

CLINICAL AND URODYNAMIC CHANGES IN BLADDER  
FUNCTION WITH SPINAL CORD STIMULATION  
IN MULTIPLE SCLEROSIS

By

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SUMMARY

The effect of spinal cord stimulation upon bladder dysfunction in eleven M.S. patients with bladder symptoms is reported. Six patients had an improvement in subjective symptoms and the improvements included: reduction in frequency and urgency; return of bladder sensation; and restoration of continence. Of the eight patients with severe bladder symptoms, four showed a marked improvement (two grades on the Kurtzke scale) and two a moderate improvement (one grade on the Kurtzke scale). Cystometric studies were done before and after stimulation in six patients and in five the pre-stimulation findings were abnormal. In two patients there was an improvement on repeating cystometry during stimulation. The duration of bladder symptoms was an important factor in determining the response to stimulation.

## INTRODUCTION

Since 1973, when Cook and Weinstein (1) reported improvement in five patients with multiple sclerosis during repetitive electrical stimulation of the spinal cord, evidence has been accumulating from New York (2, 3) and from elsewhere (4-7) that this treatment may have an important part to play in the rehabilitation of patients with neurological diseases, especially M.S. At the same time, however, it has become clear that not all patients benefit from this form of treatment. The striking improvements, such as were seen in the first cases reported from our centre, are not always seen. Further work is, therefore, needed to define the role of this expensive and time consuming form of treatment to determine both its value and its limitations, the latter being particularly important in relation to its use in a disease such as M.S., where, self evidently, it is unlikely to act as a cure. An essential part of this work will be to identify those types of patients with M.S. who are most likely to respond to stimulation and those manifestations of M.S. which are most likely to be improved.

Abbate and others (3) reported that in 40 patients with M.S. and bladder symptoms, stimulation of the thoracic spinal cord produced subjective improvement of symptoms in 77 per cent of cases. Of their patients who had cystometry, 42.5 per cent showed objective improvement. The results from the Wessex Neurological Centre at Southampton, already given by Dr. Illis earlier in this meeting, indicated that our best results occurred in relation to improvement of bladder function, both in respect of the number of patients responding and in terms of the extent of the responses seen.

In this paper I should like to report the clinical results with bladder dysfunction in more detail, giving the cystometric findings where these are available. I should like then briefly to discuss some of the factors that in the case of bladder symptoms may influence the therapeutic response.

## PATIENTS

A total of 13 patients with multiple sclerosis has received spinal cord stimulation in the Wessex Neurological Centre to date. Of these, 11 patients had definite bladder symptoms. In eight patients they were severe enough to constitute a serious problem. The mean duration of symptoms at the time of stimulation was 35 months.

The patients' symptoms are summarised in Table 1. All patients had frequency and in six it was severe. Urgency was severe in three patients and mild or moderate in five patients. In three patients bladder sensation was lost so that urgency was not experienced. Sensation was, in addition, markedly impaired in a fourth patient. Eight patients had incontinence, this occurring almost continuously in five patients and frequently in three patients. Hesitancy was experienced to a mild degree by two patients and one patient had an episode of retention when her dose of Cetiprin had been increased. At the time of stimulation, four patients were grade 5 on the Kurtzke scale of bladder dysfunction, one was grade four, three were grade three and three had mild symptoms between grade one and two.

The results of urodynamic studies are also given in Table 1. Five patients showed detrusor hyper-reflexia, with the bladder contracting excessively and prematurely to small filling volumes. There was little ability to suppress

these contractions and they quickly led to leakage around the filling catheter. These cystometric findings corresponded to the symptoms of urgency, frequency and urge incontinence. One patient had an areflexic bladder with a lax sphincter and impaired sensation of filling. In one patient with mild symptoms the findings were normal. Four patients were stimulated before we had started doing routine cystometry and so urodynamic data are not available on them.

All except one patient had had one or more courses of ACTH without beneficial effect upon bladder function. In three cases, Probanthine and/or Cetiiprin had been given without much improvement. In one case, Cetiiprin had proved beneficial initially but had long ceased to be of any value. One patient had had a bladder neck resection two years before stimulation without benefit. Six patients were requiring to use appliances: three females were catheterised permanently and two males used condom portable urinals permanently and one alternated between this and living with a bottle permanently to hand. One female patient had resorted to the expediency of living on a slipper bedpan day and night.

#### RESPONSE TO INITIAL STIMULATION

##### a) CLINICAL

The response of bladder symptoms to initial stimulation is summarised in Table 2. Four out of eleven patients with frequency reported marked improvement, one a slight improvement and six no change. Two out of the eight patients with urgency had a marked improvement and five a slight improvement. Of the eight patients in whom incontinence was a serious problem, four were markedly improved and two were slightly improved. Two of the patients with absent bladder sensation recovered normal sensation and one in whom it was impaired gained a more reliable sensation of fullness.

