HIRURŠKI TRETMAN RADIJACIJOM INDUKOVANOG OSTEOSARKOMA PREDNJEG ZIDA GRUDNOG KOŠA NAKON KARCINOMA DOJKE: PRIKAZ SLUČAJA

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CASE REPORT

SURGICAL TREATMENT OF RADIATION-INDUCED ANTERIOR CHEST WALL OSTEOSARCOMA AFTER BREAST CARCINOMA: A CASE REPORT

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SAŽETAK

Uvod/Cilj: Radioterapija kod karcinoma dojke može retko da dovede do pojave radijacijom indukovanog osteosarkoma (RIOS), jako agresivnog maligniteta. Cilj ovog rada je da prikaže specifičan hirurški tretman i agresivnost ovog retkog malignog tumora.

Prikaz slučaja: Pacijentkinja stara 63 godine, primljena je na Odeljenje grudne hirurgije Vojnomedicinske akademije zbog velike egzulcerišuće sternalne mase sa secernacijom purulentnog sadržaja, koja je inicijalno pogrešno shvaćena kao recidiv 15 godina nakon tretmana karcinoma dojke, i anemije. Biopsijom je dokazan visoko gradusni osteosarkom na terenu prethodnog tretmana radioterapijom. Isključenjem metastatske bolesti, nakon neoadjuvantne hemioterapije, učinjena je resekcija sarkoma, sternuma i anteriornih delova, od III–VII rebara, uz pripadajuća meka tkiva zida grudnog koša. Rekonstrukcija zida grudnog koša je učinjena titanijumskim pločicama i klipsevima, kao i miokutanim režnjem najšireg leđnog mišića (lat. *musculus latissimus dorsi*). Usled pojave recidiva, učinjena je dodatna resekcija manubrijuma i anteriornih okrajaka II rebara, uz pripadajuća meka tkiva. Godinu dana nakon prve operacije, verifikovana je promena potkožja leve pektoralne regije, suspektna na recidiv, koja je odstranjena radi histopatološke verifikacije.

Zaključak: RIOS zida grudnog koša pokazuje agresivniji tok i lošiju prognozu od sporadičnih sarkoma, sa većom stopom recidiva uprkos širokoj resekciji, kao što je pokazano u ovom slučaju. Rekonstrukcija titanijumskim pločicama i klipsevima, nakon opsežne resekcije prednjeg grudnog zida, pruža izvodljivu rigidnu alternativu za uspostavljanje stabilnosti. Ovaj slučaj naglašava važnost prepoznavanja RIOS-a kao retke, ali ozbiljne kasne komplikacije radioterapije karcinoma dojke, te ističe složenost i specifičnost hirurškog lečenja i rekonstrukcije neophodnih za optimalne ishode.

Ključne reči: sternalna masa, resekcija, rigidna rekonstrukcija, titanijumske pločice, titanijumski klipsevi, miokutani režanj, rekonstrukcija mekih tkiva

ABSTRACT

Introduction/Objective: Radiotherapy for breast cancer can rarely lead to radiation-induced osteosarcoma (RIOS), a highly aggressive malignancy. This article aims to present the specificity of the surgical treatment applied and the level of aggressiveness of this rare malignant tumor.

Case report: A 63-year-old female patient was admitted to the Chest Surgery Department of the Military Medical Academy due to a large exulcerated sternal mass releasing a purulent secretion, initially misdiagnosed as recurrent breast carcinoma 15 years post-treatment, and anemia. Biopsy confirmed high-grade osteosarcoma following prior radiotherapy. After metastasis was ruled out, the patient received neoadjuvant chemotherapy and underwent radical resection of the sarcoma, sternum, anterior III–VII ribs, and adjacent soft tissues. Chest wall reconstruction was achieved using titanium bars, clips, and a latissimus dorsi myocutaneous flap. Upon local recurrence, further resection of the manubrium and anterior II ribs, with soft tissues, was performed. A year after the initial operation, a suspicious subcutaneous mass in the left pectoral region was excised for histopathological analysis.

Conclusion: RIOS of the chest wall exhibits a more aggressive course and worse prognosis than sporadic chest wall sarcomas, with higher rates of recurrence despite wide resection, as demonstrated in this case. Reconstruction with titanium bars and clips, after extensive anterior chest wall resection, provides a rigid and feasible alternative for restoring stability. This case underscores the importance of recognizing RIOS as a rare but serious late complication of breast cancer radiotherapy and highlights the complexity and specificity of surgical management and reconstruction for optimal outcomes.

