

# Surgical treatment of tumours of the sternum – 10 years' experience

Katarzyna Kozak<sup>1</sup>, Mariusz P. Łochowski<sup>1</sup>, Adam Białas<sup>2</sup>, Michał Rusinek<sup>1</sup>, Józef Kozak<sup>1</sup>

<sup>1</sup>Clinic of Thoracic Surgery and Respiratory Rehabilitation, Medical University of Lodz, M. Copernicus Provincial Specialist Hospital, Lodz, Poland

<sup>2</sup>First Department of Internal Medicine, Department of Pulmonology and Allergology, Medical University of Lodz, Poland



Kardiochirurgia i Torakochirurgia Polska 2016; 13 (3): 213-216

## Abstract

**Introduction:** Tumours of the sternum are rare and can be malignant, benign or inflammatory.

**Aim:** To determine the clinical, pathological and therapeutic options for tumours of the sternum.

**Material and methods:** We report a series of 30 cases of sternal tumours treated in our institution in the period 2006–2015. There were 10 malignant tumours located in the body of the sternum, 2 in the manubrium (metastases of kidney and thyroid carcinoma) and 18 benign tumours located in different parts of the sternum. Diagnosis was obtained by computed tomography scan of the chest, surgical biopsy or excision of the tumours.

**Results:** Malignant tumours were excised radically. Reconstruction of the sternum was obtained by allogenic mesh (polypropylene) and local tissues (mainly pectoralis major muscle). There was 1 postoperative cardiac death. Patients with malignancy were referred for adjuvant chemoradiotherapy. After 2 years there were 4 cases of recurrence of chondrosarcoma (1 case of local recurrence and 3 cases of pulmonary metastases). Recurrence of other tumors were not observed.

**Conclusions:** The management of sternal tumours is dependent on the histological type and the possibility of surgical excision. Reconstruction of the chest wall can be achieved by autogenic or allogenic materials.

**Key words:** sternal tumours, diagnosis, sternal reconstruction.

## Streszczenie

**Wstęp:** Guzy mostka spotyka się rzadko i mogą być one złośliwe, łagodne lub zapalne.

**Cel:** Przedstawienie problemów klinicznych, patologicznych i możliwości terapeutycznych dotyczących guzów mostka.

**Materiał i metody:** Przedstawiono 30 przypadków guzów łagodnych i złośliwych mostka leczonych na jednym oddziale w latach 2006–2015. Dziesięć złośliwych nowotworów mostka było zlokalizowanych w trzonie, 2 guzy przerzutowe (raka tarczycy i raka nerki) w rękojeści, a 18 guzów łagodnych w różnych częściach mostka. Rozpoznanie ustalono na podstawie obrazu tomografii komputerowej klatki piersiowej, biopsji chirurgicznej lub wycięcia guza.

**Wyniki:** Guzy złośliwe operowano radykalnie, usuwając fragment mostka wraz z przylegającymi chrzęstnymi odcinkami żeber. Rekonstrukcje mostka wykonywano siatką alogeniczną (polipropylen) i okolicznymi tkankami (najczęściej mięsień piersiowy większy). Stwierdzono jeden zgon pooperacyjny spowodowany zawałem serca. Chorych z guzami złośliwymi kierowano na chemioradioterapię adiuwantową. Po 2 latach odnotowano 4 przypadki nawrotu chrzęstniakomięsaka (wznowa miejscowa w 1 przypadku i przerzuty do płuc w 3 przypadkach). Nie obserwowano nawrotu innych guzów.

**Wnioski:** Leczenie guzów mostka zależy od ich typu histologicznego i możliwości chirurgicznego wycięcia. Rekonstrukcje ściany klatki piersiowej wykonuje się za pomocą materiałów autogenych lub alogennych.

**Słowa kluczowe:** guzy mostka, rozpoznanie, rekonstrukcja mostka.

## Introduction

Tumours of the sternum are rare. They can be primary, metastatic or arise from adjacent tissues. Histologically they can be malignant, benign or inflammatory.

Management depends mainly on their histological type, local aggressiveness and the possibility of chest wall reconstruction.

We describe our 10 years of experience in the treatment of this pathology.

