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Decompressive Laminectomy in the Management of Spinal Epidural Metastases

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In a series of 60 patients undergoing decompression laminectomy for metastatic malignancy, the median survival was 3.3 months with 11 patients (18%) living for at least one year and ambulating during part of this survival period. Forty-three per cent of the group were able to ambulate for at least some period post-operatively. If a patient could ambulate preoperatively he had a two-thirds chance of ambulating afterwards; conversely, if he could not ambulate preoperatively, he had a two-thirds chance of not ambulating postoperatively. The lymphoma group had the best prognosis. Long lesions and highly vascular tumors fared poorly. Paralysis (as defined by inability to ambulate) had developed with great rapidity in half of the patients unable to walk prior to operation. We postulate that this was caused by infarction of the spinal cord. A plea is made for early diagnosis and effective removal of these lesions before signs of cord compression are evident, and especially before the patient loses his ability to walk.

Neurosurgeons are frequently requested to perform decompressive operations on patients with malignancy who show evidence of spinal cord compression. The following study was done to evaluate the effectiveness of this procedure and to learn more about the course of this disease.

Case histories of all patients undergoing spinal decompression between 1961 and 1965 (inclusive) were analyzed and the results tabulated. There were 60 such cases or an average of one patient per month during the five-year period. All but one had a proven malignant growth compressing the spinal dura. The one benign case was originally diagnosed as "lymphosarcoma" but was later changed to "granuloma." Only three patients in the series had primary tumors in the epidural area (one malignant giant-cell tumor, one osteogenic sarcoma, one a primary melanoma). The vast majority of offending lesions were metastatic deposits. The few exceptional cases are included because the problems they presented were essentially the same as those of metastatic malignant tumors.

Eighty per cent of the patients were between 40 and 60 years of age. (Fig 1) The youngest patient was 11 (em-

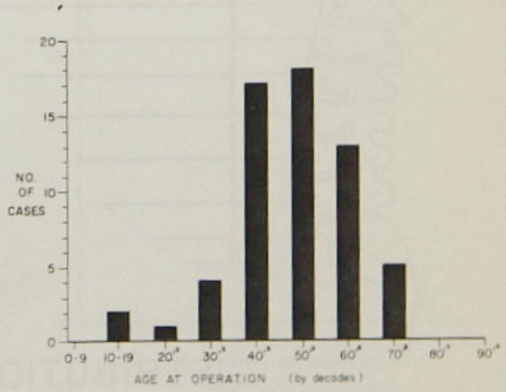


Figure 1

* Division of Neurosurgery

PRIMARY	NUMBER
BREAST	9
LUNG	6
RENAL CELL	6
CA - ? PRIMARY	6
G-I TRACT	6
LYMPHOMA	5
MELANOMA	4
PROSTATE	3
CERVIX	2
ALL OTHERS	13

Figure 2

bryonal carcinoma) and the oldest 77 (malignant lymphoma). The median age at operation was 52. There were 28 males and 32 females. The primary tumors responsible for the epidural metastatic lesions are tabulated in Fig 2. Breast tumors were the most frequent source, followed by lung, renal-cell, gastrointestinal tract, and carcinoma site unknown. (Our overall autopsy rate for the entire group of patients was 43%). There were five lymphomas, and lesser numbers of 16 other tumor types. There was a strong tendency for the metastatic lesions to lodge in the thoracic region, as noted in Fig 3. The numbers in parentheses indicate the percentage of the vertebral column (exclusive of the sacrum) occupied by each of the major subdivisions. Figures outside parentheses indicate the proportion of metastases found at the indicated level. Note that the thoracic portion of the vertebral column occupies 47% of the total length but accounted for 72% of all

