Neuroimaging and Treatment Implications of Patients with Multiple Epidural Spinal Metastases

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BACKGROUND. Although multiple spinal epidural metastases (MEMs) commonly occur in cancer patients, their clinical significance remains uncertain. The authors attempted to ascertain the incidence of MEMs and their association with the completeness of spinal imaging by magnetic resonance (MR) scanning versus myelography to determine how often they are missed because of incomplete spinal imaging and to assess their prognostic and treatment implications.

METHODS. A review of 337 epidural spinal cord compression (ESCC) cases seen at the Mayo Clinic between 1985 and 1993 was conducted.

RESULTS. ESCC patients undergoing myelography only were significantly more likely to undergo complete spinal imaging (CSI) than patients undergoing either MR scan only or both imaging modalities ($P < 0.0001$). MEMs were detected in 32% of patients undergoing CSI and 18% of patients with incomplete spinal imaging ($P = 0.02$). Failure to image the cervical spine in patients with symptomatic thoracic or lumbar epidural lesions would have missed secondary epidural lesions in only 1% of patients; however, this figure increased to 21% for failure to image either the thoracic or lumbosacral spine when symptomatic disease was located elsewhere. Radiation oncologists included secondary epidural deposits in treatment ports in 93% of MEM cases. In a multivariate model, the presence of MEMs was an independent prognostic factor for poorer survival.

CONCLUSION. The incidence of MEMs in patients with ESCC is approximately 30%, and their presence frequently alters treatment plans. It appears safe to forgo cervical spine MR scanning in patients with radiographically verified thoracic or lumbar ESCC; however, careful imaging of the thoracic and lumbar spine should be considered in all ESCC patients to detect MEMs. Cancer 1998;83:1593–601. © 1998 American Cancer Society.

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Epidural spinal cord compression (ESCC) occurs in approximately 5% of all cancer patients.1 Until recently, myelography was the diagnostic tool of choice for imaging the epidural space.2–4 In the absence of a high grade block, intrathecal contrast material flows freely in the spinal subarachnoid space, thereby demonstrating any sites of epidural metastasis. The addition of computed tomography (CT) to myelography reduces the number of cases with apparent complete block, but in some cases a second puncture with instillation of contrast rostral to a block remains necessary to delineate the upper extent of the epidural metastasis and to demonstrate any additional sites of disease. Previous studies based on myelograms have suggested that between 9–38% of patients with ESCC have multiple spinal epidural metastases (MEM).5–11 Some authors have suggested the frequency of MEMs depends on the underlying tumor type, with
lung carcinoma being quite unlikely to produce MEMs.\textsuperscript{5,10} Whether asymptomatic sites of epidural disease that are detected incidentally should receive treatment is uncertain.\textsuperscript{10,12} Nonetheless, the phenomenon of MEMs is the principal reason many authorities recommend that the entire spine be imaged in patients with ESCC.\textsuperscript{7,8,12–17}

Over the last decade magnetic resonance (MR) scanning largely has replaced myelography in the diagnosis of ESCC.\textsuperscript{18–20} Several studies dating from MR scanning’s early years demonstrated it to be equal to myelography in diagnosing ESCC.\textsuperscript{21,22} Recent technical improvements in MR scanning, in addition to its convenience, ability to visualize the entire spine regardless of complete subarachnoid block, and superiority to myelography in demonstrating bone and intramedullary lesions make it the study of choice for patients without contraindications. We are aware of only a single MR-based study addressing the frequency of MEM; this study reported MEMs in 49% of patients with ESCC.\textsuperscript{23} We have observed that in many cases of ESCC only the symptomatic spinal segment undergoes MR scan (i.e., spinal imaging is incomplete). We reviewed our institutional experience with ESCC over the last several years to determine whether spinal imaging was more likely to be incomplete with MR scanning than with myelography, which primary tumors were most likely to produce MEMs, how often MEMs would be missed with incomplete spinal imaging, whether the presence of MEMs altered the patient’s prognosis, and whether the detection of MEMs altered treatment plans.

