

Surgical Treatment of Pathologic Fractures in Patients with Metastatic Tumors

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ABSTRACT

The study presents results in treatment of pathologic fractures of long bones of all patients who underwent surgery in the last 10 years in our hospital. The study cohort comprised 133 consecutive patients divided in two groups who underwent surgery of long bone fractures caused by metastatic tumor or trauma. We used resection, open reduction and plating with bone cement application for pathologic fracture and some cases of femoral shaft fractures were stabilized with intramedullary nailing. Proximal femoral fractures were treated with hip arthroplasty or dynamic hip screw. There were 2 amputations performed: one case of pathologic fracture of tibia and one case of humeral fracture. The present study compares results between two group of patients. We noted: age, gender, fracture site, choice of the surgical procedure, hospital stay, need for analgesia after surgery, postoperative complications, and reached level of physical activity after surgery. The mean survival rate was 8.1 months. Seventeen patients experienced postoperative complications. We also found statistically significant improvement in functional scores (MSTS and TESS) in surgically treated patients with pathologic fractures. There are many different techniques of surgical treatment of pathologic fractures caused by skeletal metastases including arthroplasty or a combination of internal fixation combined with polymethyl methacrylate (PMMA) that provides immediate fixation and stability. The present study showed that surgical treatment of pathologic fractures caused by skeletal metastases in vast majority of cases provides bone healing after pathologic fracture, with significant improvement of physical activity and rehabilitation in the investigated group.

Key words: surgical treatment, pathologic fractures, skeletal metastases

Introduction

Prolonged life expectancy and increased incidence of different site tumors are a noticeable feature of the developed countries¹. Malignant diseases are the second most common disease category regarding incidence and mortality².

The bone presents one of the most common sites of metastatic occurrence³. Skeletal metastases cause serious clinical problems in patients with cancer, usually severe pain and functional disability⁴. Secondary tumors interfere with metabolism and biomechanics of the bone causing pathologic fractures^{5,6} (Figure 1 and 2). The majority

of studies advocate surgery as an effective palliation method in bone metastases. It spares the patients of cast and probably improves quality of life. The successful surgical treatment of pathologic fractures caused by metastatic tumors is considered if there is a significant pain level decrease as well as satisfactory restoration of the functional status⁷.

The present study analyze results in surgical treatment of pathologic fractures and reached level of physical activity of patients with skeletal metastases in comparison with patients with trauma sustained fractures of a long bones.



Fig. 1. Pathological fractures of humerus. Pre-operative and post-operative.

Patients and Methods

The study cohort comprised 133 consecutive patients who underwent surgery of long bone fractures caused by metastatic tumor or trauma. There were two groups of patients: tumor group included 67 patients (male n=23, female n=44) and non-tumor group included 66 patients (male n=23, female n=43), with an average age 73 years. The patients in tumor group underwent surgery of pathologic fractures of following long bones: femur (58 cases), humerus (8 cases) and tibia (1 case). The non-tumor, control group consisted of patients with femoral (58 cases) and humeral fractures (8 cases).

All patients were treated at the Department of Orthopaedic and Trauma Surgery, University Hospital »Sestre milosrdnice«, Zagreb, Croatia in the ten year period. Both groups of patients underwent a bone scan preoperatively to evaluate bone density of the remaining skeleton,



Fig. 2. Pathological fractures of femur (pre-operative).

TABLE 1
PRIMARY TUMOR DISTRIBUTIONS IN TUMOR GROUP OF PATIENTS

Primary tumor site	Number of patients (n)	Percentage (%)
Lung	24	35.8
Breast	19	28.4
Kidney	11	16.5
Prostate	8	11.9
Colorectal	3	4.5
Bladder	2	2.9
Total	67	100

and to avoid pathological fractures caused by occult skeletal metastasis. The following surgical procedures were employed in both groups: plating n=90, intramedullary nailing n=14, hip hemiarthroplasty n=15, dynamic hip screw n=8, total hip arthroplasty n=4, amputation n=2 (Table 2). In all cases we used the combination of internal fixation or arthroplasty and bone cement. After opening the fracture site, we performed curettage of the metastatic tumor, filled the bone defect and medullar canal with bone cement and finally reduction and standard plating. In some cases of shaft pathologic fracture we employed intramedullary nailing with open approach, tumor resection and reduction with gap filling with bone cement. We employed hip replacement if there is significant bone loss caused by osteolytic effect of the metastatic tumor progression. All procedures were performed by three staff orthopaedic surgeons. After surgical treatment patients received postoperative radiotherapy to prevent possible local recurrence of the tumor.

