T - Functional outcome MBD

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Submission date: 21-Jun-2024 09:31AM (UTC+0700)
Submission ID: 2402377017
File name: Functional_outcome_MBD.docx (258.16K)
Word count: 3096
Character count: 17144

Functional Outcome and Survival Rate of Metastatic Bone Disease On Femur and Pelvic Bone After Surgical Treatment

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Abstract

Introduction. Most groups of cancers that often metastasize to bone invariably induce pathological fractures. Between 9-29% of patients with metastases will have a pathological fracture and 90% of fractures require surgery. Fractures on pathologic bone have a major impact on life quality.

Methods. Between 2013 - 2017, 30 patients with metastatic tumors on the femur and pelvic were treated at Cipto Mangunkusomo Hospital. Basic patients' medical records were analyzed, with particular focus on the cancer type, age, gender, tumor site, mechanism of fracture, treatment type, survival rate (Kaplan Meier test), and functional outcome (MSTS score).

Results. Eleven patients were male and nineteen patients were female. The mean age was 56 ± 7 years. The MSTS score was *excellent* in **10** (33.3%), *moderate* in **4** (13.3%), and *poor* in **4** (13.3%). The tumor located in the shaft femur and treated by ORIF had the highest mean MSTS score. Slipped was the most common mechanism of injury due to pathological fracture. The mean survival time of metastatic bone from the four most common tumor origin were 6 months (lung), 4.33 months (multiple myeloma) 18.75 months (thyroid), and 20.33 months (breast). The data were then analyzed using the Kaplan-Meier method and Log Rank (Mantel-Cox) test. From this data, the equality of survival distribution using the Log Rank (Mantel-Cox) test was calculated, and found that the P value was 0.003. It means that there is a significant difference between survival rate and tumor origin.

Conclusions. Pathologic fractures in patients with metastatic cancer needed a combination of surgical and oncological treatment. Patients were treated surgically, and most of them have an excellent functional outcome. The survival rate varied, based on cancer type.

Keywords: Metastatic bone disease, femur & pelvic bone, functional outcome, survival

Introduction

Bone is the most frequent site of metastatic disease. The sites most commonly affected are the spine, the pelvic bones, the proximal part of the femur, and the humerus.[1-3] Approximately, 70% of patients who die of breast or prostate cancer have also had bone metastases. Thyroid, lung, and kidney cancers also have a propensity to involve the skeleton.[1] Carcinoma penis spread

to bones is uncommon.[4] Most cancer groups that often metastasize to bone such as breast, lung, and kidney cancer invariably induce osteolytic lesions.[5] Approximately, 30-65% of patients with metastatic lung cancers will develop bone metastases, as will approximately 47% of patients with advanced thyroid cancer and 30% of patients with advanced renal carcinoma. 9-29% of patients with metastases will have a pathological fracture and 90% of fractures require surgery. Fractures on pathologic bone have major impact on life quality.[1, 6, 7]

Pathological fracture of the proximal femur is the main cause of loss the mobile ability in cancer survivors.[8] Metastatic lesions located in the proximal femur are particularly frequent. About 10% of patients with primary malignant tumors will develop metastasis of the proximal femur. Among femur metastatic tumors, 50% of the lesions occur in the femoral neck, 30% occur in the sub-trochanteric site, and 20% occur in the intertrochanteric site. This is related to the well-developed vascular system in the intertrochanteric area. Most frequently bone metastases are derived from breast, kidney, thyroid, and prostate cancer, or myeloma. Besides prostate cancer, most metastases are lytic or mixed, and thus patients are at a high risk of pathological fractures.[9-11]

Massive metastases to the pelvis, especially to the periacetabular area, are still a difficult treatment problem. They inhibit patients' walking independently, thus forcing the necessity to use crutches or a walking frame.[2] Ideally, operative treatment should allow immediate weight bearing with the least possible morbidity. The goals of surgery are to achieve local tumor control and structural stability to restore function as soon as possible.[12]

