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Review

Metastatic epidural spinal cord compression: current concepts and treatment

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Summary

Metastatic epidural spinal cord compression (MESCC) is a medical emergency complicating the course of 5–10% of patients with cancer [1]. When diagnosis and treatment is early with the patient ambulatory prognosis for continued ambulation is good [2]. If the patient is nonambulatory or paraplegic, prognosis for meaningful recovery of motor and bladder function is markedly decreased. In the last decade, significant advances in the understanding, management and treatment of metastatic epidural spinal cord compression have occurred.

Recent pathophysiological and pharmacological animals studies have afforded insights into disease mechanisms [3–9]. The audit of standard methods of investigation and magnetic resonance imaging have resulted in revision of guidelines for patient evaluation [10–17]. Finally, new surgical philosophies and technical advances have generated interest and controversy [18–25]. With improved clinical awareness, new imaging modalities will help us diagnose epidural spinal cord compression earlier and institute appropriate treatment.

Introduction

Metastatic epidural spinal cord compression (MESCC) will be defined as compression of the spinal cord or cauda equina nerve roots from a lesion outside the spinal dura. It is the initial manifestation of malignancy in half of cases diagnosed in a general hospital [26], but less than 8% diagnosed in cancer centers [2]. The most common tumors causing epidural compression are breast, lung, prostate, lymphoma, sarcoma, and kidney, accounting for over 70% of cases [2, 26–30].

In this paper, we review and summarize current concepts regarding the management of MESCC based on recent diagnostic advances and technical surgical developments. The review is based on our experience and critical appraisal of recent articles or seminal papers on metastatic epidural spinal cord compression. We discuss the pros and cons of diagnostic and treatment strategies to reduce the degree of uncertainty in selecting the appropriate modality for each clinical situation.

Pathogenesis and pathophysiology

The epidural space is a true space which lies between spinal cord dura and the bony spinal canal. It contains fat, connective tissue and a rich paravertebral venous plexus which drains the vertebrae and intervertebral spaces. The most common mechanism of metastatic epidural spinal cord compression is thought to be by hematogenous arterial spread to bone marrow, which results in vertebral body collapse and formation of an anterior epidural mass. A second mechanism is spread by direct in-

vasion of tumor through the intervertebral foramina from a paravertebral source. This occurs in 75% of patients wiht epidural spinal cord compression due to lymphoma, and 15% of patients with metastatic epidural spinal cord compression from other solid tumors [31–33].

Although unproven, another probable mechanism of metastatic epidural spinal cord compression is by retrograde venous spread from the primary site via Batson's paravertebral plexus. If tumor cells are injected into the femoral vein, when intra-abdominal pressure is normal, metastases develop in the lungs, and when intra-abdominal pressure is increased, epidural metastases without vertebral involvement are produced [34]. In humans, it is rare to find metastatic epidural spinal cord compression without bony involvement or direct spread through the bony foramina.

Animal models have been used to demonstrate morphological features of cord damage and subsequent recovery [35, 36]. Following 3 hours of cord compression in cats, selective demyelination without axonal disruption evolves over the subsequent 21 hours and continues for 1 week. Most demyelinated fibres show evidence of remyelination by one month [36]. If compression is produced slowly over a 48 hour period and maintained for 7 days, it is still possible to get recovery of paralysis, suggesting that demyelination is a more important factor than cord ischemia. With more prolonged compression there was cord ischemia and irreversible neurological changes. If tumor cells are injected into the epidural space in rats, one of the earliest features of metastatic epidural spinal cord compression is breakdown of the blood-spinal cord barrier with vasogenic edema [37]. Administration of steroids decreases the vasogenic edema and produces objective improvement in weakness [38].

At autopsy, in humans with metastatic epidural spinal cord compression, there is vascular congestion, hemorrhage and edema at the site of cord compression suggesting that venous occlusion is an important factor in the pathogenesis of cord damage.

Topographical localization

Eighty-four to ninty-four percent of patients with MESCC have an abnormal plain x-ray at the time of presentation [26, 27]. Over 30% of patients will have x-ray evidence of multiple sites of vertebral involvement and if plain x-rays, tomography and surgical findings are combined, as many as 86% may have more than one vertebra involved [27, 29]. Multiple vertebral involvement is particularly common in breast and prostatic carcinoma. Metastatic epidural spinal cord compression most commonly occurs at the site of vertebral involvement on plain x-ray, especially where there is evidence of vertebral collapse. The primary compression of the spinal cord from metastatic deposits occurs in the thoracic region of approximately 70% of patients, the lumbosacral spine in 20% and the cervical spine in 10% of patients [2, 26, 32]. Multiple sites of metastatic epidural spinal cord compression occur in 17–30% of all patients [39]. This is particularly common in breast cancer and is uncommon in lung cancer [26].