Keywords: sternal mass, resection, rigid reconstruction, titanium bars, titanium clips, myocutaneous flap, soft tissue reconstruction

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Primljeno • *Received*: December 12, 2025; **Revidirano • *Revised*:** January 13, 2026; **Prihvaćeno • *Accepted*:** January 19, 2026; ***Online first*:** March 25, 2026

DOI: 10.5937/smclk7-63424

UVOD

Osteosarkomi čine 10%–15% svih primarnih malignih tumora zida grudnog koša koji su zastupljeni u svega 1%–2% svih primarnih tumora [1]. Povezanost radioterapije (RT) u sklopu onkološkog lečenja karcinoma dojke i pojave radijacijom indukovanog osteosarkoma (RIOS) u zračnoj regiji, iako je izuzetno retko, već je opisano i poznato. Ovi osteosarkomi su po pravilu znatno većeg malignog potencijala i ređi nego sporadični osteosarkomi. Hirurgija je i dalje prvi izbor u multimodalnom lečenju ovih sarkoma.

PRIKAZ SLUČAJA

Pacijentkinja, starosti 63 godine, primljena je na Kliniku za grudnu hirurgiju Vojnomedicinske akademije zbog velike egzulcerišuće sternalne mase sa secernacijom purulentnog sadržaja i anemijom. Onkološko lečenje karcinoma dojke, 15 godina unazad, započeto je obostranom mastektomijom, nakon čega je u adjuvantnom režimu nastavljeno primenom hemioterapije (HT) (četiri ciklusa adriamicin-ciklofosfamid + četiri ciklusa taxotera) i radioterapije. Potom je od strane nadležnog konzilijuma indikovana primena hormonalne terapije (tamoksifen) u trajanju od pet godina.

U sklopu redovnih kontrola onkologa, snimanjem grudnog koša multislajsnim skenerom (engl. *multi-slice computed tomography – MSCT*), otkrivena je osteolitična tumorska promena veličine pet centimetara u predelu sternuma, koja je išla u prilog metastaskom karcinomu dojke uz opisane nespecifične mikronodularne promene u plućima. Scintigrafija skeleta pokazala je da opisana promena zauzima distalne partije tela grudne kosti i ksifoidnog nastavka i da pokazuje pojačanu akumulaciju radiofarmaka.

Na onkološkom konzilijumu promena je inicijalno shvaćena kao relaps primarnog karcinoma, te je lečenje prema konzilijarnoj odluci nastavljeno primenom hormonske terapije.

Na *MSCT*-u grudnog koša, učinjenom nakon pet meseci od inicijalnog na kojem je viđena promena, postojala je progresija sa tumorom ukupne veličine 5 cm x 5 cm x 8,5 cm, te je pacijentkinja upućena na biopsiju ovog tumora (patohistološki (PH) nalaz: nekonkluzivan). Rebiopsija je zatim učinjena mesec dana kasnije i patohistološki je potvrđeno da se radi o osteosarkomu, te je konzilijarno indikovana i sprovedena HT po protokolu adriamicin-ifosfamid (ukupno četiri ciklusa).

Na kontrolnom *MSCT*-u grudnog koša i abdomena, četiri meseca nakon PH verifikacije i neposredno nakon poslednjeg ciklusa HT, opisuje se velika ekspanzivna tumorska masa tela sternuma sa većim kalcifikatima i cističnom komponentom koja vrši destrukciju kosti, egzulceriše kožu i propagira retrosternalno sa kom-

INTRODUCTION

Osteosarcomas account for 10%–15% of all primary malignant tumors of the chest wall, which, in turn, account for only 1%–2% of all primary tumors [1]. The association between radiotherapy (RT) applied as a part of breast cancer oncological treatment and the occurrence of radiation-induced osteosarcoma (RIOS) in the radiation region, although extremely rare, has been previously described. These osteosarcomas have a significantly higher malignant potential and are rarer than sporadic osteosarcomas. Surgery is still the treatment of first choice in the multimodal treatment of these sarcomas.

CASE REPORT

A 63-year-old female patient was admitted to the Clinic for Thoracic Surgery of the Military Medical Academy due to a large exulcerated sternal mass with purulent discharge and anemia. The patient had received oncological treatment for breast cancer 15 years earlier. She first underwent bilateral mastectomy, followed by adjuvant chemotherapy (CHT) (four cycles of Adriamycin–Cyclophosphamide and four cycles of Taxotere) and radiotherapy. Finally, the tumor board recommended hormonal therapy (tamoxifen) for a period of five years.

