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Distal femur endoprosthesis for pathological femur fractures: A multidisciplinary approach to management

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Abstract

Background: There are a variety of approaches to the treatment of bony metastases. Surgery is typically reserved for lesions which have a high risk of fracture, or established pathological fractures.

Case Report: We present the case of an 81-year-old woman initially diagnosed with a pathological fracture of her distal femur. Fixation was performed as guided by patient goals, but she subsequently encountered debilitating progression of the tumour burden at the site of pathological fracture. An en-bloc resection was later performed with implantation of a distal femur mega prosthesis. This was combined with radiotherapy followed by immunotherapy to significant functional benefit and systemic response.

Conclusions: This case highlights the importance of the cancer multidisciplinary team approach, which allows for a more personalised approach as improvements with systemic anti-cancer therapies are seeing prolonged remissions. As such, there must be consideration of surgical options to treat bony metastases that can restore quality of life in the medium to long term, beyond just palliative measures.

Keywords: Distal femur endoprosthesis, pathological femur, management

Introduction

In solid tumours, bone metastases are one of the most common sites of distant spread of disease^[1]. There are a variety of approaches to the treatment of these lesions ranging from systemic therapies including chemo/immunotherapy or targeted therapies, complemented by anti-resorptive therapies including RANK-ligand inhibitors or local approaches such as radiotherapy or surgery. Surgery is typically reserved for lesions which have a high risk of fracture as guided by Mirel's criteria, or established fracture^[2].

We present the case of a patient with a pathological femur fracture, who initially was treated with an intramedullary nail due to her poor prognosis. However, subsequent management and her significant functional improvement has highlighted the importance of the cancer multidisciplinary team (MDT) approach. This allows for a more personalised optimal approach as improvements with systemic anti-cancer therapies are seeing prolonged remissions occurring, optimistically shifting the paradigm of care.

Case Report

Herein we present a case of a Caucasian woman aged 81 years who presented to the emergency department after a mechanical fall. She reported a six-week history of gradually worsening right leg pain and difficulty with weight bearing. On admission, X-ray and CT of her hip and femur were performed demonstrating a minimally displaced transverse fracture of the right distal femoral shaft. The appearance was unusual, with a demineralised and moth-eaten appearance highly suspicious of a pathological process (Figure 1). Nine years prior to this admission she had been diagnosed with ovarian cancer which had been treated with total hysterectomy and adjuvant curative-intent carboplatin and paclitaxel chemotherapy as the gold-standard of care. No disease recurrence had been identified on routine active surveillance to 5-years and her Ca125 tumour marker on admission to hospital was within normal range.

Past medical history included type 2 diabetes and osteoporosis which had been managed respectively with metformin 500mg/day and zoledronic acid (5 mg annually). At presentation she lived alone, widowed, and a retired medical receptionist.

There was no history of smoking or excessive drinking. Prior to this admission, she was independent with all activity of daily living, exercised and was well supported by her adult children. Prior to surgery she received a CT of the remainder of her body and whole femur. This revealed an irregular left lower lobe mass with satellite nodules suspicious of a primary lung malignancy. There was an extended discussion with the patient regarding treatment options, and given the prognosis and desire for the patient to mobilise as soon as possible, a right femoral nail was inserted. Tissue samples from the reaming were taken during the procedure for analysis, demonstrating scant carcinoma cells which were insufficient in number to allow for meaningful immunohistochemical staining, however confirmed a malignant process. Subsequent FDG-PET scan demonstrated high FDG avidity within the postoperative site and distal femur, but no other apparent bone lesions. An endobronchial ultrasound and biopsy of the lesion identified a poorly differentiated TTF1+ non-small cell carcinoma of sarcomatoid differentiation (PDL-1 >90%). Standard of care hot spot molecular testing analysis for molecular markers *EGFR*, *ALK*, *ROS1*, *KRAS* and *BRAF* were negative. Being a life-long non-smoker, Mrs H's case would be expected to be enriched to harbour an oncogene. Therefore, an attempt was made to perform complex-genomic profiling, however her sample yielded insufficient DNA sample for further sequencing.

A multi-disciplinary team approach was implemented early in the treatment of this patient. This included the oncological and surgical specialists and allied health expert team. Systemically, given her high PDL-1 status, and elevated but borderline performance status, she was commenced on single agent pembrolizumab (PD-1 checkpoint inhibitor immunotherapy). Pembrolizumab was given intravenously on a three-weekly basis and has demonstrated superior survival and fewer adverse events than platinum-based chemotherapy and has shown durable disease control out to 5 years in 1/3 of patients with advanced disease, although in a never smoking population this benefit is less clear^[3]. She next received a single fraction of 8Gy using an antero-posterior field setup with the target including the entire right femur, peri-femoral soft tissue and the superior knee joint encompassing the entire femoral nail and surgical field.

