularities of structural organisation of the heart myxomas in patients with Karney complex. Bull Med Biol Res. 2023;16(2):23–29. DOI: 10.61751/bmbr.2706-6290.2023.2.23

*Corresponding author



all heart diseases [1]. Myxomas of the heart are one of the most common benign tumours that develop from the vascular endothelium, can occur at any age, but most often they are diagnosed in 30-60 years, and in women, the development of the disease occurs 2-3 times more often than in men. Despite the proven benign nature of tumours, experimental data cause oncologists to be wary.

Analysis of papers by such researchers as: V.V. Popov *et al.* [1], R.M. Vitovskyi *et al.* [2], and A. Kumar *et al.* [3] indicates that the asymptomatic course of this pathology in the early stages of myxoma development, polymorphism of clinical symptoms with further development of the disease, requires correct steps in the diagnosis of heart myxomas.

Timely recognition of primary heart tumours is a difficult task, because, according to P.T. Lee *et al.* [4] and A.G. Griborio-Guzman *et al.* [5], there are no pathognomonic signs, and the disease has an asymptomatic course in the early stages. Myxomas of the heart are a pathology that is rare: from 0.002 to 0.02% and up to 0.2% of cases in autopsies. According to S. Espiard *et al.* [6] and P.B. Saputra *et al.* [7], myxomas of the heart most often develop in the left atrium, attach to the atrial septum in the area of the oval window or at the confluence of the pulmonary veins, are characterised by unicentric growth, benign nature and no relapses after surgical removal of the tumour.

For a long time, there was no doubt that in all cases clinical myxomas of the heart occur sporadically (CMH). However, in recent decades, in the scientific literature, reports of L.Y. Fedonyuk *et al.* [8] that the disease can occur in several members of the same family have appeared. Despite the fact that only 15 families with this pathology were described before 1992, according to M.I. Shved *et al.* [9], 5-10% of all heart myxomas are hereditary. K. Wei *et al.* [10] indicate that this nosological form is characterised by the fact that myxomas of the heart are part of a symptom complex that was originally called nevi, atrial myxoma, mucocutaneous myxomas, ephelides (NAME), or lentiginosis, atrial myxoma, mucocutaneous myxomas, blue nevi (LAMB). According to C.D.C. Kamilaris *et al.* [11] and S. Cherenko *et al.* [12], this syndrome was later renamed the Carney complex in honour of researcher Carney.

Modern literature reviews indicate that myxomas of the heart occur in 30-60% of patients with Karney complex. In this case, the neoplasm can damage any chamber of the heart. However, G. Pitsava *et al.* [13] in the Karney complex, localisation of the heart myxomas in the right parts of the heart is noted (67% of cases), which is more than 8 times higher than the localisation of sporadic heart myx-

omas. Most studies on the Karney complex and hereditary heart myxomas have a clinical focus, although some studies contain isolated data on morphological studies of the heart myxomas in patients with the clinical Karney complex (CKC). Thus, myxomas of the heart with the Karney complex continue to attract the attention of both cardiac surgeons and morphologists-oncologists. The question of the occurrence of tumours of extracardial localisation in such patients remains open.

The purpose of the study was to examine the structural organisation of the heart myxomas and determine the morphological features of tumours in patients with Karney complex.

★ MATERIALS AND METHODS

A retrospective morphological study of 16 heart myxomas removed during 7 operations was performed at the M.M. Amosov National Institute of Cardiovascular Surgery during the last 20 years. The first 4 follow-ups belonged to individuals from the same family: 2 cases of heart myxomas in the mother and 2 cases of heart myxomas in her son. In two cases of observation, tumours were detected in one patient. One observation was represented exclusively by a primary tumour. In one patient, mitral valve insufficiency was detected after removing the left atrial myxoma, associated with prolonged prolapse of the heart myxomas into the left ventricular cavity. In this regard, mitral valve plastic surgery was performed with resection of part of the anterior leaflet. The study was conducted in accordance with the rules of the Helsinki Declaration [14] and with the patient's consent due to the need for examination and surgical treatment. The choice of subjects was made among all patients with myxomas of the heart based on the established diagnosis – Karney complex.

