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Surgical treatment of acetabular metastasis

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Abstract. – Breast cancer is the most common malignancy in women. Bone represents the first site of metastasis in more than 50% of patients who relapse systematically. The pelvis in the most common localization after spine in bone metastasis due to breast cancer. The peri-acetabular localization is a greater concern rather than another part of the pelvis. Bone destruction in this anatomical localization lead to pain and mechanical instability, resulting in a great reduction of autonomy and deterioration of patient's quality of life. In the current report, the Authors review the literature about the surgical treatment, the indications and complications of each surgical technique underling the importance of tailoring each surgical procedure on life span and quality of life in order to minimize perioperative complications and maximize functional results for the patients.

Key Words:
Peri-acetabular metastasis, Breast cancer, Survival estimation, Acetabuloplasty, Harrington procedure.

Introduction

Breast cancer (BC) is the most common malignancy in women with a worldwide prevalence of 1.5 million throughout industrialized countries and its mortality rate is second only to lung cancer in USA and Europe. BC can occur even in men, with of course a very lower incidence, accounting 1% of all BC patients. In Japan and far-eastern countries, the absolute incidence rate is five-times lower than the American one[1]. At breast cancer diagnosis, 5-6% of women present with distant spread, with bone representing the most common site of the metastatic lesion. Bone represent the first site of metastasis in more than 50% of patients who relapse systematically[2]. The 25% of patients with bone lesions are asymptomatic, but the remaining 75% of bone metastasis are responsible to develop what is called SREs (Skeletal-Related Events) consisting in pathologic fracture, pain, bone marrow suppression, hypercalcemia. The pelvis in the most common localization after spine in bone metastasis due to breast cancer. The peri-acetabular localization is a greater concern rather than another part of the pelvis. This localization could lead to pain, bone destruction and mechanical instability, resulting in a great reduction of autonomy and deterioration of patient's quality of life. Whether the other part of the pelvis seldom requires a surgical procedure, metastatic lesions involving the acetabular area need an accurate examination and could require a surgical procedure. The surgical treatment of peri-acetabular areas is rarely treated surgically with consequent poor mobility. Many authors also noted that peri-acetabular reconstructive surgical procedures involve long operating times, extensive exposure and considerable blood loose[3,4] that in such fragile patients could lead to lethal complications. Radiological evaluation is made first with X-ray in standard and Judet view (obturator and iliac oblique view) to determinate extension and first involvement evaluation of walls, roof, quadrilateral plate, anterior and posterior columns. The best procedure does exactly determine the bone loos and cortical destruction in the CT scan. 3D and thin-slice CT are helpful to show small fractures, evaluate subchondral bone and more accurate bone stock for implant positioning. Biopsy should be always performed. In case of multiple metastasis and history of cancer should be done during the surgical procedure. In a solitary acetabular destruction without a history of cancer in patients under 40 years an old biopsy before surgery is mandatory to exclude a primary bone tumor. In patients with solitary acetabular lesion and > 40 years, even in the absence of cancer history the more likely to be a metastasis[5].

Classification

The most used classification is the metastatic acetabular classification MAC[6] that, depending on bone destruction, describes 4 types:

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1. Acetabular dome
2. Medial wall
3. Anterior column
4. Posterior column

The pattern of destruction leads to different reconstruction, but the decision of less invasive or more invasive surgical procedure is made on patient's general condition and life expectancy. Another classification was made by Harrington[7] who categorized the bone lesions into three classes: (1) Interruption of the articular surface with columns and wall intact (requiring acetabular cemented + femoral component); (2) Deficiency of medial wall and quadrilateral plate (requiring flanged cup); (3) Deficiency of the roof and acetabular rim (requiring total hip arthroplasty – THA – + reconstruction flanged cup and cement + Steinmann pins). In metastatic bone lesion of the pelvis the surgeon has to achieve different goals, compared to the treatment of primary bone tumor in the same anatomical region, such as pain reduction, functional ability improvement, and mechanical stability in order to allow weight-bearing as soon as possible, to preserve independence and to improve patient's quality of life.

Surgical Treatment

In the treatment of pelvic bone metastasis, several non-surgical option could be used (chemotherapy, radiotherapy, drugs), in different conditions. Surgical option, instead, has strict indications.

Currently are deemed as indication to surgery:
1. Acute pain resistant to a combination of medical therapy and avoided weight-bearing
2. Persistence of symptoms (pain and loss of function) after 1-3 months after radiotherapy.

