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Surgical treatment of metastatic lesion of the spine. A review of 51 consecutive cases operated

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Abstract Metastatic lesions of the spine have recently become a debated topic in orthopaedics, because more and more patients survive long enough to require surgical treatment. The aim of this study is to review a series of 51 patients affected by metastatic lesions of the spine. Fifty-one patients affected by metastatic lesions of the spine were treated between 1987 and 2000. In 5 cases the cervical spine was involved, in 27 the thoracic and in 19 the lumbar spine. Surgery was planned according to the following labelling factors: type of malignancy, life expectancy, neurological involvement, pain, site of lesion, lesion extension and spine stability. Surgical treatment consisted of: minimally invasive cord decompression in 3 cases, posterior stabilization in 21, posterior stabilization and cord decompression in 13 cases, anterior resection and reconstruction of anterior column associated or not at posterior stabilization in 14 cases. Two patients died due to complications related to surgery. At the last available follow-up of 4 (±2.5) years, 29 patients had excellent results, 16 had good results, 2 fair and 2 poor results. One fair and 1 poor result had recurrence of the metastatic lesions of the spine and needed another operation. We believe that surgical treatment of metastatic lesion of the spine has a positive cost/benefit ratio for the patient's condition; in fact most of our patients had improvement of quality of life. The labelling factors of each lesion have to be carefully studied together with the oncologist to decide the correct surgical option because unsatisfactory results could be sometimes related to incorrect evaluation of the evolution of the neoplasm.

Key words Metastatic lesions • Spine • Surgical treatment

Introduction

Bone is one of the sites most frequently involved by metastatic lesion from several types of malignancies [1, 2] and the spine is the most frequent site of bone metastases [2–5].

In autopsy study several authors have shown that the rate of metastatic lesions of the spine (MLS) increases in a caudal direction along the vertebral bodies from the cervical to the lumbar regions of the spine [4, 6, 7], and this phenomenon seems to be correlated to the increasing volume of bone marrow within the vertebral bodies from the cervical to the lumbar spine.

Metastatic lesion of the spine is mainly diagnosed by the oncologist, who asks the orthopaedic surgeon to perform an intervention which may vary from symptomatic

decompression–stabilization to extralesional resection of one or more vertebral bodies depending on the nature of the disease and the condition of the patient.

The most frequent initial symptom of MLS is pain [1, 8–13]. Back pain caused by MLS at the beginning can simulate a radiculopathy due to degenerated disc disease, although it usually worsens at night, it resists usual analgesics, it lasts for relatively long periods and it progressively worsens with the evolution of the metastatic disease [14]. Irritation of an intercostal nerve may falsely suggest thoracic or abdominal disease. Sometimes diffuse pain can be present below the level of the MLS. Patients with cervical or thoracic spinal cord compression may experience pain in the legs. This is thought to be due to irritation of the spinothalamic tracts of the spinal cord.

Neurologic symptoms may result from compression due to direct invasion by MLS from the osseous structures to the spinal canal. In that case there is a slow progression of the neurologic symptoms from irritation to paralysis.

Spinal canal damage may also be caused by deformity due to MLS. With the collapse of the vertebral body, retropulsion of tumour and bony fragments into the canal may produce gradual neurological deterioration or, more frequently, acute deficits.

The aim of surgical treatment depends on several neoplasm and metastatic lesion labelling factors. Neoplasm labelling factors are usually studied by the oncologist, radiotherapist or general surgeon, who ask the orthopaedic surgeon to evaluate MLS labelling factors in order to plan surgical intervention.

The aim of the study is to review a series of 51 patients affected by metastatic lesions of the spine who had undergone surgical treatment.

Materials and methods

From 1987 to 2000 we surgically treated 51 patients affected by metastatic lesion of the spine. Twenty-eight were male and 23 female, with a mean age of 62 years (range, 40–77 years). In 17 cases the primitive tumour derived from the thyroid, 8 from the breast, 8 from the lung, 5 from the prostate, 5 from the kidney, 4 from multiple myeloma, 3 from non-Hodgkin lymphoma and in 1 from adenocarcinoma of unknown origin.