The operating material was fixed in a 10% formalin solution. Histological sections were made from paraffin blocks obtained by the conventional method. The preparations were stained with hematoxylin and eosin for review microscopy, Van Gieson for investigating the state of the collagen and muscle components of the tumour, fuchselin for determining elastic fibres, and Masson's trichrome stain (MSB) in the Zerbino-Lukasiewicz modification for investigating fibrin and other blood components. The drugs were described using an algorithm scheme, which included the following characteristics of the description of sporadic heart myxomas: localisation in the heart chambers, mobility of the neoplasm, the presence of a leg in the tumour, the shape, surface, consistency of the tumour, and the cellular composition of the myxoma (Table 1).

Table 1. Algorithm for describing morphological changes by heart myxomas

Divisions of myxoma of the heart	Object	Morphological feature
Leg – the basis of the tumour	Structures from tumour cells	Single mononuclear cells
		Single multinucleated cells
		Nonperfused compact syncytia
		Nonperfused ocular syncytia
		Perfused syncytia
	Vessels	Arteries
		Veins
		Lymphatic vessels
		Small sinusoids

Table 1. Continued

Divisions of myxoma of the heart	Object	Morphological feature
Leg – the basis of the tumour	Vessels	Large Sinusoids
		Lumen obliteration
		Endothelial cell transformation
	General pathology	Dystrophy
		Fibrosis
Body (central part) of the tumour	Structures from tumour cells	Single mononuclear cells
		Single multinucleated cells
		Nonperfused compact syncytia
		Nonperfused ocular syncytia
		Perfused syncytia
	Vessels	Arteries
		Veins
		Lymphatic vessels
		Small sinusoids
		Large Sinusoids
	General pathology	Hemorrhages
		Necrosis
		Lymphocytic infiltration
		Infection
Capsule (peripheral part) of the tumour	Structures from tumour cells	Single mononuclear cells
		Single multinucleated cells
		Nonperfused compact syncytia
		Nonperfused ocular syncytia
		Perfused syncytia
	Vessels	Arteries
		Veins
		Lymphatic vessels
		Small sinusoids
		Large Sinusoids
	Subordinate sections	Hemorrhages
		Necrosis
Surface	Relief	Smooth
		Villous
	Cellular composition	Endothelium
		One row of tumour cells
		Many rows of tumour cells

Source: compiled by the authors

A comparison of the CKC group (16 tumours) with the CMH group (278 tumours) was made to identify the features of the structural organisation of the heart myxomas in patients with Karney complex.

RESULTS

When investigating patient medical histories and operating log data, it was established that the average age of patients with CKC was 18.9 ± 6.1 , and the average age of patients with CMH was 46.1 ± 4.7 years, which is more than 2 times higher than the same indicator. Analysis of the localisation of neoplasms indicates that in patients of both the first and second groups, myxomas of the heart were established in all its chambers. Therewith, CKC occurred with the same frequency in the right and left chambers of the heart (1:1). In the left atrium, CKC developed in 37.5% of cases, in the left ventricle – in 12.5% of CKC. Damage to the right atrium, and to the right ventricle, was observed in 25% of CKC, respectively.

In contrast to CKC, CMH clearly showed selective localisation in the left atrium (89.3%), and in 0.4% of cases, tumours were localised in both ventricles and in the right atrium (1.4%, respectively). CKC was established to be most often multiple (2-3 tumours). In contrast, only 1 case of CMH (0.4%) showed damage to both atria.

The site of the most frequent CMH fixation was the atrial septum in the oval window area (86% left atrium myxomas and 70% right atrium myxomas). While only 25% of CKC developed from this area of the atrial septum.