## Material and methods

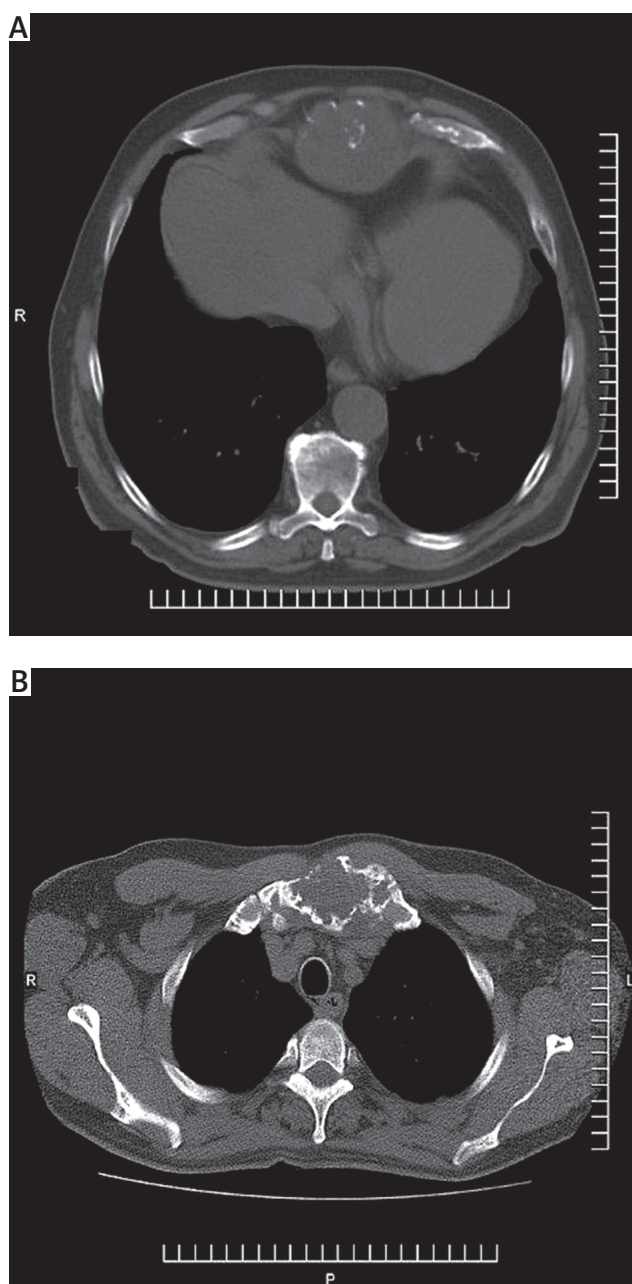
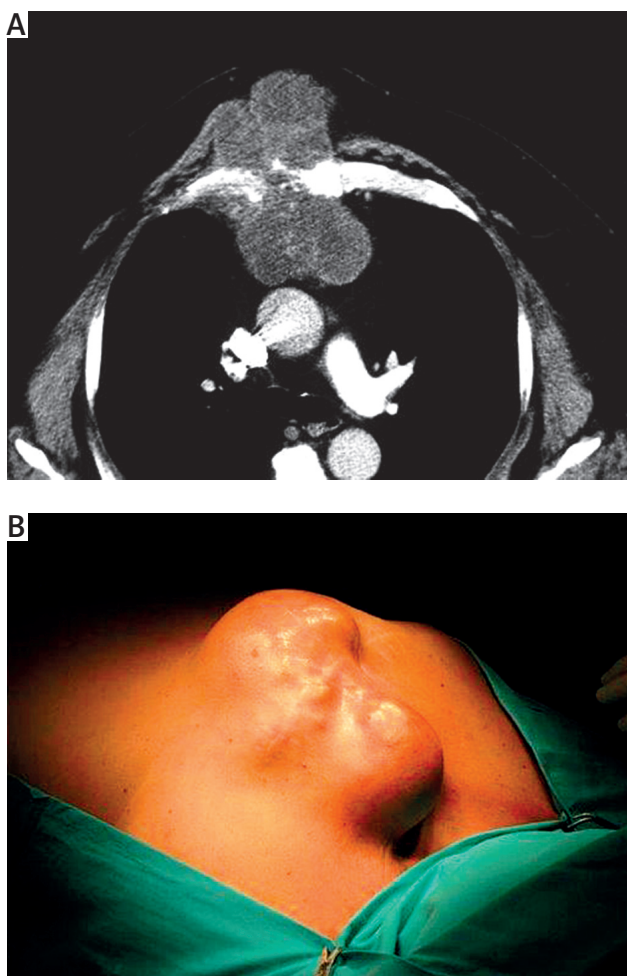
We report on a series of 30 cases of sternal tumours treated in our institution between 2006 and 2015. There were 16 men, 14 women, average 54.4 years (range: 26–73).