**METHODS**

We retrospectively reviewed the clinical histories of all 337 patients with ESCC evaluated at the Mayo Clinic between January 1, 1985 and December 31, 1993. The Mayo Clinic is a primary care facility for the city of Rochester, Minnesota and surrounding Olmsted County, a secondary referral center for southeastern Minnesota and adjoining areas of Iowa and Wisconsin, and a tertiary referral center for much of the upper Midwest. The Mayo Clinic has an indexing system for diagnostic information that we used to identify our study subjects. We reviewed each patient’s medical record, including inpatient and outpatient visits. Clinical features such as primary tumor site; degree of neurologic dysfunction; clinically suspected site(s) of epidural disease; plain spinal radiograph, radionuclide bone scan, MR scan, and myelogram findings; treatments directed at ESCC; and patient follow-up were recorded in a standardized database. The presence of ESCC was confirmed radiographically with either MR scanning or myelography (with or without CT) in all cases. Determination of the presence and location of epidural metastases was based on the original interpretation of the staff neuroradiologist. By definition, two sites of epidural disease had to be separated by at least one uninvolved vertebral level to be considered MEMs. Epidural metastases were defined as lesions in the epidural space (generally arising from contiguous bone) that altered the contour of the thecal sac, but did not necessarily have to deform the spinal cord or cauda equina. One author (B.P.O.) reviewed all available CT-myelograms and MR scans of patients with MEMs to assess the degree of thecal sac impingement from each epidural metastasis. For this determination, the percentage of thecal sac compression in the sagittal plan was measured and assigned to a category of none, 1–24%, 25–74%, 75–99%, or 100% obliteration.

The chi-square, Wilcoxon rank sum, and Fisher’s exact tests were used to test the equality of distributions of patient, imaging, or disease characteristics. Overall survival distributions were estimated with Kaplan–Meier survival curves, and the log rank test was used to test the equality of these curves.

**RESULTS**

The patient population was comprised of 129 women (38%) and 208 men (62%). Age at the time of diagnosis of the primary tumor ranged from 4–87 years with a median of 60 years; age at the time of initial presentation of ESCC ranged from 4–89 years with a median of 64 years. The most common tumor types were those of the (24%), breast (19%), and lung (17%) (Table 1). Symptomatic epidural disease was located most frequently at the thoracic level (61%), compared with 29% at the lumbo-sacral level and 10% in the cervical spine. Table 1 demonstrates that there was no significant difference in the distribution of ESCC location among the various tumor types ($P = 0.3$ by Fisher’s exact test).

Patients undergoing myelography only were significantly more likely to undergo complete spinal imaging (CSI) than patients who underwent either spinal MR scans only or both forms of imaging ($P < 0.0001$ by Fisher’s exact test). The entire spinal column was imaged in 94% (210 of 224) of patients undergoing myelography but only 51% (65 of 127) of those undergoing MR scans. Fourteen patients underwent both myelography and MR scanning; all 14 had CSI: 9 by myelogram only, 1 by MR scan only, and 4 by both modalities. There was no trend for more recent MR scans (1991–1993) to image the complete spine than earlier scans (1985–1990) ($P = 0.19$ by the chi-square test). Of the 62 patients with incomplete spinal MR scans, 68% did not have the cervical spine imaged, 28% did not have the thoracic spine imaged, and 42% did not have the lumbo-sacral spine imaged. Overall, 80% (271 of 337) of all ESCC patients received CSI.
Apart from diagnostic imaging modality, the only factors that significantly differed between patients who received CSI and those who did not (Table 2) were their primary tumor types (\(P = 0.0506\) by Fisher’s exact test) and the ESCC treatment they received (\(P = 0.0004\) by Fisher’s exact test). The marginal association between undergoing CSI and primary tumor type is attributable to patients with myeloma or sarcoma being less likely to undergo CSI than patients with other primary tumors (\(P = 0.0044\) and \(P = 0.038\), respectively).