Macroscopically, in each case, the myxoma was a translucent, “mottled” tumour on the incision due to areas of necrosis and haemorrhage with a wide base, was of a soft elastic consistency and fit snugly to the wall. Macroscopic examination of CKC indicates the existence of two types of tumours: compact with a smooth surface and loose with villous outgrowths on the surface. The size of the tumours ranged from a few millimetres to 15 cm, usually, they were spherical in shape, and had a gelatin-like or

dense consistency. The same differences were established in the CMH group. However, in the CKC group, almost all tumours were swollen. While among CMH, 62.9% were loose tumours and 37.1% were dense. In all myxomas of the heart of both groups, the “leg” (or base) was determined, that is the formation that provided fixation of the tumour in the heart cavity.

In 72% of cases, the surface of the myxoma is smooth and covered with a thin “false” capsule, which was formed by the endothelium of the endocardium, in the remaining 38%, the surface had the appearance of villi, which were formed by tumour valves. Myxomas with a villous surface were often macroscopically fragmented, which was due to the inability to completely remove the tumour. It was villous myxomas that created the threat of separation of certain fragments and parts of the tumour during heart contractions, followed by embolism of arterial vessels.

Only one observation in altered vessels identified the transformation of endotheliocytes in tumour cells. In this case, the vascularisation of the tumour was similar to that described in CMH cases. The bulk of the tumour was represented by an amorphous oxyphilic substance.

The CKC cell population was relatively homogeneous. The stroma of these tumours was dominated by single cells of rounded, elongated and fusiform shape with one or more centrally located nuclei. The latter was characterised, as a rule, by a rounded or oval shape and barely noticeable nucleoli. The karyolem was dominated by euchromatin, and the nuclei were slightly basophilic in colour. Areas of “enlightenment” of the pericellular matrix were noted around the cells.

Similar cellular forms are typical for CMH. However, the population of cells of the latter is more pronounced in diversity. In such tumours, in addition to individual cells, polymorphic nonperfused and perfused syncytia were observed, which consisted of the cellular structures of the tumour (Fig. 1).

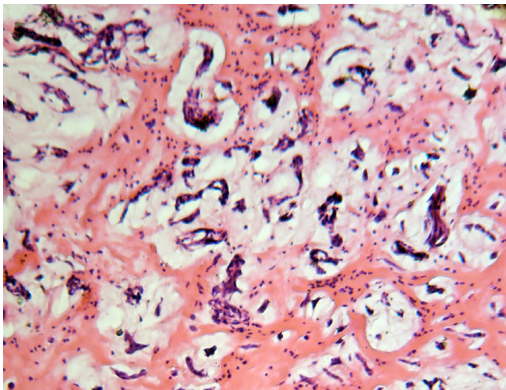


Figure 1. Single and syncytial cell structures in sporadic heart myxoma. Hematoxylin and eosin. X 400

Unlike CMH, the CKC body was characterised by a small number of syncytial structures. Only in some preparations, the presence of a small number of unanalysed compact syncytia was noted. The cells in the tumour were structurally similar to endotheliocytes and may be involved in the formation of sinusoid thin-walled blood vessels that cannot function as normal vessels. In this regard, blood-filled structures were often observed in myxomas

that could not withstand the influence of the hemodynamic factor of blood flow, which led to the formation of common hematomas in the tumour body.

The surface of most CKC was represented by tumour cells in the same way as the surface of loose villous CMH. Depending on the macroscopic organisation, the surface of smooth heart myxomas was represented by the endocardial endothelium, and the surface of loose villous tumours was represented by the vascular endothelium. In areas that are located close to the base, it was possible to detect remnants of endothelial cover. Among CKC, in only one follow-up, one of the two tumours was compact and covered with endocardial endothelium in the same way as all compact CMH.

In all observations, separate single- or multinucleated cells with a more or less pronounced pericellular rim were established. Myxomatous cells were located singly or in small groups in the myxomatous matrix. In addition, in patients with CKC, damage to the mitral valve leaves was observed, which was provoked by the prolonged existence of myxoma of the heart.

