

# Skeletal Muscle Metastases of Carcinoma: a Clinicopathological Study of 12 cases

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**Objective:** To clarify the clinical and magnetic resonance (MR) imaging features of a rare condition of metastasis of carcinoma to skeletal muscle.

**Method:** Clinicopathological findings for 12 patients (10 male, two female, age range 48–89 years, mean age 68 years) with skeletal muscle metastases of carcinomas were reviewed retrospectively.

**Results:** In nine of the 12 patients the skeletal muscle metastasis was presented as 'painful mass'. The lung was found to be the most common primary source, accounting for 33% of the cases, and the lower extremity was the most common metastatic site, accounting for 67% of the current series. Diagnosis was made by biopsy in all cases. Overall, MR images were not specific, but on the gadolinium–DTPA enhanced MR images, extensive peritumoral enhancement associated with central necrosis was found in 11 of the 12 patients (92%). Seven patients died within 2–19 months (average: 9 months) after the detection of the skeletal muscle metastasis, among whom only one patient was continuously disease free for 92 months after wide excision of the metastatic lesion.

**Conclusion:** Skeletal muscle metastasis is often presented as a painful mass in patients with known primary carcinoma. For diagnosis, needle biopsy is mandatory. However, a painful mass with an extensive peritumoral enhancement should be highly suspected to represent carcinoma metastasis to skeletal muscles. In selected patients, wide excision with combined chemotherapy could yield unexpectedly good results.

*Key words:* soft tissues – neoplasms – magnetic resonance – muscles – cancer

## INTRODUCTION

Skeletal muscle metastasis is a rare condition (1) and differentiation between a primary soft tissue sarcoma and metastatic carcinoma is difficult without biopsy (2). Although numerous case reports are now available (3–10), there have been few systematic studies with regard both to clinical and magnetic resonance (MR) imaging features of skeletal muscle metastasis. The purpose of this paper is to describe the clinical and MR imaging features of skeletal muscle metastasis.

## SUBJECTS AND METHODS

We reviewed retrospectively the records of 12 patients, with well-documented, biopsy-proven metastasis of carcinoma into

skeletal muscles treated at three oncology centers from January 1994 to October 2003. All clinical data were carefully reviewed with regard to the initial presenting symptoms, anatomical location of metastasis, histology of the primary carcinoma, treatment and survival. Follow-up data and outcome were available for all 12 patients. A needle biopsy of the metastatic lesion was performed in all cases. The primary inclusion criteria were the presence of skeletal muscle mass which was separated from the primary site and confirmed either histologically or by clinical diagnosis. The exclusion criteria were primary soft tissue sarcoma and other soft tissue metastases other than skeletal muscle metastasis. Autopsy studies were excluded. Plain X-ray, computed tomography and MR imaging with gadolinium–DTPA enhancement were available for all patients. The MR images were reviewed by two radiologists (M.H. and S.E.) and evaluated with regard to (i) signal intensity, (ii) margin, (iii) necrosis and (iv) Gd-enhancement pattern. The evaluation of signal intensity was based on comparison with adjacent muscles in both T1- and T2-

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**Table 1.** Clinical features of patients with skeletal muscle metastasis