During routine follow-up, a multi-slice computed tomography (MSCT) chest scan revealed an osteolytic tumor lesion measuring five centimeters in the region of the sternum, suggestive of metastatic breast carcinoma, along with described multiple nonspecific micronodular changes in the lungs. Bone scintigraphy showed that the described lesion involved the distal portions of the sternal body and the xiphoid process and demonstrated increased radiotracer uptake.

The oncological tumor board initially interpreted the lesion as a relapse of the primary carcinoma, and made a decision that treatment should be continued with hormonal therapy.

The chest MSCT performed five months after the initial scan that had initially detected the lesion, showed a progression, with the tumor measuring 5 cm × 5 cm × 8.5 cm in total. The patient was therefore referred for biopsy of the tumor (pathohistological (PH) finding: inconclusive). A rebiopsy was performed one month later, and pathohistological analysis confirmed osteosarcoma. Based on the decision made by the tumor board, chemotherapy according to the adriamycin–ifosfamide protocol was indicated and administered (a total of four cycles).

The follow-up MSCT of the chest and abdomen performed four months after pathohistological (PH) verification and immediately after the last cycle of che-

Slika 1. Egzulcerišući purulentno secernirajući tumor prednjeg zida grudnog koša pre prve operacije

Figure 1. Exulcerated purulent-secreting tumor of the anterior chest wall before the first operation

Slika 2. Rigidna rekonstrukcija titanijumskim klipsevima i pločicama – prva operacija

Figure 2. Rigid reconstruction with titanium clips and bars – first operation

presijom desne pretkomore i potiskivanjem medijastinuma ulevo (Slika 1). U plućnom parenhimu nalaz bez fokalnih lezija, u medijastinumu bez limfadenopatije; nalaz u abdomenu uredan.

Multidisciplinarnim pristupom, nakon konzilijarnog prikaza, doneta je odluka o sprovođenju hirurškog lečenja – široke resekcije osteosarkoma anteriornog zida grudnog koša sa rigidnom i mekotkivnom rekonstrukcijom defekta.

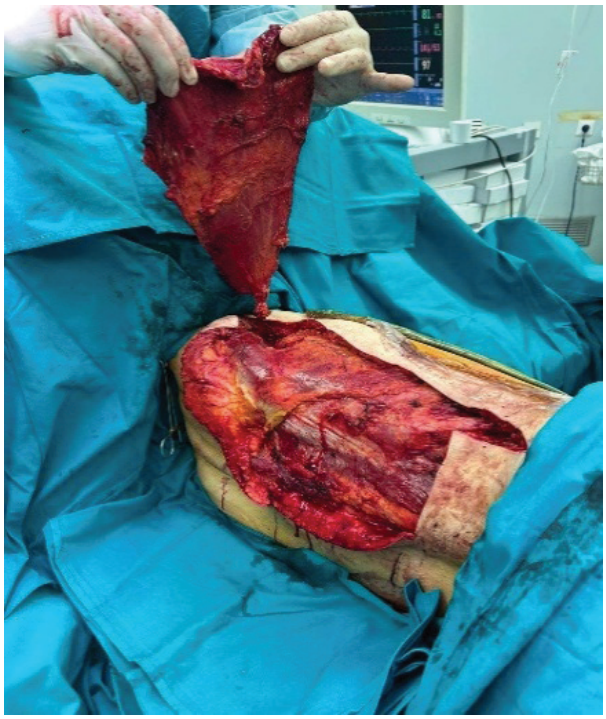
U sklopu preoperativne pripreme učinjeno je snimanje torakodorzalnih arterija kolor Doplerom, pri čemu je nalaz bio uredan – obe arterije su imale fiziološki protok, a propratne vene su bile bez znakova tromboze. Izvršena je *en bloc* resekcija osteosarkoma sa većim delom tela sternuma i ksifoidnog nastavka sternuma, uz resekciju anteriornih delova III–VII rebara obostrano do četiri cm od margina tumorske mase, sa pratećim mekotkivnim strukturama prednjeg zida grudnog koša i resekcijom perikarda. Za rigidnu rekonstrukciju korišćeni su titanijumski klipsevi i titanijumske pločice. Ideja rekonstrukcije nije bila simulacija zamene strukturama nalik sternumu nego horizontalno spajanje pločicama – premošćavanje paralelnih rebara. Učinjena je fiksacija klipseva na paralelnim rebrima III, IV i V rebru desno i levo i premošćavanje pločicama koje spajaju klipseve na pomenutim rebrima (Slika 2). Uz pomoć specijalno dizajniranih instrumenata ali i klip-

motherapy, revealed a large expansive tumor mass of the body of the sternum, with larger calcifications and a cystic component causing bone destruction, exulcerating the skin, and propagating retrosternally with compression of the right atrium and displacement of the mediastinum to the left (Image 1). In the pulmonary parenchyma there were no focal lesions; the mediastinum showed no lymphadenopathy; the abdominal findings were unremarkable.