Histological examination of the part of the mitral valve of the heart that was removed during surgery identified that in its dense surface layer on the atrial side, there were elegant bundles of collagen fibres, sometimes homogenised or fragmented and with other signs of degenerative changes. From the outside, they were covered with an unevenly organised layer of loose fibrous unformed connective tissue, and on the damaged surface of the mitral valve leaf, signs of active proliferation of endothelial cells were noted, which formed papillary structures (Fig. 2).

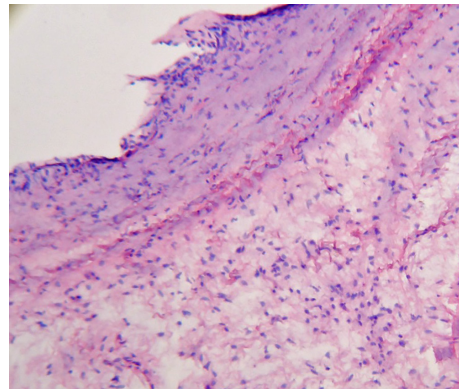


Figure 2. Mitral valve. Proliferation of endotheliocytes on the damaged leaf floor. Hematoxylin and eosin. X 400

The spongy layer of the leaf formed by loose connective tissue was very thin in a substantial area, but at the base of the chord, especially at the valvular edge, its volume increased dramatically due to oedema and fibroblast proliferation. Connective tissue cells had a typical morphological structure, which is characteristic of fibroblastic cells in mitral valve damage in patients with acquired malformations not caused by heart tumours. The described changes in the mitral valve leaf in CKC of left atrial localisation can, on the one hand, be associated with chronic mechanical injury to the valve structures by a tumour that has fallen into the left ventricle. On the other hand, it cannot be excluded that the high proliferative activity of the endothelium and connec-

tive tissue elements is a manifestation of genetic features that are characteristic of the Carney complex.

Therefore, there is reason to believe that the morphological changes described in patients with CKC are secondary to the cardiac tumours observed in patients with CMH. Microscopic examination of both groups by heart myxomas identified that the cellular composition and stroma components of these myxomatous tumours are not fundamentally different, however, when investigating CKC, massive foci of necrosis and haemorrhages drew attention to themselves, which indicated a violation of the blood supply to tumours. An indirect confirmation of this was the almost complete absence of typical CKC blood vessels with signs of intima hyperplasia and middle membrane hypertrophy in the area of the CMH base. And only in a few histological preparations from the 4th observation, sharply sclerosed deformed blood vessels of the arterial type could be detected in the “leg” of the tumour.

◆ DISCUSSION

Carney syndrome is a disease that is transmitted by an autosomal dominant type of inheritance, characterised by the development of myxomas not only of the heart but also of other organs. Clinical manifestations of this pathology can be: spotty pigmentation of the skin, the appearance of such neoplasms as tubular testicular adenoma, pituitary adenoma, and thyroid tumours in patients [15-17].

There is no clear morphological feature or several features that would allow clearly distinguishing between myxomas of the heart as part of Carney's syndrome and CMH [18]. However, according to J. Carney & R.G. Swee [19], primary heart tumours associated with Carney syndrome have no age or gender characteristics, can be either single or multiple, located in different chambers of the heart, and have a tendency to relapse despite proper surgical treatment.

In almost all CKC observations, the benign nature of the tumour was not in doubt, and this is consistent with the generally accepted view of researchers about the appearance of myxomas of the heart. In the case where signs of active proliferation were detected, but there are no atypical cells, it does not allow classifying this tumour as malignant. However, for scientific confirmation of the assumption about the malignant origin of the myxomas, additional studies are needed, in particular, a comparative immunohistochemical examination of the proliferative activity of both groups of the myxomas of the heart, and modern genetic analysis of tumours and patients [20, 21].

