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Treatment of Pathologic Fracture of the Humeral Diaphysis Using Metal and Polymer Express Endoprosthetic Replacement as an Example of the Accelerated Rehabilitation of Cancer Patients

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ABSTRACT We report a case of treatment of a 60-year-old female patient D. with a metastatic fracture of the upper and middle third of the left humerus. We made a radical removal of the metastasis, which was complicated by pathological fracture of the left humerus. To replace the removed tumor defect we performed metal and polymer endoprosthetic replacement of the left humeral diaphysis using a locking screw system and bone cement (methyl methacrylate). For accelerated recovery and rehabilitation we applied adaptogenic immunomodulator «Vitavis» (Altai elixir) and neutral anolyte (NA). After the removal of the tumor, postoperative wound was treated with neutral anolyte (NA). Dressings also contained neutral anolyte (NA). These drugs were successfully combined with postoperative basic therapy. The patient was discharged from the hospital on the 4th day after surgery. The functional results of the left upper limb are satisfactory.

Keywords: metastatic tumor of the left humerus, complicated by pathological fracture in the upper and middle left humerus, metal and polymer express endoprosthetic replacement of the left humerus, immunomodulator, adaptogen, neutral anolyte

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NA — neutral anolyte
TRD — total radiation dose

INTRODUCTION

Due to the aging of the planet's population, poor environmental situation in the world, consumption of low-quality food products, bad habits (alcohol consumption, smoking), unsatisfactory screening examinations (rare and low-quality measures to identify tumors in the population by their localization with the involvement of doctors - oncologists of narrow specialization) and poor clinical examination of the population even in industrially developed countries, numerous stresses associated with the political situation in the world and social problems within countries, an increase in the number of cases of oncological diseases is observed all over the world, including Russian Federation [1].

We report a case from the practice of treating an oncological patient, completely guided by the course of our state for highly qualified assistance to such a complex contingent of patients.

It is known that most tumors metastasize to the skeletal system due to the hematogenous spread of tumor cells. Metastases are osteolytic and osteoplastic. In particular, from the works of foreign and especially domestic authors, it is known that all types of cancer metastases to the bone, but in different percentages. In the first place in this — prostate cancer (50%), in the second — the breast (35%), in the third — the kidneys (33%), in the fourth — the lung (20%), and in the fifth — thyroid cancer (19 %). According to R.A. Willis [2] and M.D. Sewell [3], in the first place are metastases in the bone of breast cancer (40.6%), in the second — in the lung (29%), in the third — in the prostate gland (20%), in the fourth — in the stomach (8%), and on the fifth — cancer of the reproductive system of women and the genitourinary system of men (7%), etc. The same contradictory information can be found in the works of other authors [4].

The causes of metastasis of malignant tumors to the skeletal system have not yet been studied and represent a multidisciplinary scientific problem. Many authors: G.S. Bespalov [5], V.I. Stolyarov [6], A.E. Kolosov [7] with a single metastasis to the skeletal system and even complicated by a pathological fracture, consider its adequate removal within healthy tissue in compliance with all principles of ablastics as a radical removal of the tumor with a favorable prognosis of survival and quality of life [6, 8-10]. In cases of multiple metastases in the bone, when a pathological fracture occurs with a large destruction of bone tissue in a certain segment of a lytic or more rare osteoplastic type, surgeons perform the resection of the pathological focus within the healthy tissue. In this case, the following goals are pursued: to restore the musculoskeletal function of the limb, relieve the oncological patient from pain syndrome and improve his quality of life, prevent the rapid spread of tumor cells by hematogenous pathway and reduce the severity of cancer intoxication. The emergence of systemic radiation therapy with strontium-89-chloride, modern chemotherapy and targeted therapy, monoclonal antibodies and high-tech surgical interventions made it possible, even with multiple bone metastases in their absence in vital organs (lungs, liver, etc.), to achieve long-term remission and more than 5-year survival of such patients [3, 6, 8, 11-13].

With regard to the surgical treatment for bone metastases, the pioneers were well-known Russian scientists: A.V. Vorontsov, V.I. Stolyarov and A.E. Kolosov, who suggested individual metal-polymer endoprostheses of large joints and large bone defects in planned surgical oncology [6–8]. This method is based on bone cement methyl methacrylate - a fast-hardening plastic, which gives a temperature hyperthermic and cytostatic effect on tumor cells upon rapid hardening (exposure of 10 minutes). We modernized the technique of these scientists, improved it applicable to modern conditions in emergency surgical oncology and called the individual express metallopolymer endoprosthetics of bones, joints and vertebrae affected by metastatic tumors.

