METASTATIC FRACTURES OF THE TIBIA

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Pathologic fractures of the tibia due to a metastasis are rare. The treatment of an established fracture is sometimes conservative, but more often surgical. The purpose of the surgical procedure is to improve the quality of life and the ambulatory status, to relieve pain and to facilitate activities of daily living and nursing care. Four cases of operatively managed metastatic fractures of the tibia are presented with emphasis on the surgical technique. The scarce literature on metastatic tibial fractures is reviewed. The operative technique to be used does not only depend on the location of the tumor but also on the primary tumor, the response to adjuvant therapy and the life expectancy. For metastatic shaft fractures an intramedullary nail, sometimes augmented with bone cement, is preferred. For distal or proximal fractures a compound osteosynthesis with plates and screws offers a good solution. In the epiphyseal and metaphyseal region of the tibia an amputation or a tumor prosthesis is the procedure of choice.

Keywords : metastatic fractures ; tibial ; complications ; treatment ; intramedullary nailing.
Mots-clés : fractures sur métastases ; tibia ; complications ; traitement ; enclouage médullaire.

INTRODUCTION

In recent decades therapeutic advances have improved the life expectancy and the quality of life of patients with cancer and metastatic disease. The skeleton is, after the lungs and the liver, the third most frequent site of metastatic carcinoma. Over one third of all primary malignancies have a tendency to disseminate to bone. In the skeleton the most commonly affected part is the axial skeleton (4). The most frequently affected appendicular bone is the femur, followed by the humerus and the tibia (1, 20). Metastatic fractures of the tibia are rarely encountered, and few reports exist on this subject. The most common primary tumors giving rise to bone metastases are prostate, lung and colorectal cancer in men, and breast, lung and colorectal cancer in women (16).

CASE REPORTS

We report four cases of pathological tibial fracture due to metastases and treated in our institution between 1990 and 2000.

Case 1

This lady was 62 years old when she was treated for adenocarcinoma of the breast with mastectomy, chemotherapy and radiotherapy. One year later she developed left-sided below-knee pain. Initial radiographs of the lower extremities were negative. Three months later she sustained a spiral fracture of the tibia while walking. This fracture was treated with an intramedullary nail and bone cement (fig. 1). The canal was reamed to a diameter of 15 mm. Semi-liquid, cooled gentamycin-loaded bone cement was slowly introduced through the

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Fig. 1. — Case 1 : composite fixation of a metastatic fracture of the tibia with an intramedullary nail and methylmethacrylate cement.

proximal entry portal with a cement gun with a long nozzle. A 13-mm locking nail was introduced in the standard fashion. Distal and proximal locking was performed. Radiographs showed some cement leakage at the fracture site. This had no clinical consequences. The patient was able to ambulate from the first postoperative day, without pain. She received additional radiotherapy. She died six months after the operation.

Fig. 2. — Case 2 : compound osteosynthesis of a metastatic fracture of the proximal tibia with bone cement, intramedullary plate and extramedullary plate and screws.

Case 2

This 62-year-old female patient was treated at age 54 for adenocarcinoma of the breast with surgery, chemo- and radiotherapy. She fell off the table while receiving radiotherapy and broke her left humerus, femur, proximal tibia and fibula. At that time she was already bedridden. For her proximal tibial pathological fracture a compound osteosynthesis was performed (fig. 2). Through an anterolateral incision and a cortex window the gross mass of the tumor was removed with a curette. A Dynamic Compression Plate was intro-

Fig. 3. — Case 3 : intramedullary fixation with a multiple locked nail of a diffusely permeating osteolytic metastasis of the tibia with pathological fracture.

duced into the narrow cavity, and a long buttress plate with screws was applied to the anterolateral cortex. Some screws engaged in both plates. Bone cement was applied through the cortical window. The patient remained bedridden and died two months after surgery.

Case 3

This 56-year-old female patient developed pain in her right tibia. Radiographic investigation showed a diffuse osteolytic lesion of the distal tibia and ankle. An open biopsy and further investigations led to the diagnosis of endometrial carcinoma with multiple skeletal and liver metastases. After the biopsy the tibia was treated with a below-knee brace and with radiation therapy. Five months later she sustained a pathologic fracture at the site of the biopsy. This fracture was treated with a reamed multiple locked intramedullary nail (fig. 3). The tip of the nail was removed and extra locking holes were predrilled in two planes to improve fixation in the affected distal part of the tibia. Postoperatively the patient was able to ambulate with crutches ; she received local radiotherapy. She died three months after the intervention.