Preserving function and a palliative action are the goals of the surgical treatment, and the options could start from a minimally invasive palliative treatment to peri-acetabular resection and reconstruction with allograft or mega prosthesis. Acetabular reconstructions are invasive, and carries a high rate of local and systemic complications, potentially even life-threatening in such fragile patients. The decision make process should be carried out from the general oncologic conditions and survival estimation of the patient and for each technique has to be considered the preoperative morbidity for a tailored procedure to the patient. We will present and discuss the main common surgical options for in the treatment of peri-acetabular bone metastasis. The surgical procedure chosen has to minimize the risk and maximize the functional improvement as fast as possible. The surgeon has to consider the time needed for soft tissue healing and rehabilitation, and has to set the treatment to patient's life expectancy[8].

Acetabuloplasty

The acetabuloplasty is a minimally invasive technique for bone metastasis around the acetabulum, consisting in methylmethacrylate injection percutaneously into the osteolytic lesion. The lesions for acetabuloplasty are MAC1 (dome) with intact columns and medial wall (Figure 1). The aim is to provide immediate stability and ambulatory autonomy with weight-bearing by reducing pain. The aim is palliative, with pain reduction and maintenance of autonomy but for a period shorter than one year. It should be considered in patients with a short life expectancy in which is mandatory to minimize preoperative morbidity. We have listed the indication and contraindications to acetabuloplasty (Tables I and II)[9].

Figure 1. Acetabuloplasty in patients with bone metastasis of the acetabular roof.

Table I. Indications to acetabuloplasty.

Weight-bearing acetabular osteolysis
Hip pain resistant to drugs
Patients with multiple metastasis
Short life expectancy
Inability to tolerate major surgery
Histotype differing from kidney or thyroid
Radiotherapy ineffectiveness

Surgical Technique and Tips

The patient is in lateral decubitus position and using two vertebroplasty needle inserted from anterolateral and posterolateral portals, the acetabular lesion is reached under the fluoroscopic guide. Structures to avoid are femoral nerve, gluteal artery and sciatic nerve. In some cases, the osteolysis could involve the sub-chondral bone and the cartilage could be interrupted. In these cases, to avoid cement leakage in the joint, when cement is still liquid, we recommend passive flex-extension of the hip (pumping), in order to eventually spread it. The first who described the use of cement to fill acetabular defects of 11 patients was Cotten et al in 1995[10]. After just 4 days patients experienced pain relief and ambulatory improvement. Our results on acetabuloplasty on 25 patients and 30 acetabuli showed complete pain relief in 59% and pain reduction in 41%. The mean duration of the pain relief was 7.3 months. The quality of life[11] and functional improvement were significantly improved in the first 6 months. Better results have been seen in the treatment of small, contained lesions. Contraindications to acetabuloplasty are listed in Table II. Even though acetabuloplasty does not require neoplastic tissue debunking, the exothermic reaction could display a cytotoxic effect for local control of the disease. Radiation therapy and others minimally invasive therapies to locally control tumor cells are suitable after acetabuloplasty. Patients with short life expectancy are often affected by multiple metastasis and one of the advantages of acetabuloplasty is that it could be performed in the association with ipsilateral proximal femur procedure (osteosynthesis and prosthetic replacement) (Figure 2).

Table II. Controindications to acetabuloplasty.

Absolute	Relative
Acetabular fracture	Radiographic sign on medial wall interruption
Pelvic discontinuity	Local infection
	Haemorrhagic disorders
	Radiotherapy ineffectiveness

Harrington Procedure

In patients with larger defects, longer life expectancy, candidates for major surgery and better prognosis, this surgical procedure can provide mechanical stability and local control by tumor cell removal with an open procedure. This technique consists in an intra-lesional curettage and cement filling with polymethyl methacrylate (PMMA), reinforcing the structure with K-wires. Harrington first described this procedure reporting results in 58 patients with pathologic fracture of the acetabulum (class III lesion) treated with retrograde placement of 4.8 mm Steinmann pins through the acetabular roof into the iliac wing. The medial cavity was cemented including the pins and a

Figure 2. Acetabuloplasty of the acetabulum performed with an arthroprosthesis of the ipsilateral proximal femur.

Table III. Indications to harrington's technique.