MEMs were detected significantly more often in patients with CSI than in those without CSI (\(P = 0.0242\) by the chi-square test). Specifically, MEMs were detected in 31% (65 of 210) of the patients who underwent total spinal myelography but only 14% (2 of 14) of those with incomplete myelography. Similarly, MEMs were detected in 40% (26 of 65) of patients with complete spinal MR scans but only 19% (12 of 62) of those with incomplete MR scans. Overall, MEMs were found in 32% (88 of 271) of all patients undergoing CSI but only 18% (12 of 66) of all patients with incomplete spinal imaging. The only other variable with a significantly different distribution between patients with and without MEMs was the presence of MEMs (Table 4).

Of the 100 patients with MEMs, 64 had 2 sites of epidural disease, 26 had 3 sites, 7 had 4 sites, and 3 had 5 sites. As portrayed in Table 5, the number of sites involved with epidural disease did not differ by primary tumor type (\(P = 0.75\) by Fisher’s exact test). Among the patients with CSI and MEMs (n = 88), secondary epidural metastases were equally common in the thoracic and lumbosacral spine (n = 52) but were rare in the cervical spine (n = 3). Sixty of these 88 patients (68%) had at least 1 secondary epidural deposit localized in a different spinal segment from their primary ESCC site.

We then restricted analysis to the 271 patients who had undergone CSI to ascertain the risk of missing a secondary epidural metastasis if a given spinal segment (cervical, thoracic, or lumbosacral) was not imaged in a patient with symptomatic epidural disease in a different spinal segment. Failure to image the cervical spine in a patient with principal ESCC in the thoracic or lumbosacral region would have missed a cervical epidural metastasis in \(1\%\) of patients (2 of 244). In contrast, failure to image the thoracic spine in patients with primary epidural disease elsewhere would have missed thoracic epidural metastases in \(21\%\) of patients (22 of 104). Similarly, omitting imaging of the lumbosacral spine in patients whose clinically relevant lesion was located rostrally would have missed epidural metastases in \(21\%\) of patients (39 of 190).

Sixty-five of the 100 patients with MEMs had spinal MR scans or CT-myelograms available for review. The degree of thecal sac obliteration from the primary (symptomatic) epidural lesion was 100% in 3 patients (5%), 75–99% in 10 patients (15%), 25–74% in 22 pa-

### Table 1

| Tumor Type   | Cervical (N = 33; 10%) | Thoracic (N = 206; 61%) | Lumbosacral (N = 98; 28%) | Total |
|--------------|-----------------------|-------------------------|--------------------------|-------|
|              | No. | %  | No. | %  | No. | %  | No. | %  |
| Prostate     | 8   | 10%| 50  | 62%| 23  | 28%| 81  | 24%|
| Breast       | 5   | 8% | 40  | 62%| 19  | 30%| 64  | 19%|
| Lung         | 7   | 12%| 37  | 64%| 14  | 24%| 58  | 17%|
| Lymphoma     | 1   | 4% | 15  | 60%| 9   | 36%| 25  | 7% |
| Myeloma      | 0   | —  | 3   | 13%| 3   | 13%| 23  | 7% |
| Unknown primary | 1 | 7% | 10  | 67%| 4   | 27%| 15  | 4% |
| Renal cell   | 2   | 13%| 7   | 47%| 6   | 40%| 15  | 4% |
| Sarcoma      | 2   | 13%| 9   | 60%| 4   | 27%| 15  | 4% |
| Colorectal   | 3   | 23%| 3   | 23%| 7   | 54%| 13  | 4% |
| Others       | 4   | 14%| 15  | 54%| 9   | 32%| 28  | 8% |

ESCC: epidural spinal cord compression.