Researchers note that CKC recurs more often than normal heart myxomas. According to various authors, their number ranges from 7 to 20%. Complications such as embolism, acute circulatory failure, and arrhythmia, which are often observed in patients with pathology of the cardiovascular system, indicate the possibility of a malignant course of heart myxomas. Embolism is a threatening symptom in the clinical course of myxoma of the heart and occurs in 30-45% of patients with a left atrial tumour [22, 23].

According to the results of the conducted studies, it was established that relapse was considered CKC in one observation, since it occurred in the left atrium, on the atrial septum in the area of the oval window, that is, in the same place where the first tumour was localised (according to the medical institution where the first operation

was performed). In the remaining observations, the tumours were primary, as evidenced by new sites of formation and growth.

CKC, in contrast to CMH, were more likely to be multiple rather than isolated and did not have a predominant localisation in the left atrium. Comparative analysis of the cellular composition of CKC and CMH allows assuming the same origin of the two groups of tumours.

According to the analysis of literature sources, with the left atrial localisation of myxoma, the tumour prevents the complete closure of the mitral valve leaves, which causes a clinical picture of a combined mitral heart defect, myxoma of the right ventricle will clinically manifest itself as a symptom complex of pulmonary artery stenosis, and in the case of left ventricular damage, it will clinically manifest itself as signs of aortic stenosis, myxoma of the right atrium imitates the syndrome of the upper or lower vena cava due to partial overlap and difficult outflow of blood from these veins, which is consistent with the clinical trials observations. Massive foci of necrosis and haemorrhage, which were diagnosed by light-optical examination of the surgically removed heart myxomas, indicated a violation of blood supply to the myxomas, which is due to insufficient tropism of the tumour. Only in a few drugs from the 4th observation, sharply sclerosed deformed arteries could be detected in the “leg” of the tumour. Detection of these structures is extremely important for the identification of tumours since they are one of the indications of the vascular origin of heart myxomas [23, 24].

However, if in CMH the development of the tumour is directed mainly towards the formation of vascular structures (perfused syncytia, sinusoid vessels), then in CKC the growth of the tumour occurred mainly by multiplying single cells without specific structure formation. That is, there is reason to assume that CKC is characterised by a more “primitive” way of development.

Microscopically, deformed arteries were often established at the base of the tumour, and in the central part – areas of necrosis, haemorrhage. Since myxomas are washed with blood located in the chambers of the heart, tumour cells multiply and grow over their necrotic areas, which allows for villous outgrowths to form. In 80% of cases, the tumour is attached to the endocardium by a long leg, less often it is fixed by a wide base, and over time, myxomas of the heart can calcify [25].

The ability to relapse and embolic complications allow classifying myxomas of the heart as benign tumours but with the possibility of a malignant course, which causes special attention from clinicians and requires timely diagnosis.

◆ CONCLUSIONS

CKC, like CMH, are benign heart tumours, and CKC are more often multiple than separate, and unlike CMH, they do not have a predominant localisation in the left atrium. Myxomas are translucent, colourless tumours of a soft consistency that differ in the presence of an external connective tissue capsule.

The cellular composition and stroma components of these tumours do not differ fundamentally, and this allows assuming a common source of tumour growth. However, the presence of more complex cell formations in CMH and

the predominance of single cells in CKC indicate a different level of cell organisation in CKC tumours and the existence of differences in their morphogenesis.

Massive foci of necrosis and haemorrhages indicate a violation of the blood supply to tumours, which are caused by both changes in the structure of feeding vessels and newly formed sinusoid vessels. In the structures of the mitral valve that is mechanically affected by the heart myxomas in patients with CKC, there are signs of changes in the structure and activity of endothelial cells and fibrous connective tissue, which can be a sign of both alteration and high replication activity.

Further research of CKC in terms of comparative immunohistochemical studies of the proliferative activity of

tumour cells with CMH, and genetic analysis of patients, are of interest. In clinical practice, the study involves conducting a taxonomy of patients and clinical manifestations of the disease, creating an algorithm for early diagnosis of heart myxomas, which will allow the development of adequate methods for treating the disease and preventing its complications.

✦ ACKNOWLEDGEMENTS

None.