The changes in symptoms in terms of the Kurtzke scale are indicated in Figure 1. Four patients improved by two or more grades on the Kurtzke scale, two by one grade and five did not change grades at all. Of the eight patients with severe symptoms only two showed no change while four showed a marked and two a slight improvement.

##### b) CYSOMETRY

We obtained before and after urodynamic studies in only six patients and unfortunately these did not include any of the patients who had had the most dramatic clinical improvements. Case 8, illustrated in Figure 2, reported improvement of frequency and urgency. He showed striking cystometric improvement. Before stimulation premature contractions and the desire to micturate appeared at about 100 mls and an irrepressible desire to micturate at 120 mls. During the stimulation the first desire to micturate appeared at 240 mls and incontinence did not occur until over 400 mls had been instilled into the bladder. Case 7, who reported a marked improvement of frequency and urge incontinence, and who urodynamically had had detrusor hyper-reflexia, showed an increase in bladder capacity from about 100 mls to 200 mls before leakage around the catheter occurred. There was a reduction in the amplitude of premature contractions. Case 3, who reported improved bladder sensation but no improvement in incontinence (lack of sensation was replaced by severe urgency) showed no significant urodynamic changes. Neither did case 5, who reported no clinical improvement: he had unchanged severe detrusor hyper-reflexia before

and during stimulation. Case 10, with moderate symptoms who also had no definite clinical improvement, had unchanged mild detrusor hyper-reflexia. Case 11, with very mild symptoms had normal cystometry before and after stimulation. Thus out of the five patients with definite symptoms who had had before and after cystometric studies, two showed an improvement in cystometric findings.

#### RESPONSE TO PERMANENT STIMULATION

Figure 3 gives the follow-up in respect of bladder function of the five patients with significant bladder symptoms who have gone on to receive permanent stimulation. The improvement on initial stimulation is followed by, in most cases, a decline to pre-stimulation levels on the cessation of stimulation. On restarting stimulation, through implanted electrodes, improvement occurred again. In four out of the five patients this improvement has been maintained - for eighteen months in two patients, for six months in one patient and for two months in another. One patient began to deteriorate again three months after implantation. This deterioration was found to be related to electrode slippage and replacement of the electrodes and restoration of the appropriate stimulator sensation led to a brief period of improvement not shown in the figure for the sake of simplicity. This stimulator sensation again changed, this time unassociated with electrode slippage, and bladder symptoms once more deteriorated until, by nine months after the original implantation, his bladder symptoms had reached pre-stimulation level. On two occasions insertion of a second pair of electrodes percutaneously restored the stimulator sensation from the implanted electrodes by a mechanism that is obscure to us. On the second occasion, this produced restoration of the sensation of fullness of the bladder. There was, however, insufficient warning prior to micturition so that, although the patient improved by one Kurtzke grade, there was no useful gain in bladder control. Thus, in all cases, an initial response to temporary stimulation is repeated when further stimulation is given. Furthermore, the bladder response to temporary stimulation is, in most cases, a good guide to the medium term response to permanent stimulation.

#### FACTORS FAVOURING RESPONSE

In view of the fact that not all patients respond, it would be useful to identify the factors which favour a good response. The type and severity of bladder symptoms do not seem to be important. We have not done enough studies to see whether the type of patient who will respond can be defined urodynamically. There is no clear correlation with the level of the electrodes within the mid-thoracic region and we have not used electrodes outside this region. Whether the electrodes are in the midline or not is often, but not always, important. The presence of a symmetrical stimulator sensation, however, extending into both legs seems to be an invariable requirement but it is not always clear why we are unable to obtain this in some patients. Possibly it is related to the number of plaques and their distribution in relation to the electrodes. One important fact in determining response seems to be the duration of the symptoms (Figure 4). Of the eight patients with severe symptoms, all who showed a good response had had definite symptoms for three years or less; the two who showed only moderate improvement had had symptoms for about four years; and the two patients who failed to respond completely had had symptoms for five years and nine years respectively. It would seem, therefore, that in the case of bladder

symptoms the longer the duration the less the chance of having any effect upon them.

Patient selection and improvement of our technique might be helped if we knew more about how stimulation works. Possible mechanisms of spinal cord stimulation, with reference in particular to the effect on bladder dysfunction, will be discussed later on in this workshop.

#### CONCLUSION

In summary, it would seem at this stage that about 50 per cent of M.S. patients show a worthwhile response to stimulation and that in patients who do respond, an improvement in bladder function is included in the response if there are serious bladder symptoms present. The bladder improvements seen include: restoration of bladder sensation, where this is impaired; reduction of frequency and urgency; and restoration of continence. The improvements seen in bladder function which we need to document by more detailed urodynamic studies, are especially important, if only because, as Miller has pointed out (8), bladder symptoms are not only a major cause of misery in M.S. but also the commonest single reason for loss of independence and admission to hospital.