Larger bone defect
Longer life expectancy
Medial wall integrity

flanges cup was inserted and cemented inside a polyethylene socket. Compared to the others classes treatment (cemented THA for class I and flanged cup for class II) none of the patients with class III disease had evidence of prosthetic loosening even though these patients had the greatest degree of bone destruction. Harrington concluded that this was the best treatment for a long-lasting durable reconstruction that permitted immediate weight-bearing. The indications to this technique are listed in Table I. Since this original report, several authors[12] have confirmed the strength of the cement reinforced hip reconstruction technique. Many authors[3-15] described a variety of different methods differing for the anterograde, retrograde insertion of the pins/screws or both. Ho et al[13] used 3.5 mm screws in 37 patients class III, reporting at 23.6 months of follow-up improving pain, function and mobility. The complications were 6 dislocations (16%) within 2 months after surgery attributed to the extensive muscular detachment, 6 deep infections (16%) and five of them required a resection arthroplasty. Vena et al[16] reported in their 21 cases, 3 operative deaths, 2 dislocations, 2 nerve palsies. Marco et al[12] reported a large series of 55 patients treated with different variations of Harrington technique. Fifty-four of the hips were reconstructed with a protrusion cup and one, with a hemipelvis endoprosthesis. Large defects were reinforced with cement and pin or screw fixation: thirty-six acetabular reconstructions were performed with anterograde pins or cannulated screws; fifteen, with long retrograde screws; and four, with cement. The most common primary tumor was carcinoma of the breast (eighteen patients). Because of the variety of different technique it was not possible in this series to differentiate the adverse events of Harrington procedure. Walker et al[17] described 4 cases treated with threaded Steinman pins in guided anterograde fashion and an anti-protrusion ring. The mean survival was 15 months and hip construct maintained its integrity. No complication reported and all four patients progressed to independent ambulation with walking aids. Parikh and Kreder[18] presented a 10-cases series using anterograde pins combined with acetabular reconstruction ring and screws and in case of posterior column disruption with reconstruction plating. One patient required cup revision for recurrent dislocation. All patients regained independent household walking by 6 weeks postoperatively. Kunisada et al[19] managed 25 patients out of 40 reporting one intra-operative death and one dislocation. Nilsson et al[20] treated 33 hip with 3 severe hemorrhages (2 fatal), 2 dislocations, 1 deep infection. Tillman et al[14] proposed a modified Harrington technique using, through a lateral approach, fully-threaded (to prevent pins migration) 6.5 mm Steinmann pins are inserted from proximal to distal, behind and medial to the floor of the acetabulum, after the metastasis is curetted out. In our experience we performed the Harrington technique, using the anterograde insertion of 2-3 K-wires of 4 mm (depending on the size of the defect) through the iliac crest and directed between the inner and outer tables toward the roof of the acetabulum (Figures 3 and 4). The surgical approach is performed following Enneking's one, along the iliac wing crest and performing the curettage from the external table of the ilium (Figure 5).

Prosthetic Reconstruction

Patient in which tumor has infiltrated both anterior and posterior columns with medial wall and acetabular dome (MAC 4), if they are able to bear the risk connected to this surgery and have a reasonable life expectancy and an adequate bone

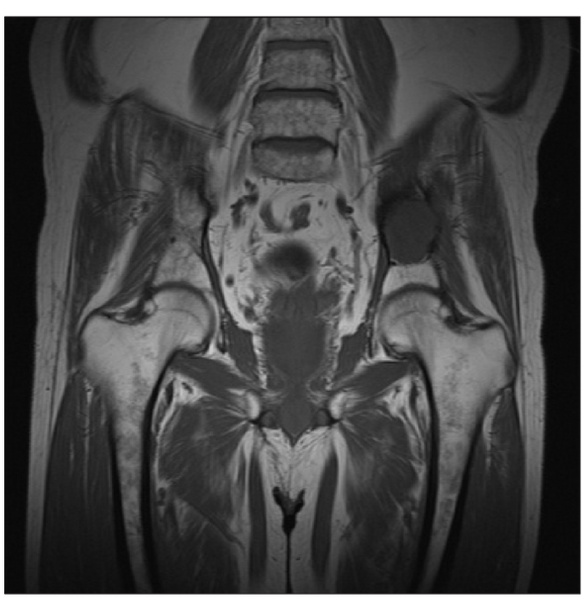

Figure 3. Patient of 55 years old with a painful bone metastasis from clear cell carcinoma of the acetabular roof.