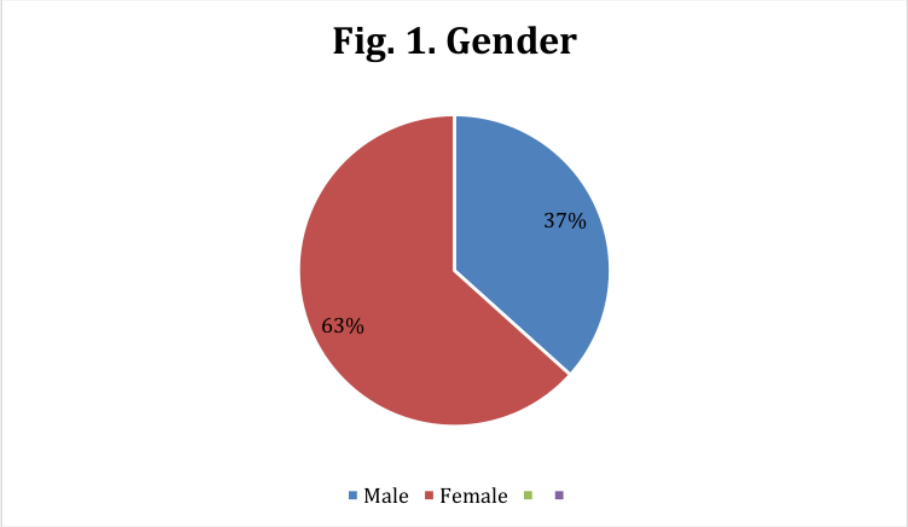
This research aims to describe metastatic bone disease on the femur and pelvic bone, including cancer type, age, gender, tumor site, mechanism induced fracture, treatment type, survival rate, and functional outcome.

Methods

Between 2013 - 2017, 30 patients with a metastatic tumor on the femur and pelvic were treated at Cipto Mangunkusomo Hospital. Basic patients' medical records were analyzed, with particular focus on the cancer type, age, gender, tumor site, mechanism induced fracture, treatment type, survival rate, and functional outcome. To determine patients' functional outcomes, MSTS scores were used. We used The Kaplan Meier test method to determine the survival rate.

Result

Based on demographic characteristics, eleven patients were male and nineteen patients were female (Fig 1). The mean age was 56 ± 7 years (Fig 2). The mean MSTS score was 24.11 ± 5.54. The MSTS was further classified into several groups. *Excellent* was defined as 75-100% of the total score, *good* as 70-74% of the total score, *moderate* as 60-69%, *fair* as 50-59%, and *poor* as <50%. The MSTS score was **excellent** in **10** (33.3%), **moderate** in **4** (13.3%), and **poor** in **4** (13.3%).