Through a multidisciplinary approach, after presentation to the tumor board, a decision was made to proceed with surgical treatment – a wide resection of the osteosarcoma of the anterior chest wall with rigid and soft-tissue reconstruction of the defect.

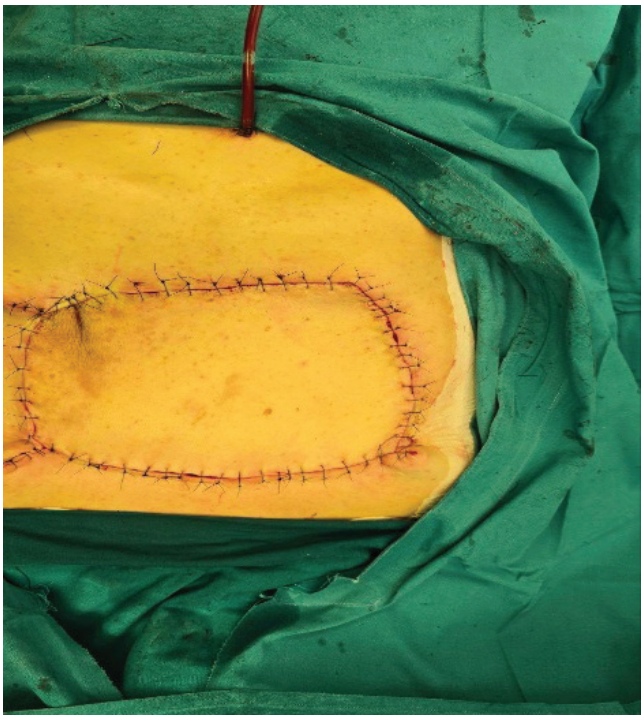
As part of preoperative preparation, imaging of the thoracodorsal arteries was performed using color Doppler ultrasonography. The findings were normal – both arteries showed physiological flow, and the accompanying veins had no signs of thrombosis.

An en bloc resection of the osteosarcoma was performed together with the greater part of the body of the sternum and the xiphoid process, with resection of the anterior portions of the third through seventh ribs bilaterally up to four centimeters from the margins of the tumor mass, along with the adjacent soft-tissue structures of the anterior chest wall and resection of the pericardium. Titanium clips and bars were used



Slika 3. Odignut miokutani flap latisimusa – prva operacija

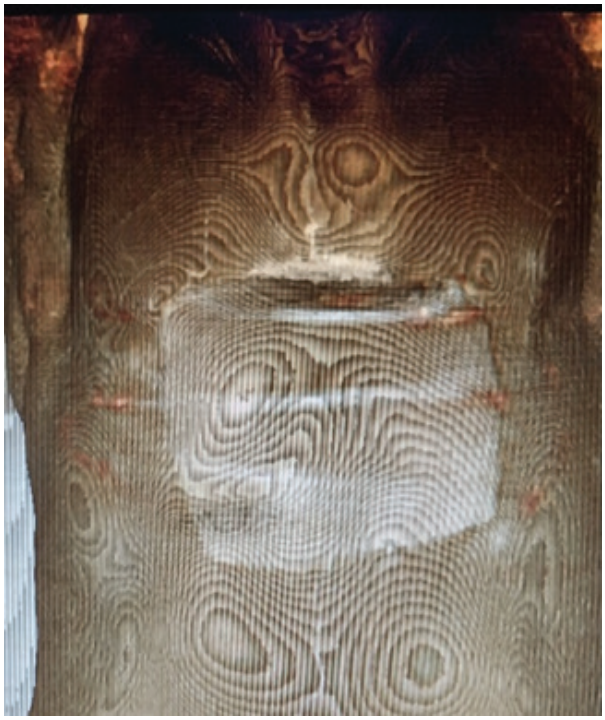
Figure 3. Raised latissimus dorsi myocutaneous flap – first operation



Slika 4. Zatvoren defekt anteriornog zida grudnog koša – prva operacija

Figure 4. Closed defect of the anterior chest wall – first operation

seva, moguće je upravljati velikim opsegom različitih uglova u sve tri ose i napraviti najstabilniji i najbolji 3D izgled.