* Six thyroid, five melanoma, five head and neck, three hepatocellular, two pancreas, one esophageal, one gastric, one chronic myelogenous leukemia, one intestinal carcinoid, one ovary, one malignant schwannoma, one basal cell.
patients (34%), 1–24% in 25 patients (38%), and minimal in 5 patients (8%). The extent of thecal sac compression from the most extensive secondary epidural metastasis was 75–99% in 4 patients (6%), 25–74% in 8 patients (12%), 1–24% in 32 patients (49%), and minimal in 21 patients (32%). The largest secondary epidural metastasis produced a higher category of thecal sac compression than the primary clinical lesion in 11% of patients (7 of 65), the same category in 28% of patients (18 of 65), and a lower category in 62% of patients (40 of 65).

Because treatment was not standardized, the 100

### TABLE 2
Association between Extent of Spinal Imaging and Descriptive Factors

| Descriptive factor | CSI |
|--------------------|-----|
|                    | Yes (N = 271) | No (N = 66) |
|                    | No. | %  | No. | %  | P value |
| Gender             |     |    |     |    |        |
| Male               | 173 | 64%| 35  | 53%| 0.121 |
| Female             | 98  | 36%| 31  | 47%|        |
| ESCC main level    |     |    |     |    | 0.96   |
| Cervical           | 26  | 10%| 7   | 11%|        |
| Thoracic           | 166 | 61%| 40  | 61%|        |
| Lumbosacral        | 79  | 29%| 19  | 29%|        |
| Neurologic dysfunction |      |    |     |    | 0.71   |
| Back pain only     | 57  | 21%| 13  | 20%|        |
| Radiculopathy      | 119 | 44%| 32  | 48%|        |
| Myelopathy/cauda equina syndrome | 93 | 34%| 20  | 30%|        |
| Asymptomatic       | 2   | 1% | 1   | 2% |        |
| Treatment          |     |    |     |    | 0.0004 |
| Surgery only       | 6   | 2% | 3   | 4% |        |
| Radiation only     | 184 | 68%| 35  | 53%|        |
| Chemotherapy only  | 2   | 1% | 5   | 8% |        |
| Surgery/radiotherapy| 19 | 7% | 8   | 12%|        |
| Surgery/chemotherapy| 1  | 0.4%| 0 | — |        |
| Radiotherapy/chemotherapy | 49  | 18%| 7   | 11%|        |
| All three          | 6   | 2% | 1   | 2% |        |
| None               | 4   | 1% | 7   | 11%|        |
| Tumor Type         |     |    |     |    | 0.0506 |
| Breast             | 51  | 19%| 13  | 20%|        |
| Colorectal         | 13  | 5% | 0   | — |        |
| Lung               | 48  | 18%| 10  | 15%|        |
| Lymphoma           | 20  | 7% | 5   | 8% |        |
| Myeloma            | 13  | 5% | 10  | 15%|        |
| Prostate           | 69  | 25%| 12  | 18%|        |
| Renal cell         | 12  | 4% | 3   | 4% |        |
| Sarcoma            | 9   | 3% | 6   | 9% |        |
| Others             | 22  | 8% | 6   | 9% |        |
| Unknown primary    | 14  | 5% | 1   | 2% |        |
| Multiple vertebral metastases |      |    |     |    | 0.67   |
| Yes                | 165 | 61%| 38  | 58%|        |
| No                 | 106 | 39%| 28  | 42%|        |
| ESCC as initial manifestation of malignancy? |     |    |     |    | 0.60   |
| Yes                | 52  | 19%| 15  | 23%|        |
| No                 | 219 | 81%| 51  | 77%|        |
| Mos between initial cancer diagnosis and ESCC |     |    |     |    | 0.94   |
| Minimum            | −0.4|    | −0.1|    |        |
| Median             | 18  |    | 23  |    |        |
| Maximum            | 379 |    | 230 |    |        |
| Age (yrs)          |     |    |     |    | 0.69   |
| Minimum            | 19  |    | 4   |    |        |
| Median             | 64  |    | 67  |    |        |
| Maximum            | 88  |    | 89  |    |        |

CSI: complete spinal imaging; ESCC: epidural spinal cord compression.
patients with MEMs received a variety of therapies directed at the primary epidural disease (Table 3). Fractionated radiotherapy was part of the treatment in 96 of these patients. Radiation treatment ports were available for review in 90 of the MEM patients receiving radiotherapy, and at least 1 secondary epidural metastasis was included in the ports in 93% (84 of 90) of these patients.