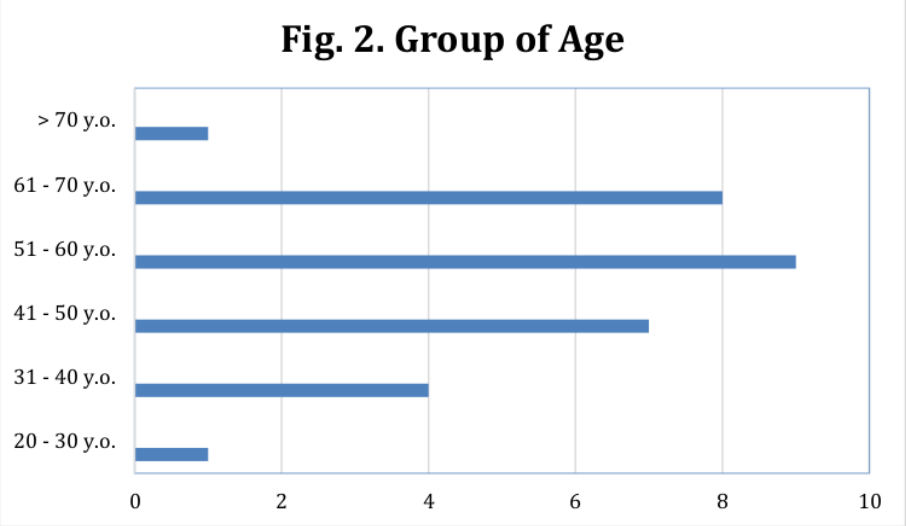


The MSTS score was analyzed between the male and female groups. 20 patients underwent surgical treatment, but two patients had been drop out due to death after surgery. The mean MSTS score in the male group was 25.28 whereas in the female group was 23.36. The mean difference between the two groups was 1.92, 95% CI (-3.84-7.68). There was no significant difference in MSTS scores in male and female groups (p=0.49) [Tabel 1].

Table 1. Comparison of MSTS Score Between Gender Group

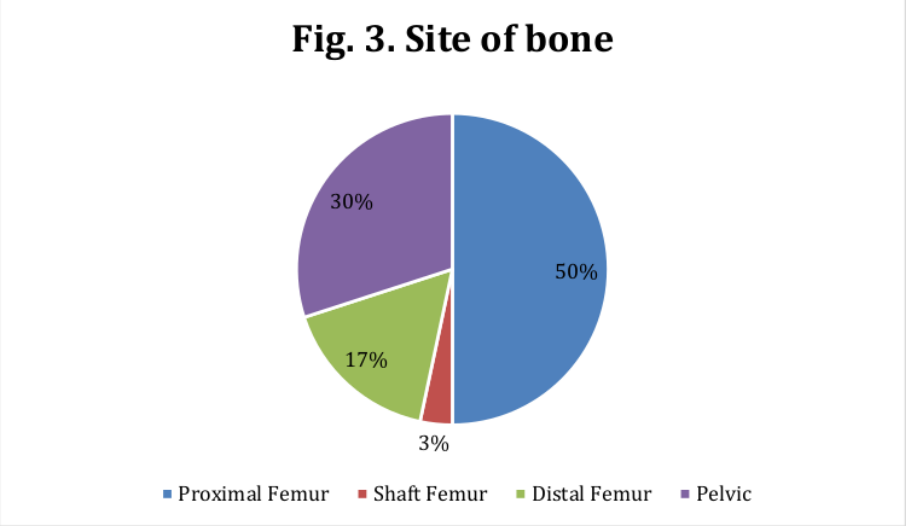
Gender	Mean MSTS Score	p	95% CI
Male	25.28 ± 4.95	0.49	1.92 (-3.84 – 7.68)
Female	23.36 ± 5.98		

The distribution of the patient was based on the group of age as below (Fig. 2). The age group between 51 – 60 years old was most frequent.



The MSTS score was analyzed based on age group. There was no statistical difference in MSTS scores between different age groups (p=0.25).

The site of bone that metastasized by cancer is as below (Fig. 3). Most metastatic bone disease was spread to the proximal femur bone.



The tumor site of bone metastatic disease is pelvic, proximal femur, distal femur, and shaft femur. The tumor located in the shaft femur had the highest

mean MSTS score (Tabel 2). However, there was no statistical difference in MSTS scores between tumor site groups (p=0.75).

Table 2. Comparison of MSTS Score Based on Tumor Site

Tumor Site	Mean Score	p
Pelvic	21.00	0.75
Proximal femur	23.54 ± 5.73	
Distal femur	25.00 ± 6.16	
Shaft femur	29.00	

The distribution of patients is based on the origin of cancer as below (Fig. 4). The most tumor origin was from lung cancer. The MSTS score was analyzed based on tumor origin (Tabel 3). There was no statistical difference in MSTS score between the tumor origin group (p=0.25).