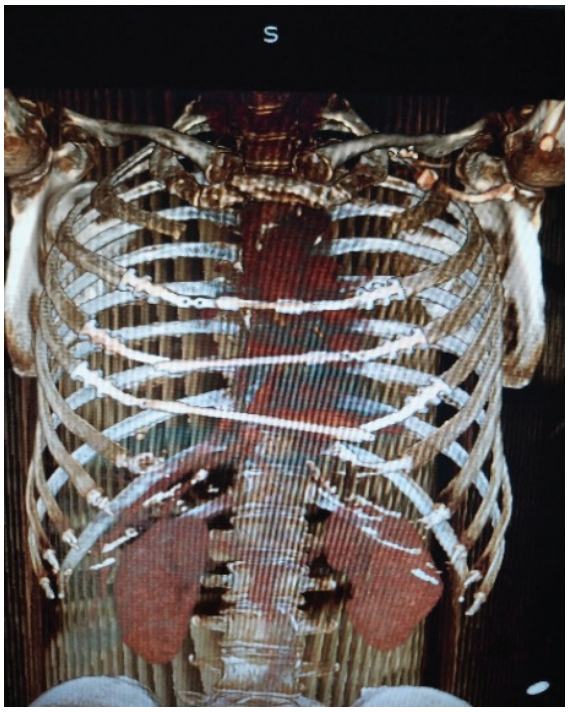
Slika 5. Multiplanarna rekonstrukcija mekotkivnih komponenti nakon druge operacije

Figure 5. Multiplanar reconstruction of soft-tissue components after the second operation

for rigid reconstruction. The concept of reconstruction was not to simulate replacement with structures resembling the sternum but rather to connect the ribs horizontally, with bars bridging the parallel ribs. Clips were fixed to the parallel ribs III, IV, and V on the right and left sides, and bridging bars were placed connecting the clips on the aforementioned ribs (Figure 2). With the help of specially designed instruments, as well as the clips themselves, it is possible to manipulate a wide range of different angles in all three axes and achieve the most stable and optimal three-dimensional configuration.

After osteosynthesis, reconstruction of the defect was performed using a myocutaneous flap of the latissimus dorsi muscle, while the secondary defect on the back was partially closed directly, sewn in layers, and partially reconstructed using a previously harvested Thiersch skin graft from the region of the right thigh.

The patient was extubated early and generally tolerated the intervention well. After drainage was reduced, the bilateral pleural drains, as well as the aspiration drain for control of bleeding from the myocutaneous flap, were removed. The wounds healed *per primam*, with adequate acceptance of the graft and myocutaneous flap and daily dressing. The patient was discharged for further home treatment on the twentieth postoperative day without significant complications.



Slika 6. Multiplanarna rekonstrukcija rigidnih komponenti nakon druge operacije

Figure 6. Multiplanar reconstruction of rigid components after the second operation

Nakon rigidne rekonstrukcije, učinjena je rekonstrukcija defekta miokutanim režnjem najšireg leđnog mišića, a sekundarni defekt na leđima je delimično direktno ušiven po slojevima, a delimično rekonstruisan prethodno uzetim graftom kože po Tiršu sa regije desne natkolenice.

Pacijentkinja je rano ekstubirana i generalno je dobro podnela navedenu intervenciju. Po smanjenju drenaže, odstranjeni su obostrani pleuralni drenovi kao i aspiracioni dren za kontrolu krvarenja režnja. Rane su zarasle *per primam,* uz adekvatno prihvatanje grafta i miokutanog flapa i svakodnevno previjanje. Pacijentkinja je otpuštena na dalje kućno lečenje dvadesetog postoperativnog dana bez značajnih komplikacija.

Dobijen je sledeći PH nalaz: solitarni tumor 220 mm x 130 mm, visoko gradusni osteosarkom (engl. *osteosarcoma high grade)* (G3) u pT2 stadijumu (*WHO Classification of Bone Tumors, 5th Edition*). Na resekcionom rubu grudne kosti prisutno tumorsko tkivo RR1; na ostalim strukturama bez tumorskog tkiva. Imunofenotip tumorskih ćelija: Vimentin +, SATB +/-, SMA +/-, CD 31 -, CD 34 -, EMA -, S100 -/+.

Konzilijarnom odlukom, tri meseca nakon operacije, lečenje je nastavljeno primenom tri ciklusa hemioterapije po protokolu adriamicin-ifosfamid. Kontrolno *MSCT* snimanje grudnog koša, šest meseci nakon operacije i

The following PH finding was obtained: solitary tumor measuring 220 mm × 130 mm, high-grade osteosarcoma (G3) in pT2 stage (WHO Classification of Bone Tumors, 5th Edition). Tumor tissue was present at the sternal resection margin (R1); no tumor tissue was present in the other structures. Immunophenotype of the tumor cells: Vimentin +, SATB +/–, SMA +/–, CD31 –, CD34 –, EMA –, S100 –/+.

