Hip Hemiarthroplasty Periprosthetic Loosening Caused by Papillary Ovarian Carcinoma Metastasis in a 78-Year-Old Woman: A Rare Presentation and a Literature Review

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Abstract

Hip arthroplasty failure secondary to septic or aseptic loosening is common, but periprosthetic loosening caused by metastasis of a distant primary lesion is unusual and seldom described in the literature. In this report, we present the case of a 78-year-old woman with bipolar hemiarthroplasty implant loosening secondary to metastatic spread of papillary ovarian carcinoma. We also review the literature and describe the factors that could possibly predispose to metastatic seeding in patients with hip arthroplasty. In addition, we highlight the radiologic features that might help differentiate such loosening from other, more common causes at an early stage of presentation.

Total hip arthroplasty (THA) is one of the most common and successful procedures in modern surgery. In the United States alone, more than 200,000 THAs are performed annually.[1] With the number of procedures on the rise, the incidence of complications also is increasing.

Prosthetic loosening, a well-known complication, was defined by Gruen and colleagues[2] as a radiographically demonstrable change in the mechanical integrity of the load-carrying cemented prosthetic component that produces a radiolucent zone in the cement–stem or cement–bone interface. Infection is an important differential diagnosis to be considered in any patient with implant loosening.

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In this article, we describe the rare scenario of metastasis as a cause of prosthetic loosening 3 years after cemented bipolar hemiarthroplasty. The patient's first relative provided written informed consent for print and electronic publication of this case report.

Case Report

In February 2005, a 75-year-old woman presented with a fracture of the neck of the left femur after a trivial fall (Figure 1). The patient had diabetes and hypertension but no other comorbidity or illness. Radiographs suggested a pathologic fracture. A complete skeletal survey revealed generalized osteopenia, especially of the axial skeleton. Blood tests were performed: complete hemogram, including erythrocyte sedimentation rate (ESR) and platelet count; serum electrolytes; renal and liver function tests; coagulogram; serum proteins; and calcium profile, including alkaline phosphatase. The renal results were borderline: creatinine, 130 µmol/L, and urea nitrogen, 29.3 mmol/L. All other test results were within normal limits. Results of serum protein electrophoresis for M-band proteins and urine test for Bence-Jones proteins were also negative. Whole-body technetium-99m

Figure 1. Anteroposterior radiograph of left hip shows fracture of neck of femur.

Figure 2. Postoperative radiograph shows cemented bipolar hemiarthroplasty.

Figure 3. Radiograph at 38-month follow-up shows expansion and lysis in region of lesser trochanter.

(^{99m}Tc) bone scan showed raised activity at the fracture site. Magnetic resonance imaging (MRI) of the pelvis with both hips again failed to show any local pathologic lesion. Dual-energy x-ray absorptiometry (DXA) showed low bone mineral density, and a diagnosis of osteoporosis was made. The patient was then surgically treated with a cemented bipolar hemiarthroplasty (Figure 2). Intraoperative assessment did not point to a malignant pathology as the cause of pathologic fracture. The resected head was sent for histologic examination, which also did not reveal any positive finding. The patient was mobilized early and was started and maintained on an antiosteoporotic regimen. Her postoperative period was uneventful.

The patient was on regular follow-up and was asymptomatic the next 3 years. In April 2008, she presented to our outpatient department with continuous pain in the left groin, with further aggravation on joint movement. A radiograph showed an expansile lytic area around the implant in the lesser trochanter and the medial cortex (Figure 3). A week later, the pain was substantially increased, and the patient reported of being easily fatigued and having lost her appetite. Blood tests were performed: complete hemogram; serum electrolytes; renal and liver function tests; coagulogram; serum proteins; and calcium profile. ESR (55 mm/h) and C-reactive protein level (1238 nmol/L) were increased. Total leucocyte count was 12 x 10^9/L. Alkaline phosphatase level was 5.1 μkat/L, calcium was 2.5 mmol/L, and inorganic phosphorus was 1 mmol/L. All other test results were within normal limits. The patient also had on-and-off febrile episodes. Infection was suspected at first, and the patient was started on antibiotics. However, she did not return for follow-up until about 2 months later. Repeat radiography showed rapid progression of the lytic area, which now involved Gruen zones 1, 2, 3, 6, and 7, as well as a pathologic fracture of the lesser trochanter (Figure 4). ^{99m}Tc bone scan showed multiple foci of increased uptake: left first rib (posterior), fourth costovertebral junction, right sixth rib (anterior), multiple thoracic vertebrae (D6, D8, D11, D12), third lumbar vertebra, and right sacral ala. In addition, there was increased uptake around the prosthesis. Fused SPECT (single-photon emission computed tomography) showed lytic lesions without surrounding sclerosis in the L5 vertebral body, the right sacral ala, and the left iliac crest. Results of a myeloma workup, which included serum protein electrophoresis for M-proteins and urine test for Bence-Jones proteins, again ruled out a marrow neoplasm. The involved area around the prosthesis was biopsied, and the culture was found to be sterile. However, histopathologic findings suggested a metastatic papillary carcinoma. Contrast-enhanced CT of the pelvis showed a mass in the right ovary, chest CT showed multiple metastatic nodules in the lungs, and contrast-enhanced CT of chest and abdomen (Figure 5) showed multiple lytic areas in the dorsal and lumbar vertebrae, the left ilium, and the