Two months following the initial diagnosis and treatment of the lung cancer, the patient had responded poorly locally in the femur and continued to deteriorate globally with frailty. She reported significant nausea and weight loss, confounded further by a urinary tract infection. Her pain was escalating with an inability to weight bear on her right leg. Physiotherapy reported her mobility continued to decline, prior to representation to hospital for further investigation. Repeat X-ray showed limited bone union at the fracture site (Figure 2). Subsequent MRI of the right thigh revealed multiple intraarticular non-enhancing bodies with increased heterogenous signal in the extraosseous tissue of the anterolateral distal femur (Figure 3). To further characterise these radiographic findings, a sterile aspiration of the knee was performed, with clear, straw-coloured synovial fluid extracted and culture negative. After extensive discussion with the MDT, and consideration of the patient's high level of activity prior to initial admission, comorbid health and oligometastatic disease status, it was decided on balance that

an en bloc excision with distal femur replacement would be performed.

The operation was performed under general anaesthesia with per protocol pre- and post-operative antibiotic cover. The intramedullary femoral nail was removed via incisions through the previous surgical scars. Following this, an extended longitudinal incision over the knee was made to expose the distal femur. The tumour was identified, and dissection of the surrounding soft tissue was performed. The distal femur and proximal tibia were excised with the hinged distal femur replacement cemented into position (Figure 4). The excised tissue was sent for histopathological analysis as complete biological molecular assessment had not been possible on the original specimens (Figure 5). However due to the decalcification process required to prepare the specimen, there was again insufficient DNA for next-generation sequencing. A plasma sample was sent opportunistically to assess for circulating tumour DNA (ctDNA) for molecular sequencing, however there was no detectable DNA, likely attributed to a low disease burden. Post-operatively there were no complications and X-ray showed satisfactory alignment and positioning of the prosthesis. The patient was able to begin weight-bearing day 1 following the operation and continued to progress with physiotherapy for the following weeks she remained an inpatient. Her wound healed well, however she encountered significant oedema in her leg, ipsilateral to her chronic lymphoedematous lower limb.

Further post-operative radiotherapy with a total prescribed dose of 25Gy in 5 fractions over a one week period. The treatment was delivered using a volumetric arc technique with the target volume encompassing the entire new prosthesis and surgical bed.

Follow-up and outcomes

On review six months post en-bloc resection, the patient had responded well to her ongoing therapy with pembrolizumab, with no further lesions present on FDG PET scan. However, her chronic right leg lymphoedema had worsened post-operation, confounded by the addition of dose adjusted chemotherapy to enhance the efficacy of pembrolizumab with cellulitis developing in her foot following an accidental cut. This was treated with a 2-month course of intravenous and oral antibiotics, using hospital in the home services. Her inflammatory markers slowly improved and remained stable with a CRP around 40. Concurrently she was linked with the outpatient specialist lymphoedema team who provided a pneumatic pump before stepping down to a custom bandaging garment once the leg returned to a baseline size. There was no sign of osteomyelitis on recurrent imaging. She is now pain free in her leg and can mobilise comfortably with a walking stick. She continues to proactively participate in outpatient physiotherapy to improve muscle strength in the leg and knee range of motion, which can now reach 90 degrees of flexion. Her quality of life has improved to approaching her pre-diagnosis level as she continues pembrolizumab immunotherapy. FDG-PET performed six months post-diagnosis revealed a complete metabolic response

Discussion

With advancements in cancer therapies, the prognosis of patients with metastatic disease has improved^[3-5]. However,

this is associated with an increase in the incidence of bony metastases, particularly to the femur ^[1-4]. This can predispose the patient to pathological femur fractures, which can be highly detrimental to the patient's quality of life ^[6-7]. Management of these patients is challenging and requires a multi-disciplinary team approach.

Pain in the limb is one of the most common complaints as it can significantly inhibit a patient's ability to mobilise and perform activities they would normally enjoy ^[6]. For prophylactic fixation of impending fractures, the decision to operate is based on the Mirels scoring system, taking into account site, pain, type of lesion and size ^[2]. However, after the occurrence of a pathological fracture, weight bearing ability and stability is compromised. Thus, operative intervention of pathological lower limb fractures is almost always required in combination with chemotherapy and radiotherapy. This is reinforced by multiples studies highlighting poor results with conservative management of pathological femur fractures ^[8]. The goals of surgical treatment are to provide a single procedure to stabilize the pathological fracture and allow early mobilization. The type of construct chosen should also last the expected life expectancy of the patient, however this often difficult to assess at initial presentation ^[8].

