The patella as an unusual site of renal cell carcinoma metastasis

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ABSTRACT

We report a rare case of renal cell carcinoma with metastasis to the patella in a 49-year-old man, who presented with seven months of left knee pain after a fall. Only two similar cases have been reported. Patellar metastasis is rare because it has a relatively poor blood supply and microemboli would have been sieved out by the pulmonary circulation. Patellectomy is the usual treatment for such cases. We suspect that the preferential metastasis in our patient is a result of tropism. Our treatment for this patient is unique. We opted for a patella-preserving operation involving the use of cryotherapy, as this treatment modality preserved the quality of life. An opportunistic biopsy one year later confirmed the absence of active disease within the patella. This case uniquely provides human *in vivo* histological confirmation that an intralesional procedure with local and systemic adjuvant therapy effectively controls local disease.

Keywords: cryotherapy, patella, patellar metastasis, renal cell carcinoma, tropism

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INTRODUCTION

Metastasis to the patella is extremely rare. Only 23 cases of patellar metastasis have been reported,[1] with renal cell carcinoma (RCC) as the primary tumour in two of the cases.[2,3] Ironically, there are more cases of primary tumours of the patella in the literature.[4] We report a case of RCC with metastasis to the patella and sternum, with a presenting symptom of left knee pain.

CASE REPORT

A 49-year-old man sought treatment in the emergency department for aggravation of left knee pain after a fall. He had chronic left knee pain for seven months prior to the fall. The pain became progressively worse over the months and disturbed his sleep. Other than being a heavy smoker and drinker, his medical history was unremarkable. Specifically, he had no previous history of malignancy and his family history was unremarkable.

Clinical examination revealed an average-sized, middle-aged man, who was alert and well-nourished. He was afebrile and vital signs were stable. Examination of the cardiovascular, respiratory and neurological systems was normal. The abdominal examination was also unremarkable with no palpable masses. There was no clinical lymphadenopathy. The patient's left knee was found to be tender and swollen, and the patella was laterally subluxed. Range of movement was limited by pain but no neurological deficit of the lower limbs was found. Both dorsalis pedis and posterior tibial pulses were well felt. Bruising was noted but there was no clinical breach of the skin. A radiograph of the left knee showed an osteolytic lesion of the left patella with a comminuted fracture (Figs. 1a & b). This appeared aggressive as erosion was noted in the subchondral bone.

Laboratory investigations did not show significant abnormalities. These included a full blood count, routine biochemistry including serum calcium, erythrocyte sedimentation rate, as well as C-reactive protein and prostate specific antigen levels. The patient's chest radiograph was unremarkable. Computed tomography (CT) of the thorax showed both lungs to be of normal appearance with no lymphadenopathy or pulmonary nodules. The sternum was noted to be expanded, but there was no clear erosion. The lower thoracic and upper abdominal section showed a heterogeneous 6.0 cm × 4.8 cm lesion in the upper pole of the right kidney.

In view of the right renal lesion, CT of the abdomen and pelvis was subsequently performed. The scan revealed a heterogeneous mass (5.0 cm × 5.3 cm × 5.8 cm) arising from the upper half of the right kidney extending into the pararenal fat (Fig. 2). There was no evidence of renal vein or inferior vena caval thrombosis or tumoral extension. An isotope bone scan showed increased uptake of Tc-99m in the body of the mid sternum, in addition to that in the left patella. Magnetic resonance imaging of the left knee showed bony destruction of the patella with only a small area of normal tissue superolaterally. The remainder of the patella showed tumorous

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Fig. 1 (a) Anteroposterior and (b) lateral radiographs of the left knee show comminuted pathological fracture of the patella, which shows a heterogeneous appearance with lucency and sclerosis.