Patient No.	Age (years) and gender	Symptoms (mass)	Duration (months)*	Tumor detected first	Primary tumor		Skeletal muscle metastasis		Follow-up <sup>‡</sup>
					Site	Treatment <sup>†</sup>	Site	Treatment <sup>†</sup>	
1	55M	Painful	1	Primary	Lung	Excision	Thigh	RaTx	2 m DOD
2	77F	Painful	8	Primary	Lung	Excision	Thigh	Wide	92 m NED
3	48M	Painful	1	Primary	Gastric	Excision	Buttock	Wide	6 m DOD
4	61M	Painless	72	Primary	Thyroid	Excision	Elbow	Wide	6 m DOD
5	73F	Painful	50	Primary	Uterus	Excision	Calf	RaTx	32 m AWD
6	74M	Painful	–	Metastatic	Lung	Chemo	Calf	RaTx	19 m DOD
7	51M	Painful	–	Metastatic	Bladder	Chemo	Thigh	RaTx	3 m DOD
8	53M	Painless	–	Metastatic	Lung	Chemo	Calf	RaTx	16 m DOD
9	72M	Painful	–	Metastatic	Occult	Chemo	Calf	RaTx	8 m DOD
10	80M	Painless	–	Metastatic	Occult	Chemo	Shoulder	RaTx	30 m AWD
11	82M	Painful	9	Primary	Gingiva	Excision	Forearm	RaTx	2 m AWD
12	89M	Painful	38 years	Primary	Gastric	Excision	Shoulder	RaTx	10 m AWD

\*Duration between primary tumor resection and the detection of metastases. <sup>†</sup>Chemo, systemic chemotherapy; RaTx, radiation therapy; Wide, wide excision. <sup>‡</sup>DOD, died of the disease; AWD, alive with disease; NED, no evidence of disease.

weighted images. The tumor margins were evaluated as clear or unclear according to their relationship to the surrounding muscles. Necrosis was evaluated according to the signal intensity of the tumors on the T1- and T2-weighted images. Necrosis was evaluated as positive when the tumor showed low signal intensity on the T1-weighted images, high signal intensity on the T2-weighted images, and no enhancement on the Gd-enhancement images.

## RESULTS

The clinical data for the 12 patients (10 male, two female) are summarized in Table 1. The average age of the patients was 68 years, range 48–89 years. In nine of the 12 patients the skeletal muscle metastasis was presented as 'painful mass'. The size of the mass ranged from 2 to 12 cm with an average of 7 cm. In seven patients the primary lesion was detected first, among whom subsequent skeletal muscle metastasis occurred after an average of 23.5 months in six, whereas in one patient (No. 12) the skeletal muscle metastasis occurred 38 years after the excision of the primary tumor. However, in the other five patients, the skeletal muscle metastasis was detected first, among whom the primary lesion was clarified in three cases. The primary tumors in 10 patients were located in the lung (four), stomach (two), urinary bladder (one), thyroid (one), uterus (one) and gingiva (one). In two patients (Nos 9 and 10), the biopsy showed poorly differentiated adenocarcinoma with unknown origin, and carcinoma of the rectum was suspected in one of them. No osseous metastasis was found in a radiographic bone survey. In two cases (Nos 2 and 10) the skeletal muscle metastases occurred as a solitary mass without any other clinically detectable metastases, whereas in the other 10 cases the skeletal muscle metastases occurred as part of disseminated disease such as lymph node, visceral and brain metastases. The pri-