Fig. 4. — Case 4 : impaction fracture through a solitary metastasis of the tibia after biopsy and early ambulation.

Case 4

This 62-year-old patient complained of a painful swelling of the proximal tibia for about six months.

Plain radiographs, CT scan and MR images showed an expansive hypervascular osteolytic lesion with cortex destruction and periostal reaction. No primary tumor was found, and an incisional biopsy was performed. Histological investigation suggested a renal cell carcinoma. MR images of the left kidney showed a tumor with a diameter of 2.5 cm. No other metastases were found. Wide resection and local reconstruction of the tibia were planned. However the patient put weight on the affected leg two weeks after the biopsy despite our advice and sustained an impaction fracture of the affected tibia. A curative resection was considered to be impossible in this situation (fig. 4). Because of the favorable life expectancy in renal cell carcinoma, and in order to promote rapid ambulation a knee disarticulation was proposed to the patient and performed. Left nephrectomy was performed as well. Six months after the operation the patient is doing fine and uses an external prosthesis without crutches.

DISCUSSION

Prophylactic fixation of impending metastatic fractures of the tibia is generally advocated in cases with significant cortical destruction, pain on weightbearing and lack of improvement after radiotherapy (20). Harrington developed criteria for the identification of impending fractures in long tubular bones (8). Mirels proposed a scoring system depending on the size and site of the lesion, the type of lesion (blastic or lytic) and the degree of pain (14). There are no cases with prophylactic fixation in our series.

If there is only a small risk of fracture in a symptomatic metastasis of the tibia, external immobilization with protective bracing may be all that is needed in addition to radiotherapy and oral bisphosphonates. The tibia, unlike the femur, can be readily braced (1, 6, 12).

This study demonstrates again that there is a higher risk of pathologic fracture after biopsy. A plaster cast should always be applied after biopsy.

Once there is a fracture, there is only a minimal role for conservative treatment. In a study by Leeson *et al.* 100% of metastatic fractures of the appendicular skeleton treated nonoperatively remained ununited (12). External immobilization of these fractures leads to prolonged morbidity, suboptimal pain relief, increased risk of thromboembolic disease and hypercalcemia.

However, there is an indication for nonoperative treatment in cases where surgery is not appropriate. Surgery is contraindicated when the life expectancy of the patient is less than four to six weeks, when his general condition is an obstacle to a safe operation or when there is severe mental deterioration of the patient (3, 4).

In the case of an established metastatic tibial fracture, internal fixation alleviates the patient's discomfort, improves the quality of life, facilitates nursing care and mobilization and increases duration of survival (1, 8). Surgery aims at immediate and lasting stability with weightbearing or functional use, not depending on bone healing, at stabilization of the entire bone and at salvage of as much healthy bone as possible to maintain limb function while minimizing complications and recovery time (3, 6). Often these principles are achieved by integration of bone, methylmethacrylate cement and implant into one solid unit. The decision to use simple or reinforced osteosynthesis is not only dependent on the localization of the fracture, but also on the primary tumor, on its possible response to adjuvant therapy and on the probability of reossification. Capanna *et al.* proposed a scoring system incorporating these criteria, which may help in decision making (4).

For diaphyseal fractures we prefer a reamed, statically locked, intramedullary nail. A nail is preferred by most authors for reasons of smaller surgical exposure, limited blood loss and sound mechanical stabilization of the entire bone (1, 4, 6, 7, 10, 12, 15, 20). Locking is important to prevent telescoping and rotation secondary to tumor progression. The largest diameter possible is recommended since thin rods may fail mechanically and since the device must bear weight for the remaining life of the patient. Reamed nails have not been shown to cause more fatal fat emboli than unreamed nails in the treatment of metastatic disease of the femur (5, 17). However, some authors favor unreamed nailing (7, 17). Local or systemic

tumor cell dissemination by inserting intramedullary rods is not a practical problem or one that has been proven in the treatment of metastatic disease (6).

The use of polymethylmethacrylate bone cement is more controversial (1, 2, 4, 7, 10). On the one hand local tumor progression can lead to hardware failure or stress fractures (20). This is why bone cement may be added to the fixation device to fill larger defects after open intralesional curettage and to reinforce the construction (6). Bone cement may also be injected in a closed fashion into the medullary canal to improve intramedullary fixation (8, 10, 12). This technique was used in one case with good results.