For a single distal femur bony metastasis without fracture, primary bony resection and mega prosthesis insertion is a viable option. However, once fracture has occurred, tissue planes are violated and the tumour spread makes this larger operation less appealing as a primary intervention. Many surgeons may consider intramedullary nail (IMN) fixation following pathological fracture as patients are often frail and have short life expectancy. IMN fixation is thus advantageous as it is minimally invasive, relatively easy to insert and cost-effective. Multiple studies have also demonstrated its success in reducing pain and restoring mobility ^[9]. However, the limitations of IM nailing can be seen in this case report. Firstly, the tumour burden is not reduced by this procedure, which can predispose the patient to further local progression of cancer and recurrence of pain. Healing at a pathological fracture or irradiated bone can also result in poor bony healing and non-union, subsequently increasing risk of hardware failure ^[10].

In this case, we demonstrate that even with pathological fracture and violation of tissue planes, en bloc resection with mega prosthesis insertion may still be an appealing primary intervention. With en bloc resection of a tumour with mega prosthesis insertion, the bulk of the tumour can be removed, reducing associated pain and restoring stability to the femur ^[4-8]. Patients are also able to load-bear immediately following the procedure allowing for relatively rapid progression through rehabilitation ^[11]. This is particularly pertinent in this demographic of patients, where quality of remaining life outside of rehabilitation is paramount. After fracture, it is important that adequate clearance of the surrounding soft tissues is performed to reduce the risk of recurrence. Often adjuvant radiotherapy or embolization is performed to further control local disease and minimise early failure of the implant ^[1]. In regard to survival, there is no consensus in the literature regarding whether en bloc resection of a solitary metastasis can reduce patient mortality ^[8, 11-13]. However, multiple studies have demonstrated a lower mechanical failure rate with femoral reconstruction when compared to IMN ^[8]. This makes en bloc resection and distal femur replacement appealing in

patients who have a prognosis of greater than 12 months. However, there are limitations to distal femur replacement, including its greater invasiveness, costs, operating time and complications (i.e. infection, aseptic loosening) when compared to IMN ^[14]. As such there needs to be careful MDT discussion regarding prognosis, patient goals and comorbidities prior to any surgical intervention. Such a robust discussion ultimately enabled the ultimate regaining of independence, comfort, and excellent local cancer control for Mrs H



Fig 1: AP XR of right knee showing a pathological fracture at the distal femur



Fig 2: AP XR of right knee 10 weeks following intramedullary nail insertion

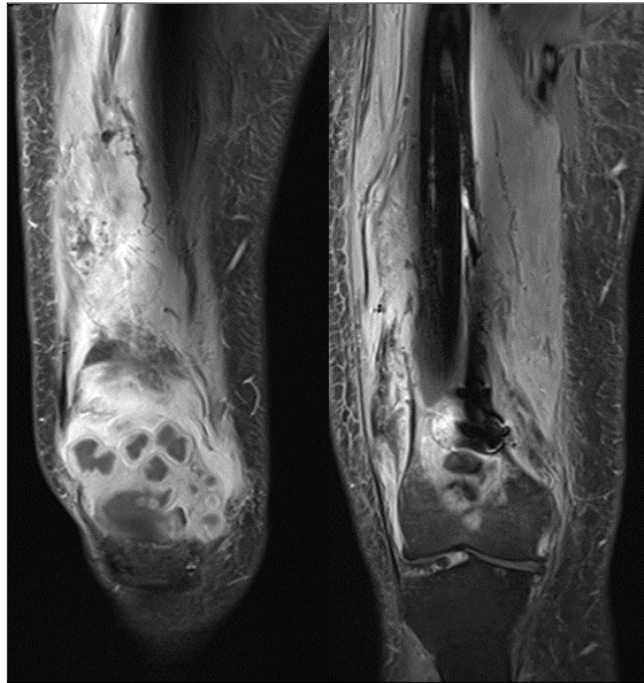


Fig 3: MRI of right knee showing multiple intraarticular bodies and growth of abnormal extraosseous tissue