Eighteen patients presented solitary metastatic lesion and 33 presented other metastatic lesions (skeleton, lung, liver, brain etc.).

Forty-three patients had a single spinal localized, 3 on the cervical spine, 25 on the thoracic spine and 15 on the lumbar spine. Eight cases presented multiple localized, 3 cervicodorsal and 5 dorsolumbar.

Surgical strategy was planned according to a classification proposed in a previous paper [15], which considers labelling factors of the neoplasm (Table 1) and labelling factors of the metastatic lesion of the spine (Table 2).

Metastatic lesions of the spine can be studied by standard radiographs, CT scan and MRI. Studying vascularization of MLS may be very useful for planning surgical intervention: arteriography should be performed routinely to plan, when possible, preoperative embolization of the MLS. This technique facilitates the intralesional or extralesional resection by reducing bleeding during surgery.

According to the labelling factors of the neoplasm and metastatic lesion of the spine, surgical treatment may be based on one or more of the following procedures:

- posterior decompression;
- posterior stabilization;
- intralesional resection and substitution/reconstruction;
- extralesional resection and substitution/reconstruction.

Four patients with isolated osteolysis of the vertebral body without fracture or deformity, presenting solitary metastasis or multiple metastasis of a curable neoplasm, sensitive to therapies and in good condition with a life expectancy of more than 2 years, were classified as type 1A (Fig. 1). These patients were treated by a posterior stabilization performed by titanium instrumentation combined with extralesional anterior column resection. An anterior column resection was then performed in a second operation. Depending on the age and general condition of the patient and life expectancy, anterior reconstruction was performed with cages and PMMA or autologous bone graft.

Twenty-one patients, presenting isolated osteolysis of vertebral bodies without fracture or deformity, solitary metastasis or multiple metastasis of relatively controllable neoplasm, sensitive to some therapies and in fair condition with a life expectancy

Table 1 Labelling factors of neoplasm (type A, B, C)

Type of primitive tumour and its curability	A. High differentiation	B. Low differentiation	C. Anaplastic
Presence of other metastatic lesion	A. None	B. At follow-up	C. At diagnosis
Response to non-surgical treatment	A. Sensitive	B. Sensitive to some	C. Unsensitive
Previous surgery/radiation therapy	A. None	B. Surgery	C. Radiation therapy
General condition of the patient	A. Good	B. Fair	C. Poor
Life expectancy	A. More than 2 years	B. 1–2 years	C. Less than 1 year

Table 2 Labelling factors of metastatic lesion of the spine

MLS without deformity or pain	Type 1
MLS with instability or fracture associated with pain	Type 2
MLS with neurologic involvement	Type 3

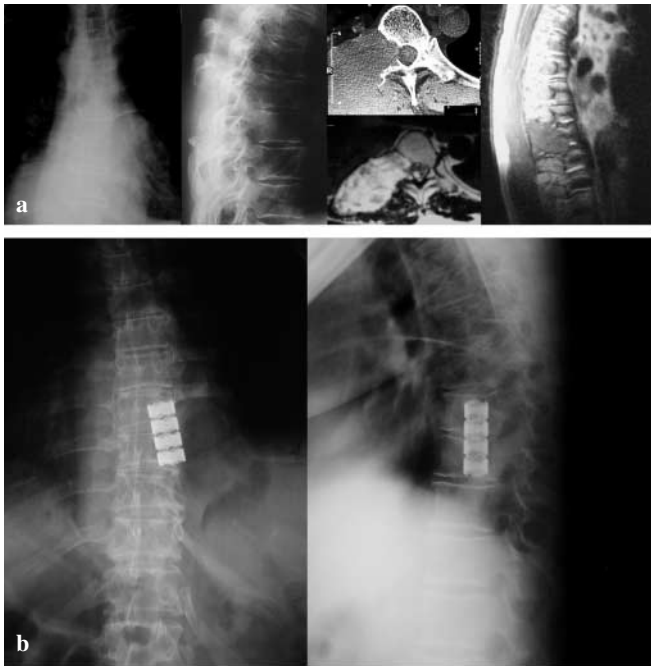

Fig. 1a Metastasis of T8–T9 from thyroid follicular carcinoma in a male aged 53 years. Imaging shows anterior and posterior metastatic bony involvement. **b** A thoracotomy approach was performed and wide resection of metastasis and of 8th rib, and anterior stabilisation by cage augmented by autogenous bone graft was performed. After 18 months the patient is still treated by I^{131}; no local recurrences or neurologic involvement

less than 2 years were considered as type 1B. These patients were treated by posterior stabilization alone, performed by titanium instrumentation with the goal to reduce the risk of pathologic fractures with intractable pain or neurologic involvement.