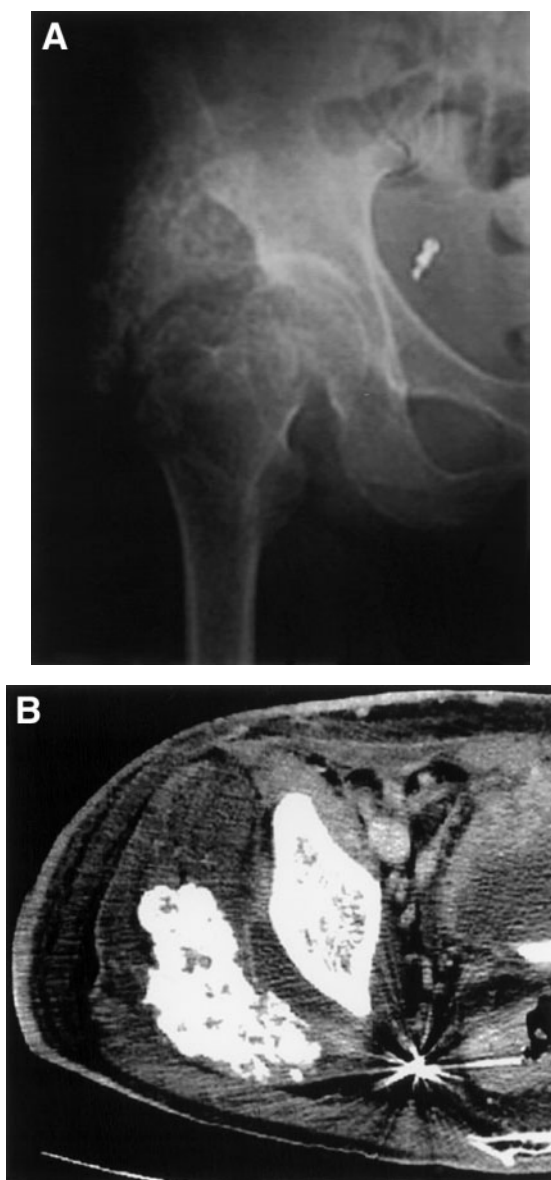
mary tumors were treated with wide excision in seven patients whereas the other five patients received chemotherapy. The sites of the muscle metastases were lower limb in seven patients (quadriceps, three; soleus, three; peroneus brevis and longus, one), buttock in one patient (gluteus medius) and upper limb in four (deltoid, one; brachioradialis, one; infraspinatus, one; flexor carpi radialis, one). The metastatic lesions were treated with wide excision in three patients whereas nine patients received radiotherapy.

Plain X-ray and CT were of little value for characterization of the mass. However, in one case calcification was characteristic (No. 3) (Fig. 1). On T1-weighted images, the skeletal muscle metastasis showed isosignal intensity in nine of the 12 cases. The margin of the mass on the T1-weighted images was ill-defined in nine patients whereas in the other three patients the margin of the mass was relatively clear. The T2-weighted images revealed a heterogeneous intramuscular mass with a well-defined margin. On the gadolinium-DTPA enhanced images, extensive peritumoral enhancement associated with central necrosis was observed in 11 patients (92%) (Fig. 2).

Histological findings of the biopsy specimen were consistent with the primary carcinoma in 10 patients. Seven patients died at 2–19 months (mean, 9 months) after the detection of the skeletal muscle metastasis. Only one patient (No. 2) was continuously disease-free for 92 months after the wide excision of the metastatic lesion. The remaining four patients (Nos 5, 10, 11 and 12) were alive with disease (32, 30, 2, 10 months) with an average of 18.5 months after radiation therapy.