A Kaplan–Meier survival curve (Fig. 1) was generated to compare the survival of patients with MEM with that of patients with a single site of epidural disease. Patients with MEM had a significantly worse

### TABLE 3

| Association Between Number of Epidural Metastases and Descriptive Factors |
|---|---|---|---|
| Descriptive factor | MEM | MEM | P value |
| | Yes (N = 100) | No (N = 237) | |
| Gender | | | 0.195 |
| Male | 67 | 67% | 141 | 59% |
| Female | 33 | 33% | 96 | 41% |
| ESCLC main level | | | 1.00 |
| Cervical | 10 | 10% | 23 | 10% |
| Thoracic | 61 | 61% | 145 | 61% |
| Lumbosacral | 29 | 29% | 69 | 29% |
| Neurologic dysfunction | | | 0.86 |
| Back pain only | 22 | 22% | 48 | 20% |
| Radiculopathy | 42 | 42% | 109 | 46% |
| Myelopathy/cauda equina syndrome | 35 | 35% | 78 | 33% |
| Asymptomatic | 1 | 1% | 2 | 1% |
| Treatment | | | 0.21 |
| Surgery only | 0 | — | 9 | 4% |
| Radiation only | 73 | 73% | 146 | 62% |
| Chemotherapy only | 1 | 1% | 6 | 2% |
| Surgery/radiotherapy | 6 | 6% | 21 | 9% |
| Surgery/chemotherapy | 1 | 1% | 0 | — |
| Radiotherapy/chemotherapy | 16 | 16% | 40 | 17% |
| All three | 1 | 1% | 6 | 2% |
| None | 2 | 2% | 9 | 4% |
| Tumor type | | | 0.42 |
| Breast | 21 | 21% | 43 | 18% |
| Colorectal | 3 | 3% | 10 | 4% |
| Lung | 17 | 17% | 41 | 17% |
| Lymphoma | 4 | 4% | 21 | 9% |
| Myeloma | 8 | 8% | 15 | 6% |
| Prostate | 31 | 31% | 50 | 21% |
| Renal cell | 2 | 2% | 13 | 5% |
| Sarcoma | 3 | 3% | 12 | 5% |
| Others | 6 | 6% | 22 | 9% |
| Unknown primary | 5 | 5% | 10 | 4% |
| Multiple vertebral metastases | | | < 0.0001 |
| Yes | 95 | 95% | 108 | 46% |
| No | 5 | 5% | 129 | 54% |
| ESCLC as initial manifestation of malignancy? | | | 1.00 |
| Yes | 20 | 20% | 47 | 20% |
| No | 80 | 80% | 190 | 80% |
| MOS between initial cancer diagnosis and ESCLC | | | 0.75 |
| Minimum | ~0.2 | ~0.4 |
| Median | 18 | 19 |
| Maximum | 218 | 379 |
| Age (yrs) | | | 0.84 |
| Minimum | 27 | 4 |
| Median | 64 | 64 |
| Maximum | 85 | 89 |

MEM: multiple spinal epidural metastases; ESCLC: epidural spinal cord compression.
survival after ESCC diagnosis (log rank P value = 0.0045; median, 19 weeks vs. 33 weeks). A forward Cox model was performed to assess the prognostic significance of several baseline factors on survival after ESCC diagnosis, including age, time from cancer diagnosis to ESCC diagnosis, gender, main ESCC location, extent of neurologic dysfunction (back pain vs. radiculopathy vs. myelopathy), presence of MEMs, presence of multiple vertebral metastases, primary tumor type, and treatment directed at ESCC. The resulting best-fitting model contained three significant unfavorable prognostic variables (presence of MEMs or diagnosis of lung carcinoma or renal cell carcinoma) and three favorable prognostic variables (diagnosis of breast carcinoma and receiving either chemotherapy or surgery as treatment for ESCC) (Table 6).