In keeping with the tumor board decision, three months after the operation, treatment was continued with three cycles of chemotherapy according to the adriamycin – ifosfamide protocol. Follow-up MSCT imaging of the chest, six months after surgery and one and a half months after the last administered cycle of chemotherapy, showed the following finding: presence of the residual/recurrent previously described tumor lesion of the proximal part of the sternum measuring 45 mm × 62 mm.

The tumor board again indicated surgical treatment, and seven months after the first operation a partial resection of the distal part of the manubrium of the sternum was performed with en bloc resection of the anterior portions of the second ribs bilaterally and wedge resection of the portion of the left lung adherent to the tumor, i.e., subtotal resection of the sternum with preservation of the sternoclavicular and sternocostal connections with wedge resection of the left lung. In the second operation there was no need for additional reconstruction.

The following PH finding was obtained: *Osteosarcoma "high-grade" in textu ossealis costae infiltrativum.* No tumor tissue was present at the sternal resection margin (R0). Tumor cells were present in the lateral soft-tissue structures of the chest wall and in the lungs – R1 resection.

MSCT of the chest, three months after the second operation, detected three oval-shaped, soft-tissue lesions, partially calcified, with central hypodense zones suggestive of necrosis. The first lesion was positioned mediastinally, para-aortically, at position 6. The second was on the right side, anteriorly, supradiaphragmally, adjacent to the diaphragmatic pleura and posterior contour of the anterior chest wall. The third lesion was positioned paramediastinally, adjacent to the superior vena cava. All three lesions measured approximately two centimeters in diameter, primarily corresponding to residual/recurrent disease or metastases of the treated neoplastic lesion.

The tumor board indicated cyclophosphamide monotherapy for the duration of one month.

Less than a year after the first operation, clinical examination verified a tumor lesion in the subcutaneous tissue of the left pectoral region, which was oval-

jedan i po mesec nakon poslednjeg ordiniranog ciklusa hemioterapije pokazalo je sledeći nalaz – prisutan rest/recidiv ranije opisivane tumorske promene proksimalnog dela sternuma, prečnika 45 mm x 62 mm.

Ponovo je konzilijum indikovao operativno lečenje, te je sedam meseci nakon prve operacije učinjena parcijalna resekcija distalnog dela manubrijuma grudne kosti sa *en bloc* resekcijom prednjih delova drugog rebra obostrano i klinastom resekcijom uz tumor adherentnog dela levog pluća, odnosno subtotalna resekcija sternuma sa poštedom sternoklavikularnih i sternokostalnih veza sa klinastom resekcijom levog pluća. U drugoj operaciji nije bilo potrebe za dodatnom rekonstrukcijom.

Dobijen je sledeći PH nalaz: *Osteosarcoma „high-grade" in textu ossealis costae infiltrativum.* Na resekcionom rubu grudne kosti nema tumorskog tkiva R0. Na mekotkivnim strukturama zida grudnog koša bočno i u plućima prisutne tumorske ćelije – R1 resekcija.

Na *MSCT*-u grudnog koša, tri meseca od druge operacije, detektuju su tri ovalne mekotkivne promene, delimično kalcifikovane, sa centralnim hipodenznim zonama u prilog nekrozi – prva promena medijastinalno paraaortalno na poziciji 6, druga, sa desne strane anteriorno supradijafragmalno uz dijafragmalnu pleuru i posteriornu konturu anteriornog zida grudnog koša, i treća paramedijastinalno uz gornju šuplju venu; sve tri promera oko dva centimetra najpre odgovaraju restu/recidivu ili metastazama tretirane neoplazme.

Konzilijum je indikovao ciklofosfamid u monoterapiji u trajanju od mesec dana.

Nepunih godinu dana nakon prve operacije, kliničkim pregledom je verifikovana tumorska promena potkožja leve pektoralne regije, ovalnog oblika, promera oko četiri centimetra, bezbolna, mobilna u odnosu na podlogu, suspektna na recidiv, te je odstranjena radi PH verifikacije. Odlučeno je da se ostale promene ne reseciraju u tom trenutku.

Godinu dana nakon inicijalne hirurgije, pacijentkinja je dobrog opšteg stanja, motivisana za dalje multidisciplinarno sagledavanje i odabir najefektivnijeg, ali i najracionalnijeg pristupa lečenju.

