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The role of vertebral body collapse in the management of malignant spinal cord compression

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SUMMARY The management of malignant spinal cord compression has been reviewed recently and attention drawn to the adverse effects of laminectomy. Data from that review suggested that the presence of vertebral body collapse could have an important negative effect on the outcome of laminectomy. However, there was only scant evidence available in the literature to support that conclusion. Eighty consecutive patients with thoracic spinal cord compression due to a single metastasis treated by laminectomy are reported here. It is seen that the presence of vertebral collapse signified: a much reduced chance of regaining the ability to walk; a much greater possibility of further neurological deterioration; and a major increase in the incidence of post-operative spinal instability. The role of laminectomy in the management of such patients needs to be further questioned and alternative therapeutic measures such as radiotherapy, posterior spinal instrumentation or anterior surgery should be strongly considered in the presence of vertebral body collapse.

The accepted treatment of spinal cord compression due to a metastatic tumour traditionally has been by urgent decompressive laminectomy followed, if appropriate, by radiotherapy. Certain authors[1-4] have explored the possibility of treatment by primary radiotherapy given in conjunction with steroids but there is no clear consensus as to which of these options is the most beneficial and least hazardous. More recently, a review article[5] was published in this journal which undertook an analysis of the reported results of surgical and radiotherapeutic treatment since 1960. It concluded that urgent laminectomy did not appear to confer any overall improvement in outcome as compared with primary radiotherapy. However, laminectomy appeared to have an appreciably higher incidence of adverse effects; especially in terms of wound healing and spinal instability.

From that review, the factor which seemed to have the greatest bearing on neurological outcome regardless of the nature of treatment was not surprisingly the extent of the neurological deficit at presentation. Patients who were still ambulant faired substantially better than those whose deficit was more severe. Only a greater awareness of the importance of early diagnosis and referral by the public and referring practitioners can influence this factor. Unfortunately, many patients will still present to the radiotherapist or neurosurgeon at a stage when they have already lost the ability to walk. Certain aspects of the management of these patients were considered in the discussion section of that article and one factor which appeared to be important in the outcome and frequency of complications was the role of vertebral body collapse. This aspect has been little studied in the past and the data available from such a literature review were scanty. This present paper explores further the significance of metastatic vertebral collapse on the degree of neurological recovery and on the frequency of complications in patients treated by laminectomy.

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Methods

The study was of 80 patients with spinal cord compression due to a single metastasis in the thoracic spine presenting consecutively to either the Institute of Neurological Sciences, Glasgow, or the Mersey Regional Department of Surgical and Medical Neurology over a three year period. All patients were treated by a standard decompressive laminectomy performed soon after admission with no attempt at spinal stabilisation or instrumentation. Operations were performed by various surgeons usually in a neurosurgical training grade. Patients whose clinical condition and tumour histology made it appropriate were treated by radiotherapy once the surgical wound had healed. The neurological condition of each patient was graded at the time of presentation as follows: ambulant (even if only with the use of a walking aid); paraparetic but non-ambulant; and paraplegic, indicating a complete motor and sensory paralysis. Following treatment the patients were similarly graded either at follow-up or by contact with the radiotherapist or general practitioner. The same grading system was used after operation and the patients were assessed to the best grade they attained even if there was a later deterioration. This was done to ensure that loss of the ability to walk due to terminal disease was not misconstrued as neurological deterioration. "Improvement" was only accepted if a patient moved to a better grade and likewise "deterioration" indicated a change to a lower grade. As the grading was designed as a functional assessment, lesser degrees of neurological change were considered as "unchanged".

Plain spinal radiographs of all patients were reviewed and an assessment of the degree of vertebral collapse of the vertebral body was made. Vertebral collapse was defined as loss of height of the vertebral body by greater than 50%. This produced two groups of patients: one with vertebral collapse (n = 41); and another group without vertebral collapse (n = 39). Twenty-four (59%) of the patients with collapse were male and 24 (64%) of the non-collapse group were male; this difference was not significant. Similarly, there was no difference in age between the two groups (collapse = 30–78 years, mean 60·0 years; non-collapse = 15–85, mean 58·9 years). The distribution of the level of vertebral involvement did not differ between the two groups. Myelography was performed in most cases but where the clinical level correlated with a single lesion on plain radiographs, it was occasionally omitted.

