

The 'Queen Square bladder stimulator': a device for assisting emptying of the neurogenic bladder

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Objective To describe the effectiveness of a vibrating device for emptying the neurogenic bladder in patients with neurological disease.

Patients and methods The study involved 36 patients, comprising 29 with multiple sclerosis (MS), four with multiple system atrophy (MSA), one with radiation myelitis and two with neurological disease of uncertain aetiology. Most patients with MS (27) were able to walk unaided or with aids. Three of the 36 patients had loss of suprapubic sensation (two MS, one with uncertain diagnosis). All patients had free flow rates and ultrasonographic post-void residual volumes (PVRs) measured before and after voiding while using a vibrating device (frequency 60 Hz) applied to the suprapubic region. They also completed questionnaires about their urinary symptoms before and after the continued use of this device. The mean follow-up was 11.5 months (range 8–14).

Results The device improved the symptoms in 25 of 36 patients (70%) and reduced the PVR from a mean (standard deviation) of 175 (78) mL to 68 (32) mL. It was not useful in patients with PVRs of >400 mL, Kurtzke pyramidal function scores of >3, and in those with suprapubic numbness. There were no complications and most patients complied well.

Conclusions Suprapubic vibration is an effective means of emptying the neurogenic bladder in patients who are not severely disabled and who have detrusor hyper-reflexia. It probably acts through a tonic vibration reflex which is under supraspinal influence. This device may be a useful alternative to clean intermittent self-catheterization.

Keywords Vibration device, post-micturition residual volume, detrusor hyper-reflexia, multiple sclerosis, vibration reflex

Introduction

Patients with neurological disease are likely to have incomplete bladder emptying either as a result of detrusor hypocontractility or detrusor sphincter dyssynergia. Incomplete emptying can in turn lead to the worsening of urinary symptoms. If detrusor hyper-reflexia coexists, significant post-micturition residual volumes (PVRs) decrease the functional bladder capacity, giving rise to increasing frequency and associated urge incontinence. Incomplete bladder emptying can also lead to deterioration of renal function and recurrent urinary tract infections. The introduction of CISC by Lapedes *et al.* revolutionized the management of the neurogenic bladder [1]; however, it is not a technique that all patients are either willing or able to use. Another method which is less satisfactory is the Crede manoeuvre. Almost 20 years ago, Nathan reported that the neurogenic bladder can sometimes be induced to empty using a vibrator on the abdominal wall between the umbilicus and the

symphysis pubis [2], finding this more effective than manual pressure or repeated suprapubic tapping, and suggesting the use of a mains-powered vibrator. A year later, Nathan's findings were confirmed by a small study from Belgium; vibration was effective in emptying the bladders of patients with multiple sclerosis (MS), but the authors reported it had practically no effect in patients with paraplegia caused by spinal cord injury [3]. To date, nothing further has been reported on this topic.

A mains-powered vibrator has the disadvantage that it cannot be used in most homes which, for safety reasons, do not have mains power in toilets. The aim of this study was to evaluate an old method and to test a hand-held, battery-operated vibrating device for its effectiveness in emptying the neurogenic bladder.

Patients and methods

The 'Queen Square bladder stimulator' (Fig. 1) is a commercially available body massager; the vibrator comprises a motor-driven spindle with an eccentric cam attached to its axis. Using an accelerometer, the

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Fig. 1. The 'Queen Square bladder stimulator'.

frequency of vibration was determined to be about 60 Hz. The device is powered by two 1.5 V batteries in series that fit into a compartment in the body of the device. The head of the device vibrates when pressed against any part of the body and there is also a clearly audible buzzing when it is used.

This study reports its use in 36 patients, comprising 29 with MS, four with multiple system atrophy (MSA), one with radiation myelitis and two with neurological diagnosis of uncertain aetiology. The Kurtzke pyramidal function score is a clinical estimate of the degree of spinal cord disease in patients with MS, with scores of 3 indicating that the patient is still able to walk either unaided or with aids. The score was 1 in three patients, 2 in 15, 3 in nine, 4 in one and 5 in one. Of these 29 patients with MS, 27 presented with symptoms of frequency and urge incontinence, as did the patient with radiation myelitis. Cystometry was not performed routinely in these patients as it was reasonably assumed that their symptoms were due to detrusor hyper-reflexia. Furthermore, two of these 27 patients with MS had a combination of hesitancy and frequency and were unable to initiate voiding. The other two patients with MS had poor streams and were able to initiate micturition only with difficulty. Most patients had a sensation of incomplete emptying. The two patients with neurological disease of uncertain aetiology were already using CISC to alleviate large PVRs of > 400 mL; one also had numbness in the lower abdomen. In addition, two of the patients with MS had patchy loss of sensation in the suprapubic region.