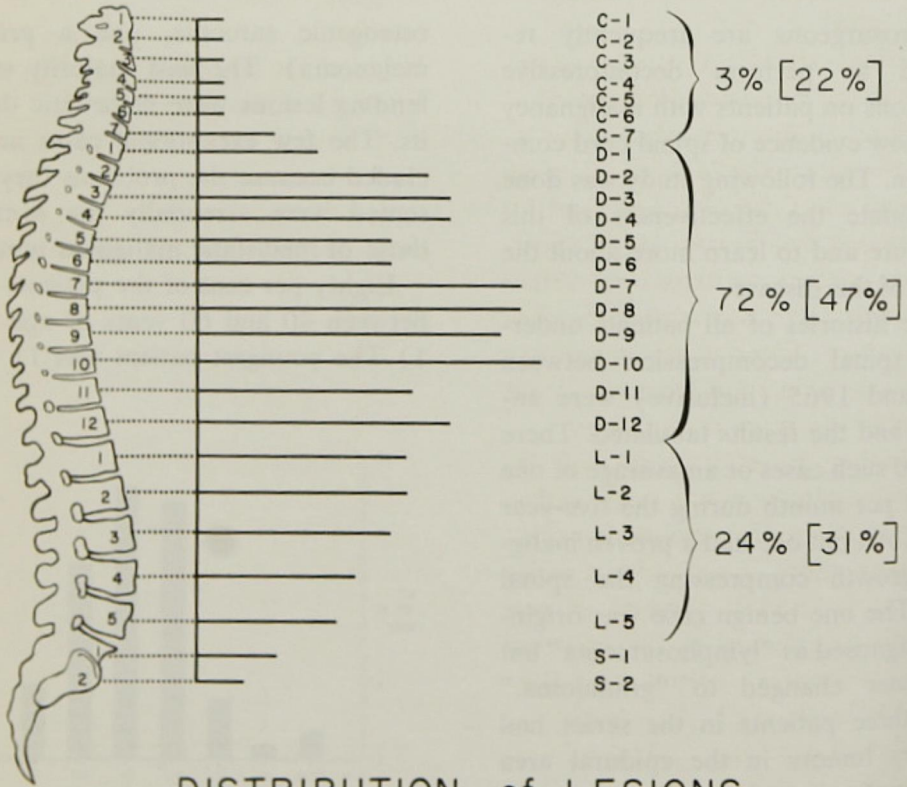


Figure 3

the metastases, a concentration factor of approximately 1.5.

From the clinical standpoint it became evident that these tumors give rise to a "pain stage" which was almost always present for weeks or months preceding a "cord compression stage," characterized by sensory, motor, or sphincter signs of spinal cord involvement. The pain was usually "vertebral" in nature, characterized by severe midline pain and tenderness. Frequently, involvement of the adjacent nerve roots led to typical radicular pain. The cord symptoms characteristically began with distal sensory changes, followed by a flexion type of weakness (hip flexors, hamstrings and dorsiflexors of the feet), and urinary retention. The motor and sphincter signs and symptoms, often sudden in onset, will be analyzed in detail later.

The diagnosis of a compressive extradural lesion was made from the clinical picture as outlined above, by x-rays of the spine, (in 24% of the cases there were no x-ray changes) and by myelography which was 100% positive since a block or extradural defect was considered a necessary condition for operation. Bone scans were not used in this series, but we have found them helpful in more recent cases.

In judging the effectiveness of decompressive laminectomy, some rather arbitrary criterion for success is necessary. One author[2], in analyzing a series of this type, used a survival of one year with ambulation as the criterion for a successful operation. Others[1, 3, 4, 5] have used the degree of motor function or the general clinical status to divide their patients into "excellent, good, fair and poor," or similar categories of results. We have used ambulation as the basis for "favorable" or "unfavorable" results; feeling that if a patient cannot ambulate postoperatively, then we have not been very helpful in subjecting him to a major operative procedure.

Of the 60 patients, 13 survived operation for more than one year (20%) and 11 of these 13 patients were ambulatory for at least some portion of this time. Only three of our patients are still alive, all surviving more than four years after surgery. One of them is the patient diagnosed as having granuloma, a 75-year-old female who remains apparently free of disease. Another is a 72-year-old male who had metastatic carcinoma suspected of being in the prostate, but biopsies of that organ were negative. He remains ambulatory after five years. The third survivor is a 57-year-old female with renal-cell carcinoma who is also ambulatory, after four years.

A survival curve (Fig 4) shows the median survival to be 3.3 months; and also indicates, by its hyperbolic pattern, that the survivors can be grouped

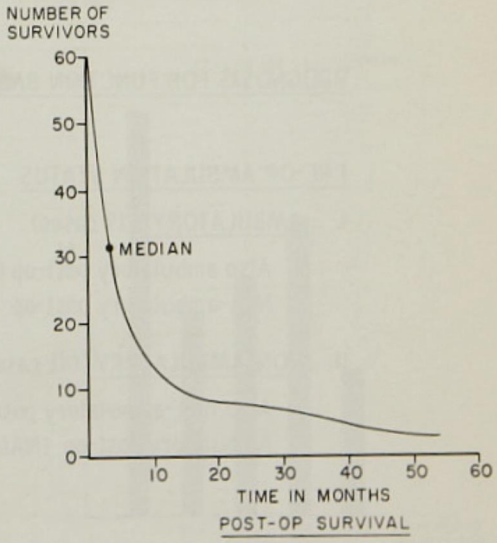


Figure 4

ANALYSIS OF CASES BASED ON POST-OP AMBULATION STATUS

POST-OP AMBULATION STATUS	No. OF CASES	% OF TOTAL	
I. AMBULATORY ("favorable")			
Ambulatory pre-op (A/A)	13	22%	43% "favorable"
Non-ambulatory pre-op (NA/A)	13	22%	
II. NON-AMBULATORY ("unfavorable")			
Non-ambulatory pre-op (NA/NA)	28	47%	57% "unfavorable"
Ambulatory pre-op (A/NA)	6	10%	

Figure 5

into short-term and long-term survivors, with the former predominating.