Thirty study patients (9%) developed a radiographically verified second episode of ESCC in a previously unirradiated port. In 26 of these patients the responsible site had been imaged at the time of initial ESCC and found to be free of epidural disease, whereas in 4 patients the new ESCC site had not been imaged previously. Eleven other patients had radiographically proven local epidural recurrence within a previously irradiated port, whereas 3 patients were known to have developed late neurologic deterioration but were never reimaged.

**DISCUSSION**

Our results confirm and extend prior reports regarding the descriptive epidemiology of ESCC and the phenomenology of MEMs. The predominance of breast, prostate, and lung carcinoma as causes of ESCC and the localization of ESCC in the thoracic and, to a lesser extent, the lumbosacral spine have been noted previously. The observed incidence of 30% of our ESCC patients with MEMs is within the range of 9–38% previously.
ously described in smaller, myelography-based series. Similarly, the 40% of patients with MEMs detected on total spine MR scan in our study does not differ greatly from the figure of 49% in one previous MR-based report. The observation that MEMs were detected significantly more often in patients with CSI than in those without, albeit seemingly intuitive, has not been reported previously. Because patients undergoing CSI did not differ notably in baseline characteristics from patients with incomplete spinal imaging, it appears unlikely that physicians preferentially ordered CSI in patients they believed were more likely to develop MEMs. Consequently, it would appear that incomplete spinal imaging necessarily will leave some epidural metastases undetected and therefore untreated. We also found that all primary tumor types were equally likely to produce MEMs, with no evidence to support previous reports that found lung carcinoma to be a relatively uncommon cause of this syndrome.

Although many authorities recommend that patients with suspected ESCC should undergo CSI, our data indicate that this suggestion is frequently disregarded in the era of MR scans. Some institutions have MR protocols for suspected ESCC that include a sagittal screen of the entire spine, but even such efforts to detect MEMs occasionally may fail when epidural disease is situated laterally or in scoliotic patients. Our results suggest that the likelihood of finding an asymptomatic epidural metastasis in the cervical spine is quite low when epidural disease in the thoracic or lumbosacral spine correlating with clinical symptoms already has been detected. The likelihood of having an asymptomatic or unsuspected second site of epidural disease is much higher in the thoracic and lumbosacral spine. Thus, if detecting asymptomatic sites of epidural disease is clinically important, it would be advisable for all ESCC patients to undergo careful study of the thoracic and lumbosacral spine. Why asymptomatic cervical spine epidural metastases should be rare is unclear, although the small mass of the cervical spinal column compared with the rest of the spine is one proposed explanation for the scarcity of cervical epidural disease in general. The ability of cervical spinal cord compression to produce false-localizing thoracic sensory levels underscores the importance of ensuring congruity between clinical and radiographic findings.