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TABLE 1 BLADDER SYMPTOMS IN MS PATIENTS RECEIVING SPINAL CORD STIMULATION

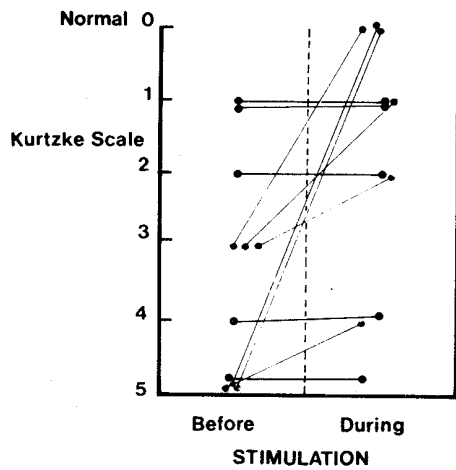
Name	Bladder Symptom Dur <sup>n</sup>	Frequency	Urgency	Hesitancy	Bladder sensation	Incontinence	Kurtzke	Cystometry metry
1 C.P.	15/12	+++	No Sensation	0	Absent	+++	5	Detrusor Areflexia
2 S.E.	12/12	+++	No Sensation	0	Absent	+++	5	Not Done
3 M.R.	4 years	+++	+++	0	Variable	+++	5	Detrusor Hyperreflexia
4 N.P.	9 years	+++	No Sensation	↓	Absent	+++	5	Not Done
5 G.M.	5 1/2 years	+++	++	+	Impaired	++	4	Detrusor Hyperreflexia
6 D.S.	9/12	++	++	0	Present	++	3	Not Done
7 S.B.	3 years	+++	+++	++	Present	+++	3	Detrusor hyperreflexia
8 A.M.	4 years	++	+++	0	Present	++	3	Detrusor Hyperreflexia
9 O.B.	8/12	+	+	0	Present	0	2	Not Done
10 J.M.	>	+	+	0	Present	0	1	Detrusor Hyperreflexia
11 C.F.	>	+	+	+	Present	0	1	Normal

Symptom Change	Frequency (11)	Urgency (8)	Incontinence (8)	Impaired (5) Bladder Sensation
Marked Improvement	4	2	4	2
Slight Improvement	1	5	2	1
No Change	6	1	2	2
Worse	0	0	0	0

Figure in brackets gives the number of patients with this symptom.

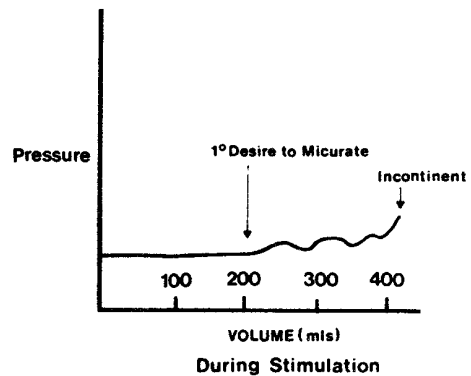
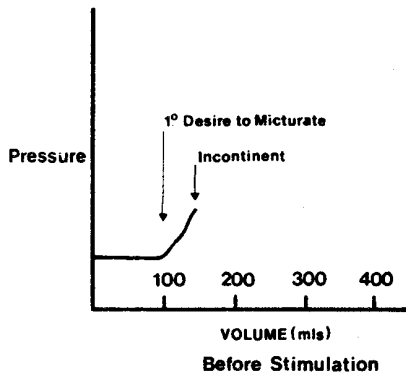
Table 2 RESPONSE OF BLADDER SYMPTOMS TO INITIAL STIMULATION

**RESPONSE OF BLADDER DYSFUNCTION TO INITIAL STIMULATION**



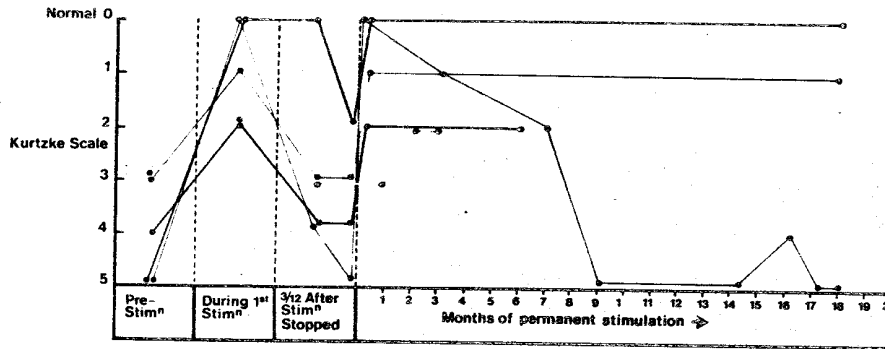
IMPROVED	6
NO CHANGE	5
WORSE	0
TOTAL	11

**DETRUSOR HYPER-REFLEXIA: IMPROVEMENT OF CYSTOMETROGRAM DURING STIMULATION**





**EFFECT OF S.C.S. ON BLADDER FUNCTION IN MS PATIENTS RECEIVING PERMANENT STIMULATION**



**RESPONSE TO STIMULATION IN RELATION TO DURATION OF BLADDER SYMPTOMS**