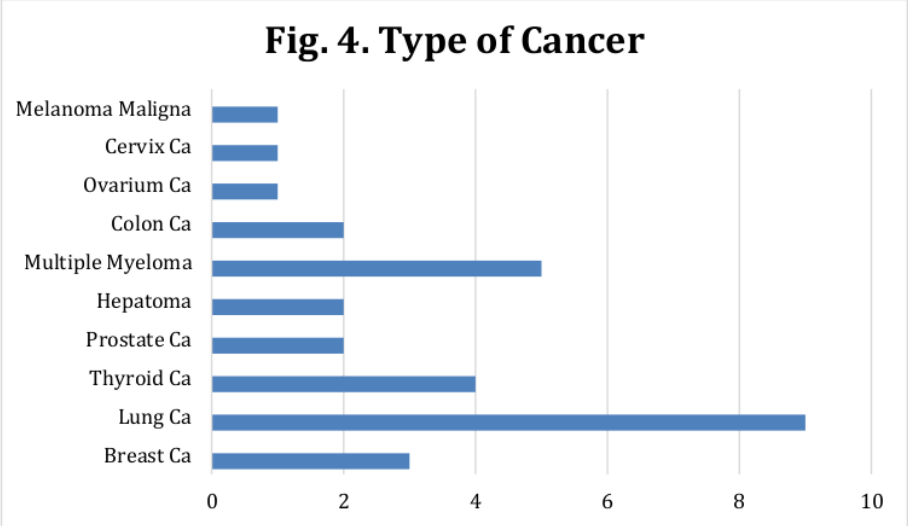
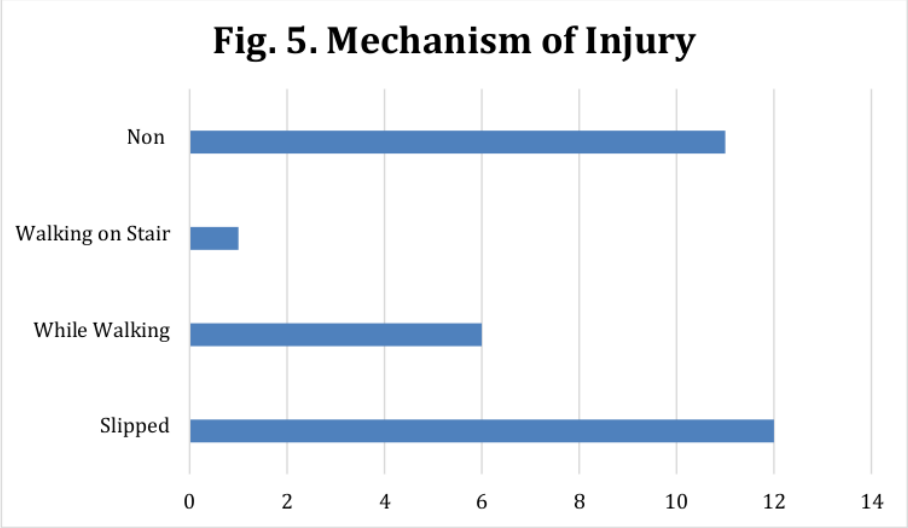


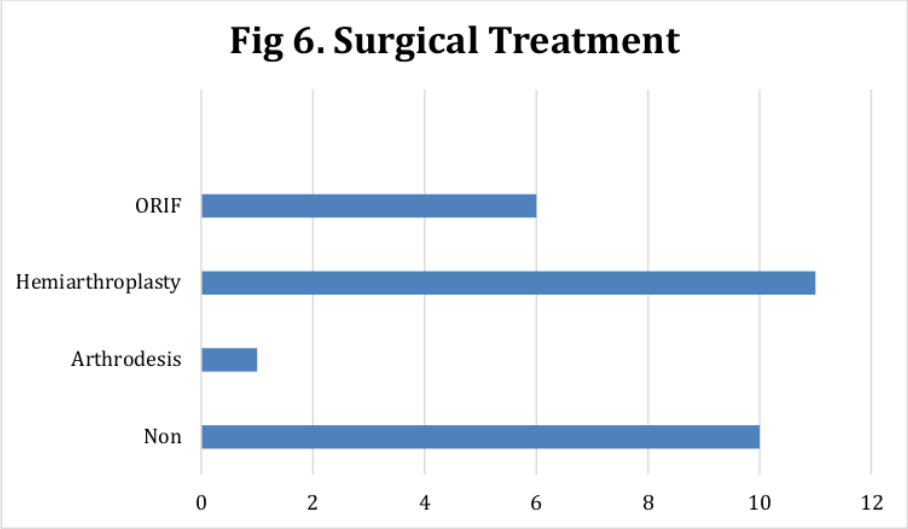
Table 3. Comparison of MSTS Score based on tumor origin

