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REVIEW

Surgical management of bone metastasis located in the proximal femur-review of literature

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Abstract

Neoplasms are the second leading cause of death worldwide. The increase in diagnostic possibilities and development of new treatments has led to an increase in life expectancy among cancer patients.

The proximal region of the femur is a favorite site for bone metastases, these lesions being accompanied by increased mortality and morbidity.

The methods of treatment for metastatic bone disease can be surgical or non-surgical.

Bone metastases and pathological bone fractures in the proximal femur are most commonly located in the intertrochanteric or subtrochanteric region. Patients with bone metastases at this level most often require osteosynthesis with a centromedullary nail, but also plates and screws or dynamic hip screw can be used.

Bone metastases located in the femoral neck or femoral head can be treated surgically by hemiarthroplasty (HA) or total hip arthroplasty (THA). Both HA and THA have been shown to be successful surgeries in patients with bone metastases.

In patients with multiple bone metastases located in the head or neck of the femur and trochanteric region, but with increased life expectancy, resection and reconstruction using endoprostheses is a viable solution.

Given the complexity of oncological pathologies, the therapeutic decision in the case of a patient with secondary bone determinations must be established by a multidisciplinary team comprising the oncologist, orthopedic surgeon, pathologist, anesthetist, and radiotherapist.

Surgical treatment of symptomatic bone metastases that cause pain and functional impotence with limited patient mobility increases survival and quality of life regardless of the type of surgery and the implant chosen.

Keywords: bone metastases, proximal femur, surgery, osteosynthesis, endoprostheses, arthroplasty

Abbreviations: HA = hemiarthroplasty, THA = total hip arthroplasty

Introduction

Neoplasms are the second leading cause of death worldwide [1]. The increase in diagnostic possibilities and development of new treatments has led to an increase in life expectancy among cancer patients [2]. Also, the increase in life expectancy among patients with secondary bone determinations has led to the need to establish therapeutic protocols for the surgical management of metastases [3,4].

The proximal region of the femur is a favorite site for bone metastases, these lesions being accompanied by increased mortality and morbidity [5]. The diagnosis of bone metastases can be made as a result of periodic screening in the case of cancer patients, as a result of painful symptoms in the case of bone lesions with significant osteolysis of the bone cortex, which determines the patient to see a doctor. In many cases, the diagnosis of bone metastases is made as a result of pathological bone fractures, an accidental radiological discovery because of another osteo-articular pathology or in the diagnostic process of anemia or hypercalcemia [6]. Symptoms induced by the presence of bone metastases can severely affect the quality of life, leading to the patient's inability to move or to pathological bone fractures.

The treatment of bone metastases must be individualized according to the number of metastases, the patient's life expectancy, the clinical and biological condition, and the primary tumor that determined the appearance of metastases or the presence of pathological bone fractures.

The methods of treatment for metastatic bone disease can be surgical or non-surgical. The non-surgical treatment of bone metastases consists of radiotherapy, chemotherapy, hormone therapy for certain neoplasms, multimodal analgesia or bone modifying agents [7]. Complementary to the non-surgical treatment is the minimally invasive treatment by interventional radiology techniques consisting of radiofrequency ablation, photodynamic therapy and vertebroplasty in the case of patients who also associate metastases of the spine [8].

Surgical treatment of bone metastases located in the proximal femur can be performed using osteosynthesis materials, primary prostheses, or tumor endoprostheses depending on the location and local extent of the metastasis, the number of metastases, the clinical and biological condition of the patient, the histopathological type of primary tumor and the patient's life expectancy.

Preoperative assessment and establishment of surgical indication

The decision for surgical treatment is different in patients with imaging documented bone metastases versus patients with pathological bone fractures. Surgical treatment should be initiated as soon as possible for those in the latter category. If the primary tumor is not known, the patient should be evaluated by a multidisciplinary team and investigated to differentiate a primary bone tumor formation from a bone metastasis.

Survival in the case of bone metastatic disease, but also surgical treatment, may vary depending on the stage of impending fracture or pathological bone fracture [9].

Regarding imaging documented bone metastases, the best-known score used in assessing the risk of pathological bone fracture is Mirel's criteria [10]. The increased risk of fracture requires prophylactic surgery that may consist of comfort osteosynthesis in multiple metastases or resection and reconstruction using tumor prostheses in unique metastases. Prophylactic osteosynthesis in metastases with high risk of

fracture increases quality of life, improves pain and decreases mortality by 25% [11].