✦ CONFLICT OF INTEREST

The authors declare no conflict of interest.

✦ REFERENCES

- [1] Popov VV, Bolshak OO, Boukarim VZh, Khoroshkovata OV, Gurtovenko OM. Case of dilated cardiomyopathy in combination with left atrial myxoma and left atriomegaly (rare clinical case). *Ukr J Cardiovasc Surg.* 2022;30(4): 47–52. DOI: [10.30702/ujcvs/22.30\(04\)/PB059-4752](https://doi.org/10.30702/ujcvs/22.30(04)/PB059-4752)
- [2] Vitovskiy RM, Zakharova VP, Martyshchenko IV, Tregubova MO, Isaenko VV, Kupchinsky AV. Features of clinical course, diagnostics and surgical treatment of a giant left atrial myxoma with subsequent mitral valve insufficiency. [in Russian]. *Card Surg Intravent Cardiol.* 2020;1(28):24–32. DOI: [10.31928/2305-3127-2020.1.2432](https://doi.org/10.31928/2305-3127-2020.1.2432)
- [3] Kumar A, Kushwaha S, Jaiswal S, Singh P, Deshpande R, Acharya S. Unusual presentation of Cardiac Myxoma. *Med Sci.* 2020;24(102):521–25. Available from: http://www.discoveryjournals.org/medicalsecience/current_issue/v24/n102/A11.pdf
- [4] Lee PT, Hong R, Pang PY, Chua YL, Ding ZP. Clinical presentation of cardiac myxoma in a Singapore national cardiac centre. *Singapore Med J.* 2021 Apr;62(4):195–98. DOI: [10.11622/smedj.2020041](https://doi.org/10.11622/smedj.2020041)
- [5] Griborio-Guzman AG, Aseyev OI, Shah H, Sadreddini M. Cardiac myxomas: Clinical presentation, diagnosis and management. *Heart.* 2022 May 12;108(11):827–33. DOI: [10.1136/heartjnl-2021-319479](https://doi.org/10.1136/heartjnl-2021-319479)
- [6] Espiard S, Vantyghem MC, Assié G, Cardot-Bauters C, Raverot G, Brucker-Davis F, et al. Frequency and incidence of Carney complex manifestations: A prospective multicenter study with a three-year follow-up. *J Clin Endocrinol Metab.* 2020 Mar 1;105(3):436–46. DOI: [10.1210/clinem/dgaa002](https://doi.org/10.1210/clinem/dgaa002)
- [7] Saputra PB, Jannah AR, Rofananda IF, Al-Farabi MJ, Wungu CDK, Susilo H, et al. Clinical characteristics, management, and outcomes of pulmonary valve myxoma: Systematic review of published case reports. *World J Surg Oncol.* 2023;21(1):99. DOI: [10.1186/s12957-023-02984-0](https://doi.org/10.1186/s12957-023-02984-0)
- [8] Fedonyuk LY, Kovanova EN, Ruzhytska OY, Lomakina Y, Garvasiuk OV. Peculiarities of HLA antigens inheritance of the main histocompatibility complex in women and men. *Pharmacol Online.* 2021;3:1185–90. Available from: https://pharmacologyonline.silae.it/files/archives/2021/vol3/PhOL_2021_3_A129_Fedonyuk.pdf
- [9] Shved MI, Moroz VS, Humennyi IZ, Oryshchyn IY, Sydorenko OL. Small-symptomatic giant left atrial myxoma: A modern algorithm for diagnosis and radical surgical treatment. [in Ukrainian]. *J Cardiovasc Surg.* 2019;60(1):86–92. DOI: [10.11603/2414-4533.2019.1.9919](https://doi.org/10.11603/2414-4533.2019.1.9919)
- [10] Wei K, Guo HW, Fan SY, Sun XG, Hu SS. Clinical features and surgical results of cardiac myxoma in Carney complex. *J Card Surg.* 2019 Jan;34(1):14–19. DOI: [10.1111/jocs.13980](https://doi.org/10.1111/jocs.13980)
- [11] Kamilaris CDC, Faucz FR, Voutetakis A, Stratakis CA. Carney complex. *Exp Clin Endocrinol Diabetes.* 2019 Feb;127(2-03):156–64. DOI: [10.1055/a-0753-4943](https://doi.org/10.1055/a-0753-4943)
- [12] Cherenko SM, Cherenko MS, Martsinik EM. Carney complex manifested itself in pituitary somatotropinoma and Cushing syndrome: A clinical case and current understanding of the problem. *Int J Endocrinol.* 2020;16(2):172–79. DOI: [10.22141/2224-0721.16.2.2020.201305](https://doi.org/10.22141/2224-0721.16.2.2020.201305)
- [13] Pitsava G, Zhu C, Sundaram R, Mills JL, Stratakis CA. Predicting the risk of cardiac myxoma in Carney complex. *Genet Med.* 2021 Jan;23(1):80–85. DOI: [10.1038/s41436-020-00956-3](https://doi.org/10.1038/s41436-020-00956-3)
- [14] The World Medical Association. Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects [Internet]. Available from: <https://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/>
- [15] Zipes DP. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine, 11th Edition. Book Review. *BMH Med J* [Internet]. 2018 Mar;5(2):63. Available from: https://www.babymhospital.org/BMH_MJ/index.php/BMHMJ/article/view/163
- [16] Schmidt C, Doi A, Ura M, Cole C, Mundy J. Familial atrial myxoma: Three related cases at an Australian tertiary institution. *Ann Thorac Cardiovasc Surg.* 2017 Aug 20;23(4):203–6. DOI: [10.5761/atcs.cr.16-00169](https://doi.org/10.5761/atcs.cr.16-00169)
- [17] Cuny T, Mac TT, Romanet P, Dufour H, Morange I, Albarel F, et al. Acromegaly in Carney complex. *Pituitary.* 2019 Oct;22(5):456–66. DOI: [10.1007/s11102-019-00974-8](https://doi.org/10.1007/s11102-019-00974-8)
- [18] Tronko MD, Kvachenyuk AM, Lutsenko LA, Suprun IS, Ohrimchuk OO. Orphan diseases in endocrinology (literature review and own experience). [in Ukrainian]. *Pract Oncol.* May 2020;3(2):5–17. DOI: [10.22141/2663-3272.3.2.2020.215659](https://doi.org/10.22141/2663-3272.3.2.2020.215659)