In a review of 600 cases of spinal cord or nerve root compression, vertebral metastases occurred in 563 patients [27]. The vertebral body was involved in 45% of these patients, the posterior arch in 41% and the entire vertebra in the remaining 14% of patients. Epidural lesions without vertebral involvement occurred in 30 patients and intradural lesions in 7 patients. The location within the vertebra of metastatic involvement is important for the surgical treatment of epidural spinal cord compression but is not a good indicator of the primary site of neoplasm [33]. Epidural metastases usually do not invade the dura. Posterior extradural tumor is easily accessible by laminectomy, but anterior extradural disease may require an anterior cervical, transthoracic or transabdominal approach.

History and examination

The median age at diagnosis of metastatic epidural spinal cord compression has varied from 53 to 63 years with sex differences reflecting the primary neoplasm e.g. breast and prostate [2, 26–30].

Back pain is the initial complaint in up to 96% of

patients with epidural spinal cord compression [2]. Pain may precede neurological symptoms by days to 3 or more years [1]. It is very unusual for patients with metastatic epidural spinal cord compression to present without pain [28], but cord compression from lung or renal metastases and lymphoma do so more frequently [1, 26]. The median duration of pain before development of neurological signs has varied from 7 to 23 weeks [2, 26]. Duration of pain is probably related to tumor growth rate, being shortest for highly malignant tumors such as lung and kidney and longest for more typically less malignant tumors such as breast and prostate carcinoma. The majority of patients have local pain, secondary to stretching of the pain sensitive cortical bone and periosteum. Local pain is usually constant, relentlessly progressive and exacerbated by coughing, sneezing, straining or exercise [1, 2]. The worsening of pain on recumbency is the most distinctive feature of the pain of metastatic epidural spinal cord compression and differentiates it from disc disease [1, 2]. Radicular pain is present in 90% of patients with lumbosacral, 79% of cervical and 55% of patients with thoracic metastatic epidural spinal cord compression [2]. It is frequently bilateral in the thoracic area and unilateral or bilateral in the lumbosacral and cervical areas. Radicular pain is an important localizing sign [2].

Weakness is present in about 80% of patients with metastatic epidural spinal cord compression at presentation [2]. Fifty percent of patients are ambulatory, 35% are paraparetic and 15% are paraplegic at the time of diagnosis [2]. Once weakness is present, progression is often rapid and urgent investigation and treatment is crucial [2, 26]. Thirty percent of patients with weakness become paraplegic within one week [1]. Rate of progression of weakness is dependent on the tumor growth rate [1]. Weakness is usually bilateral and symmetrical (87%) [2]. The degree of weakness and ability to ambulate at the time of diagnosis are important clinical predictors of outcome [2, 26–29].

Bladder and bowel symptoms are also frequently present at the time of diagnosis (57%) and can take the form of frequency, urinary retention or incontinence [2]. Autonomic disturbance is a bad prognostic sign as it implies bilateral cord or root damage and is usually associated with moderate to severe weakness [2]. Objective sensory disturbance is found in 78% of patients at the time of diagnosis [2]. The severity of sensory loss almost always mirror the severity of motor weakness [1, 40].

Care should be taken to examine lymph nodes, breasts, lungs, kidneys and perform a rectal exam [40]. Limited straight leg raising usually points to an epidural or intradural extramedullary lesion causing root compression, while segmental pain and sacral sparing suggests intramedullary disease [40]. Spinal cord, conus medullaris, cauda equina, or peripheral nerve lesions can produce a flaccid areflexic paralysis [1, 40]. Concurrent cerebral symptoms or signs favor performance of MRI where there is no risk of neurologic deterioration [41]. If there are two spinal levels involved clinically or on an x-ray, then both sites must be clearly imaged [2].

Differential diagnosis

If clinical outcome is to be improved, it is important to identify patients with metastatic epidural spinal cord compression early in their illness and start treatment as soon as possible [26, 28, 41]. Approximately 50% of adult patients presenting with an acute transverse myelopathy will be diagnosed as having metastatic epidural spinal cord compression [42]. In 47% of patients who develop metastatic epidural spinal cord compression, it is the initial presentation of their malignancy, and of these almost half will have lung carcinoma identified [2, 27].

However, less than 50% of patients with malignancy, considered clinically to have metastatic epidural spinal cord compression, will have this diagnosis confirmed by myelography [43]. Myelography in cancer patients with back pain and myelopathy is normal in 23% of patients, and with back pain and radiculopathy is normal in 37% of patients [44].

A history of previous radiation therapy, trauma, vascular or disc disease or infection is important. Patients taking anticoagulants have an increased risk of subdural hematoma [45]. Chemotherapy increases the risk of infections and hemorrhage [46, 47]. Patients receiving chronic steroids may develop cord compression from epidural fat [48].