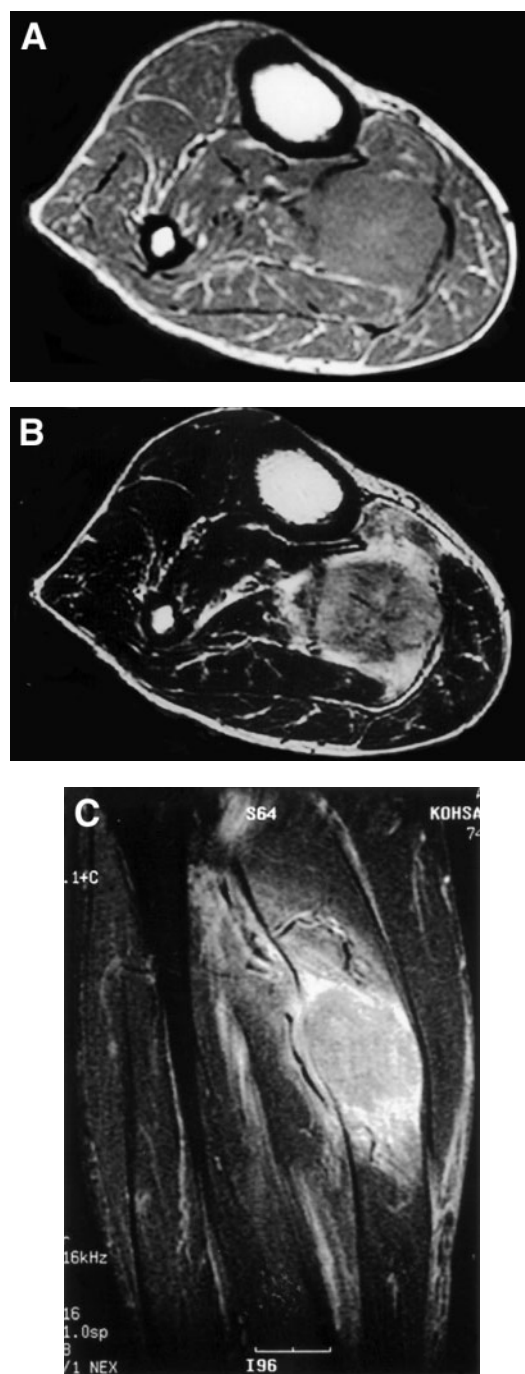
## DISCUSSION

Metastasis of carcinoma to the skeletal muscle is a rare event. From January 1994 to May 2001, among 2557 patients with lung cancer who were treated in three oncology centers in



**Figure 1.** Carcinoma of the stomach with metastasis to the buttock. A 48-year-old man (patient No. 3) with a painful mass in the buttock. (A) Anteroposterior radiogram showed a mass with amorphous calcification in the right hip region. (B) On the CT scan, the mass with heterogeneous calcification was located in the gluteus muscle.

Japan, only four patients (0.16%) developed metastasis to the skeletal muscle. As there have been numerous case reports but very few studies on large case-series for this condition, there is a lack of clear guidance for the clinical management of such patients. Therefore, it is of great value to establish guidelines for the management of skeletal muscle metastasis and also the primary lesions for these patients. In our study, the most common primary lesion was carcinoma of the lung and the most common location of the metastasis was the skeletal muscles of the lower limb, which was in agreement with a previous study (2). In the current series, the skeletal muscle of the thigh and the calf became the most common anatomical sites whereas the skeletal muscle of the upper limb and other sites were less



**Figure 2.** Adenocarcinoma of unknown origin with metastasis to calf muscle. A 72-year-old man (patient No. 9) with a painful mass in the left calf. (A) On the axial T1-weighted image (TR, 519; TE, 9.8), the boundaries of the mass are not clear and the mass has isosignal intensity. (B) On the axial T2-weighted image (TR, 4500; TE, 97.8), the mass is heterogeneous with central necrosis. (C) On the sagittal enhanced image (TR, 440; TE, 9.4), the mass is located in the soleus. Peritumoral enhancement is characteristic.

involved. The most common histological type was adenocarcinoma of the lung or of the gastrointestinal tract, which was confirmed by needle biopsy. However, the histological findings in five patients in whom the skeletal muscle metastasis was detected prior to the primary tumors were not informative

regarding the identification of the sites of the primary tumors. The clinical features of the metastatic carcinoma to skeletal muscles closely resemble those of soft tissue sarcomas in many respects (4). However, from our clinical experience, the 'painful mass' may have occurred more often in patients with skeletal muscle metastasis than in patients with soft tissue sarcomas, even though there are no quantitative data to support this impression. Diagnosis is established mainly by needle biopsy. However, prior to this pathological diagnosis, radiographic evaluation of the mass often provides valuable information with regard to the overall assessment and treatment of this lesion. Compared with the MR image, a plain radiogram and CT were of little value with regard to the character of the mass. Therefore, MR imaging is a valuable imaging modality both to establish the diagnosis and to plan treatment strategy. Especially MR imaging with intravenous gadolinium enhancement was helpful when planning the biopsy of these lesions as it is useful to evaluate the vascularity of the tumor. We believe that the extensive peritumoral enhancement associated with the central necrosis was one of the characteristic features of the skeletal muscle metastasis. This was found in 92% of the cases. Although MR imaging is not specific for skeletal muscle metastasis (11), it is an indispensable tool for the diagnosis and treatment with which clinicians may contemplate the general management of those patients.