DISKUSIJA

Osteosarkomi zida grudnog koša imaju značajno lošiju prognozu od sarkoma drugih regija, sa petogodišnjim preživljavanjem od 15%–20% [1]. Radijacijom indukovani osteosarkomi (RIOS) imaju još goru prognozu od sporadičnih osteosarkoma, odlikuje ih visok gradus, značajna mitotska aktivnost, agresivniji tok i lošija prognoza [2,3]. Kad god je to moguće, za tumore zida grudnog koša potrebno je preoperativno učiniti biopsiju. Iglena ili kor biopsija je uglavnom dovoljna. Incizi-

shaped, approximately four centimeters in diameter, painless, mobile relative to the underlying tissue, suspect of recurrence. The lesion was therefore removed for PH verification. It was decided that the other lesions would not be resected at that time.

A year after the initial surgery, the patient is in good general condition, motivated for further multidisciplinary evaluation and selection of the most effective, but also the most rational therapeutic approach.

DISCUSSION

Osteosarcomas of the chest wall have a significantly poorer prognosis than sarcomas of other regions, with a five-year survival rate of 15%–20% [1]. Radiation-induced osteosarcomas (RIOS) have an even worse prognosis than sporadic osteosarcomas; they are characterized by high grade, significant mitotic activity, a more aggressive course, and poorer prognosis [2,3]. Whenever possible, tumors of the chest wall should undergo preoperative biopsy. Needle or core biopsy is generally sufficient. Incisional biopsy may be performed to obtain a larger sample in rare tumors.

In our patient, the lesion was identified and monitored on consecutive contrast-enhanced CT scans of the chest and abdomen. The introduction of PET-CT imaging into standard preoperative preparation, along with magnetic resonance imaging of the head, might better select patients, potentially better demarcate the tumor, and ultimately provide better surgical outcomes.

After pathohistological confirmation, multidisciplinary assessment, and induction chemotherapy, surgery is the treatment of choice when feasible [4]. The greatest challenge in the surgical treatment of this disease is planning and performing reconstruction of the defect created by radical resection of such a tumor. Historically, reconstruction of the resected sternum has always been more difficult than reconstruction of other bony structures. However, with the introduction of the technique that uses titanium clips and bars, it has become feasible [5]. Titanium has exceptional strength, it is not prone to frequent infections, and when the described technique is applied it can mimic the normal movements of the chest wall [6,7].

In the literature, the expert consensus is that for high-grade tumors of the chest wall a distance of four centimeters from the macroscopically visible tumor is necessary. However, in radiation-induced osteosarcomas, additional caution is required because of the high rate of local recurrence (39%) and spreading of malignancy (27%) [8]. Rigid reconstruction, particularly in subtotal sternotomy, is feasible and may be considered as the initial treatment for osteosarcomas of the

ona biopsija se može učiniti radi obezbeđivanja većeg uzorka kod retkih tumora.

Kod naše pacijentkinje promena je identifikovana i praćena na konsekutivnim skener snimcima grudnog koša i abdomena sa kontrastom. Uvođenje *PET CT* snimanja u standardnoj preoperativnoj pripremi, uz magnetnu rezonancu glave, možda bi bolje selektovalo pacijente, potencijalno bolje demarkiralo tumor, i u krajnjem ishodu hirurški dalo bolje rezultate.

Nakon patohistološke potvrde, multidisciplinarne procene i indukcione hemioterapije, hirurgija je metod izbora, ukoliko je izvodljiva [4]. Najveći izazov za hirurški tretman ove bolesti jeste planiranje i sprovođenje rekonstrukcije defekta nastalog radikalnom resekcijom ovakvih tumora. Resecirani sternum je kroz istoriju uvek bio teži za rekonstrukciju od ostalih koštanih struktura, ipak uvođenjem tehnike titanijumskih klipseva i pločica postao je izvodljiv [5]. Titanijum ima izuzetnu čvrstinu, nije podložan čestim infekcijama, a primenom opisane tehnike može da imitira uobičajene pokrete grudnog koša [6,7].

U literaturi, konsenzus stručnjaka jeste da je za visokogradusne tumore zida grudnog koša neophodna udaljenost četiri centimetra od makroskopski vidljivog tumora, ipak kod radijacijom indukovanih osteosarkoma treba biti dodatno oprezan zbog visoke stope lokalnog recidiva (39%) i širenja maligniteta (27%) [8]. Rigidna rekonstrukcija, pogotovo kod subtotalne sternotomije je izvodljiva i možda bi trebalo da bude inicijalni tretman kod osteosarkoma distalnog sternuma, u slučaju da bolest nije proširena, ali svakom pacijentu treba pristupiti individualno.