Regardless of the number of metastases, the patient's life expectancy, the local extension or the origin of the primary tumor, the surgical treatment of bone metastases has the role of restoring the function of the affected pelvic limb as quickly as possible, increasing quality of life, and increasing survival.

Indications for osteosynthesis

Bone metastases and pathological bone fractures in the proximal femur are most commonly located in the intertrochanteric or subtrochanteric region. Patients with bone metastases at this level most often require osteosynthesis with a centro-medullary nail, but plates and screws or dynamic hip screw can also be used. Centromedullary implants allow immediate post-operative weight bearing with increased quality of life and pain relief [12]. A variety of implants are used in the treatment of fractures in the trochanteric region, but the best results were obtained in those implants with fixation at the femoral neck (cephalomedullary nail) [13].

Open reduction and internal fixation (ORIF) are used in the case of small bone lesions located at the trochanteric level [14]. Given the local changes induced by the presence of tumor cells, the consolidation rate is low in case of a fracture and thus the risk of surgical reoperation is high.

Osteosynthesis in the case of bone metastases is a valuable surgical resource, available in any trauma center, relatively easy to perform from a technical point of view, with good postoperative functional results and the advantage of a shorter anesthetic time and a lower risk of bleeding than in case of resections and reconstructions with tumor prostheses. The surgical indication for osteosynthesis must be established following a rigorous evaluation of the patient by a multidisciplinary team made up of orthopedic surgeon, oncologist, pathologist, radiotherapist, and anesthetist (Fig. 1).

Fig. 1 Postoperative X-ray in a patient with pertrochanteric pathological fracture

Indications for hemiarthroplasty and total hip arthroplasty

Bone metastases located in the femoral neck or femoral head can be treated surgically by hemiarthroplasty (HA) or total hip arthroplasty (THA). Considering the osteotomy performed at the base of the femoral neck, one can discuss metastasectomy and reconstruction with the help of a hip prosthesis.

Both HA and THA have been shown to be successful surgeries in patients with bone metastases [15].

The advantages of hemiarthroplasty are related to the shorter duration of surgery with less blood loss and a lower complexity of the surgical technique compared to THA. The disadvantages of this type of implant are related to the risk of cartilage erosion and the installation of the painful syndrome that led to

gait limitation, impaired quality of life and the need for another revision surgery. Thus, in the case of younger patients with a long-life expectancy, THA is preferable.

Although a more complex surgery with a longer operating time, THA remains a viable solution in the treatment of bone metastases located in the neck and femoral head that ensure an optimal functional result and an increase in the long-term quality of life.

An essential condition in the case of both types of arthroplasties remains the integrity of the acetabular cavity and of the trochanteric region. Since the functional results and the complication rate were similar in the case of both types of implants, the final decision considered the experience of the orthopedic surgeon, the patient, the particularities of the tumor and its location (Fig. 2).