The origin of the metastases was unknown in 25 (61%) of the collapse group and in 20 (51%) of the non-collapse group (p = n.s.). There was also no difference in the number of patients in either group who had a bronchogenic primary or a primary tumour carrying a more favourable prognosis such as breast or lymphoma. Of the patients with vertebral collapse, pain was not a prominent feature on presentation in 11 (27%). The remainder of this group had had marked spinal pain for a period ranging from 24 hours to one year (mean 17 ± 18·5 weeks). There was no significant difference in the group without collapse: nine (23%) were free of pain on presentation; the remainder having pain duration of similar range with a mean of 11 ± 11·5 weeks. The length of history of neurological deficit also ranged widely from an instantaneous onset to a duration of 6 months. In the group with vertebral collapse, the mean duration of neurological deficit was 3 ± 3·5 weeks and in those without collapse was 3·8 ± 3·3 weeks.

Results

The neurological status of the patients at the time of presentation is shown in table 1. There was no significant difference in the degree of neurological deficit present prior to laminectomy. Table 2 shows the best neurological status attained by patients in the two groups following laminectomy and radiotherapy, if appropriate. It can be seen that there is a significant difference with regard to outcome between the two groups with the collapse group outcome being worse.

Table 1 *Neurological grade on presentation*

*Grade**	*Collapse (n = 41)*	*No Collapse (n = 39)*
Ambulant	5 (12·2%)	6 (15·4%)
Paraparetic	31 (75·6%)	27 (69·2%)
Paraplegic	5 (12·2%)	6 (15·4%)

$\chi^2 = 0·409$; $p > 0·5$ (NS)
*See text for explanation

Complications directly related to the operative procedure were also examined. Other complications such as pulmonary embolus were not studied. Attention was directed specifically towards: mortality rate at one month from surgery; wound infection or dehiscence; and the post-operative development of spinal instability. This latter factor was defined in two ways. Clinically, instability was judged to be a major increase in or the development of spinal pain specifically related to trunk movement. Radiologically, the criteria taken were: evidence of dislocation of the spinal column on a static radiograph; or abnormal degrees of motion on stress films. Most of the patients who developed instability satisfied both these definitions. Three of the patients who developed instability had had no pain prior to treatment. Despite the evidence of instability, two of these patients actually showed neurological improvement despite their pain. However, one required a later transthoracic stabilisation procedure while the other required large doses of opiates to control the pain. Table 3 presents the incidence of complications in each group.

Discussion

There have been many reports in the literature over the years regarding the management of metastatic spinal cord compression. The majority of these papers, though reporting the results of differing therapeutic strategies, have made assessment of the results difficult because of a basic lack of specific information about the neurological condition of the patients before and after treatment. This has recently been discussed in a review article[5] in which attention was drawn to the deleterious results of laminectomy in many of these unfortunate patients. Relatively, little attention has been given to such adverse effects of

Table 2 *Best neurological grade following treatment*

Grade	*Collapse (n = 41)*	*No Collapse (n = 39)*
Ambulant	6 (14·6%)	13 (33·3%)
Paraparetic	13 (31·7%)	14 (35·9%)
Paraplegic	22 (53·7%)	12 (30·8%)

$\chi^2 = 5·361$; $p < 0·5$

Table 3 *Complications of laminectomy*

Complications	*Collapse (n = 41)*	*No Collapse (n = 39)*
Mortality	4 (9·8%)	2 (5·1%)
Wound dehiscence or infection	3 (7·3%)	5 (12·8%)
Spinal instability	9 (22%)	0

therapy. In similar fashion, there has been surprisingly little attention paid towards factors which influence the outcome of treatment other than on the pretreatment neurological status and the histology of the tumour, both of which are widely accepted as important prognostic factors. The role of the actual mechanics of the bony destruction and its effect on neural compression has only rarely been adequately discussed in a clinical forum. From the literature review[5] it appeared that there was a suggestion that the presence or absence of vertebral body collapse might be an important factor and this has been examined in this present study.

Some previous papers have made the observation that the presence of vertebral collapse reduced the chances of neurological recovery following laminectomy but have given only scant evidence in support of this observation. In the study reported in 1965 by Brice and McKissock,[6] there were 30 patients with vertebral collapse. The results of this sub-group were not analysed separately but the authors were able to observe that "no patient with severe neurological deficit and vertebral collapse improved" following laminectomy. Two years previously, Wright[7] published his results and showed that 38% of his patients without bony involvement had a satisfactory outcome as compared with only 19% of those with involvement of the vertebral body. However, neither the degree of bony involvement or what constituted a "satisfactory outcome" were made clear. More recently Barcena *et al*[8] showed that anterior bony disease carried an unfavourable prognosis though again the degree of involvement and the actual definition of outcome were unclear.