Fig 5 is a tabulation of results using postoperative ambulation as a criterion; thus 43% of our cases were "favorable" in the sense that they were able to ambulate for at least some period in their postoperative course. Fifty-seven per cent were "unfavorable" in that they did not ambulate postoperatively. The "favorable" group was equally divided between those who could ambulate also preoperatively, and those who could not. The "unfavorable" group showed a large percentage of patients who were unable to walk preoperatively.

Figure 6 is an analysis of the group viewed from the standpoint of their *preoperative* ambulation status. It is evident that a patient who is able to ambulate preoperatively has a two-thirds chance of being able to ambulate, at least temporarily, after the operation. Conversely, if a patient has already lost the ability to walk preoperatively, (as had two out of three of our patients) then he has only a one-third chance of walking afterwards—an eloquent reason for early diagnosis and treatment.

PROGNOSIS FOR FUNCTION BASED ON PRE-OP AMBULATION STATUS

PRE-OP AMBULATION STATUS	No. OF CASES	% OF SUB-GROUP
I. AMBULATORY (19 cases)		
Also ambulatory post-op (A/A)	13	68%
Non-ambulatory post-op (A/NA)	6	32%
II. NON-AMBULATORY (41 cases)		
Also non-ambulatory post-op (NA/NA)	28	68%
Ambulatory post-op (NA/A)	13	32%

We were able to discern three other factors of prognostic importance, namely the type of tumor, the linear extent of epidural involvement, and the vascularity of the tumor. Thus the lymphoma group generally has a much more favorable chance for postoperative ambulation. This has been true of all similar studies reported by other authors; the number of lymphomas included in a given series of patients has an important bearing on the results obtained. The breast metastastes appeared to be slightly more favorable than those from lung or kidney, but this is not certain statistically (Fig 7). Tumors involving five or more segments of the vertebral column were found to have a much less favorable prognosis than those involving two, three, or four segments (Fig 8). This may be related to the effect of the tumor mass on blood supply to the spinal cord.

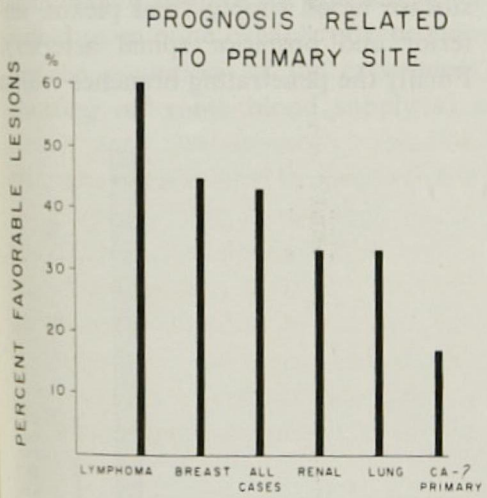


Figure 7

Finally (Fig 9), it was found that "vascular" tumors, as defined by those cases requiring more than two units of blood for replacement (500 cc equals one unit), had a much less favorable

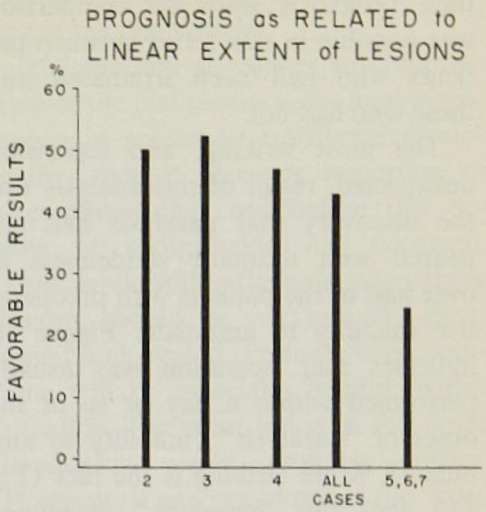
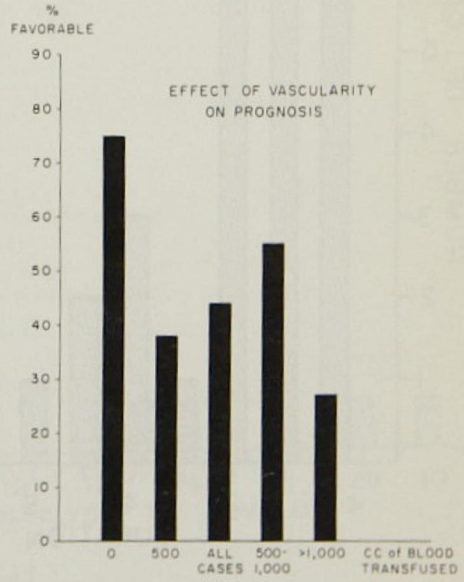