- [19] Carney JA, Swee RG. Carney Complex. *Am J Surg Pathol*. 2002 Mar;26(3):393. Available from: https://journals.lww.com/ajsp/Citation/2002/03000/Carney_Complex.16.aspx
- [20] Benzar IM, Rebenkov SO, Levytskyi AF, Fedoniuk LY, Fomina LV, Sas LM, Stravskyy TY. Newborns with Kasabach–Merritt phenomenon-associated kaposiform hemangioendothelioma: A report of 6 cases. *Wiad Lek*. 2020;73(8):1785–89. DOI: [10.36740/WLek202008136](https://doi.org/10.36740/WLek202008136)
- [21] Pacheco-Velázquez SC, Gallardo-Pérez JC, Díaz D, Adán-Ladrón de Guevara A, Robledo-Cadena DX, et al. Heart myxoma develops oncogenic and metastatic phenotype. *J Cancer Res Clin Oncol*. 2019 May;145(5):1283–95. DOI: [10.1007/s00432-019-02897-0](https://doi.org/10.1007/s00432-019-02897-0)
- [22] Islam AKMM. Cardiac myxomas: A narrative review. *World J Cardiol*. 2022 Apr 26;14(4):206–19. DOI: [10.4330/wjcv.v14.i4.206](https://doi.org/10.4330/wjcv.v14.i4.206)
- [23] Yokoyama S, Nagao K, Higashida A, Aoki M, Yamashita S, Fukuda N, et al. Diagnosis of Carney complex following multiple recurrent cardiac myxomas. *Gen Thorac Cardiovasc Surg*. 2022;70(1):87–91. DOI: [10.1007/s11748-021-01719-w](https://doi.org/10.1007/s11748-021-01719-w)
- [24] Pirogkova AO, Prokopovych OA. Orphan diseases in cardiology. [in Ukrainian]. *Nursing*. 2019;(2):22–25. DOI: [10.11603/2411-1597.2019.2.10194](https://doi.org/10.11603/2411-1597.2019.2.10194)
- [25] Vitovskiy RM, Isaienko VV, Pishchurin OA, Vitovskiy AR, Serdiuk MM, Zakharova VP. Features of the blood supply of cardiac myxoma which can cause bleeding. *Ukr J Cardiovasc Surg*. 2022;30(4):122-27. DOI: [10.30702/ujcvs/22.30\(04\)/VI060-122127](https://doi.org/10.30702/ujcvs/22.30(04)/VI060-122127)