Transpozicija miokutanog režnja najšireg leđnog mišića je često dovoljna za mekotkivni defekt, ipak u slučaju da nije dovoljna može se planirati i transpozicija transverzalnog režnja r*avnog trbušnog mišića* (lat. *musculus rectus abdominis*). Sekundarni defekt na leđima nastao nakon transpozicije miokutanog režnja najšireg leđnog mišića se aproksimira i smanjuje okolnim tkivom, pogotovo kod osoba koje imaju, uslovno rečeno ,,višak tkiva", a ostatak se pokriva autotransplantatom kože po Tiršu iz regije natkolenice, u našem slučaju sa desne strane.

Postoperativni tok je protekao uredno, sa manjim bolovima, mada kod resekcija koštanih struktura bol može biti neizdrživ i teško kupiran kombinacijom opioidnih i neopioidnih analgetika sa tendencijom da pređe u bol hroničnog karaktera. Manjem bolu sigurno doprinosi disekcija neurovaskularne peteljke prilikom pripreme rebara radi aplikacije titanijumskih klipseva. Ukoliko bi se titanijumski klipsevi pritegli neurovaskularnom peteljkom za rebra to bi dovelo do značajnog bola. R0 resekcija je obavezna za bolje preživljavanje.

distal sternum when the disease is not disseminated, although each patient should be approached individually.

Transposition of the myocutaneous latissimus flap is often sufficient for the soft-tissue defect. However, if it is insufficient, transposition of a transverse rectus abdominis muscle flap can also be applied. The secondary defect on the back created after transposition of the myocutaneous latissimus flap is approximated and reduced by surrounding tissues, especially in individuals who have "excess tissue," while the remainder is covered with a Thiersch skin autograft from the thigh region, in our case from the right side.

Postoperative recovery was uneventful, with mild pain, although in resections of bony structures the pain can be unbearable and difficult to manage with a combination of opioid and non-opioid analgesics, and may have the tendency of becoming chronic. The precise dissection of the neurovascular pedicle during the preparation of the ribs for the application of titanium clips certainly contributes to less pain. If the titanium clips were to clamp the neurovascular bundle to the ribs, this would lead to significant pain. R0 resection is mandatory for improved survival.

In our patient, in the first procedure, due to a positive sternal margin and microscopic presence of tumor cells, the operation did not achieve R0 resection, while the lateral soft-tissue margins and resected ribs achieved R0 resection. During the second operation, after recurrence, the lateral soft-tissue component did not achieve R0 resection, whereas the sternum did.

In such patients, a multidisciplinary approach is essential. In addition to surgery, induction and adjuvant chemotherapy may be effective. In our patient, chemotherapy was ineffective. In R1 resections, adjuvant radiotherapy may be attempted. However, since the osteosarcoma developed in previously irradiated tissue, the final effect and the potential benefit-to-harm ratio are issues of concern. In certain circumstances, stereotactic body radiation therapy (SBRT) may yield acceptable results [9]. In some cases, the use of SBRT as adjuvant therapy after breast cancer, or, in fact, the use of more precise radiation therapy compared with conventional methods, may potentially reduce the incidence of RIOS [10].

Conflict of interest: None declared.

Kod naše pacijentkinje, u prvom aktu, zbog pozitivne margine sternuma i mikroskopskog prisustva tumorskih ćelija, operacija nije zadovoljila R0 resekciju, dok su bočne mekotkivne margine i resecirana rebra zadovoljile R0 resekciju. Pri drugoj operaciji, nakon recidiva, bočna mekotkivna komponenta nije zadovoljila R0 resekciju dok sternum jeste.

Kod ovakvih pacijenata, važan je multidisciplinarni pristup. Osim hirurgije, indukciona i adjuvantna hemoterapija mogu imati efekta. Kod naše pacijentkinje, hemoterapija nije bila učinkovita. Za R1 resekcije može da se pokuša sa adjuvantnom radioterapijom, ali s obzirom da je osteosarkom nastao na terenu radijacije, postavlja se pitanje krajnjeg efekta i odnosa – potencijalna dobit naspram potencijalne štete. U određenim okolnostima stereotaktička telesna radioterapija (engl. *stereotactic body radiation therapy* (*SBRT*)) može dati prihvatljive rezultate [9]. U pojedinim slučajevima, primena *SBRT* u adjuvantnom režimu, nakon karcinoma dojke, odnosno, primena preciznije zračne terapije u odnosu na konvencionalnu, potencijalno smanjuje učestalost radijacijom indukovanog osteosarkoma [10].

Sukob interesa: Nije prijavljen.

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