Whether incidentally detected asymptomatic epidural metastases warrant therapy or are best managed with observation is debatable and cannot be answered in an observational descriptive study. Certainly, when effective chemotherapy exists for a neoplasm, there are rationale and precedent in its use for epidural disease. When no effective chemotherapy is available, the options generally include radiation and observation (spinal surgery generally is not considered for asymptomatic epidural metastasis in patients with MEMs). Data regarding the likelihood of an untreated asymptomatic epidural metastasis to become symptomatic would be useful in choosing between these disease management options. Unfortunately, our study does not provide such data because nearly all the incidentally detected epidural metastases were irradiated. The best data in this regard come from the study by Helweg-Larsen et al. in which 107 patients with ESCC from solid tumors had undergone total spine myelography and were followed prospectively. Thirty-seven patients had MEMs; 14 patients had all epidural metastases irradiated whereas 23 patients had asymptomatic epidural metastases left untreated. Three of the 23 patients (13%) progressed clinically at the untreated epidural site. Notably, the median survival of all patients in that series was 3.4 months, which is considerably less than in our series (6.6 months) and in another recent large study.
months). Part of this difference likely is attributable to our inclusion of hematologic malignancies (generally more treatment-responsive than solid tumors) and some perhaps to referral bias or differences in treatment approach. As the median survival of patients with ESCC increases, it appears probable that the percentage of patients who progress at untreated epidural metastatic sites would increase. Like the anticipated duration of survival, the extent of thecal sac compression also may be a useful variable in making treatment decisions regarding incidentally detected epidural metastases. The degree of spinal block correlates positively with the degree of neurologic impairment, and the degree of neurologic impairment prior to treatment is the most important prognostic factor in neurologic outcome after radiation for ESCC. Consequently, when an asymptomatic epidural metastasis produces substantial thecal sac deformation, we believe that serious consideration of prophylactic radiotherapy is warranted. Although Helweg-Larsen et al. concluded that asymptomatic epidural metastases did not require radiotherapy, they specified that the 23 untreated patients had only "minor epidural impression," raising the possibility that large epidural lesions were irradiated despite absence of symptoms.

Why having MEMs should prognosticate shorter survival in patients with ESCC, a novel observation, is not immediately apparent. One possible explanation is that MEMs are a marker of burden of disease, and that disease outside the spinal column is the principal determinant of survival. The inclusion of sites of visceral disease such as the liver and lung as well as the brain would strengthen the multivariate analysis and address this possibility. Conceivably the presence of MEMs increases the likelihood of death related to neurologic causes. Several previous studies have suggested that neurologic dysfunction related to ESCC negatively impacts on survival. Adding the extent of thecal sac compression, pretreatment ambulatory status, and posttreatment ambulatory status as variables to the model might enhance its utility further. Other authors have noted the relatively poor prognosis of lung carcinoma and multiple vertebral involvement in patients with ESCC.

Several additional limitations of our study relate to its retrospective nature. It is possible that our study population’s physicians were suspicious of MEMs in some patients without documenting this concern and consequently obtained CSI. If this were the case, incomplete spinal imaging would miss fewer asymptomatic lesions than we have proposed. Our study undoubtedly underestimates the late occurrence of remote and local ESCC. Our figure of 9% late remote ESCC, although similar to the figures of 7% and 9% recorded in two European studies, is markedly lower than the 16–26% other studies have noted. Neurologic follow-up data were not considered in our study because this information frequently was unavailable toward the end of our patients’ lives, reflecting the tendency of patients not to return to a distant tertiary care medical center as their disease progresses and complications occur or recur. Finally, although myelogram and MR scanning both are accepted means of diagnosing ESCC, pooling patients diagnosed by different modalities may obscure differences between the groups. For example, the degree of thecal sac compression estimated by MR scan correlates imperfectly with myelographic results.

Given the heterogeneity of tumor types producing ESCC as well as the variability of disease status in such patients, it is extremely doubtful that prospective randomized treatment trials addressing the need to image the entire spine and the issue of whether asymptomatic epidural metastases should be treated will ever be conducted. Consequently, it is difficult to make absolute recommendations regarding these matters. Nevertheless, based on our findings, our approach is to image all symptomatic spinal segments and the thoracic and lumbosacral spine in all ESCC patients expected to survive more than several weeks. When large asymptomatic epidural metastases are detected and no effective chemotherapy is available, we favor focal radiotherapy; decisions regarding lesions producing only minor degrees of thecal sac compression are made on an individualized basis. Our data also strongly support the need to image the entire vertebral column in patients who are potential candidates for aggressive surgical interventions such as vertebral body resection, because the prognostic and technical implications of MEMs may influence surgical decision-making.

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