Figure 8

prognosis for ambulation than those requiring no blood replacement. However, this relationship did not hold true in comparing those cases requiring only one or two units of blood.

It should be noted that all our patients, who survived long enough to complete their treatment, received a tumorcidal dose of irradiation. It is assumed that this played a part in



their prognosis since no comparison was possible in this series between patients who had been irradiated and those who had not.

The most striking, and somewhat unexpected, result of this analysis was the discovery that paralysis had appeared with dramatic suddenness in over half of the patients with preoperative inability to ambulate. Figure 10 indicates that operation was usually performed within a day or so of the onset of "paralysis" (inability to ambulate). More striking is the fact (Fig 11) that this "paralysis" developed (from no weakness to inability to walk) in less than one day in 16 patients, and in two days or less in 23 of the 41 patients involved.

Discussion

The fact that paralysis develops with such rapidity in about half of the involved cases demands explanation. It would seem that compression alone would tend to produce a more gradual onset of weakness, and that the results of decompression would be considerably better as observed in benign intradural, extramedullary tumors. On clinical grounds there is much to support the concept that infarction of the spinal cord is the final event, beginning with interference of segmental and spinal artery supply. Later, perhaps by compression, flow is obstructed in the surface blood supply (pial plexus, anterior and posterior spinal arteries). Finally the penetrating branches within

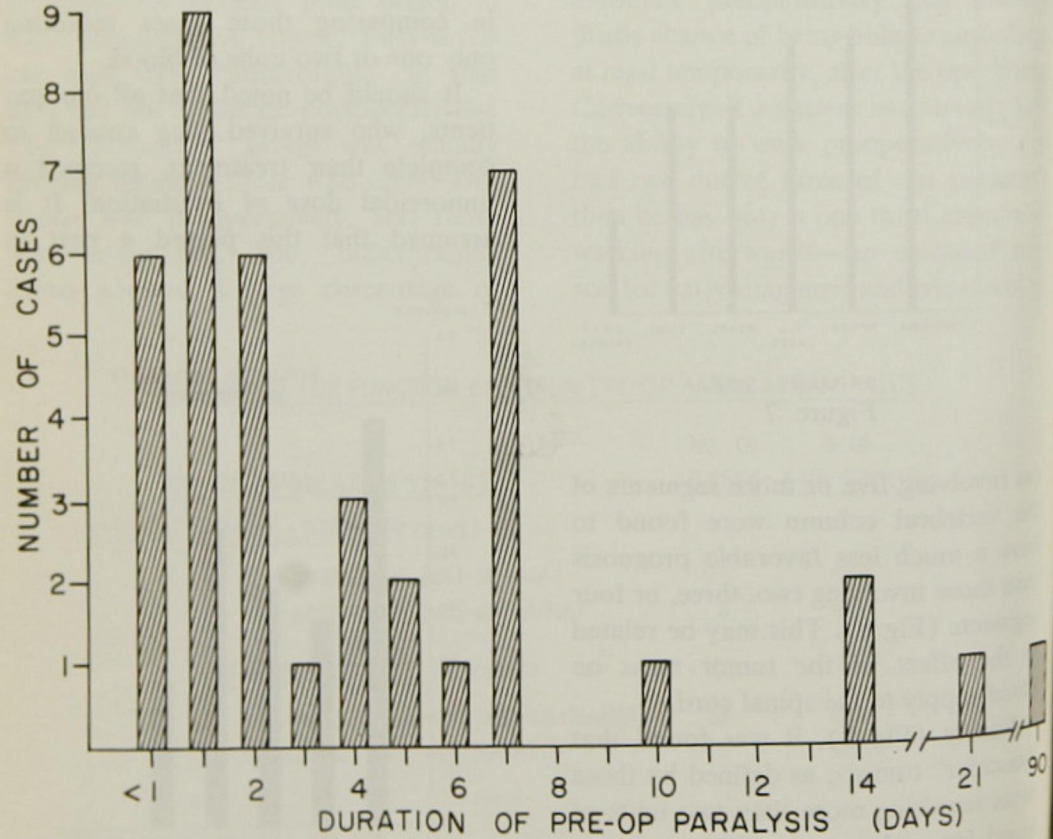


Figure 10

the cord substance are involved.