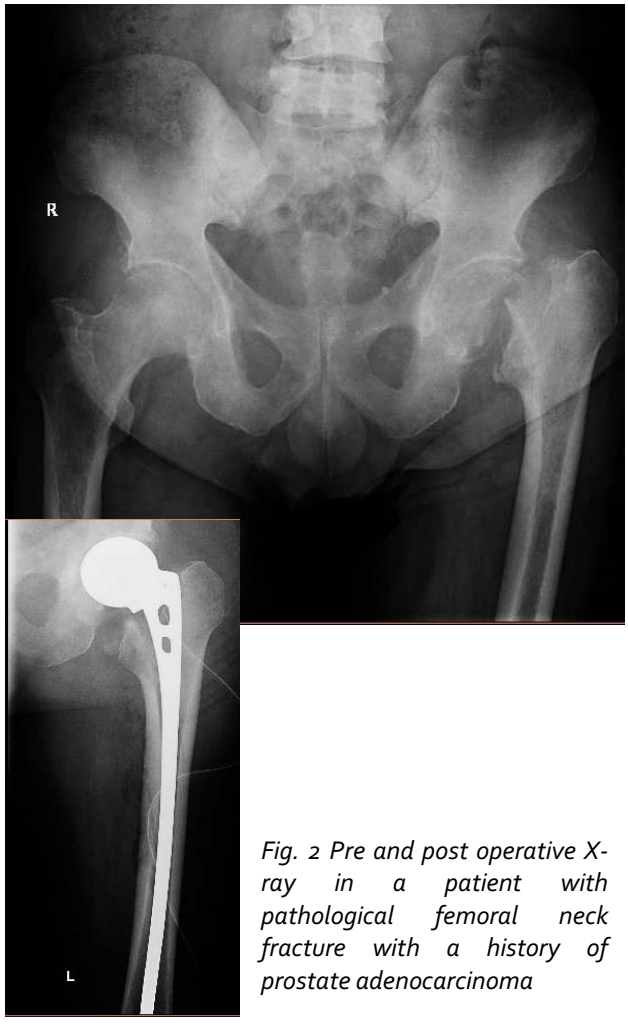

Fig. 2 Pre and post operative X-ray in a patient with pathological femoral neck fracture with a history of prostate adenocarcinoma

Indications for resection and reconstruction using endoprostheses

In patients with multiple bone metastases located in the head or neck of the femur and trochanteric region, but with increased life expectancy, resection and reconstruction using endoprostheses is a viable solution.

This type of implant can be used in the case of metastases involving both the femoral neck and the trochanteric region, ensuring an increased quality of life, with the advantage of allowing immediate post-operative weight bearing and long-term durability [16,17].

In the case of single lesions, this surgery has a curative effect. Many orthopedic surgeons involved in the treatment of oncological musculoskeletal pathology recommend this type of surgery in exchange for osteosynthesis with the centromedullary nail in patients with increased life expectancy [18,19].

In addition to the benefits of this type of surgery, there are several specific complications. A first disadvantage is the prolonged duration of this surgery, with significant blood loss and increased risk of death considering the fragility of a cancer patient. Another disadvantage is related to the anatomical component, considering the numerous muscular insertions at the level of the proximal femur, a situation that can frequently lead to episodes of dislocation of the prostheses [20]. Considering the complexity of the surgery, the infection rate is also higher in this case.

Despite all the complications of resection and reconstruction with endoprostheses, the overall risk and need for revision is similar to centromedullary osteosynthesis and arthroplasty with primary prostheses [21].

In conclusion, the use of endoprostheses in young patients with good clinical and biological status and increased life expectancy is an optimal solution with increased survival, especially in patients with metastatic renal cell carcinoma or multiple myeloma (Fig. 3) [22].

Fig. 3 Pre and post operative X-ray in a patient with multiple myeloma

Discussion

Oncological disease is a complex pathology with significant changes in all organs and systems. The proximal femur remains a preferred site for bone metastases of carcinomas with major implications for quality of life and survival. Given the complexity of oncological pathologies, the therapeutic decision in the case of a patient with secondary bone determinations must be established by a multidisciplinary team comprising the oncologist, orthopedic surgeon, pathologist, anesthetist, and radiotherapist. In determining the surgical indication, the histological degree of the primary tumor, the response to adjuvant therapy, the availability of effective treatments, the number of metastases, the life expectancy for each type of tumor, the biological condition and the healing capacity of the patient must be considered. The goal of surgical treatment is to improve the quality of life, restore motor function and increase survival. The choice of the implant type must consider the complication rate, the complexity of the surgery, the patient's motor recovery capacity, the patient's ability to undergo a new surgery in case of implants with high risk of dislocation or infection and finally, of the patient's preferences.

Conclusions

Surgical management of bone metastatic disease remains a complex topic with many variables still incomplete.

Surgical treatment of symptomatic bone metastases that cause pain and functional impotence with limited patient mobility increases survival and quality of life regardless of the type of surgery and the implant chosen.

The treatment of pathological bone fractures is a priority in the case of the cancer patient and must be performed as soon as possible to avoid all the complications specific to prolonged immobilization in bed.

Patients with increased life expectancy and unique metastases are candidates for resection and reconstruction with endoprostheses.

Most orthopedic surgeons involved in the treatment of metastatic bone disease tend to resect and reconstruct with endoprostheses, but in the end the treatment must be individualized for each patient. There are no clear studies to establish a protocol for the management of this disease. Several comparative studies on the survival and long-term functional outcome of each implant are needed.

Conflict of Interest statement

Authors state no conflict of interest.

Informed Consent and Human and Animal Rights statement

Informed consent has been obtained from all individuals included in this study.

Authorization for the use of human subjects

Ethical approval: The research related to human use complies with all the relevant national regulations, institutional policies, is in accordance with the tenets of the Helsinki Declaration, and has been approved by the review board of University Emergency Hospital of Bucharest, Bucharest, Romania.

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Disclosures

None.

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