Free-flow rates and PVRs (determined by ultrasonography) were measured in all patients before using the vibrator. The PVRs were ≥ 100 mL in all except the two MS patients with hesitancy, in whom the device was used primarily to initiate micturition.

The patients held the device on their suprapubic region about 2.5 cm above the symphysis pubis while voiding.

Flow rates and PVRs were again measured after using the vibrator and repeated twice. The same variables were determined one month later. The patients also completed a postal questionnaire about their urinary symptoms before and after using the vibrator, which included a AUA quality-of-life score. The mean follow-up was 11.5 months (range 8–14); at the follow-up assessment, the same quality-of-life questionnaire was administered to those who benefited from using the device. The upper tracts were and continue to be monitored (by serum creatinine level and ultrasonography of the kidneys).

Results

The new device gave symptomatic benefit in 25 of the 36 patients, an overall success rate of 70%; success was defined as a PVR of < 100 mL with a subjective improvement in urinary frequency, hesitancy, sensation of incomplete emptying and continence. Many of the patients reported that with the help of the device, they did not have to wait for their bladders to feel full, but rather initiated micturition at a convenient time, something most of them had become unable to do because of their neurological deficit. This was a major factor in improved bladder control. In addition, patients reported improvements in their quality-of-life scores after using the device.

The PVRs in those responding to vibration reduced from a mean (SD) of 175 (78) mL to 68 (32) mL, while the mean (SD) maximum flow rate improved from 13.5 (6.4) mL/s to 19.2 (7.1) mL/s. The marked decrease in PVR to about one-third of that before using the vibrator is depicted in Figs 2 and 3.

The device was successful in only one of the four patients (patient 24 in Fig. 3) with MSA. Patients 1, 4, 7, 19 and 20 used the device towards the beginning of micturition; the latter two found it very useful in relieving hesitancy. All the others used the device throughout

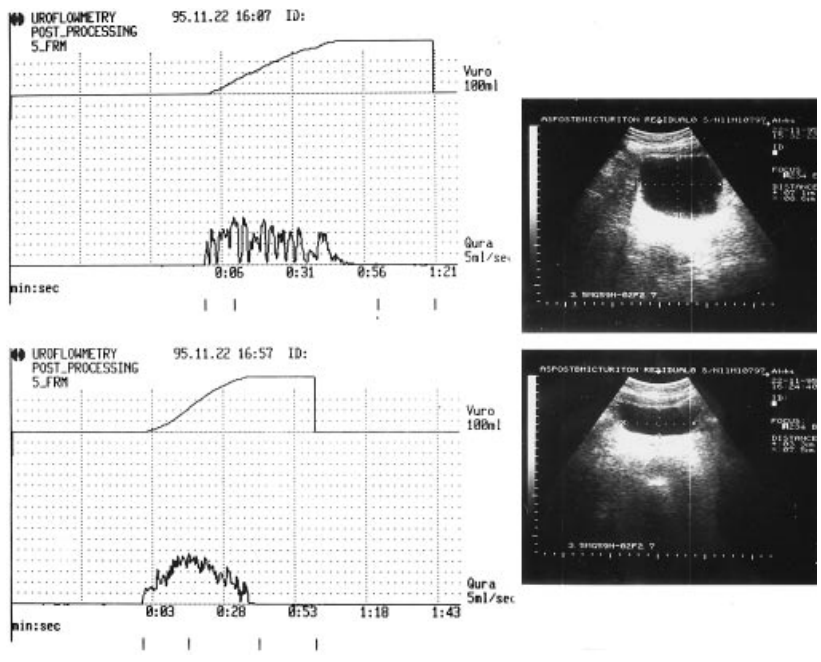


Fig. 2. Flow rates and PVRs from a patient with MS before (above) and after vibration (below).

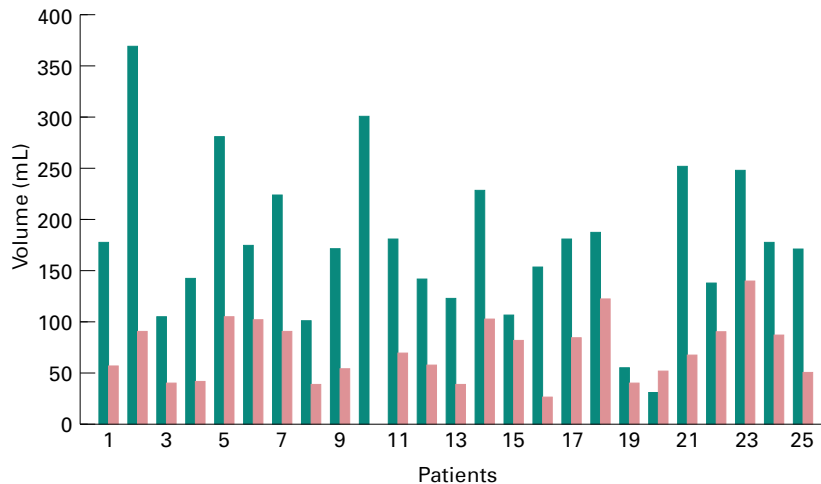


Fig. 3. Post-void residual volumes before (green) and after (red) vibration in those responding to treatment.