On the other hand a danger of the closed intramedullary cementing technique is the increased intramedullary pressure with increased risk of fat emboli (9). Theoretically this can be reduced by proximal and/or distal venting but this has not been proven in clinical practice (13). Another possible complication of the technique is extramedullary diffusion of cement. Prior injection under pressure of the intramedullary canal with contrast dye may signal possible expansion sites. If these sites are exposed and curetted the defects may be temporarily occluded while the cement is introduced. Some authors think that inflating a sterile pneumatic tourniquet around the lower leg at the level of the osteolytic area during cement injection, will reduce the chance of extrusion of cement (4). Kunec and Lewis described a technique of PMMA injection through a cortical window after visualization of the rod through the window. Another possible application of bone cement is augmentation of the fixation of the proximal and distal locking screws (4). Recently chemotherapeutic agents such as methotrexate have been added to bone cement to destroy remaining tumor cells, to avoid systemic effects and to overcome progressive local bone destruction (11, 19).

Circular bony defects in metastatic shaft fractures may be treated by intercalary prostheses in solitary metastases, or by shortening (4, 18).

In distal or proximal fractures intramedullary fixation becomes more difficult. In most cases curettage and cementing of the juxta-articular defect combined with the application of a buttress plate is the preferred technique. In one case we applied an additional plate into the marrow cavity with some screws penetrating both plates. The technique of two orthogonal, extramedullary plates, although biomechanically more stable, is not favored because of increased surgical soft tissue trauma and associated complications (2). Olerud *et al.* presented a case of a distal intra-articular fracture where the intramedullary nail was intentionally driven down through the talus and calcaneus and augmented with cement (15).

For true epiphyseal or intra-articular fractures knee disarticulation, a below-knee amputation or a tumor prosthesis is indicated (6, 12).

Radical resection of a metastatic deposit should be performed when the patient has a significant chance of extended life expectancy. Solitary plasmocytoma and isolated metastases from renal or thyroid carcinoma are part of this category. Preoperative arteriography and embolization may be helpful in the prevention of excessive hemorrhage. In these cases there is a possibility of curative instead of palliative therapy (1, 3).

In radiosensitive tumors radiotherapy is routinely administered to the entire bone after the operation.

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SAMENVATTING

K. DE GEETER, P. REYNDERS, J. SAMSON, P .L. O. BROOS. Metastatische tibiafrakturen.

Pathologische tibiafrakturen t.g.v. metastasen zijn zeldzaam. De behandeling van deze frakturen is soms conservatief, maar meestal chirurgisch. Het doel van de chirurgische procedure is de kwaliteit van het leven en de mobiliteit te verbeteren, de pijn te verzachten en de dagelijkse aktiviteiten of de verpleegkundige zorgen te vergemakkelijken. Vier gevallen van operatief behandelde metastatische tibiafrakturen worden beschreven met klemtoon op de gebruikte operatietechniek. De beperkte literatuur over dit onderwerp wordt besproken. De toegepaste behandeling verschilt niet alleen naargelang de lokatie van de tumor, maar ook naargelang de repons op adjuverende therapie en de levensexpectantie. Voor metastatische frakturen t.h.v. de tibiashaft wordt een intramedullaire nagel, soms versterkt met intramedullaire botcement, verkozen. Voor distale of proximale frakturen is een gecombineerde osteosynthese met platen, schroeven en botcement een goede oplossing. Voor frakturen t.h.v. de epi- of meta fysaire regio moet soms het plaatsen van een tumorprothese of een amputatie worden voorgesteld.

RÉSUMÉ

K. DE GEETER, P. REYNDERS, J. SAMSON, P. L. O. BROOS. Fractures sur métastases du tibia.

Les fractures pathologiques du tibia sur métastase sont rares. Le traitement est parfois conservateur, mais dans la majorité des cas chirurgical. Le but du traitement chirurgical est d'améliorer la qualité de vie et la mobilité, de soulager la douleur et de faciliter les soins et la fonction. Nous rapportons quatre cas de fracture métastatique du tibia en détaillant la technique chirurgicale utilisée. La littérature sur ce sujet est discutée. Le choix de la technique ne dépend pas seulement de la localisation de la tumeur, mais aussi de la tumeur primitive, de la réponse au traitement adjuvant et de l' espérance de vie. Dans les fractures métastatiques diaphysaires, un clou alésé et verrouillé, dans certains cas associé à du ciment acrylique, est proposé. Pour les fractures distales et proximales la fixation par vis-plaque et ciment est une bonne solution. Pour certaines fractures de la région épiphyso-métaphysaire, une amputation ou une prothèse sont indiquées.