Papers and Originals

NATURAL HISTORY AND PROGNOSIS OF CERVICAL SPONDYLOSIS

BY

F. LEES, M.B., Ch.B., M.R.C.P., D.C.H. J. W. ALDREN TURNER, D.M., F.R.C.P.

From the Department of Neurology, St. Bartholomew's Hospital, London

It is now fifteen years since cervical spondylosis was clearly defined (Brain, Knight, and Bull, 1948), but this is not long in terms of natural history, and it is not surprising that little has been written on this aspect of the disease. Brain (1962) considered that the natural tendency of cervical spondylosis was to become arrested, but most of those affected were left with a variable degree of disability. Wilkinson (1962) wrote that the prognosis of cervical spondylosis was good, provided that the condition was recognized early, appropriate treatment was given, and the patient was told how to cope with his disability.

The natural history of the disease is especially important in relation to myelopathy. Without knowledge of it we cannot put treatment, whether conservative or operative, into proper perspective. This study is concerned with the prognosis of the disease and some of the factors which might influence it.

Case Material and Definitions

All the patients attended the department of neurology at St. Bartholomew's Hospital. Two groups of patients were studied: (1) 44 who had myelopathy when they first attended, and (2) 51 who had no signs of myelopathy when they were first seen.

Group 1, Myelopathy.—These 44 patients had radiological and myelographic evidence of cervical spondylosis with signs of cord damage when they first attended. All had extensor plantar responses. After repeated clinical examinations, investigations, and prolonged follow-up there was no reasonable doubt in any of these cases that the myelopathy was due to cervical spondylosis. All doubtful cases have been excluded. All patients with other neurological diseases such as disseminated sclerosis, even if spondylosis was also present, have also been excluded.

Group 2, Non-myelopathy.—These 51 patients complained of symptoms in the neck, shoulders, arms, or hands which were ascribed to cervical spondylosis, and demonstrated by radiography. At the time of the first and later attendances there were no symptoms in the trunk, legs, or sphincters which could be ascribed to the disease, and there were no signs of "long tract" affection in the spinal cord, either pyramidal or sensory. All those with any evidence of other neurological disease were excluded.

Myelopathic Group

The period of follow-up in St. Bartholomew's Hospital is shown in Table I. One patient was first seen 32 years ago. The first diagnosis was motor neurone disease, but subsequent observation proved this to be wrong. Twenty-six patients have been followed for five years or more. A 100% follow-up was achieved. More important than the period of follow-up is the duration of symptoms, which is shown in Table II. This refers to the total period since the first definite neurological symptoms until the death or last visit of the patient. It can be seen that the final assessment in 34 patients was at the end of a period of more than five years. In 22 it was more than 10 years, and in one it was 40 years.

TABLE I.—*Myelopathy. Actual Period of Follow-up*

Period in years	1	2	3	4	5	6	7	8	9	10	11	14	30	32
No. of patients	2	6	5	5	4	3	2	7	3	3	1	1	1	1

TABLE II.—*Myelopathy. Duration of Symptoms to Follow-up or Death of Patient*

Duration in years	3–5	6–10	11–15	16–20	21–30	32	40
No. of patients	10	12	11	5	4	1	1

The sample is further defined in Table III, which shows the age at onset of neurological symptoms and the sex distribution. In 36 patients the symptoms began after the age of 40. The concentration of females in age-group 51–60 years is noteworthy. With one exception all patients who began to have symptoms after the age of 60 were men.

TABLE III—*Myelopathy. Age at Onset*

Age in Years:	31–40	41–50	51–60	61–70	71–80
No. of patients	8	11	15	9	1
Male	6	7	6	8	1
Female	2	4	9	1	0

Natural History

The history of each patient with myelopathy was studied and from it a pattern of disease could be drawn. This pattern is illustrated in Figs. 1 and 2. Fig. 1 concerns the patients whose total period of symptoms to follow-up was more than 10 years. Each "block" represents the first symptoms or an exacerbation of symptoms. For convenience the "blocks" are shown to be at least one year in length, but in fact many were less than one year. In between the "blocks" and leading to the point of follow-up or death (the vertical line on the right of the figure), is a horizontal line for each patient. This line means that no new symptoms developed during that time and no new signs were observed; in fact, the patient was in a static or improving state during this time. Two examples will serve to explain this figure more fully.