The differentiation between epidural abscess and metastasis is often difficult [40]. Epidural abscess is more frequently posteriorly situated and will often cover multiple vertebral body segments [49]. If there is vertebral collapse due to an infective cause, the disc space is frequently destroyed while metastatic vertebral disease usually spares the disc space [49, 50]. Epidural abscess may be associated with increased systemic white blood cell count, fever or cerebrospinal fluid pleocytosis, but as the dura is an effective barrier, the cerebrospinal fluid may be normal. Blood cultures yield the correct organism more often [49, 50].

Arteriovenous malformations can produce myelopathy as a result of direct pressure or following hemorrhage. In the majority of cases the arteriovenous malformation is at the thoraco-lumbar junction, either extradural or intradural, while in approximately 10% the arteriovenous malformation arises from the anterior spinal artery and is intramedullary in the cervical cord [40]. They may be identified by their 'snake like' appearance on myelography or by demonstrating flow voids or characteristic signal changes of hemorrhage using magnetic resonance imaging [51].

Carcinomatous meningitis occurs in approximately 5% of cancer patients at autopsy [52, 53]. Intradural extramedullary or intramedullary metastases have frequencies of less than 4% that of epidural spinal cord compression [54]. Noncompressive causes of neural involvement should also be considered. Vascular damage to the spinal cord may cause myelopathy as a result of direct pressure or compression of major feeding radicular arteries as they enter through the intervertebral foramina. Myelopathy secondary to radiation, intrathecal methotrexate chemotherapy, infectious diseases, coagulopathies and paraneoplastic syndromes may occur in patients with cancer [10, 40].

Clinical prognosis

The severity of weakness at presentation is the most significant prognostic variable for recovery of function. Eighty percent of patients who were ambulatory at presentation, remain so after treatment [2]. Between 30–45% of patients who are nonambulatory with antigravity proximal leg function will regain ambulation, where as only 5% of patients who have no antigravity proximal function will walk again [2]. (Helweg-Larson S, Sorenson PS, Hanson SW, personal communication). The radiobiology of the tumor also plays an important role in response. In one study, 75% of patients with radiosensitive tumors, who were nonambulatory but could raise their legs off the bed became ambulant after radiotherapy, but only 34% of comparable patients with radioresistant tumors became ambulant after radiotherapy [2]. After treatment, the probability of ambulant patients surviving one year is 0.73 and the probability of non ambulant patients surviving one year is 0.09 [55]. In selected series of paraplegic patients with anterior epidural spinal cord compression treated with anterior decompression and radiotherapy, between 50–90% of patients had an improvement in motor function [24, 56].

Histology of the tumor may be more important in determining prognosis than the type of treatment [1]. Myeloma, lymphoma and breast carcinoma have almost a 80% initial response rate and 75% of patients with breast carcinoma who are still alive at a year remain ambulatory [2, 28]. Only 25% of patients with lung or renal carcinoma and melanoma respond to any treatment modality [2].

Rapid onset and quick progression are bad prognostic variables [57]. Patients with a pre-operative symptom duration greater than 2 months have better postoperative recovery of function than those with shorter histories [58]. The duration of paraplegia before starting treatment is also important. It has been traditionally taught that when paraplegia is present for greater than 24 hours before initiation of treatment the changes of recovery are slight [59, 60], although recent reports question this doctrine [61].

Investigations

Plain x-rays are an essential, highly predictive, inexpensive, quick investigation that should be obtained if myelography or magnetic resonance imaging scanning is pending. Between 85–94% of pa-

tients with metastatic epidural spinal cord compression have an abnormal plain x-ray at the time of presentation [26]. If there is back pain or a localizing sign and spinal x-ray is abnormal, the probability of epidural disease is 0.9, but if the x-ray is normal, it is only 0.1 [16, 62]. Spinal x-rays have a sensitivity of 91% for predicting epidural disease and a specificity of 86% [62]. Bone scanning has a similar sensitivity but a specificity of only 53%. Particularly useful radiological features for predicting epidural disease are; greater than 50% vertebral collapse (85%), and pedicular erosion (31%) [14, 62].

Spinal computed assisted tomography is valuable in investigating cancer patients with local back pain who have a normal exam and spinal x-rays. Two thirds of these patients have spinal metastases on computer assisted tomography scan but only 17% will have metastatic epidural spinal cord compression and in these cases none will have greater than 50% block [13]. Patients without cortical disruption on computer assisted tomography, rarely develop metastatic epidural spinal cord compression at that site at a later date [63].

Different algorithms for the investigation of patients with cancer and back pain have resulted from recent clinical studies utilizing spinal x-rays, bone scanning and spinal computed assisted tomography [15, 16, 62]. All advise myelography, with or without computed assisted tomography, if the spinal x-ray is abnormal (Table 1, authors algorithm).