Закономірності структурної організації міксом серця у хворих із комплексом Карнея

Лариса Ярославівна Федонюк

Доктор медичних наук, професор, завідувач кафедри
Тернопільський національний медичний університет імені І. Я. Горбачевського МОЗ України
46001, майдан Волі, 1, м. Тернопіль, Україна
<https://orcid.org/0000-0003-4910-6888>

Олена Володимирівна Руденко

Кандидат медичних наук, провідний науковий співробітник
Національний інститут серцево-судинної хірургії імені М. М. Амосова
02000, вул. Миколи Амосова, 6, м. Київ, Україна
<https://orcid.org/0000-0003-3640-566X>

Олена Юріївна Ружицька

Кандидат біологічних наук, асистент
Тернопільський національний медичний університет імені І. Я. Горбачевського МОЗ України
46001, майдан Волі, 1, м. Тернопіль, Україна
<https://orcid.org/0000-0001-6846-888X>

Анотація. Міксом серця – одні з найпоширеніших первинних пухлин серця, які найчастіше розвиваються у лівому передсерді, характеризуються доброякісним характером і відсутністю рецидивів після хірургічного видалення пухлини. Комплекс Карнея – аутосомно-домінантне захворювання, що характеризується численними пухлинами, зокрема – міксомами серця. Недостатнє висвітлення даної патології у літературі призводить до помилкового діагнозу, прогресування захворювання та неадекватного лікування. Метою роботи було визначення морфологічних особливостей міксом серця у хворих із комплексом Карнея. За допомогою світлової мікроскопії проведено морфологічне дослідження міксом серця, видалених під час 7 операцій. З операційного матеріалу виготовляли гістологічні зрізи, які фарбували гематоксиліном та еозином, за Ван Гізон, фукселином, а також Masson's Trichrome Stain у модифікації Зербіно-Лукаевич. Для виявлення морфологічних особливостей було зроблено порівняння групи міксом серця хворих із комплексом Карнея (16 пухлин) із групою міксом серця, що виникають спорадично (278 пухлин). Встановлено, що міксом серця є множинними, вони з однаковою частотою визначались у правих і лівих камерах серця. Було узагальнено, що при міксом серця відзначаються ознаки як альтерації, так і високої проліферативної активності ендотеліоцитів і клітин волокнистої сполучної тканини. Вторинні міксом серця у хворих на комплекс Карнея мають таку ж структурну організацію, що й первинні пухлини, проте найчастіше вони не є рецидивами, частіше бувають множинними, не мають переважної локалізації у лівому передсерді. Проведений аналіз встановив ідентичний клітинний склад обох груп міксом серця, що дозволяє припустити однакове джерело росту пухлин, проте наявність у спорадичних міксом більш складних клітинних утворень та переважання в Карнея міксом серця поодиноких клітин свідчить про існування відмінностей в їх морфогенезі

Ключові слова: доброякісні пухлини; морфологія; мітральний клапан; синдром Карнея; світлова мікроскопія