**Address for correspondence:** Dr. Mariusz Łochowski, Clinic of Thoracic Surgery and Respiratory Rehabilitation, Medical University of Lodz, M. Copernicus Provincial Specialist Hospital, 62 Pabianicka St, 95-050 Lodz, Poland, phone: +48 602 776 887, e-mail: marilo@op.pl

**Received:** 3.08.2016, **accepted:** 16.08.2016.

**Tab. I.** Histological types of sternal tumours

Type	Histological type	Number	Total
Malignant	Chondrosarcoma	5	10
	Hodgkin lymphoma	2	
	Lymphoma	2	
	Plasmocytoma	1	
Benign	Chondroma	2	18
	Aneurysmal bone cyst	2	
	Chronic tenosynovitis	2	
	Inflammation	4	
	Benign tumor	8	
Metastasis	Renal cancer	1	2
	Thyroid cancer	1	

**Fig. 1.** A – Benign tumour of the xyphoid process. B – Plasmocytoma of the sternum**Fig. 2.** A – Chondrosarcoma of the sternum. B – View of the sternum before the operation

Most patients had the following symptoms: pain (22 cases), a palpable mass (all patients) and swelling (6 cases) in the sternoclavicular joint region.

Tumours were located in the sternoclavicular joint in 6 cases, in the manubrium in 7, in the body in 14 and in the xyphoid process in 2 cases. One patient had a large infiltration of the chest wall, and it was difficult to establish the location of the disease.

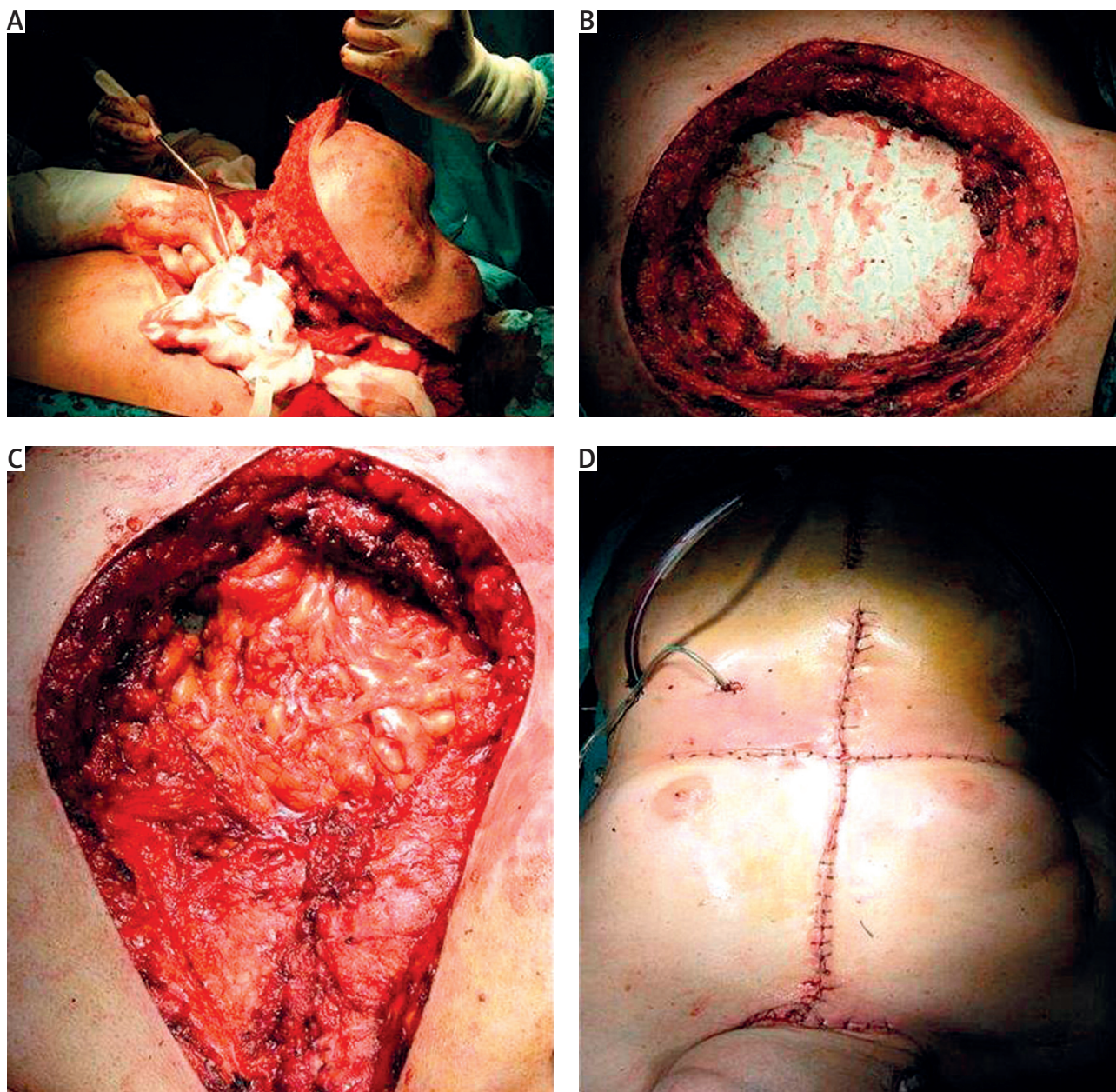
The histological type of tumour was determined by surgical biopsy or excision of the tumour. There were 18 benign, 10 malignant and 2 metastatic tumours (Tab. I).