Example 1.—The patient represented by the second lowest line in Fig. 1 was 45 years of age when he first came to Bart's in 1930. He had fallen a short time before and sustained an indirect injury of the neck. He had weakness of both hands and could not fully flex his fingers or oppose his thumbs.

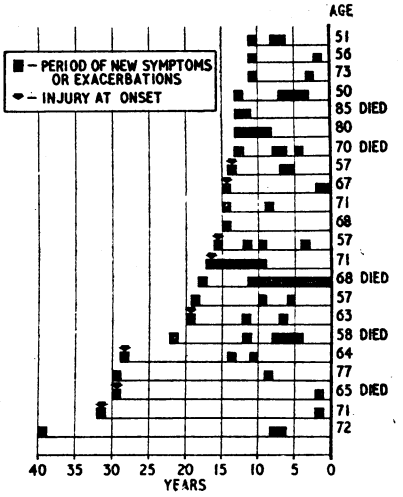

FIG. 1.—Myelopathy: pattern of disease in 22 patients who had symptoms for more than 10 years.

After two months some improvement was noted, but the right hand never recovered. His condition remained static for 30 years. In 1960 his right leg became weak and the right hand weaker. He had extensor plantar responses. He was 71 years of age at the point of final assessment as shown in the figure.

Example 2.—This patient, represented in the ninth lowest line of Fig. 1, was 50 years of age at the onset of symptoms. His left leg was dragging and he had flexor spasms in both legs. The arm muscles were wasted and the legs spastic, with extensor plantar responses. Amyotrophic lateral sclerosis was the diagnosis made. For five years his condition remained static. After this he began to deteriorate. A diagnosis of cervical disk lesion causing spinal-cord compression was then made and led to a cervical laminectomy, which showed no disk protrusion but the signs of severe spondylosis. For the next 11 years he gradually deteriorated, could no longer go to work, became bedridden, and finally died of pneumonia in a severely incapacitated state at the age of 68. A mark indicates that the time of final assessment was at death (in 1959).

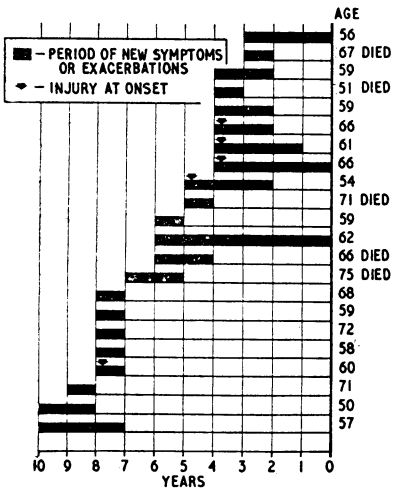

FIG. 2.—Myelopathy: pattern of disease in 22 patients who had symptoms for 10 years or less.

A glance at Fig. 1 gives an immediate visual picture of the pattern of disease in these patients. A few began to have symptoms after a fall, most have had "bouts" of symptoms during a year then a static period or one of improvement. Another bout or exacerbation might then occur, only to settle again into a static state, though often leaving the patient worse than he was previously. Only a few patients deteriorated gradually over many years.

In the same way Fig. 2 illustrates this pattern in those who had symptoms for 10 years or less. It can be seen that three patients were getting worse during the whole period, but most had more or less short exacerbations and long periods of improvement or of a non-progressive disability.

Cervical spondylosis with myelopathy is clearly a condition in which there are long periods without new or worsening symptoms. Exacerbations can occur at long or shorter intervals for many years.

Further Details of the Myelopathic Group

Degree of Incapacity or Disability.—Mild disability consisted of symptoms, often in the hands and arms, producing some incapacity but not preventing ordinary everyday activities. Leg symptoms were slight and sphincter symptoms not very troublesome. Moderate disability consisted of considerable difficulty in using hands or legs, sufficient to affect the performance of everyday tasks, and to cause slowness in walking or disturbance of balance. Severe disability consisted in such a degree of paresis in the limbs that the patient could hardly walk or needed sticks or crutches, and at the time of the worst symptoms was unable to work and was often confined to bed, chair, or house. Each of these degrees of disability refers to the maximum degree reached by the patient at the time of his worst symptoms.

Mild Disability (Table IV).—Four patients were classed as mildly disabled. Two died at age 71 and 86 of other disease. All had improved after wearing a collar and then remained static; none became worse during the period of follow-up. One had no residual disability.