Table. Metastasis in and Around Joint Arthroplasty Sites

Year	Authors	Case(s)
1986	Kim & Yun[7]	Postoperative metastasis of lung carcinoma to proximal femur
1987	Donohoe & Patton[8]	Non-Hodgkin lymphoma in which periprosthetic metastasis mimicked implant loosening
1996	Schmidt et al[9]	2 cases of periprosthetic secondary lesions—1 metastatic osteolytic lesion from unknown primary, 1 diagnosed as clear cell variant of hepatocellular carcinoma
1998	Allain et al[5]	Squamous cell carcinoma metastasis to periprosthetic neosynovial tissue 5 years after cemented hip arthroplasty
2005	Bonnevialle et al[10]	3 cases of periprosthetic metastasis after total hip arthroplasty
2006	O'Shea et al[11]	3 similar cases of periprosthetic malignancy—66-year-old man with metastatic gastric carcinoma presenting as periacetabular lytic lesion; 64-year-old man presenting with femoral metastases from previously undiagnosed lung carcinoma; 75-year-old woman presenting with painless discharging thigh sinus around total hip arthroplasty subsequently diagnosed as immunoblastic lymphoma
2008	Dramis et al[3]	79-year-old Caucasian man with prosthesis loosening after metastatic renal cell carcinoma
2008	Simon et al[12]	Renal cell carcinoma metastasis presenting as osteolysis in total hip arthroplasty

right superior ramus along with multiple nodules in the lungs and left-sided basal atelectasis with pleural effusion. Carcinoembryonic antigen level was 310 µg/L (normal, < 3 µg/L), and cancer antigen 125 level was 303.58 kU/L (normal, <35 kU/L). The patient was referred to general surgeons and gynecologists for further management, and staging laparoscopy was planned, but the patient died in September 2008.

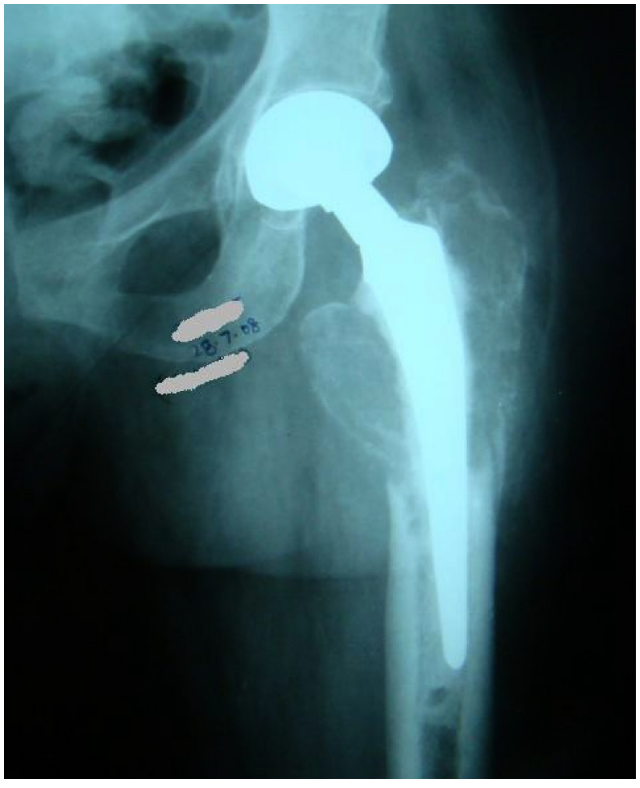

Figure 4. Radiograph at 41-month follow-up shows further expansion and progression of lytic area.

Discussion

The literature includes reports of malignancy associated with joint arthroplasty or fracture fixation.[3] Primary tumors, such as malignant fibrous histiocytoma, undifferentiated sarcoma, squamous cell carcinoma, and synovial sarcoma have been found in bone and soft tissue juxtapositional to implants, but up until now, no direct relationship has been demonstrated between tumor and surgery.[4] Metastasis to a joint arthroplasty is exceptional, however, and fewer cases have been reported.