Magnetic resonance imaging is replacing myelography as the procedure of choice, although there are no prospective trials comparing the diagnostic yield of myelography, with or without spinal computer assisted tomography, with that or magnetic resonance imaging in patients presenting with symptoms suggestive of metastatic epidural spinal cord compression [64, 65]. However, it is adviseable to get the test that is readily available, as the patient may deteriorate while waiting for investigation. In many centers this may still be myelography with or without computer assisted tomography.

Magnetic resonance imaging is non-invasive, effectively demonstrates metastatic epidural spinal cord compression and gives a positive image of the spinal cord to better diagnose intramedullary disease [64–66]. Intradural extramedullary metastases [12] are equally well diagnosed by gadolinium enhanced magnetic resonance imaging or by myelography [64, 66]. Asymptomatic second areas of metastatic epidural spinal cord compression are identified with MRI and are important for radiation planning. Anatomical definition of vertebral and extraspinal disease on magnetic resonance imaging is helpful when planning a surgical procedure. It is helpful to perform sagittal magnetic resonance imaging 'scout scans' (Fig. 1), using the body coil, as they will often identify multiple vertebral deposits which can subsequently be studied in more detail using local spinal coils (Fig. 2). Magnetic resonance imaging has fewer risks than myelography in patients with intracranial mass lesions or bleeding tendencies. Where there has been previous surgery or scoliosis, sagittal images are difficult to interpret. Patients who are claustrophobic or who have a ferromagnetic implant cannot be scanned. Severe pain or other causes of movement artifact may limit interpretation of the scans and myelography would then be preferable.

Myelography is as sensitive as magnetic resonance imaging at identifying extradural or intradural extramedullary lesions and has the added advantage of yielding cerebrospinal fluid which may help to exclude or confirm alternative diagnoses, e.g. carcinomatous meningitis or abscess. The addition of spinal computer assisted tomography improves sensitivity for bony and paravertebral involvement. Clinical deterioration may occur directly following myelography [67, 68], however, it is difficult to separate this from natural history of disease. If there is a complete block following lumbar injection, a cervical myelogram or magnetic resonance imaging is necessary to visualize the upper limit of the block and to exclude second lesions. All patients with suspected MESCC should have their total spine imaged [69].

If the cause of epidural spinal cord compression is uncertain, computer assisted tomography guided biopsy of a paraspinal or epidural mass or percutaneous needle biopsy of a collapsed vertebral body may be helpful [70].

Simple investigations such as chest radiograph, prostatic specific antigen, mammography, abdominal ultrasound or abdominal and chest computer

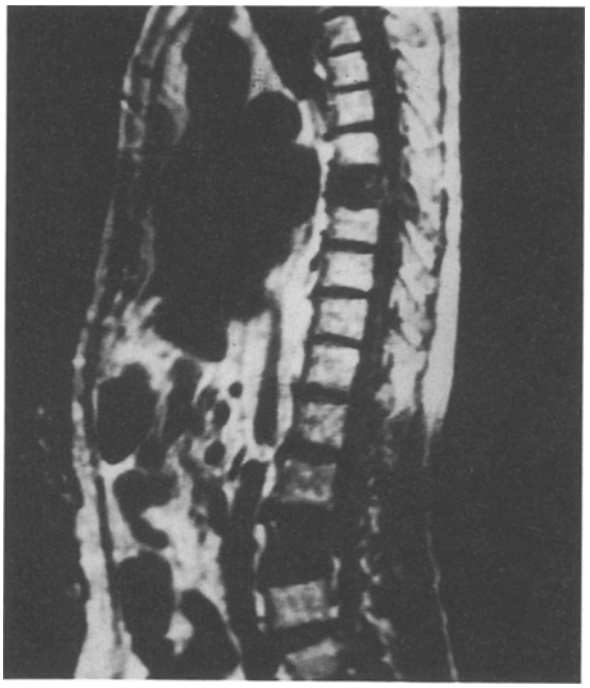


Fig. 1. MRI (using the body coil) showing two areas of vertebral involvement. One with ESCC at T8 and another asymptomatic L3 metastasis.