Moderate Disability.—Six patients with more than 10 years of symptoms were classed as moderately disabled. All six had approximately the same degree of disability at follow-up, though one had improved a little and two had deteriorated slightly but had not changed to "mild" or "severe." Nine with symptoms for 10 years or less were classed as having moderate disability. Four had improved and one was worse, but only one had changed category at follow-up. Three of the whole group were dead—two of coronary thrombosis and one of cancer.

TABLE IV.—*Disability and Employment*

Duration of Symptoms	Maximum Disability			Disability at Follow-up				Unemployed
	Mild	Mod.	Sev.	Nil	Mild	Mod.	Sev.	
More than 10 years	1	6	15	1	1	6 5	9	0 0 3
10 years or less ..	3	9	10	1	2	8 2	1 8	0 0 3
Totals ..	4	15	25	2	3	21	18	6

Severe Disability.—Fifteen patients with over 10 years of trouble were classed as severely disabled at worst. At follow-up one had no symptoms at all, though the plantar responses were extensor. Five had improved to the category of moderate disability—one was retired, two were housewives, one was a secretary, and one a driver. Nine were still severely affected at review. Two of these needed sticks for walking; one was bedridden and died; a teacher, an electrician's mate, and two housewives were still able to do their work; and two were retired, but not because of the disease. Of those with a history of 10 years or less 10 were severely disabled. At final review two had entered the "moderate" category and eight were still severely affected; three of these were housewives, one worked in a shop, three were unemployed because of disability, and one was retired.

Disability and Employment (Table IV).—Data concerning myelopathic patients are shown in Table IV. Six patients were unemployed as a result of their disability. At follow-up or shortly before death 13 were working, 13 were housewives, and 12 had retired.

Cause of Death (Table V).—Ten patients died, but in only two was death directly associated with the spinal-cord

TABLE V.—*Details of Patients who Died*

Sex	Age at Onset	Disability		Final Work State	Age at Death	Cause of Death
		Maximum	Final			
M	64	Moderate	Moderate	Lathe operator	67	Coronary thrombosis
F	47	,,	,,	Housewife	51	Carcinoma breast
F	66	Mild	Mild	Retired	71	Stroke
F	60	Severe	Severe	Housewife	66	Venous thrombosis. Pulmonary embolus
M	68	,,	,,	Retired	75	Bleeding from gastric ulcer
M	74	Mild	Mild	,,	85	Coronary thrombosis
F	57	Severe	Moderate	Housewife	70	Stroke
M	50	,,	Severe	Unemployed	68	Quadriplegia (pneumonia)
M	36	,,	,,	,,	58	Road accident
M	35	Moderate	Moderate	Retired	65	Coronary thrombosis

affection—one died tetraplegic after 11 years of unemployment, and one, severely affected, died of a pulmonary embolus which may have resulted from stasis.

Course and Final Disability without Therapy (Table VI).—Eleven patients with myelopathy had no treatment. Only one was classed as severely disabled at worst. Patients who were given a "collar" but did not wear it are in this group.

TABLE VI.—*Course and Final Disability Without Treatment*

Duration of Symptoms (Years)	Longest Period Without Deterioration (Years)	Final Disability
4	2	Moderate
6	5	"
8	8	Nil
8	7	Mild
10	7	Moderate
13	11	Mild
15	13	Severe
20	7	Moderate
30	8	"
30	30	"
32	29	"

Apparent Effect of Therapy (Table VII).—Eight patients had operative treatment. Two of these had "fixation" of cervical vertebrae and six had laminectomy with "decompression." Of the eight, four had deteriorated while wearing a collar and the other four were considered to require laminectomy before wearing a collar. Twenty-eight wore a collar and did not have an operation. Three of the four who were worse after wearing a collar are included in the six who had laminectomy.

TABLE VII.—*Effect of Therapy*

Therapy	No.	Duration of Therapy		No Worse	Improved	Worse
		Few Months	1–10 Years			
Collar ..	28	20	8	7	9 8	4
Fixation (operative)	2			1	1	
Laminectomy	6			3	2	1

Prognosis and Age at Onset.—In the myelopathic group there appeared to be no relation between age at onset and prognosis in terms of disability, employment, or death because of myelopathy.

Non-Myelopathic Group

These 51 patients were unselected except that they attended the neurological clinic from 1947 onwards and were consecutive cases. The 51 were reviewed in 1961 or 1962.