The size of the tumour was determined by a chest computed tomography (CT) scan (Figs. 1 and 2). The size of the benign lesions was 1.8 cm to 4.9 cm and of the malignant lesions was 3.6 cm to 10.2 cm. All malignant tumours were located in the body of the sternum, metastatic in the manubrium, inflammatory in the sternoclavicular joints, and benign in different parts of the sternum.

Before surgery, pulmonary function tests were routinely used in all patients, and a metastatic work-up was undertaken to eliminate an extrathoracic metastatic lesion.

Surgical excision of the tumour was undertaken in 24 cases, surgical biopsy in 6.





**Fig. 3.** Excision of the sternal chondrosarcoma and chest wall reconstruction. **A** – Excision of the tumour. **B** – Methyl-methacrylate sandwich location. **C** – An omentum covered the mesh. **D** – Final view

Following general anaesthesia the sternal tumours located in the chest wall with at least a 4 cm margin were totally removed. For small resection direct closure was performed.

For the longer defects, regional musculocutaneous flaps were used for coverage of the polypropylene mesh. A prosthesis was sutured with 0-Prolene sutures to the edges of the resected chest wall. After whole body sternal resection, polypropylene/methyl methacrylate sandwiched mesh was used for closing the defect. In 1 case an omental flap was used as coverage mesh (Fig. 3). Microscopic evaluation of the margins by frozen section was not routinely performed due to wide resection. Subcutaneous drainage was not used at the mesh site. Pressure dressing was rou-

tinely used when there was no respiratory support postoperatively.

## Results

The postoperative period was complicated in 1 patient (cardiac arrest and death). Average length of stay in hospital was 2–11 days (mean: 4.3).

The patients with malignancy were referred for radio and/or chemotherapy postoperatively. The first visit was in the 4 weeks postoperatively, and then patients were seen every 3 months in the first year, every 6 months in the second and subsequently every 12 months.

Local recurrence was observed after 2 years in 2 patients and lung metastases in 2 patients with chondrosar-

coma. They needed further operations and lung metastasis excision.

## Discussion

The incidence of sternal tumours has not been established. Malignant tumours represent 0.6–0.9% of all primary bone tumours [1–3]. Chondrosarcoma is the most common tumour of the sternum, followed by osteosarcoma, myeloma and malignant lymphoma. Benign sternal tumours according to the Mayo Clinic were found in 0.1% of all benign bone tumours [2].

Among benign chondromas, osteoblastoma and haemangioma have been described [4–6]. Two thirds of sternal tumours are metastatic or locally invasive. Most frequently, there is breast cancer invasion, lung or pleural malignancy invasion or rarely solitary metastasis from the kidney or thyroid [7, 8].

Clinical signs are not specific. Chest pain, palpable mass and signs of swelling are frequently found. Signs of inflammation were seen mainly in sternoclavicular regions.

A CT scan of the chest gives precise information about extension, pulmonary invasion or metastases and aids in the assessment of mediastinal lymph nodes.

The diagnosis was obtained by surgical biopsy. However, even surgical biopsies may be uncertain when the cortex of the sternum is not involved. For this reason most of our patients had surgical excision of the tumour (24 cases).

The causes of sternoclavicular joint pain and swelling were usually non-malignant, and moderate to severe degenerative changes were found [9]. In the manubrium we found 2 metastases (1 from a kidney, 1 from a thyroid). Distant solitary metastases of kidney or thyroid cancer to the sternum are very rare and associated with a poor prognosis [7, 8].

Most malignant tumours were located in the body of the sternum. Tumours in the xiphoid process were non-malignant and very easy to remove.

Whenever possible, surgery is the best therapeutic option for a sternal tumour. In some cases radiation and/or chemotherapy may be used pre- or postoperatively, especially in tumours with sensitivity to their treatment (Hodgkin or non-Hodgkin lymphoma, plasmocytoma) [10].