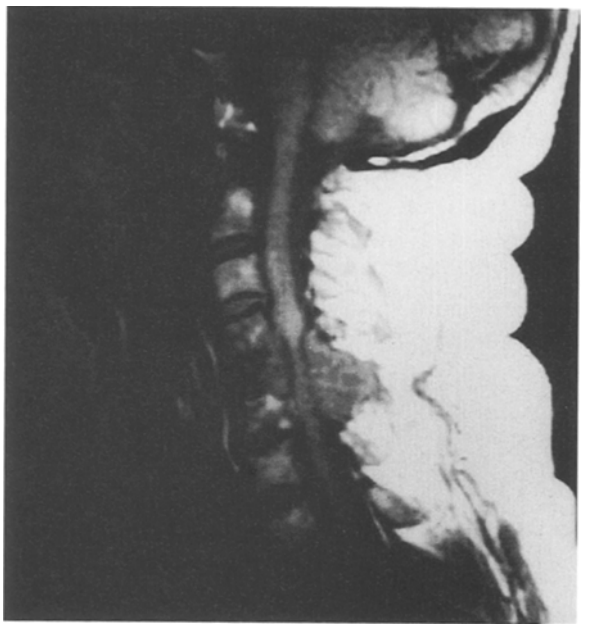


Fig. 2. MRI (using local spinal coil) showing severe metastatic ESCC with collapse of C5 vertebral body and severe destruction of posterior elements and local invasion of C4 and C6 bodies.

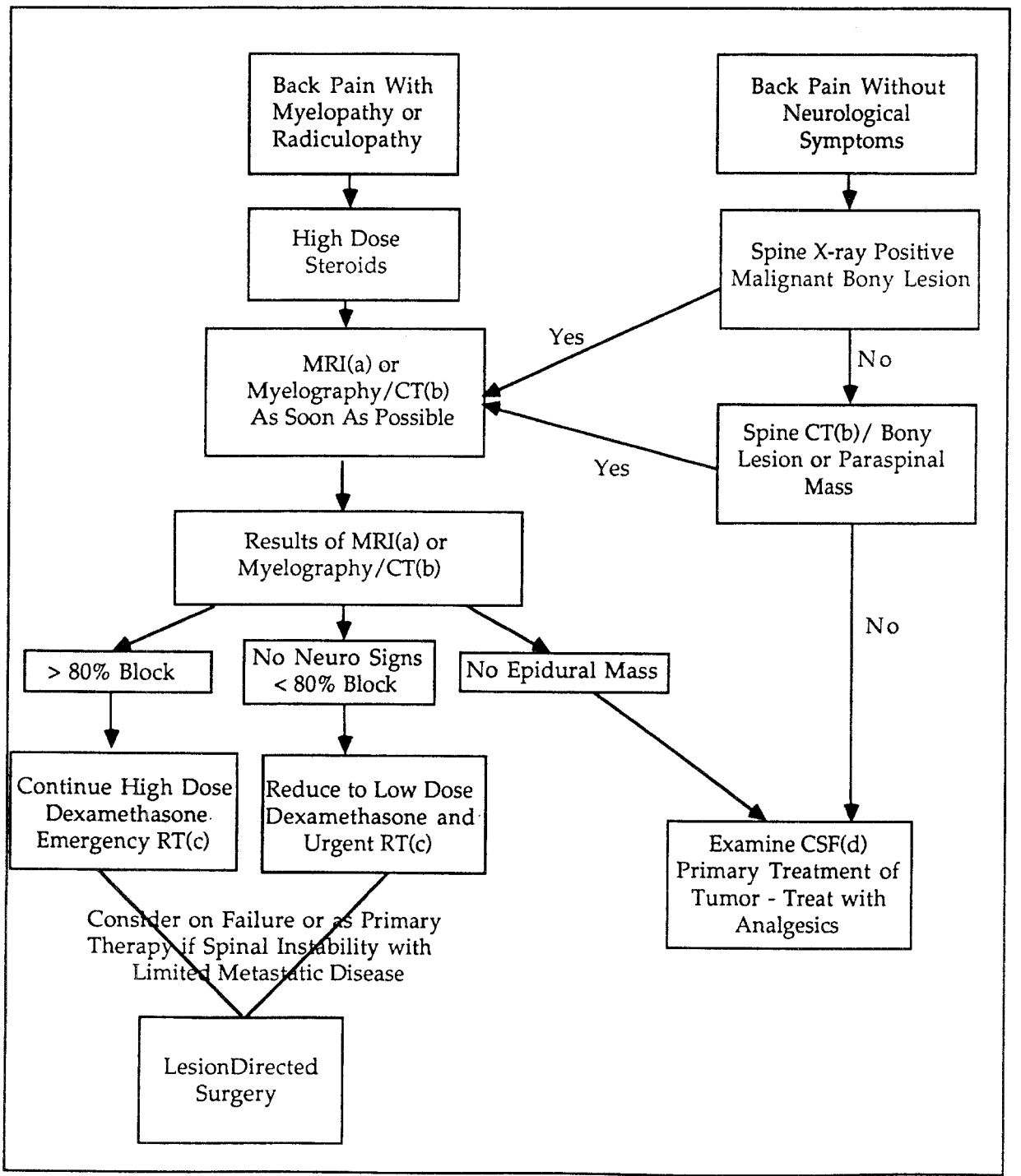
assisted tomography scan may immediately demonstrate the primary malignancy in patients who present with metastatic epidural spinal cord compression.