Five patients presented instability with intractable pain or pathologic fracture or deformity. These patients, in good condition with a life expectancy more than 2 years, were affected by solitary metastasis or multiple metastasis of curable neoplasm, sensitive to therapies and were classified as type 2A (Fig. 2). In these cases surgical treatment was considered to relieve pain or to reduce the risk of neurologic involvement. The posterior procedure consisted of stabilization with titanium instrumentation. An anterior column resection was then performed in a second operation. Reconstruction of the anterior column was performed with cages and PMMA, or with cages and autologous bone graft.

Eight patients affected by solitary metastasis or multiple metastasis of relatively controllable neoplasm, sensitive to some therapies, presented instability with intractable pain or pathologic fracture or deformity. These patients, in fair or poor condition, with a life expectancy of less than 2 years, were classified as type 2B. In these cases posterior stabilization alone was considered the treatment of choice with the goal of reducing pain due to instability and reduce the risk of neurologic involvement.

Five patients presented neurologic involvement due to the direct invasion of the spinal canal of the tumour, or fragments of a pathologic fracture, or narrowing of the spinal canal due to pathologic deformity. These patients, in good condition with a

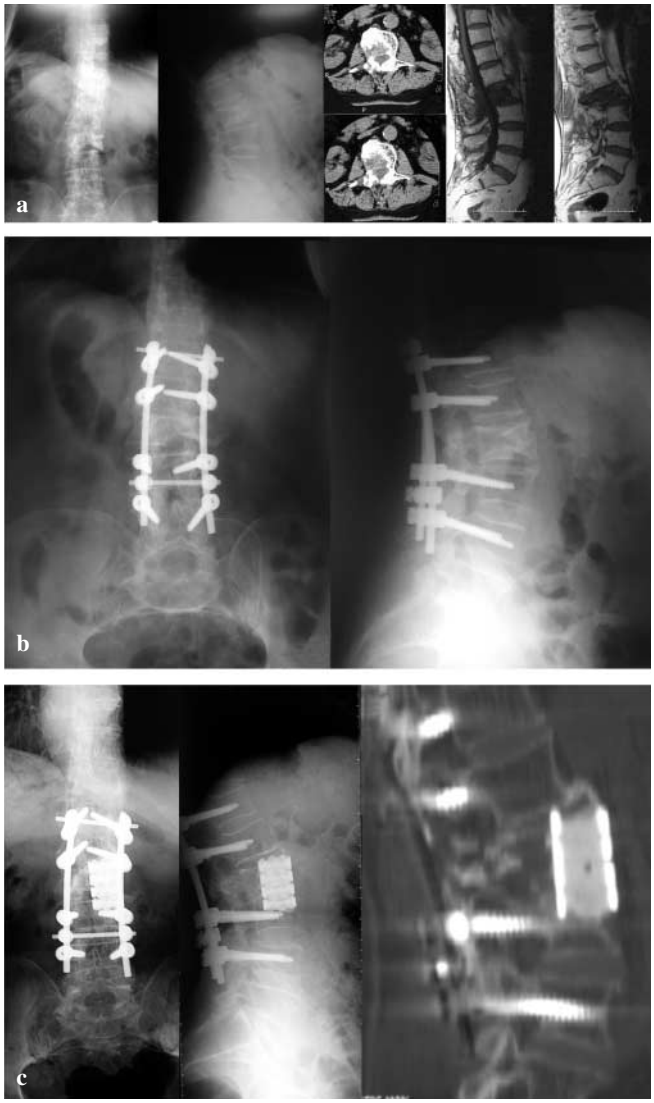

Fig. 2a Metastasis of L2 from hypernephroma in a female aged 61years. **b** First stage: posterior stabilisation. **c** Second stage: anterior wide resection by transperitoneal approach and stabilisation by cage augmented by acrylic cement. No neurological involvement. No local recurrence 1 year after surgery