Wide resection and simultaneous reconstruction is essential for the surgical procedure. The resection margin has been discussed in the literature since the extent of resection is associated with radical resection [11]. Most suggest a 4–5 margin, or simply negativity in a frozen section without a specific distance was safe enough [12].

Many techniques have been described for the closure of the chest wall defect to minimize paradoxical movement and protect the mediastinal structures after sternal resection [11–14]. Autoplastic reconstruction is suggested for small defects, while alloplastic materials are suggested for larger defects.

Reconstruction with a skin flap, myocutaneous flaps, Marlex mesh, Gore-Tex dual mesh, methyl methacrylate

sandwiched between Marlex mesh, allogenic sternal graft, autogenous rib graft, porous titanium mesh, and metallic bars was described [5, 11–14]. In our patients we used polypropylene mesh, and we obtained rigidity (when necessary) by using a methyl methacrylate sandwich.

After manubrium resection, a muscle flap is recommended and rigid reconstruction after lower sternal resection to protect the heart and stabilise the thorax [6]. Omental flaps are used for infected sternal wounds and filling residual cavities [12].

The role of chemotherapy and/or radiation in sternal tumours remained unclear. For tumours that appeared to be radio/chemosensitive (Hodgkin lymphoma, Ewing sarcoma, plasmocytoma) and patients who were at high risk of local recurrence or compromised margin a benefit from adjuvant treatment might be obtained.

Despite the adjuvant treatment our 4 patients with chondrosarcoma had local or metastatic recurrence.

The multidisciplinary management of primary malignant tumours of the sternum is worth further discussion.

## Disclosure

Authors report no conflict of interest.

## References

1. Dorbari A, Tandon S. Unusual sternal mass: adenocarcinoma with unknown primary site. *Ann Thorac Med* 2006; 1: 84–86.
2. Futani H, Okumura Y, Fukuda Y, Fukunaga S, Hasegawa S, Yoshiya S. Giant cell tumor of the sternum: a case report and review of the literature. *Anticancer Res* 2008; 28: 4117–4120.
3. Zehani A, Ayadi-Kaddour A, Marghli A, Kassar L, Zidi A, Kilani T, El Mezni F. Primary malignant tumors of the sternum. *Tunis Med* 2012; 11: 824–828.
4. Kumar Iha A, Gupta S, Saha S. Sternal chondrosarcoma: a case report. *India J Thorac Cardiovasc Surg* 2011; 27: 182–184.
5. Ye C, Zhang G, Chai Y. A rare desmoid tumor arising from the manubrium. *J Cardiovasc Surg* 2015; 10: 33–36.
6. Villalobos CE, Rybak LD, Steiner GC, Wittig JC. Osteoblastoma of the sternum. Case report and review of the literature. *Bull NYU Hosp Jt Dis* 2010; 68: 55–59.
7. Batista RR, Marchiori E, Takayasu TC, Cabral FC, Cabral RF, Zanetti G. Sternal metastasis as an initial presentation of renal cell carcinoma: a case report. *Cases J* 2009; 2: 9045–9048.
8. Ishinaga H, Miyamura T, Tenpaku H, Takeuchi K. Metastasis of thyroid cancer to the sternum after total thyroidectomy and laryngectomy. *Case Rep Surg* 2013; 2013: 346246.
9. Robinson CM, Jenkins PJ, Markham PE, Beggs I. Disorders of sternoclavicular joint. *J Bone Joint Surg Br* 2008; 90: 685–689.
10. Kabiri el E, Kabiri M, Doghimi K. Primary non-Hodgkin lymphoma of the sternum. *Arch Bronconeumol* 2009; 45: 259–260.
11. Yang H, Tantai J, Zhao H. Clinical experience with titanium mesh in reconstruction of massive chest wall defects following oncological resection. *J Thorac Dis* 2015; 7: 1227–1234.
12. Zhao Y, Peng C, Liu Y, Hao Y, Zhao X, Chang B. Clinical study of allogeneic graft reconstruction for sternum tumor. *Exp Clin Transplant* 2016; 14: 353–357.
13. Chapelier AR, Missana MC, Couturaud B, Fadel E, Fabre D, Mussot S, Pouillart P, Dartevelle PG. Sternal resection and reconstruction for primary malignant tumours. *Ann Thorac Surg* 2004; 77: 1001–1007.
14. Hong-sheng L, Ying-zhi Q, Shan-qing L, Li L, Yu-shang C, Zhi-yong Z. Surgical resection of sternal tumors and reconstruction with titanium mesh. *Chin Med Sci J* 2011; 26: 237–240.