Tumor Origin	Mean MSTS Score	p
Lung	23.33	0.25
Thyroid	28.00	
Breast	24.33	
Multiple Myeloma	23.00	
Prostate	21.00	
Hepatoma	27.00	
Colon	29.00	
Melanoma	29.00	
Cervix	17.00	

The distribution of patients based on mechanism injury due to fracture as below (Fig. 5). Slipped was the most common mechanism of injury due to pathological fracture.



The distribution of patients based on treatment is as below (Fig. 6). Most of the patients were treated by hemiarthroplasty.



The surgical treatment of femur and pelvic metastatic bone disease is hemiarthroplasty, arthrodesis, or open reduction internal fixation (ORIF). The group treated with ORIF had the highest mean MSTS score. However, based on statistical analysis, there was no difference in MSTS score between surgical treatment groups (p=0.66) [Tabel 4].

Table 4. Comparison of MSTS Score Based on Surgical Treatment

Treatment	Mean Score	p
Hemiarthroplasty	23.54 ± 5.73	0.66
Arthrodesis	23.00	
ORIF	25.60 ± 2.3	

This study used The Kaplan Meier test method to determine the survival rate. The censored patient could be defined as the patient who underwent loss of follow-up or was still alive during the collecting data process. Time was in months, while the cumulative survival of 1 means alive and 0 means event of death. Based on the result, the mean survival rate of Femur and Pelvic Metastatic Bone Disease was 11.23 months.

Most femur and pelvic bone metastatic are derived from lung, breast, thyroid, prostate, liver, or myeloma. The survival data could be seen in the following tables 4 & 5:

Table 4. Summary of Remission Status of Femur & Pelvic Metastatic Bone Disease Based on Tumor Origin

Tumor Origin	Total N	N of Events	Censored	
			N	Percent
Lung	9	9	0	0%
Thyroid	4	4	0	0%
Breast	3	2	0	0%
Multiple Myeloma	3	3	0	0%
Prostate	2	2	0	0%
Hepar	2	2	0	0%
Colon	1	1	0	0%
Ovarium	1	1	0	0%
Cervix	1	1	0	0%
Overall	26	26	0	0%

Table 5. Mean of survival time of Pelvic Metastatic Bone Disease Based on Tumor Origin

	Mean		95% Confidence Interval
	Estimate	Standard error	
Lung	6.00	0.60	2.68 – 20.32
Thyroid	18.75	5.04	4.82 – 7.17
Breast	20.33	2.02	8.87 – 28.62
Multiple Myeloma	4.33	1.66	0 – 23.24
Prostate	11.50	4.50	1.06 – 7.60
Hepar	10.50	6.50	26.00 – 26.00
Colon	26.00	0.00	16.35 – 24.30
Ovarium	14.00	0.00	14.00 – 14.00
Cervix	5.00	0.00	5.00 – 5.00

The four most common tumor origins of the femur and pelvic metastatic bone disease were lung, multiple myeloma, thyroid, and breast. The mean survival time for each group based on tumor origin was computed. The mean survival time of metastatic bone from the four most common tumor origin were 6 months (lung), 4.33 months (multiple myeloma) 18.75 months (thyroid), and 20.33 months (breast). The data were then analyzed with the Kaplan-Meier method and Log Rank (Mantel-Cox) test. From this data, the equality of survival distribution using the Log Rank (Mantel-Cox) test was calculated, and found that the P value was 0.003. It means that there is a significant difference between survival rate and tumor origin.