Unfortunately, because of shifting population and other factors, it was not possible to achieve a 100% follow-up in this group, but we did not feel that it was quite as important as in the myelopathic group. The follow-up achievement was about 85%. It seems likely that patients still suffering from symptoms would be more likely to attend than those who were not.

TABLE VIII.—*Non-myelopathy. Age at Onset*

Age in Years:	21–30	31–40	41–50	51–60	61–70	71–80
No. of patients ..	2	11	18	16	2	2
Male	1	8	15	10	1	2
Female	1	3	3	6	1	0

TABLE IX.—*Non-myelopathy. Duration of Symptoms to Follow-up or Death of Patient*

Duration in years ..	2–5	6–10	11–15	19
No. of patients ..	5	36	9	1

The sample is defined in Table VIII, which shows age at onset and sex distribution. The concentration of females in age-group 51–60 is noticeable. The duration of symptoms is shown in Table IX. All except five had symptoms for more than five years before follow-up. In 10 the follow-up was more than 10 years, the longest being 19 years.

Pattern of Disease.—In the 10 patients with a history of 10–19 years three had no symptoms after the first few months, three continued to have mild symptoms, and four had slightly more troublesome symptoms. Of the 41 patients followed up for 10 years or less, 19 had no further trouble, 12 had slight intermittent symptoms, and 10 had moderate disability. Only one had a further relatively severe bout of symptoms after the first. This was a patient aged 53 at review who had had symptoms intermittently for eight years. Nine patients began to have the first symptoms after an indirect injury to the neck. None had symptoms in the legs, trunk, or sphincters which could be ascribed to myelopathy. One patient had extensor plantar responses which were not found on first examination at the age of 72 years in 1947, when he attended with neck and shoulder pain and cervical root symptoms. When seen in 1961 at the age of 86 he still had local symptoms of spondylosis, but in spite of extensor plantar responses his legs felt normal to him and there were no new neurological signs. He was apparently fit and well. Two patients had equivocal plantar responses at follow-up.

Cause of Death.—Six patients died in the follow-up period. All were males. None died of any condition associated with spondylosis. The causes were pneumonia (age 60), cardiac failure due to hypertension (aged 83), stroke due to hypertension (age 55), amyloidosis with uraemia (aged 41), and carcinomatosis (age 61 and 64). All these patients had improved by wearing a collar at the time of their first symptoms.

Employment.—At follow-up, or shortly before death, not a single patient was unemployed because of spondylosis; 36 were fully employed, 3 had retired, 11 were housewives, and 1 was not traced.

Apparent Effect of Therapy.—Twelve (66%) of 18 improved while wearing a collar; 15 (60%) of 25 improved without wearing a collar during or after physiotherapy, osteopathy, or manipulation; three of five improved with no treatment; and two improved with rest only. These data are shown in Table X. Some patients had many treatments, and there did not seem to be much difference in the results, whichever treatment was the main one. Many who wore a collar also had exercises and traction, but none of those classified under exercises, rest, manipulation, or osteopathy wore a collar. Our impression of the results of treatment, coupled with detailed examination of the disease pattern, is that the wearing of a collar often relieves symptoms but that any or no treatment will often give the same final results. The most important of our observations is that

TABLE X.—*Apparent Effect of Therapy on Symptoms in the Non-Myelopathic Group*

Main Therapy	Improved	Still Troubled or Static
Collar	12	6
Exercises and traction ..	12	8
Rest only	2	0
No therapy	3	2
Manipulation	2	2
Osteopathy	1	0
	32	18

myelopathy hardly ever appears to develop in those patients who do not show it when they first attend. Our data cannot adequately compare the relative merits of the treatments used. This would require a prospective, not a retrospective, approach.

Discussion

Brain, Northfield, and Wilkinson (1952) in their paper on the neurological manifestations of cervical spondylosis gave some data relevant to the discussion of the natural history of this disease. The average age at onset of symptoms was 49 years with a range of 14–70, 75% of these patients being between 40 and 59 years. Of 31 males and 14 females, eight died (six men and two women), the average age at death being 65 with a range of 55–70 years. Six cases had full necropsy. The causes of death were: (1) coronary occlusion and urinary infection after acute cervical-cord injury, (2) heart failure four days after cervical laminectomy, (3) bronchopneumonia and coronary atherosclerosis five months after chordotomy and previous treatment with intrathecal alcohol, (4) cardiac failure after many years of myelopathic symptoms, (5) carcinoma of the prostate without myelopathy, and (6) cardiac failure. The only deaths in the whole group which could be ascribed to spondylosis were in Nos. 1, 2, and 3, and two of these had laminectomy and one had an acute cord injury.