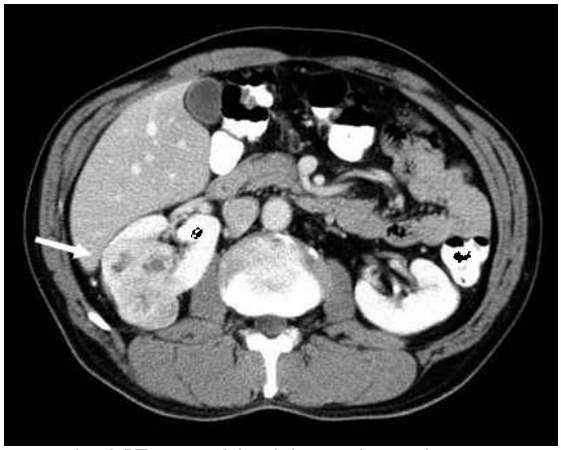

Fig. 2 Axial CT image of the abdomen shows a heterogeneous mass in the right kidney extending into the pararenal fat (arrow). There is no renal vein or inferior venal cava thrombosis.

infiltration of the normal fatty marrow signal. The tumour had broken through the cortex into the knee joint. There was a large joint effusion demonstrated with extension of the joint fluid into the surrounding prepatellar soft tissues (Figs. 3a & b).

We performed an intralesional patella-preserving resection of the tumour in the left knee under tourniquet applied at 250 mmHg for two hours. This provided adequate haemostatic control obviating the need for preoperative angiographic embolisation, which is our routine practice in more axial sites of involvement. There was a multiloculated lesion within the patella, and the tumour had extruded anteriorly to involve part of the patella extensor expansion overlying the patella. The tumour mass was first curetted and the wall burred at high speed (Midas Rex Legend® Pneumatic, Medtronic, Minneapolis, MN, USA). The cavity wall was then coagulated with an argon beam coagulator (Birtcher Medical Systems, Irvine, CA, USA) after which three cycles of cryotherapy were performed. This involved application of a cryoprobe at -200°C to the cavity wall followed by thawing to room temperature (CryoHit®, Galil Medical, Israel). The patella was then reconstituted with 18G steel cerclage wire and antibiotic cement maintaining continuity of the patella (Figs. 4a & b). A frozen section confirmed the diagnosis of metastatic RCC of the clear cell type (Fig. 5a).

Postoperative recovery was unremarkable. The patient was able to bear partial weight with the aid of crutches by the seventh postoperative day and had full extensor mechanism function by six weeks postoperation (Fig. 6). At two months postoperation, he was able to return to work as a blue-collar worker.

The patient continued to be managed by a multidisciplinary team comprising an orthopaedic

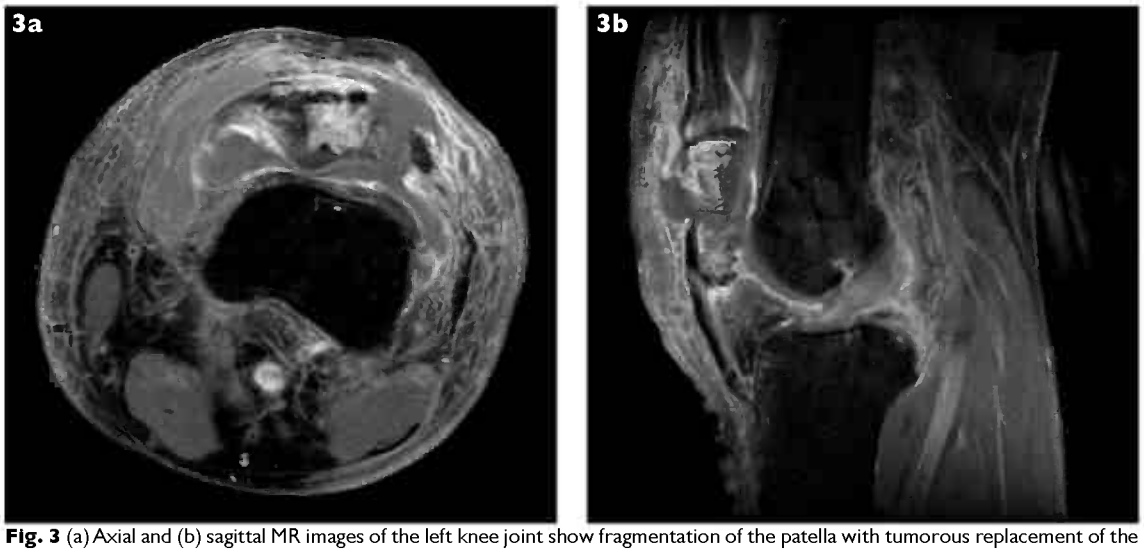

Fig. 3 (a) Axial and (b) sagittal MR images of the left knee joint show fragmentation of the patella with tumorous replacement of the normal fatty marrow signal. There is a very large joint effusion with extension of the joint fluid into the surrounding prepatellar soft tissue.