Apart from periprosthetic fractures and recurrent dislocations, the commonest delayed complications of arthroplasties are septic loosening and aseptic loosening. However, the elderly are prone to developing tumors, and the skeletal system is one of the most

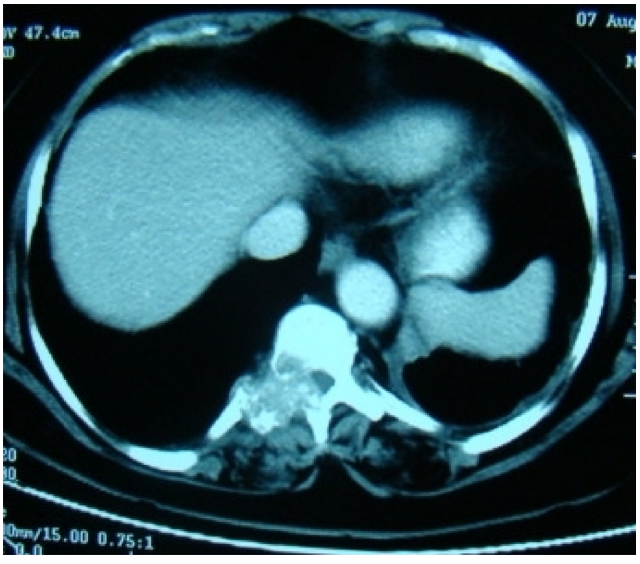

Figure 5. Contrast-enhanced computed tomography of chest and abdomen shows destruction of dorsal vertebrae.

common sites of tumor metastases. Therefore, primary and metastatic neoplastic lesions definitively should be ruled out before revision THA is planned for an elderly patient. Metastatic lesions to the skeletal system, if detected early, can be managed with radiation or, in some cases, surgical excision. Some authors have suggested that subjecting loosening-side tissue to histologic examination will help in making the correct diagnosis in these situations.[5,6] Particularly in revision arthroplasties, intraoperative analysis of frozen sections of periprosthetic tissue might be a very useful investigation.[6]

Metastasis in and around joint arthroplasty sites is rare, and periprosthetic loosening secondary to metastasis to the hip arthroplasty site even rarer. To our knowledge, very few such cases have been reported (Table). [3,5,7-12]

The process by which a malignant tumor cell metastasizes is complex and requires completion of a series of steps.[13] Seeding of the tumor cell in a particular tissue involves mechanical trapping of the tumor cell and a fibrin-platelet clot. There is controversy as to whether surgical trauma in any distant organ renders it more susceptible to metastasis. It has been suggested that the surgical trauma and the resulting hematoma and blood clot increase deposits of the hematogenous tumor cells, with the process further facilitated by platelet-derived growth factor. This increased susceptibility of an innocuous, distant organ has been demonstrated experimentally in mice.[14] Some have attributed stoma site metastases of gastric adenocarcinoma after partial gastrectomy with gastrostomy tube placement to direct tumor seeding or hemolymphatic spread.[15]

Some also have speculated increased susceptibility of periprosthetic tissues to metastatic seeding, and several theories regarding the pathology of metastatic disease in relationship to implants have been expounded. Roques and colleagues[16] believed that blood flow abnormalities resulting from surgical insult and healing may predispose to metastasis around surgical implants. The immune processes involved in these metastatic seedings are exceedingly complex, and their role in local defense against malignancy is still far from being understood. The inflammatory reaction of periprosthetic tissues to metastasis includes activation of macrophages, giant cells, and leukocytes, and these may play an important role in aseptic loosening.

Specific findings in patients with prosthetic loosening should be viewed with a high degree of suspicion for neoplasia. Bloodstained aspirate from a joint in the setting of aseptic or septic loosening specifically should arouse suspicion of the potential presence of a primary or metastatic tumor. Radiographically, aseptic autolysis, which is usually extensive, appears as endosteal scalloping without invasion of the outer cortex. Single lesions that involve the entire cortex and progress rapidly are not typical of aseptic osteolysis and should raise suspicion of malignancy.[3] Furthermore, according to study results reported by Mohler and colleagues,[17] early loosening of the femoral component at the cement–prosthesis interface occurs at Gruen zones 1 and 2, and any lucent areas in zones 3 and 4 should suggest metastatic lesions. Even our patient's lytic lesion was aggressive and extended far beyond zones 1 and 2.

Conclusion

Periprosthetic loosening caused by metastasis from a distant primary lesion is relatively rare. However, such a scenario has been known for some time, and a high index of suspicion is important for early diagnosis and proper management. Whether arthroplasty procedures predispose the surrounding tissues to metastatic seeding is a question still to be answered.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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