In an experimental model, recently reported from Osaka University[6], it was shown that the canine cervical cord was not compromised by vertebral artery obstruction or by occlusion of spinal branches extrinsic to the cord. Even occlusion of the anterior spinal artery caused damage only to the anterior portions of the cord sparing the pyramidal tracts. Only by obstructing the pial plexus *and* the anterior spinal artery could complete transverse cord lesions be produced in dogs. Obstruction of the pial plexus on one side caused hemiplegia on that side. A malignant growth of the epidural space would seem quite capable of reproducing the conditions of the experiment, shutting off some blood supply at a distance, and the rest by direct squeezing of the pial vessels.

If infarction secondary to compression of the pial plexus is the final mechanism in producing transverse myelopathy, then it becomes important to decompress the cord before this degree of compression has occurred. Thus, while still in the pain stage, these lesions should be energetically diagnosed and treated. Perhaps bone scanning will be especially helpful in this situation. For most lesion in this stage irradiation would probably suffice. However, if any symptoms of the "cord compression stage" appear (numbness, weakness, trouble voiding) the situation should be considered urgent, calling for myelography, and subsequent operation if a block is found. Even this

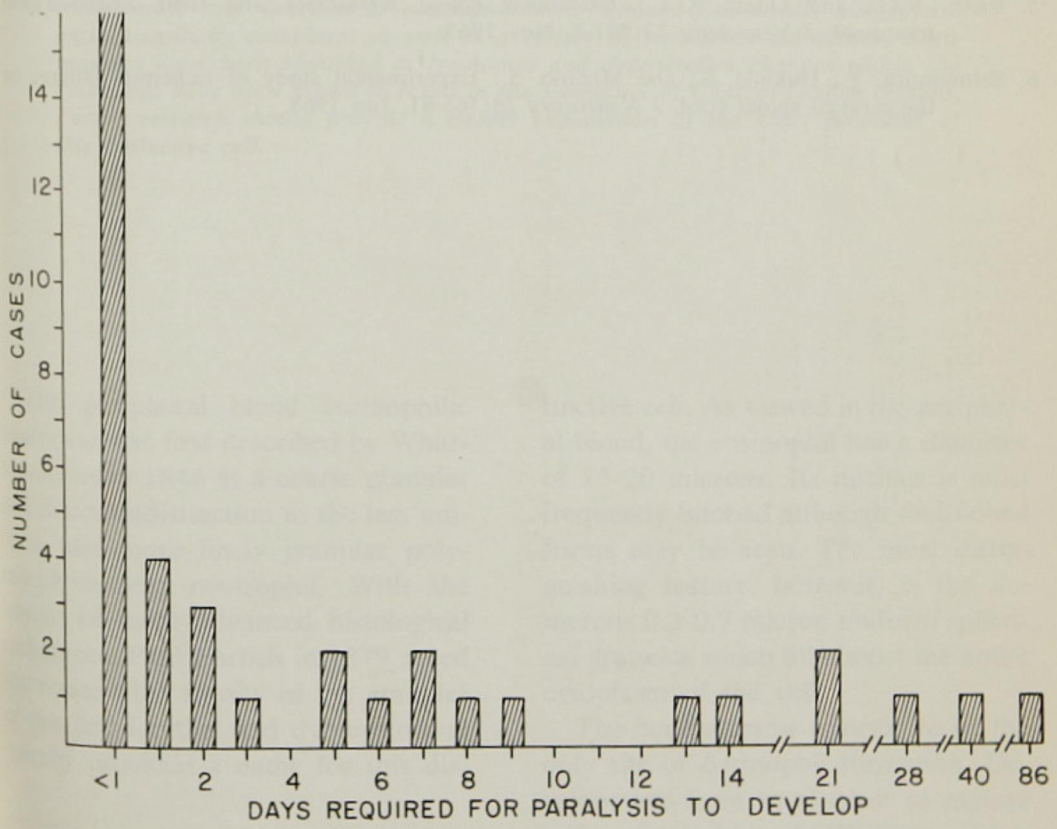


Figure 11

regimen will be too little and too late in many cases. Perhaps myelography should be done in suspicious cases, even before there is any clinical evidence for cord compression. If a myelographic block, or high grade narrowing is present, we advise operation followed by the usual irradiation. Our study indicates that any lesser degree of vigilance will lead to many irreversible lesions.

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