Discussion

Pathologic fractures in patients with metastatic cancer of the breast, prostate, lung, multiple myeloma, bladder, thyroid, kidney, and other primary carcinomas with skeletal involvement are a common problem in clinical orthopedic. Metastatic lesions can be lytic, blastic, or a mixed type, whereas the majority of all metastatic lesions are lytic and these lesions have the highest impact on bone strength, which causes pathological fractures. Pathological fractures of the femur mostly occur during daily activities, such as starting to walk, standing, raising from a chair or bed, or stair climbing.[13, 14] In this research, slipping while walking was the most mechanism-induced pathological fracture.

Most patients with bone metastases need a combination of surgical and oncological treatment. The disease is associated with the general bad condition, pain, reduced mobility, walking and working disability, and problems with independent functioning.[9, 15] Orthopedic treatment for the metastatic bone disease of the extremities may be prophylactic to prevent a fracture or to stabilize a fracture that has occurred. Surgical resection of primary tumors or metastatic lesions of the proximal femur can result in large bone and soft tissue resections. Surgical treatment of pelvic bone tumors continues to pose a challenge to the orthopedic oncology community. Traditionally, pelvic tumors were resected through hindquarter amputation. The surgical procedure choice is associated with detrimental cosmetic, physical, and psychological outcomes. At present, the majority of patients can be treated with limb-salvaging internal hemipelvectomies.[16-19]

Stabilization of a fracture or prevention of an impending fracture usually requires internal fixation devices such as plates and screws or intramedullary rods. Sometimes, partial or complete bone replacement is required to help a patient return to their premorbid functional state. Orthopedic treatment for metastatic bone disease aims to alleviate pain and increase mobility and functional independence in a metastatic condition.[16-18, 20, 21]

In this research, patients were treated surgically, and most of them have an excellent functional outcomes. But, a few of them have a poor functional outcome, which may be due to bad performance before undergoing surgery or progression of cancer disease. The research by Guzik et al showed surgical treatment for proximal femur bone metastases is particularly good in patients after standard or modular endoprostheses replacement.[9, 22]

Over the past 20 years, the combination of improved systemic therapies, high-resolution cross-sectional imaging modalities, and evolving technological advances in orthopedic implant design has afforded greater opportunity for limb

salvage after the oncological resection of malignant bone neoplasms.[23] Cancer mortalities are determined by individual characteristics and behaviors. Several cancer incidences and mortality studies in European countries have implied that there is wide variation among geographic areas because of various exposures to risk factors such as air pollution, occupational exposures, education, and differences in lifestyle.[24] In this research, the mean survival time of metastatic bone from the four most common tumor origin were 6 months (lung), 4.33 months (multiple myeloma), 18.75 months (thyroid), and 20.33 months (breast). Lung cancer research in Korea showed the median survival time at which half the patients were expected to be alive was 12.4 months with a 95% confidence interval (CI) (11.3–13.8 months).[24] Multicenter study in German, collecting data on thyroid cancer between 2000 – 2015, stage-dependent OS at 6 months was 78, 54%, and 18% for stage IVA, B, and C, respectively, 29% of patients survived >1 year.[25] Study about metastatic bone breast cancer in Japan showed that the median OS and 5-year survival rates were 60.0 months and 50.0% (95% CI: 48.8–71.3 months), respectively. In Denmark, the median OS and 5-year survival rates were 17 months and 23%, respectively.[26]

Conclusion

Pathologic fractures in patients with metastatic cancer need a combination of surgical and oncological treatment. Orthopedic treatment for metastatic bone disease aims to alleviate pain and increase mobility and functional independence in a metastatic condition. Patients were treated surgically, and most of them have excellent functional outcomes. The survival rate varied, depending on the cancer type.

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