This present paper has defined the degree of vertebral body destruction amounting to collapse and also has accurately graded the neurological status before and after treatment in order to examine the role of anterior spinal deformity in the outcome of patients with metastatic spinal cord compression undergoing laminectomy. The group of patients with vertebral body collapse was comparable to those without collapse in all factors likely to influence outcome. Each group was treated in identical manner.

The outcome as shown in table 2 in the group of patients without collapse of the vertebral body was very similar to the outcome deduced from the literature review referred to previously,[5] with approximately one third of patients being ambulant following treatment and one quarter undergoing deterioration by at least one neurological grade. However, in the group with vertebral body collapse, the situation is quite different. Here, only 15% of the group were ambulant following laminectomy and 54% were paraplegic. It is to be recalled that there was no difference between the groups with regard to the number of patients who were ambulant or to their overall neurological status prior to treatment.

A more detailed study of the outcome shows that, of the six patients who were ambulant following laminectomy in the presence of vertebral collapse, all five had been ambulant prior to surgery. In the non-collapse group, 13 were ambulant post-operatively of whom only five had been ambulant pre-operatively. This signifies that, of the 37 patients with vertebral collapse whose neurology had been severe enough pre-operatively to prevent them walking, only one (3%) achieved ambulation following laminectomy. This fact confirms the opinion of Brice and McKissock[6] that patients who have paraparesis severe enough to render them unable to walk and who have vertebral body collapse are extremely unlikely to regain either the ability to walk or any meaningful, functional neurological improvements following laminectomy. Moreover, the data show that laminectomy in the presence of vertebral body collapse carries a significantly greater risk of major neurological deterioration by at least one grade (50% as compared with 24% in the non-collapse group). The reasons for this would seem to be two-fold. Firstly, in the presence of a destructive lesion in the anterior spinal column laminectomy may result in a further destabilisation of the already threatened spinal column. Support for this factor is seen in that, in the group without vertebral collapse, no patients developed clinical or radiological evidence of spinal instability during the study, whereas this occurred in 22% of the patients with vertebral body collapse. Secondly experimental evidence[9 10] has shown that laminectomy in the presence of a significant anterior extradural mass is unlikely to produce neurological recovery. It is reasonable to assume that patients with bony vertebral collapse will have compressive forces subjected to the cord from anteriorly but from plain radiographs alone it is not possible to say whether circumferential compression could be present. Siegal and Siegal[11] felt that this information was important and it did influence their surgical approach. Their paper, however, does not indicate how much of this topographical information came from the plain radiographs and how much from myelography and CT scanning. It is possible that the greater topographical detail given by myelography and CT scanning could produce further evidence that it is the anterior compression which is the important factor in the poor neurological outcome but as this evidence was not available in all patients in this series it was not subjected to analysis.

It may be concluded, therefore, that laminectomy in the presence of vertebral body collapse carries a very low potential for neurological recovery, a 50/50 chance of producing major neurological deterioration and a high incidence of spinal instability therefore adding an extremely distressing and painful problem to such unfortunate patients. The evidence produced in this paper allows the conclusion that a decompressive laminectomy is contraindicated in the presence of collapse of the vertebral body has a very high incidence of adverse outcome and, especially in the presence of marked neurological deficit, a very low success rate in terms of the return of the ability to walk. Alternative methods of treatment must therefore be applied to this situation.

The use of radiotherapy should not further affect spinal stability. However, no evidence is available to establish whether radiotherapy would produce better neurological results than laminectomy in the presence of vertebral collapse. Many radiotherapists do feel, however, that radiotherapy in a patient with severe neurological compromise and anterior collapse is relatively unsuccessful. Accurate data on this point are required. Tissue diagnosis remains important if surgery is not performed and can be achieved by the techniques of percutaneous needle biopsy on a collapsed body using a large diameter needle,[12 13] This is a procedure with very low morbidity and preliminary results in our unit show that immediate smear histology assessment of the cores gives accurate diagnosis within half an hour with excellent correlation with final histology.

A possible logical approach to the problem lies in the use of anterior surgical approaches to the spine, either transthoracic or thoraco-abdominal. Such approaches allow direct excision of the compressing tumour bulk with visual confirmation of dural decompression. Immediate spinal stabilisation and early mobilisation are also possible. Morbidity and mortality are acceptably low given experienced teams and good pre-operative respiratory function but it is a major procedure for such patients. Although initial reports are encouraging[11 14] it remains to be seen whether a controlled study would substantiate this approach. A somewhat less aggressive approach might be to supplement laminectomy with a posterior spinal instrumentation.[15-17] Although it may be hoped that this will reduce the incidence of spinal instability, it remains to be seen whether it can improve on the poor neurological results of laminectomy for malignant spinal cord compression.

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