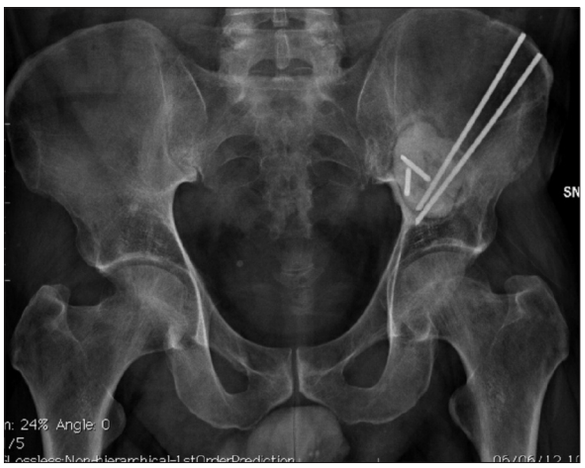

Figure 4. Pins positioning in Harrington technique, after the curettage of the lesion.

stock in the ilium, resection with the prosthetic solution could be a suitable option. Different options on prosthesis could be adopted. Saddle prosthesis is a modular device that uses a notch made in the ilium for a proximal U-shaped saddle that articulates distally with the modular femur prosthesis. Functionally, flexion and extension are permitted; other motions are more limited. Muscular balance (abductors) and good soft tissue tension keep the device in its place. Even if some authors report good to excellent functional results with this procedure[20], the major complications of saddle prosthesis are: infection, dislocation and extensive upward migration. Infection was the most common peri-operative complication in Kitagawa et al[21] series of 16 patients treated with saddle prosthesis (12 primary sarcomas and 4 peri-acetabular metastasis) accounting. Risk factors of infection are long operation time, dead space, blood loose, radiotherapy, wide resection of surrounding muscles, chemotherapy, foreign body reaction, infections in other organs. Other reconstructive options are also affected by high complication rate. Infection rates have been reported 18% to 33% in saddle prosthesis, 17% to 26% in the pelvic prosthesis and 8% to 60% in allograft reconstruction. Dislocation rates have been reported in the literature as 0% to18% in saddle prosthesis arthroplasty, 11% to 17% in pelvic prosthesis arthroplasty, and 15% to 24% in allograft reconstruction. Considering the high risk of series complications due to prosthetic replacement, we suggest an accurate selection of the patients that will benefit from this solution, suggesting in metastatic bone lesion around acetabulum other surgical solution to improve patient quality of life. Recently Shaid et al[22] have proposed an algorithm recommending the "ice-cream cone" prosthesis for pelvic discontinuity and Harrington rod reconstruction for severe bone loss.

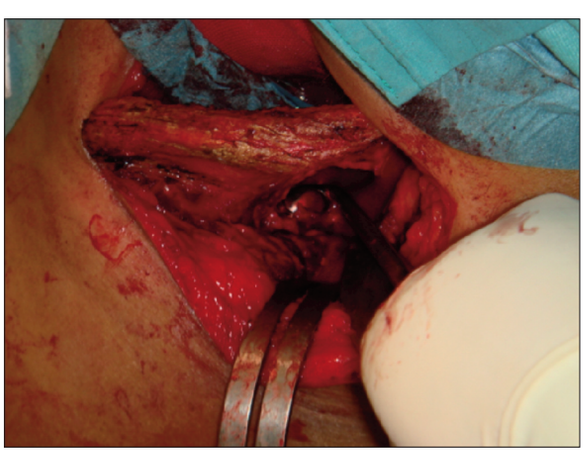

Figure 5. Curettage of the metastatic lesion from the external table of the ilium.

Conclusions

Bone metastasis in the peri-acetabular area is of great concern to the orthopedic surgeon because he is easily responsible for a fast loss of autonomy, increasing pain and marked reduction of quality of life. Patient affected by bone metastasis from breast carcinoma seldom has single metastasis involving the acetabulum, compared to other carcinomas. Usually, peri-acetabular involvement in these cases is presented with other localization. A different surgical option could be chosen. Considering the high rate of morbidity, is challenging the tailoring of the surgical option that has to minimize the preoperative morbidity and maximize patient's quality of life. Minimally invasive surgical procedure as acetabuloplasty could lead to a fast recovery of ambulatory function in a small bone lesion and short life expectancy patients. As a drawback are not durable and pain relief in no more than 7-12 months. In patients with severe bone loss and longer life expectancy, more aggressive and invasive procedure should be considered.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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