Fig. 4 (a) Anteroposterior and (b) lateral radiographs of the left knee show reduced patella fracture with cerclage wire.

oncologist, medical oncologist, urologist and radiation oncologist. He underwent an elective laparoscopic radical right nephrectomy (Fig 5b), and subsequently underwent high-dose radiotherapy (40 Gy in 16 fractions) to his left knee and sternum. He is also on monthly parenteral zoledronic acid (Zometa, Novartis, Switzerland).

At one year postoperation, the patient developed symptoms related to his cerclage wire, which needed to be removed. All implants were removed at the time of surgery. An opportunistic biopsy was performed and this confirmed the absence of active disease within the bone (Fig. 5c).

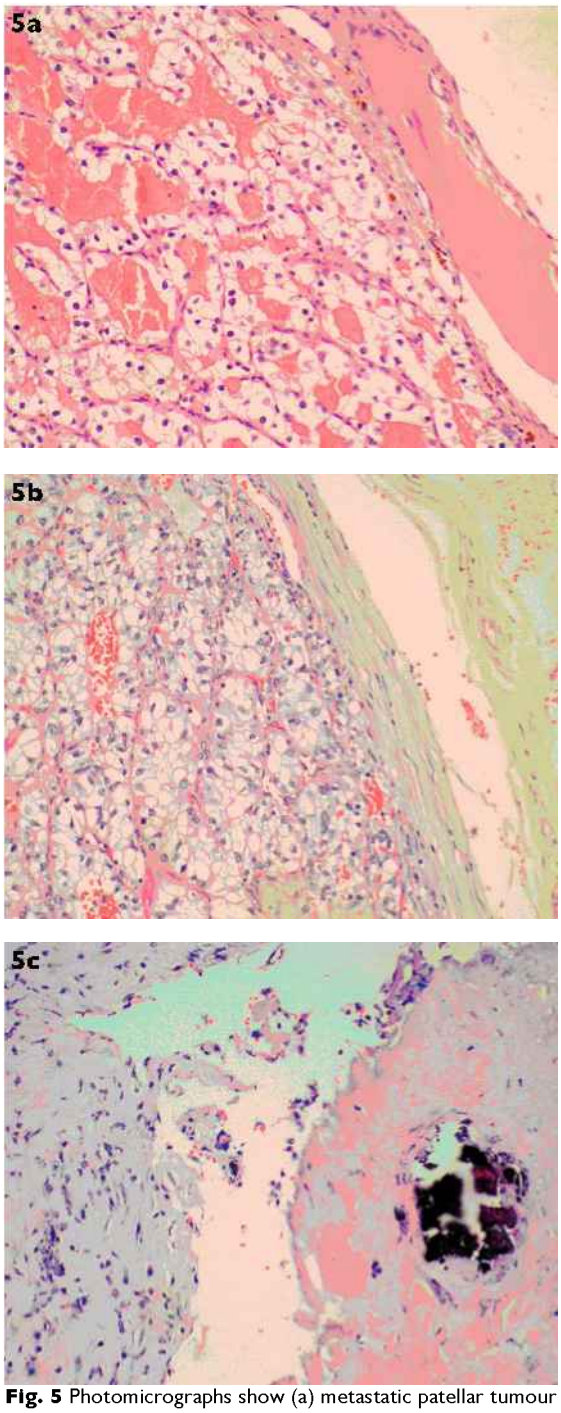

Fig. 5 Photomicrographs show (a) metastatic patellar tumour with infiltration of bone (Haematoxylin & eosin, × 200); (b) a histological specimen from a primary renal cell carcinoma (Haematoxylin & eosin, × 200); and (c) reactive changes with complete absence of viable tumour tissue from a post-radiation biopsy of the patella (Haematoxylin & eosin, × 200).

The patient was followed up clinically, and with regular blood-work, bone scans and CT scans of the chest, abdomen and pelvis. At the time of writing, the patient is at one year post diagnosis with no evidence of progressive disease systemically.

DISCUSSION

Metastatic involvement of the patella in RCC is extremely rare. A MEDLINE search from 1960 to the present yielded only 23 reported cases of patellar metastases,[1] of which only two originated from RCC.[2,3] Of these 23 cases, ten of them presented with knee pain without prior diagnosis of malignancy. Ironically, primary tumours of the patella are more common than metastatic diseases.[4] In most of these cases, trivial trauma and osteolytic lesion on radiography led to further investigations and work-up. In our patient, the protracted duration of pain together with the trivial impact of the fall aroused our suspicion of a pathological fracture. Furthermore, initial radiography was diagnostic.