Treatment recommendations for patients at risk from metastatic epidural spinal cord compression

In order to improve clinical outcome in the future, it is important to identify patients at high risk for metastatic epidural spinal cord compression, before the appearance of neurological symptoms of signs. Patients with malignancy should be advised to inform their physician if they develop new back pain, the initial complaint in up to 96% of patients who go on to develop metastatic epidural spinal cord compression. High risk patients will include patients with known malignancy and recent onset back pain and patients who are not known to have malignancy, but who have new backache, worse on recumbency or radicular, situated in the thoracic region or associated with spinal tenderness. These patients will require A-P and lateral plain x-rays of the involved areas (Table 1). Oblique x-rays are needed if there is radicular pain as foramina enlargement may be missed on standard views. If there is evidence of focal bony pathology, myelography will demonstrate an abnormality in approximately 60% of cases [44]. If the spine x-rays are normal but the pain is characteristic, a spinal computer assisted tomographic scan is recommended [13], since plain x-rays have a false negative rate of up to 17% [71]. Spinal computer assisted tomographic scanning will accurately differentiate between bony metastases and benign bony disease [63]. If computer assisted tomography demonstrates bony metastases or a paraspinal mass, then MRI or computer assisted tomography-myelography is indicated.

Radiation therapy is the treatment of choice for bony metastases without metastatic epidural spinal cord compression, as this provides very effective palliation for bone pain and will prevent progression to epidural metastases in most cases [72].

Table 1.



(a) MRI: Magnetic Resonance Imaging (b) CT: Computed Tomography (c) RT: Radiation Therapy
(d) CSF: Cerebrospinal Fluid

Emergency measures

Patients with cancer, back pain and an abnormal progressing neurologic examination, demonstrating myelopathy or radiculopathy, should undergo emergency MRI or computer assisted tomography-myelography, whichever is the most readily available procedure (Table 1). Stable patients with uncertain neurological findings can be scanned urgently over the next twenty-four hours. Control of pain prior to myelography or magnetic resonance imaging may help to prevent movement artifact. High doses of steroids such as 100 mg dexamethasone i.v. and 24 mg six hourly will produce pain relief in 64% of patients within 24 hours and can also result in significant clinical improvement [28]. High dose i.v. dexamethasone can cause side effects including vaginal burning, elevations in blood pressure and glucose intolerance and electrolyte disturbance, and caution should be used in those suspected of having an infection or gastrointestinal symptoms. Doses should be tapered rapidly and immediately if there is less than 80% spinal block or gradually after 72 hours, following treatment with radiotherapy or surgery.

Patients with MESCC and abnormal neurologic examination with weakness should be monitored at frequent intervals with a neurologic exam. If patients develop a neurologic deficit during radiation therapy and it is unresponsive to steroid dose increase, directed surgical approach should be considered. If back pain is due to vertebral involvement with spinal instability and the patient has otherwise limited disease spinal stabilization should be considered [73].

In experimental studies, dexamethasone can be identified in spinal cord within 5 minutes of i.v. injection and has a half life of approximately 4 hours. A dexamethasone dose response effect has been demonstrated in an animal model of metastatic epidural spinal cord compression [7, 38], producing decreased spinal cord water content, reduced epidural swelling and a transient clinical improvement. A prospective randomized double blinded trial of single high dexamethasone dose (100 mg iv) compared with conventional initial dose (10 mg iv), both subsequently followed by 4 mg orally every 6 hours did not demonstrate a significant difference in ambulation, bladder function or control of pain at 24 hours [74]. However at 3 hours, 7% of patients treated with the conventional initial dose steroids deteriorated and only 41% had pain relief, compared with no deterioration and 53% pain relief in the high initial dose group. Based on the half life of dexamethasone any effect of single high dose decadron would be expected to be of short duration and a more prolonged course of high dose steroids may be justified. In a prospective randomized double blind placebo controlled trial in acute spinal cord injury, high dose bolus and then continuous methylprednisone improved neurologic motor and sensory recovery [75].

Patients with neoplastic spinal cord compression are at an increased risk of deep venous thrombosis and pulmonary embolus. Prophylactic subcutaneous heparin, anti-embolic stockings or compression pumps [76], will help reduce morbidity and mortality. In the presence of urinary retention or constipation, intermittent or permanent catheterization should be considered and laxatives/suppositories should be initiated early in the course of admission. Care should be taken when nursing patients with paraparesis or paraplegia to prevent pressure sores. In patients who have previously been treated with maximal radiation therapy and who are unfit for surgery, non operative treatment with spinal braces can be offered.