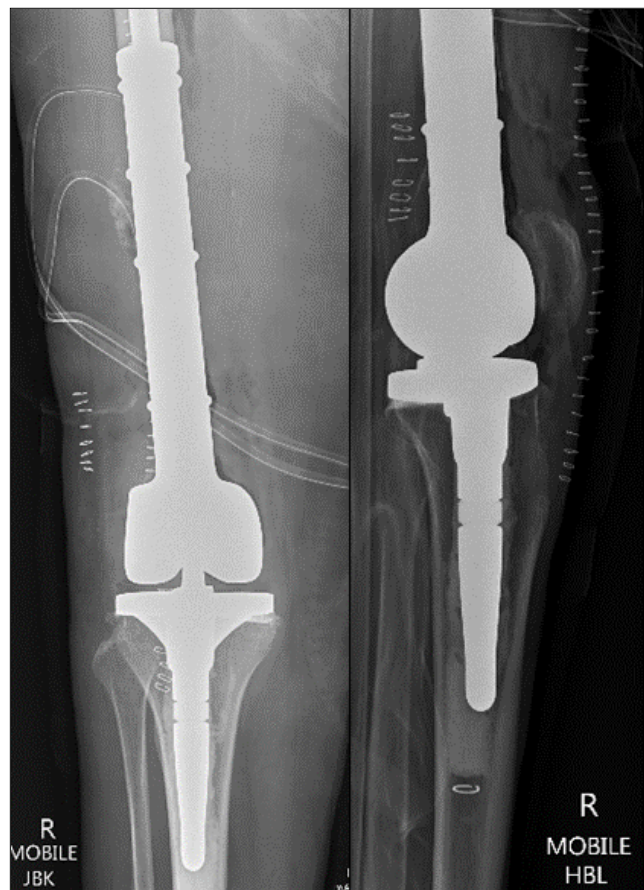


Fig 4: XR of right knee demonstrating a cemented hinged distal femur mega prostheses



Fig 5: Specimen of the resected distal femur sent for histopathological analysis

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None

Conflict of Interest

None

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None

Informed Consent

The patient has consented to for the case to be published.
No institutional review was required

Author Contributions

JX - conceptualisation, clinical management, drafting and editing

MI - conceptualisation, clinical management, drafting and editing

DJ - conceptualisation, clinical management, drafting and editing

TM - conceptualisation, clinical management, drafting and editing

References

1. Weber KL, Randall RL, Grossman S, *et al.* Management of lower-extremity bone metastasis. *J Bone Joint Surg Am.* 2006;88(4):11-9.
2. Mirels H. Metastatic disease in long bones. A proposed scoring system for diagnosing impending pathologic fractures. *Clin Orthop Relat Res.* 1989;249:256-64.
3. Reck M, Rodriguez-Abreu D, Robinson AG, *et al.* Pembrolizumab versus Chemotherapy for PD-L1-

Positive Non-Small-Cell Lung Cancer. *N Engl J Med.* 2016;375(19):1823-33.

4. Park DH, Jaiswal PK, Al-Hakim W, *et al.* The use of massive endoprotheses for the treatment of bone metastases. *Sarcoma;* c2007. p. 62151.
5. Mok T, Camidge DR, Gadgeel SM, *et al.* Updated overall survival and final progression-free survival data for patients with treatment-naïve advanced ALK-positive non-small-cell lung cancer in the ALEX study. *Ann Oncol.* 2020;31(8):1056-64.
6. Nilsson J, Gustafson P. Surgery for metastatic lesions of the femur: good outcome after 245 operations in 216 patients. *Injury.* 2008;39(4):404-10.
7. Harrington KD. Orthopedic surgical management of skeletal complications of malignancy. *Cancer.* 1997;80(8):1614-27.
8. Errani C, Mavrogenis AF, Cevolani L, *et al.* Treatment for long bone metastases based on a systematic literature review. *Eur J Orthop Surg Traumatol.* 2017;27(2):205-11.
9. Anract P, Biau D, Boudou-Rouquette P. Metastatic fractures of long limb bones. *Orthop Traumatol Surg Res.* 2017;103(1S):S41-S51.
10. Gainor BJ, Buchert P. Fracture healing in metastatic bone disease. *Clin Orthop Relat Res.* 1983;178:297-302.
11. Torbert JT, Fox EJ, Hosalkar HS, *et al.* Endoprosthetic reconstructions: results of long-term followup of 139 patients. *Clin Orthop Relat Res.* 2005;438:51-9.
12. Evenski A, Ramasunder S, Fox W, *et al.* Treatment and survival of osseous renal cell carcinoma metastases. *J Surg Oncol.* 2012;106(7):850-5.
13. Fottner A, Szalantzy M, Wirthmann L, *et al.* Bone metastases from renal cell carcinoma: patient survival after surgical treatment. *BMC Musculoskelet Disord.* 2010;11:145.
14. Sevelde F, Waldstein W, Panotopoulos J, *et al.* Is Total Femur Replacement a Reliable Treatment Option for Patients With Metastatic Carcinoma of the Femur? *Clin Orthop Relat Res.* 2018;476(5):977-83.

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