Spillane and Lloyd (1952) stated that in their cases the story was one of progressive disability which, though sometimes halting, was never characterized by fleeting and recurrent episodes of weakness and disturbed sensation. This concept of progressive disability is not borne out by our study. Most of our cases had one or more periods of symptoms followed by improvement or a static condition. The episodes were not "fleeting and recurrent." They were prolonged for weeks or months, and then in the majority of cases subsided.

It is difficult to draw conclusions about the natural history of cervical spondylosis from the figures of Wilkinson (1962): 106 patients were followed up for an average of 50.9 months, but it is not clear what proportion had myelopathy. Some of them had other disease in the central nervous system, including four who died. Of those deaths directly related to spondylosis, four followed cervical injury and three occurred shortly after cervical laminectomy. Others who died had cardiovascular disease, cancer, or Hodgkin's disease. Wilkinson estimated that of 91 patients followed up for 12 months or more an overall 53% improved, and of those who had physiotherapy alone 57% improved, though these cases were less severe. The figures for collar and physiotherapy were: 46% improved, 48% unchanged, and 6% worse. Those for operation were: 57% improved, 24% unchanged, and 19% worse, but 2 of those 12 who had operation with improvement had only root compression. Of 19 patients operated on for cord compression, 4 (21%) were worse, 5 (26%) were unchanged, and 10 (53%) were improved. The last figure is no better than the overall 53% improvement and does not suggest that operation was strikingly beneficial. A larger percentage of patients were worse after operation than after any other treatment.

The effects of therapy are difficult to assess because in most reports there are no control cases. Our data give some standards by which therapeutic results can be compared with the natural history of the disease. At one time it was thought that exploratory operation was necessary in patients with cord involvement due to spondylosis (Brain *et al.*, 1948), but since that time doubt has been expressed about the desirability and results of operation in patients with myelopathy. The results in surgical series are certainly not very impressive (Brain *et al.*, 1952; Northfield, 1955; Campbell and Phillips, 1960). Perhaps these doubts have been expressed most fully by O'Connell (1956) in discussing the place of surgery in the treatment of cervical spondylosis. He was "aware of the inadequacy of operative treatment," and stated that only two of his patients operated on for myelopathy had unequivocally improved.

We hope that the results of our study, which show the long-term natural history of both types of this disease, will produce more reflection about the question of operation. The results suggest to us that a very conservative approach should be the rule.

Further work is required in order to formulate accurately the proper indications for operation and indeed the kind of operation required. The factor of trauma and the differential diagnosis of an acute disk prolapse are important. Further prospective studies are also required in order to assess properly different methods of conservative treatment in relation to the natural history.

Summary

Patients suffering from cervical spondylosis with and without myelopathy were subjected to a long-term follow-up study in order to determine the natural history of this disease.

The course of the disease may be very prolonged. Long periods of non-progressive disability are the rule, and a progressively deteriorating course is exceptional. Very few deaths were attributable to spondylosis.

Myelopathic symptoms did not develop in any patient who did not have them at first attendance.

The effects of conservative or operative treatment are difficult to assess in this relatively benign condition, in which prognosis may be good without treatment. Treatments may alleviate symptoms without influencing the natural history.

It is suggested that the approach to the operation of cervical laminectomy should be most conservative in patients with spondylotic myelopathy.

Prospective studies might help to define the indications for operation and the value of various forms of treatment in this disease.

REFERENCES

Brain, W. R., Knight, G. C., and Bull, J. W. D. (1948). *Proc. roy. Soc. Med.*, **41**, 509.
—— (1962). *Diseases of the Nervous System*, 6th ed. Oxford Univ. Press, London.
—— Northfield, D. W. C., and Wilkinson, M. (1952). *Brain*, **75**, 187.
Campbell, A. M G., and Phillips, D. G. (1960). *Brit. med. J.*, **2**, 481.
Northfield, D W. C. (1955). Ibid., **2**, 1474.
O'Connell, J. E. A. (1956). *Proc. roy. Soc. Med.*, **49**, 202.
Spillane, J. D., and Lloyd. G. H. T. (1952). *Brain*, **75**, 177.
Wilkinson, M. (1962) *Recent Advances in Neurology and Neuropsychiatry*, edited by Lord Brain, 7th ed. Churchill, London.