From 1963–1980 several selected series [30, 33, 37] compared the results of surgical decompression alone versus decompression followed by radiation therapy and demonstrated markedly better results in the latter group. In 1978, a retrospective non-randomized series of 235 patients with metastatic epidural spinal cord compression concluded that radiation therapy alone is as effective as decompressive laminectomy and radiation therapy [2]. This study was instrumental in changing initial therapy for metastatic epidural spinal cord compression from surgery to radiation therapy. There has only been one randomized prospective comparison of laminectomy followed by radiation therapy versus radiation therapy alone [78]. This failed to reveal any difference between the treatment arms, however the sample size made it difficult to demonstrate a significant difference [29, 78]. Recently, a renewed

interest in surgery has focused on a directed surgical approach based on the site and level of metastatic epidural spinal cord compression.

Radiotherapy

The response of epidural metastatic lesions to radiation is well documented [27, 79–81]. Lymphoma, seminoma, myeloma, Ewing's sarcoma and neuroblastomas are very radiosensitive, breast and prostate less so, and kidney, colon, lung and melanoma are frequently radioresistant.

Radiation therapy is still the generally accepted first line of treatment of metastatic epidural spinal cord compression in radiosensitive tumors. Its use in radioresistant tumors is more controversial. A large retrospective study reported that radioresistant tumors are as effectively treated with radiation therapy alone as with laminectomy and radiation therapy [2]. The optimal dose and fractionation regimen for metastatic epidural spinal cord compression remains unknown [82]. In fact, there may be no generally optimal plan. Each plan constructed represents a compromise between delivery of the highest dose achievable to improve tumor control, a desire to achieve palliation as expediently as possible, and the intrinsic radiosensitivity of the spinal cord, often a regimen of 30 Gy in 10 fractions is chosen as the best solution [82].

The treatment technique depends upon the region of spinal involvement. Cervical spine lesions are generally treated with opposed lateral portals that provide a homogenous dose distribution to the involved region while sparing the pharyngeal mucosa from the acute effects of radiation. Thoracic spine lesions are most often treated with posterior fields for simplicity and ease of patient setup. The additional dose delivered to more superficial tissues with a posterior-only beam arrangement can be significant especially for lower energy treatment units. A posterior wedged-pair arrangement minimizes this problem and also spares anteriorly situated soft tissues. Due to the near-midline location of the lumbar spine, these lesions are usually treated with opposed anterior and posterior portals. Traditionally, two vertebral bodies above and below the myelographic block have been treated, taking into account other vertebral bodies with documented metastasis. Whether these volume recommendations for spinal irradiation will continue in the modern imaging era remains to be seen. The sensitivity of the spinal cord to radiation limits the prescribed amount of therapy and the spinal cord dose should always be calculated as well as the dose to the involved vertebral body. The incidence of permanent radiation injury to the spinal cord directly correlates with the total dose and fraction size [83]. Spinal cord tolerance has been considered to be between 45–50 Gy in 180 cGy fractions, between 35–37.5 Gy in 250 cGy fractions and between 30–33 Gy in 300 cGy fractions. In primates given a total radiation dose of 52 Gy in 2.2 Gy fractions, only 0.1% developed myelopathy with a latent period ranging from 5 to 20 months [84]. The size of the radiation field also plays an important role and reductions in treatment volume allow a larger dose [85]. Radiation therapy has recently been reported to produce a delayed recovery in ambulation (3 to 6 months) in patients paraplegic for up to nine days. Recovery was more common in patients whose weakness had a gradual onset over weeks [61].

Surgery

The role of surgery is being re-evaluated. Surgery is a major undertaking in patients with metastatic disease who have limited life expectancy. Nevertheless, it has been advocated to obtain diagnostic material, to help the rapidly deteriorating patients, to decompress the spinal cord and nerve roots, correct spinal instability, relieve pain and promote early mobilization. Spinal instability is a potential cause of cord damage and is not affected by radiation therapy [25]. Recently, spinal surgeons extrapolating from traumatic spinal cord injury, and using a similar framework have divided the bony space into three columns: Anterior Column – anterior longitudinal ligament and vertebral body; Middle Column – posterior longitudinal ligament, posterior vertebral body, pedicles; Posterior Column – facet joints, lamina, interspinous ligaments. Spinal instability occurs most often if the cortical bone in more than

one of three columns are involved, either by tumor or by previous surgery. Surgical relief of pain can be achieved in 68% to 85% of patients [20, 21].