In the majority of the reported cases, a patellectomy was performed. Few cases in the literature have utilised argon beam coagulation and cryotherapy with patella preservation in the treatment of patella metastasis. The prognosis is poor for stage four RCC according to the American Joint Committee on Cancer Staging (AJCC), with a five-year survival rate of 10%.[5] Based on Nathan et al's sliding scale, which incorporates various prognostic factors, the patient life expectancy is projected to be 6–8 months.[6] Due to the short life expectancy, the aim of our treatment plan was to retain patient function without compromising tumour clearance. The patella has been shown to be an integral part of the extensor mechanism and a patellectomy would have led to extensor lag and a decreased range of knee flexion.[7] The patient would also not be able to bear weight on the left lower limb and would require the use of an ambulatory aid and knee brace. Also, compressive stresses generated by the quadriceps mechanism would be concentrated over a much smaller area without the patella, resulting in an increased strain over the tibiofemoral joint.

RCC metastasis represents a unique histological type of bony metastasis in which disease control concepts appear to be similar to primary bone disease.[8] Cryosurgery has also been used as a modality of treatment as early as 1964, when it was used as a form of palliation for metastatic RCC.[9,10] With improved survival, more consideration is given to the functional outcome of treatment and less to mutilating and defunctioning surgery. Cryosurgery, which allows anatomical preservation, suits these aims well.

The procedure of cryosurgery involves the thorough excision and curettage of gross tumour, followed by high-speed drilling of the reactive shell before the application of the cryosurgery probe. Three cycles of cryosurgery are routinely applied. In this patient, we lowered the probe temperature

Fig. 6 Photograph of the patient at six weeks postoperation shows that he had regained full extension mechanism function.

to -200°C which provided a cavity temperature of at about –50°C to –70°C, which is advised for treatment of cancer. A tourniquet is essential during cryotherapy to decrease bleeding, as blood can act as a heat sink and thermal barrier.[11] The application of cryotherapy has also evolved from a 'direct pour' technique to the use of 'pressurised spraying', and finally the use of a 'cryoprobe'.[12] Our case study uniquely provides human *in vivo* histological confirmation that even with intralesional therapy, cryosurgery is able to achieve local remission.

In our patient, metastatic disease was found in the left patella and sternum only, with no other lesions found on the isotope bone scan. The patella is a sesamoid bone with a relatively poor blood supply, consisting of a few nutrient branches from the collateral vessels of the knee.[13] Conversely, the plexus of vessels around the knee should preferentially conduct most of the blood flow in the region away from the patella. This plexus of blood vessels is fed by six arteries that surrounds the patella. Of these, one is from the superficial femoral artery, another one is from the anterior tibial artery and the rest are from the popliteal artery. The blood supply is mainly from distal to proximal.[14] Moreover, because of preferential entrapment of tumour emboli in the pulmonary circulation, the tumour load in the arterial circulation is further reduced. Hence, patellar circulation would seem insufficient for tumour embolism to occur and for metastasis to develop.

This presentation is unusual as tumour emboli tend to be embedded in long bones where there is good vascularity. The haematogenous route provides the means of metastasis. However, the tumour emboli did not show preferential metastasis to highly vascularised bones like the lumbar spine. This raises the consideration of another aspect of carcinogenesis,[15] namely, tissue tropism. Studies have shown that tumour cells have been detected in patients' blood without evidence of metastatic disease, as these circulating tumour cells may not yet have the ability to establish themselves in distal sites. In one such study, the probability of disease-free and overall survival in colorectal cancer was dependent on lymph node metastasis and degree of tumour differentiation, but not on the presence of circulating tumour cells.[16]

Tissue tropism has recently received attention as an important factor in tumour metastases. Cells isolated from human breast metastases to bone-generated bone metastasis efficiently when re-inoculated into nude mice, whereas cells from the primary tumours failed to form distant lesions.[17] This demonstrates the development of mutations allowing metastasis in a targeted tissue-specific manner. We propose that our patient may have a case of RCC with a molecular makeup enabling preferential metastasis to the patella and sternum. Further molecular studies are currently underway to determine the tumour tropism of the RCC cells isolated from this patient.

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