We noted: age, gender, fracture site, choice of the surgical procedure, postoperative complications, hospital stay, need for analgesia after surgery and reached level of physical activity after surgery. The final function and activity of tumor group was evaluated according to the Musculoskeletal Tumor Society (MSTS) score and the Toronto Extremity Salvage Score (TESS). All patients, both with pathologic and traumatic fractures, were invited for follow-up examinations, along with radiographs of affected limb on 1st postoperative day, than 6 weeks, 3 months, and 1year after surgery or until patient's death.

TABLE 2
SURGICAL PROCEDURES EMPLOYED IN BOTH GROUPS

Procedure	Tumor group (n)	Non-tumor (n)	Total
Plating	45	45	90
Intramedullary nailing	7	7	14
Hip hemiarthroplasty	7	8	15
Dynamic hip screw	4	4	8
Total hip arthroplasty	2	2	4
Amputation	2	0	2
Total	67	66	133

The data were tested for significance using the two-tailed unpaired Student's *t*-test and beta coefficients less than 0.05 was considered statistically significant.

Results

The mean hospital stay was similar between the two groups of patients: 8.2±2.0 days for tumor group and 7.4±1.5 for non-tumor group ($p=0.07$), and as such, was considered to be not statistically significant. Local and systemic complications after surgery appeared in 17 patients: 12 tumor and 5 non-tumor patients.

Six patients in tumor group required reoperation: 3 cases of fixation failure, 2 cases of aseptic loosening of the hip endoprosthesis and 1 case of deep wound infection. The average survival rate was 7.8 months. We found statistically significant difference in duration of analgesic therapy between two group of patients, $p=0.03$ (tumor group 6.5±1.1 days and non-tumor group 5.9±1.0). We noted statistically significant progression in functional recovery of surgically treated patients with pathological fractures. The MSTS increased from 11.9±1.8 at 6 weeks to 16.2±1.1 at 3 months postoperatively ($p=0.0001$). We also found statistically significant increase in TESS from 49.7±19.2 at six weeks to 60.7±20.1 three months after surgery ($p=0.0001$).

Discussion

Management of skeletal metastases remains a topical issue due to poor long term results despite the number of different treatment protocols proposed by numerous authors.

There are some major disadvantages in surgical treatment of pathologic fractures caused with metastatic disease including overall deterioration and synchronous metastatic lesions. Bone metastases are the result of hematogenous dissemination of tumor cells and surgical treatment of pathologic fractures of limb bones is exclusively palliative. The goals of the surgical treatment are well known and include: relieving pain, assessing histo-

logical diagnosis, fracture fixation and restoration of the function with intention of an early ambulation and quality of life improvement. Demographic data presented in this study showed a higher number of female patients in both investigated groups.

The vast majority of authors report similar findings^{8,9}. The following factors may contribute to this demographic distribution: bone metastases are the most frequently caused by breast cancer, incidence vary between 30% and 50%. Patients with primary breast carcinoma have higher survival rate but increased risk for bone metastases occurrence^{10,11}. The majority of cases had pathologic humeral fracture (n=58) and only 8 patients sustained humeral fracture, this incidence of the site of the pathologic fracture is supported by other authors^{3,8}. The numerous authors consider that intramedullary nailing should be method of choice for femoral and humeral shaft fractures, as well as arthroplasty for proximal femoral fractures^{12–15}. In the present study the choice of surgical procedure mainly depended on the fracture site, number of metastases, a tumor local progression and general health condition of the patients. Seventeen patients experienced postoperative complications during postoperative period. We found 5 cases in tumor-group with local postoperative complications requiring reoperation because of loosening and dislocation of the hip replacement or loss of fixation at the fracture site. All of 2 cases of hip arthroplasty dislocation as well as 2 cases of DHS and 1 case of femoral shaft fracture managed with plating combined with resection and bone cement were caused by local recurrence of a tumor, regardless postoperative chemo and radiotherapy. One patient in tumor group had transitory radial nerve palsy after fixation of the humeral shaft fracture which was fully recovered. There was also one case of deep wound infection in each group required revision surgery. One patient from each group died in the early postoperative period. The other systemic complications were moderate in nature and successfully treated conservatively with cooperation with different specialists. The other authors notify similar complication rates^{8,16–18}. We found significant improvement in recovery and physical activity using MSTS and TESS scoring system in surgically treated patients with pathologic fractures. These findings are comparable to those reported by authors and confirm results found in the literature^{19–21}. Patients in tumor group received analgetics longer period of time in comparison with patients in other group. The possible causes that could contribute to prolonged perioperative pain in patients with pathologic fractures might be addition of pain caused by primary tumor or multiple skeletal metastases. Talbot and many other authors support this observation as well as favorably results in relieving pain in surgically treated patients^{18,19,22}. A proper surgical procedure resulted in satisfactory local tumor control and vast majority of patients in tumor group (96.4%) achieved ambulation within few weeks after surgery.