Treatment of these patients may depend on the clinical setting and the condition of the patient. Treatment options may include radiotherapy, chemotherapy and surgical excision. Excision of the painful mass may be helpful in carefully selected patients. In our series, three patients underwent wide excision, among whom one patient was the longest survivor. Interestingly, in the study of Herring et al. (2), one of the longest survivors, in whom the primary source was lung cancer, had also received wide excision with radiotherapy. The wide excision effectively relieved the clinical symptoms of these three patients. During the wide excision, the infiltrative borders of the tumor were excised as much as possible since the excision area was predetermined according to the peritumoral area on the MR image. No recurrence was found after the wide excision in the current series, despite an earlier report (9) of the recurrence of a local lesion after wide excision. Therefore, we believe that in carefully selected patients excision of the painful mass will not only relieve pain but would boost the morale of the patient and therefore may prolong the survival time. Compared with wide excision, radiotherapy also effectively controlled the 'pain' and the 'size' of the metastatic lesion in nine out of the 12 patients to whom combined chemotherapy and radiotherapy were administered. However, the complications associated with radiotherapy such as skin burn and muscle contracture were also frequently encountered. In that case, radiotherapy should be commenced after the local complication has been brought under control. Since skeletal metastasis was often manifested as part of disseminated disease, the radiotherapy dose should be specific. The radiotherapy dose was often decided according to the location and depth of this type of metastatic lesion, in which an average of 40–50 Gy can

effectively control the size of the lesion. Should the metastatic lesion be located in the buttock area the radiotherapy dose can be slightly increased. The prognosis of the patients in the current study was similar to that reported previously (2). In our series, seven of the 12 patients died at an average of 9 months after the detection of skeletal muscle metastasis, and only one patient (No. 2) was continuously disease-free for 92 months after the wide excision of the metastatic lesion. The remaining four patients (Nos 5, 10, 11 and 12) were alive with disease (32, 30, 2, 10 months) with an average of 18.5 months after the radiation therapy. Treatment of those patients should be specific, although in most of the patients chemotherapy and radiotherapy were also promising.

The true incidence of skeletal muscle metastasis in the general population could not be established from this study. Four skeletal muscle metastasis patients were found during a 7 year period (1994–2001), whereas eight skeletal muscle metastasis patients were found during the next 2 years (2001–2003). This sudden increase in skeletal muscle metastasis patients within 2 years may or may not be related to the increased incidence of carcinomas in the Japanese population (12) due to aging and other factors. Also, the improvements in diagnostic techniques in recent years, namely the detection of small metastatic lesions by high-resolution MRI and other investigative methods, and better follow-up systems may have helped in detecting these additional lesions. Since our study was a hospital-based, multi-center investigation of skeletal muscle metastasis among different carcinomas patients, the 'frequency' of these lesions among carcinomas patients did not truly reflect their 'incidence' in the general population. Therefore, the incidence of this lesion in the general population should be further investigated in future studies.

In summary, the clinical manifestations and the MR imaging features of metastatic carcinoma to skeletal muscles closely resemble those of the soft tissue sarcomas in many respects, but painful mass and the extensive peritumoral enhancement pattern in MR imaging are common in the former. Therefore, any painful soft tissue mass occurring in patients with a known history of carcinoma, particularly with extensive peritumoral enhancement associated with central necrosis, is highly suspicious for skeletal muscle metastasis. For diagnosis, needle biopsy is mandatory. Since the metastasis of carcinomas appears to be a late event in the progression of the disease, the treatment of these patients should be specific. In general, wide excision, chemotherapy, radiotherapy and a combination of the three usually provide satisfactory results. Since most patients eventually died of the primary carcinomas, we believe that skeletal muscle metastasis is one of the ominous signs for prognosis.

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