Most old trials compared decompressive laminectomy with radiation therapy. Decompressive laminectomy for metastatic epidural spinal cord compression in the presence of vertebral body collapse is contraindicated. It has a 25% risk of major neurological deterioration, 22% risk of spinal instability and only 3% recovery of ambulation [56, 86]. The only indications for decompressive laminectomy are tissue diagnosis and removal of posteriorly situated epidural deposits, when vertebral disease is absent. In a retrospective study of patients with rapidly progressing weakness developing over 48 hours or less, radiation therapy was shown to be superior to posterior decompressive laminectomy in return of patients to ambulatory status [2]. In this same series radiosensitive lesions did better than radioresistant lesions regardless of treatment (surgery or radiation) emphasizing that the type of tumor is prognostically more important than the type of therapy [2]. Paraplegic patients traditionally have not improved with posterior decompressive laminectomy but anterior vertebral body resection shows some promise in paraplegic patients [24, 25]. In surgically treated posterior metastatic epidural spinal cord compression, one-third of patients regain ambulation and continence, but the incidence of paraplegia increases from 8% pre-operatively to 26% post-operatively [23]. Problems with wound closure and infection, which may be increased with radiation therapy, produce significant morbidity. Longer term problems are spinal instability or nonfusion and worsening pain. Posterior stabilization may be required following decompressive laminectomy to prevent spinal instability.

In selected patients with spinal instability, anterior decompression should be considered before radiation therapy [73]. Patients with vertebral compression with anteriorly placed epidural lesions will require a transthoracic, transabdominal or retroperitoneal approach for vertebral body resection. Anterior stabilization is usually produced using Steinmann pins and methyl methacrylate or bone graft. Concomitant posterior stabilization may be necessary if the neural arch is also involved with tumor.

Clinical outcome following anterior decompression in patients with a single anteriorly situated epidural metastasis is remarkably good. Fifty-two percent of these patients, who are in good general health and have either failed radiation or have a radioresistant tumor, will have an improvement in ambulation and a median survival of 16 months [24]. Operative mortality is 7% and surgical morbidity is 11%. Transient neurological worsening occurs in approximately 2%. Spinal instability develops in 5% of patients and recompression at the initial site will eventually occur in 22% of patients.

In other surgical series the vertebral body resection, pain improved in 60 to 97% and neurologic function improved in 55 to 97% [19, 22, 25, 87]. However, in one study the post-operative mortality was almost 36% [22]. In a small series of thirteen patients who had anterior decompression after failure of decompressive laminectomy, almost 50% deteriorate and only 8% improve [56]. Prior radiation therapy may also increase the morbidity and mortality of anterior decompression [25, 88].

Single stage synchronous anterior decompression by a posteriolateral approach with posterior stabilization has been advocated in patients with vertebral collapse and destruction of the neural arch posteriorly [20, 23]. Initial results in selected patients are encouraging with two-thirds of nonambulant patients in one series regaining the ability to walk [20]. This combined procedure by a posteriolateral approach may reduce respiratory or abdominal complications related to anterior transthoracic or transabdominal surgery.

Chemotherapy

Chemotherapy may have a place in treating patients who have metastatic epidural spinal cord compression and have previously had radiation and are not surgical candidates, or those with widespread metastases [89–91]. Complete resolution of paraparesis following intravenous chemotherapy has been reported in patients with breast cancer who have failed radiation [92].

Conclusion

Epidural spinal cord compression is a complication of systemic malignancy and usually signifies disseminated disease with shortened survival. Early diagnosis is crucial. The initial symptom is almost always local back or radicular pain. If radiculopathy or myelopathy is present on neurological exam, or spine x-rays are abnormal, emergent magnetic resonance imaging or myelography/computer assisted tomography is indicated. In cancer patients with local back pain and normal neurologic exam and spine x-rays, the probability of metastatic epidural spinal cord compression is 0.1 and computer assisted tomography or magnetic resonance imaging scanning is recommended. If computer assisted tomography of the spine demonstrates cortical disruption, the patient should then have MRI or myelography. If investigations demonstrate a benign cause for backache this can be treated symptomatically. If investigations fail to reveal a clear cause for backache and symptoms presist, MRI and cerebral spinal fluid analysis for cytology is justified.

Proper emergent management of metastatic epidural spinal cord compression requires the close and timely cooperation of medical oncologists, radiologists, neurologists, neurosurgeons, orthopaedic surgeons and radiation oncologists. Steroids will reduce pain and may lead to temporary neurological improvement. Radiation therapy is equal in effect to posterior decompressive laminectomy in both radiosensitive and radioresistant tumors. Therefore, radiation is the most appropriate and readily available option for the majority of patients. In selected cases with anterior epidural compression and spinal instability, initial management should be an anterior surgical approach or synchronous vertebral decompression with posterior stabilization. Posterior decompressive laminectomy alone is contraindicated in patients with vertebral collapse. In patients with posterior epidural disease without tissue diagnosis, laminectomy with or without stabilization should be performed.

The literature on metastatic epidural spinal cord compression is notable for the lack of good randomized studies dealing with clinical aspects and therapeutic options. There is however, a randomized multi-institutional study in progress to investigate patients with metastatic epidural spinal cord compression who are 'surgical candidates' to study the question whether lesion directed surgery with stabilization and radiation is more effective than radiation alone.

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