Now in surgical practice, modern metal structures of foreign and domestic firms are used, in particular, the Arete company, which are much more perfect than the old domestic ones, which were used at the inception of this unique technique of individual endoprostheses [3, 10, 11].

During the operation, the surgeon, like a sculptor, with the help of bone cement removes the bone defect, using metal structures and thereby confirming that surgery is not only a branch of medical science, but also to some extent an art. It is appropriate to note here a great economic advantage as the domestic metal-polymer endoprosthesis is much cheaper than foreign analogs and, moreover, an individual approach to the patient is maintained here (personalization of the patient's treatment in modern medical terminology). Thus, individual express metal-polymer intraoperative endoprostheses may accurately and quickly restore the affected bone tissue defect in almost any segment of the musculoskeletal system. At the same time, when using standard endoprostheses, it is necessary to "adjust" the patient to the endoprosthesis, which violates the individual approach to treatment [3, 6, 8, 14].

Our method of individual express metal-polymer intraoperative endoprostheses of bone defects in cancer patients allows us to customize the endoprosthesis for the patient, which is impossible with standard endoprostheses [6, 8]. Its use in combination with the additional immunomodulator-adaptogen elixir "Altaysky" with neutral anolyte (NA) during the pre- and postoperative periods may significantly reduce the postoperative recovery period: the number of infectious complications decreases, the healing of the postoperative wound of an oncological patient is accelerated by 2–2.5 times, thereby the duration of hospitalization is reduced by 7–10 days [15, 16].

The advantage of an individual express metal-polymer intraoperative endoprosthesis is the design of the endoprosthesis within the operating time. There is no need to order and wait a long time for the manufacture of an individual endoprosthesis in various companies. This method for pathological metastatic fractures is extremely necessary, since it allows you to quickly solve the problem of treating the named pathology in emergency traumatology, orthopedics and oncology [14]. All this is reflected in the large economic effect of endoprosthetics and an improvement in the quality of life of this difficult contingent of cancer patients.

We present a clinical case of an operation with the use of metal-polymer express endoprosthetics of the diaphysis of the left humerus for a metastatic fracture in a cancer patient.

A 60-year-old female patient D. was admitted to S.S. Yudin State Clinical Hospital on November 16, 2018 with a diagnosis of closed fracture of the upper and middle third of the left humerus. According to the anamnesis, on Nov 16, 2018, she grabbed the door to the apartment, after then she felt a crunch and acute pain in the left shoulder area. There was no mechanism of injury. The patient went to the trauma center at the place of residence, where an X-ray examination was performed and a diagnosis was made based on the X-ray data: a closed pathological fracture of the left humerus. From the trauma center, the

patient was referred to S.S. Yudin State Clinical Hospital for inpatient treatment. Also from the anamnesis, information was obtained that the patient had endometrial cancer T3NxMx, the state after radiation therapy was the total focal dose (TRD = 60g) : closed pathological fracture of the left humerus of the upper and middle third. The patient was consulted by an oncologist, who found that the pathological fracture had been associated with metastatic lesions of the left humerus.

The council made a decision on surgical treatment. The operation was performed on November 21, 2018. Within the limits of healthy tissues, a metastatic tumor of the left humerus was removed, complicated by a pathological fracture of its upper and middle third, with metal-polymer express endoprosthetics of the diaphysis of the left humerus. The radiograph of the left humerus before surgery is shown in Fig. 1.

Operation description. A lateral access to the left humerus was performed (30 cm). An incision was made on skin and subcutaneous tissue. A fracture of the diaphysis of the left humerus was revealed at the border of the upper and middle third.

In the area of the fracture, the tissue was gray, edematous, bleeding when being touched. The boundaries of healthy bone tissue were noted above and below the pathological fracture. Observing ablastic measures, the bone was transected within the healthy tissue with a Gigli saw (Fig. 2). A segment with a tumor 9 cm long was removed (Fig. 3).

Partial bone marrow removal from the proximal and distal ends was performed. Bone marrow canals were treated with ethyl alcohol, iodine and neutral anolyte (pH = 7.4; ORP = ± 750 mV). A pin with a diameter of 7.5 mm and a length of 200 mm was inserted, and the proximal and distal bone fragments were blocked (Fig. 4).