micturition. Of the 28 patients with symptoms suggestive of detrusor hyper-reflexia, vibration improved bladder emptying in 24 (86%).

The device failed in the following categories of patients: (i) those with PVRs of ≥ 400 mL; (ii) those with Kurtzke scores of > 3 ; (iii) those with suprapubic numbness even if the Kurtzke scores were ≤ 3 ; (iv) three of the four patients with MSA and (v) both patients with neurological disease of uncertain aetiology. The device worked well in patients with: (i) hyper-reflexic bladders; (ii) Kurtzke scores of ≤ 3 , i.e. able to walk unaided or with aids; (iii) PVRs of < 400 mL; (iv) normal suprapubic sensation, i.e. the patient should be able to feel the vibration.

All those who responded to the device now use it 3–4

times daily. No serious side-effects have so far been reported by any of the patients and there has been no deterioration in renal function or hydronephrosis. The use of the 'Queen Square bladder stimulator' is painless and compliance has been excellent except in three patients who found the noise emitted by the device embarrassing and have stopped using it during the day in public toilets. Three other patients have stopped using the device in the long-term, one due to worsening MS necessitating an indwelling catheter, one due to bladder spasms and one due to remission of MS with marked improvement in urinary symptoms.

In addition, the device has helped in relieving severe constipation in four of seven patients with MS who apply it to the left iliac fossa for this purpose. This was an

incidental finding reported by the patients. All those who continue to have significant improvement in their quality of life have said they do not want to return the device.

Discussion

A vibrating stimulus applied to the suprapubic region facilitates bladder emptying and significantly improves urinary symptoms in patients with neurogenic bladders. The best response occurred in patients with detrusor hyper-reflexia with incomplete emptying who are still relatively mobile. It is important to inform patients that if their neurological disease progresses the device may become ineffective. The device is portable and is easy to use even by patients with poor hand function who may find it difficult to perform CISC. In the UK, CISC alone costs about £66 per patient per year, excluding other expenses such as antibiotics and hospitalization caused by urinary tract infections. The vibrator used here costs £15 and the batteries cost around £18 per year.

Patients with MS generally do not develop upper tract dilatation [4] and so far this group of patients using vibration has shown no evidence of this; long-term monitoring continues.

It has been postulated that vibration acts not directly by stimulating the bladder musculature but by stimulating the medullary reflex mechanisms [2,3]. It is known that a vibrating stimulus can induce a vibration reflex of the somatic muscles in patients with spinal cord lesions as well as in normal subjects [5]. In spinal cord lesions, this consists of a short-latency brief bursts of phasic activity of motor units followed by a rapidly decreasing phasic component and later a slowly declining tonic component. In comparison with normal subjects the phasic component is increased and the tonic one reduced. The tonic component is susceptible to potentiation by voluntary effort to contract the vibrated muscle and probably depends on segmental interneurons and supraspinal pathways. On the other hand, the phasic component is a short monosynaptic or oligosynaptic spinally mediated reflex, similar to a tendon jerk. It is also known that patients with spinal cord disease need a stronger vibrating stimulus to induce responses that would approximate those in normal subjects [5]. The idea underlying vibration for bladder emptying was to see if a vibration reflex might be useful in the detrusor in patients with neurological disease (Nathan, personal communication). This indeed seems to be the case in patients with detrusor hyper-reflexia caused by spinal cord disease. That this device is ineffective in patients

who are unable to feel the stimulus indicates that a centrally mediated reflex underlies the possible mechanism of action. It seems that the appreciation of the vibrating stimulus by the patient is essential for generating a detrusor contraction and therefore it is likely to be the supraspinal tonic component of the vibration reflex that is effective in this situation. It is possible that increasing the frequency of the device may be effective in patients with lack of suprapubic sensation. However, so far only 60 Hz has been used, as a frequency of 110 Hz reportedly causes intractable diarrhoea in some patients [3]. Further studies are now underway to determine exactly how the device works and to examine the effects in patients with partial and complete spinal cord injury. Our experience has shown that in patients who are likely to respond, i.e. mobile and without excessive PVRs, vibration should be tried before CISC.

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