We found tumor recurrence rate among patient cohort to be acceptable (7.5%) and comparable to those re-

TABLE 3
COMPLICATIONS AFTER SURGERY OBSERVED IN BOTH GROUPS OF PATIENTS

Complications	Tumor group (n)	Non-tumor (n)	Total
Dislocation of arthroplasty	2	0	2
Fixation failure	3	1	4
Nerve palsy	1	0	1
Wound infection	1	1	2
Pneumonia	1	2	3
Deep vein thrombosis	2	0	2
Stroke	1	0	1
Death	1	1	2
Total	12	5	17

ported by other authors²³. In conclusion, in spite of short life expectancy we believe that surgery is an effective tool for restoration of limb function and improvement of pa-

tients life quality with pathologic fractures caused by skeletal metastases.

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KIRURŠKO LIJEČENJE PATOLOŠKIH FRAKTURA U PACIJENATA SA METASTATSKIM TUMORIMA

SAŽETAK

Zahvaljajući napretku u liječenju malignih bolesti a prema tome i produljenom očekivanom preživljenju zamijećuje se veća pojavnost koštanih metastaza. Koštane metastaze su posljedica hematogene diseminacije tumorskih stanica, a kirurško liječenje je još uvijek isključivo palijativnog karaktera. Ova studija je rezultat desetogodišnjeg praćenja rezultata liječenja patoloških prijeloma dugih kostiju na našoj Klinici. U studiji su komparirane dvije skupine pacijenata koji su podvrgnuti kirurškom liječenju prijeloma dugih kostiju radi metastaza ili traume. Izbor operacijske metode je ovisio o lokalizaciji, broju metastaza i lokalnoj tumorskoj progresiji. Kod liječenja patološkog prijeloma učinjena je resekcija, otvorena repozicija te osteosinteza pločicom u kombinaciji sa koštanim cementom a određeni broj slučajeva prijeloma dijafize bedrene kosti je zbrinut endomedularnom osteosintezom. Prijelomi proksimalnog okrajka bedrene kosti su zbrinuti artroplastikom ili dinamičkim vijkom za kuk. Kod jednog slučaja patološkog prijeloma tibije i humerusa učinjena je amputacija. U studiji se uspoređuju rezultati dvije skupine pacijenata. Tumorsku skupinu čini 67 pacijenata sa manifestnim patološkim prijelomom dugih kostiju a ne-tumorsku skupinu čini 66 pacijenata sa traumatskim prijelomom. U studiji se prate demografski čimbenici (dob i spol), operacijska metoda, duljina hospitalizacije i analgezija, poslijeoperacijske komplikacije te postignuta razina rehabilitacije i funkcije ekstremiteta. U sklopu praćenja pacijenti su podvrgnuti redovitim kliničkim kao i radiološkim kontrolama prvi poslijeoperacijski dan, šest tjedana kasnije, tri mjeseca i godinu dana nakon operacije ili do smrti pacijenta. Za evaluaciju funkcionalnog statusa koristili smo: Musculoskeletal Tumor Society sustav verzija 1993 i Toronto Extremity Salvage Score. Za evaluaciju dobivenih rezultata koristili smo se odgovarajućom statističkom analizom (two-tailed unpaired Student's t-test), a β koeficijent veći od 0,05 smo smatrali statistički značajnim. Prosječna duljina hospitalizacije nije se bitno razlikovala među ispitanicima u dvije skupine. Prosječna duljina preživljenja je bila 8,1 mjesec. Sedamnaest pacijenata je imalo neku od poslijeoperacijskih komplikacija. Nađen je također statistički značajan napredak u funkcionalnom statusu kirurški liječenih pacijenata sa patološkim prijelomima. Patološki prijelomi prouzročeni koštanim metastazama predstavljaju jasnu indikaciju za kirurško liječenje jer kost prožeta tumorskim tkivom gotovo nikada ne cijeli bez kirurške stabilizacije. Ciljevi stabilizacije su smanjiti bol, poboljšati funkciju, poboljšati njegu pacijenta i kvalitetu preostalog života. Postoji više različitih operacijskih metoda uključujući artroplastiku kao i kombinacije unutarnje fiksacije i košanog cementa koji osigurava trenutačnu solidnu stabilnost. Nakon završenog cijeljenja rane potrebno je provesti sukcesivno radioterapijsko liječenje koje će omogućiti cijeljenje te suzbijanje lokalnog recidiva. Ova studija dokazuje da u najvećem broju kirurški liječenih pacijenata dolazi do cijeljenja patološkog prijeloma kao i do značajnog poboljšanja funkcionalnog statusa.