Fig. 1. X-ray image of the metastasis in the left humerus with a pathological fracture

Fig. 2. Removing the tumour with a Gigli saw

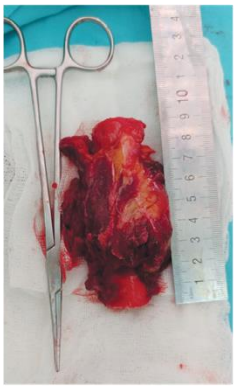

Fig. 3. The removed tumor

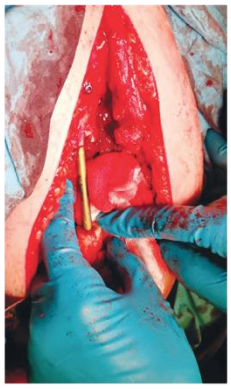

Fig. 4. The metal pin is inserted into the medullary canals of proximal and distal ends of the left humerus after the removal of the tumor

The wound was washed for 3-4 minutes with a neutral anolyte in compliance with a set of ablastic measures. The radial nerve was isolated, fixed and treated with 0.5% novocaine. A bed was created around the perimeter of the bone to replace the bone defect. A cylinder was made of 2 syringes with a capacity of 20 ml using scissors, which was brought under a metal structure in the form of a pin connecting the proximal and distal ends at the site of the resected bone (Fig. 5, 6).

Bone cement in an amount of 100 g was injected into the area of the cylinder. After the onset of hardening of the bone cement, wetting the gloves in saline, the operating surgeon recreated the resected part of the humerus and removed the cylinder made from the syringe (Fig. 7).

To reduce the temperature effect of the bone cement hardening for 10 minutes and to avoid burns of soft tissues, the surgical wound was irrigated with an ion-activated solution of neutral anolyte. As a result of the temperature effect of bone cement containing methyl methacrylate and treatment of the wound with an ion-activated aqueous solution of neutral anolyte, a local cytostatic effect on tumor cells was achieved. The bone defect was repaired, and the external fixation device was removed. The final view of the metal-polymer individual endoprosthesis of the diaphysis of the left humerus is shown in Fig. 8.

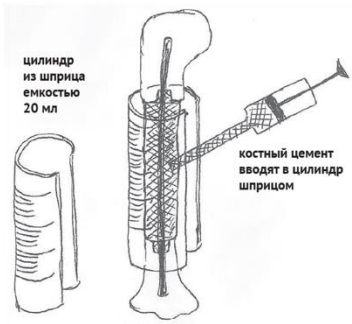

Fig. 5. Two cylinders are put under the metal construction, made with surgical scissors and syringes 20 ml for modelling of the bone cement

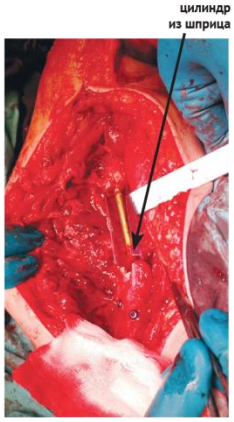

Fig. 6. Simulation of bone cement during surgery using a syringe trimmed with surgical scissors

Fig. 7. The designing of bone cement during operation with a syringe 20 ml, trimmed with surgical scissors and then removed from the the wound

Fig. 8. The final view of the metal-polymer individual endoprosthesis of the left humerus

Hemostasis was carried out during the operation. The wound was washed with an antiseptic ion-activated aqueous solution of neutral anolyte. The radial nerve bed was created. The wound was sutured tightly in layers, leaving active aspiration drainage. Fig. 9 shows an X-ray image of the left shoulder after surgery.

An aseptic bandage was applied to the wound. The left upper limb was immobilized with a scarf bandage. During the postoperative period, along with the basic therapy, the patient received an immunomodulator-adaptogen elixir Altaysky "Vitavis" in the amount of 15 ml once in the morning under fasting condition every day 15 minutes before meals. The appearane of the patient the next day after surgery is shown in Fig. 10. The patient was discharged in satisfactory condition under the supervision of an oncologist at the place of residence on the 4th day after the operation.

Fig. 9. X-ray image of the left humerus after surgery

Fig. 10. The patient on the day after surgery

Histological examination No. 223-497 dated Dec 10, 2018: clear cell adenocarcinoma, vaginal cancer.

CONCLUSION

Improving the quality of life of cancer patients with rapid recovery and rehabilitation in the early postoperative period may be achieved with the help of intraoperative metal-polymer express endoprosthesis.

Metal-polymer express replacement facilitates rapid recovery and rehabilitation of oncological patients, which makes it possible to immediately start combined treatment.

In case of multiple bone metastases, when the operation of intraoperative metallopolymer express endoprosthetic replacement was performed on one segment, where the pathological fracture occurred, it becomes possible to start systemic radiation therapy with strontium-89 chloride for therapeutic effects on multiple bone metastases.

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