life expectancy more than 2 years, affected by solitary metastasis or multiple metastasis of curable neoplasm, sensitive to therapies, were classified as type 3A. They were treated by a posterior procedure that consisted of stabilization with titanium instrumentation. Then a wide laminectomy of the compressed area was performed. Roots and dural sac were decompressed by removing fracture fragments or neoplasm mass penetrating in the spinal canal. Anterior column resection was then performed in a second operation. Reconstruction of the anterior column was performed with cages and PMMA, or with cages and autologous bone graft.

Five patients, in fair or poor condition with a life expectancy of less than 2 years, were affected by solitary metastasis or multiple metastasis of relatively controllable neoplasm, sensitive to

some therapies. These patients presenting neurologic involvement due to the direct invasion of the spinal canal of the tumour, fragments of a pathologic fracture or narrowing of the spinal canal due to pathologic deformity were classified as type 3B.

Three patients with neurologic involvement due to the direct invasion of the spinal canal of the tumour, fragments of a pathologic fracture or narrowing of the spinal canal due to pathologic deformity were affected by multiple metastasis of relatively uncontrollable neoplasm, insensitive to therapies. These patients, in poor condition with a poor life expectancy, were considered as type 3C. In these cases an isolated posterior decompression by laminectomy or foraminotomies was performed.

Posterior stabilization was usually performed by using Write SIR titanium instrumentation. Thoracic spine until the level of T-9 was generally fixed by using hooks, whereas from T-10 to the sacrum fixation was achieved by using pedicle screws. The use of a stainless steel Harshill frame and sublaminar wire fixation instrumentation, which produces problems in subsequent imaging of the metastatic lesion, was used in the first part of the study, only in cases with a very short life expectancy.

Extralesional or intralesional resection of the lesion in the anterior column was always performed by anterior approach in a second operation.

The choice of the material to reconstruct the anterior column after resection depended on the level of the lesion and the life expectancy of the patient. In cases of longer life expectancy reconstruction was performed by using cages with autologous bone graft, whereas in the other cases cages were filled by PMMA.

All patients were followed up monthly up to the 6th month, then twice a year. Surgical treatment was considered excellent if patients had no other problem related to their MLS, good if there was an improvement in pain, fair if there was an improvement only for a certain period of time, and poor if there was no difference or worsening of the preoperative conditions.

Results

One patient affected by 2A MLS and one patient affected by 3A lesion died because of complications related to anterior reconstructive surgery. One patient affected by type 2B MLS developed haematoma and wound dehiscence, which resolved. No infections were observed. Mean surgical time was 4.2(±1.3) hours for posterior stabilization and 6.3(±1.9) hours for anterior resection and reconstruction. At the last available follow-up of 4(±2.5) years, 29 cases had excellent results, 16 had good results, 2 fair and 2 poor results. Two fair results had a recurrence of intractable pain and neurological deficit, which needed another operation.

Discussion

According to the literature, we believe that surgical treatment of MLS has a positive cost/benefit ratio for the patient's condition; moreover we believe that classification as a guideline for treatment was useful for both the orthopaedic surgeon and the oncologist. We believe that the key point in treatment of MLS would be the choice of the right surgical option. By using this classification, treatment was adequate in 88% of the cases despite the complicated general status and the rather short life expectancy of these patients. Only in two patients the labelling factors of the neoplasm were probably overestimated, as they died of causes related to the anterior resection surgery; and in two more the labelling factors of the neoplasm underestimated the real status, as they needed a second operation to relieve intractable pain. All other patients received treatment which improved their of quality of life. As the labelling factors of the MLS were relatively easy to evaluate for the orthopaedic surgeon, labelling factors of the neoplasm have to be carefully studied together with the oncologist to decide the correct surgical option because unsatisfactory results could be sometimes related to incorrect evaluation.

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