The use of conventional electromyography to assess external sphincter neuropathy in man

DCC BARTOLO, JA JARRATT, NW READ

From the Departments of Surgery, Physiology and Clinical Neurophysiology, University of Sheffield, Sheffield, UK

SUMMARY Conventional electromyography was used to measure motor unit potential duration in the external anal sphincter in normal subjects and patients with idiopathic faecal incontinence. The results revealed a direct correlation between age and mean motor unit potential duration in control subjects, but no differences between age-matched male and female subjects. Patients with faecal incontinence exhibited prolongation of mean motor unit potential duration compared with matched controls. This technique provided useful quantitative data on reinnervation within the anal sphincter, complementing the results of single fibre electromyography.

Recent work has indicated that most patients with idiopathic faecal incontinence have denervation of the external anal sphincter.¹⁻⁴ This conclusion is based on histological examination of muscle specimens, taken at operation,^{1,2} and on single fibre electromyography (SFEMG).^{3,4} Conventional electromyography has been used previously to record motor unit potentials from normal anal sphincters and to demonstrate some of the qualitative abnormalities that may be found in neuropathic sphincter muscle.⁵⁻⁸ This technique was applied in a systematic quantitative manner to study motor nerve regeneration within the anal sphincter.

Material and methods

Subjects

Recordings were taken from 18 patients (17 female, one male; aged 38 to 93 years, mean = 69 years) and 20 normal controls (eight males, 12 females; aged 20 to 80 years, mean age 56 years). The controls were hospital patients with disorders not affecting the gastrointestinal or nervous systems. Informed consent was obtained in all cases, and the study was approved by the Ethical Committee of the Sheffield Area Health Authority. Each examination lasted about half an hour and was well tolerated.

Recording technique

With the patient lying in the left lateral position, a conventional concentric needle electrode (Type 13L49; Disa, Copenhagen) was inserted without anaesthetic into the external anal sphincter. A metal ground electrode was placed on the skin of the natal cleft close to the anal margin. Standard EMG apparatus (Type MES; Medelec, Woking) was used to amplify and display the potentials recorded. The settings of the amplifier (Type AA6 MK IIM; Medelec, Woking) were as follows: gain at 200 μ V/cm or 500 μ V/cm, low frequency filter at 16 Hz, high frequency filter at 3200 Hz. A time base of 5 or 10 ms/cm was used. Trigger and delay facilities (Type SD6; Medelec, Woking) enabled individual motor unit potentials to be identified and the stability of their components to be assessed. Films of the potentials were taken on light sensitive paper (Linagraph Type 1895; Kodak) from which measurements of motor unit potential durations were made. The EMG signals were also stored on an FM tape recorder (Type 7758A; Hewlett Packard, Waltham, Mass) for further analysis as required.

The "tonic" activity of the sphincter at rest provided sufficient activity for analysis. Recordings were obtained from both lateral margins of the external anal sphincter. The duration of each motor unit potential was taken as the time interval from the departure of the sweep from the baseline at the onset of the potential to the return of the sweep to the baseline after the last component of the potential.

Statistical methods and data analysis

At least twenty motor units were measured in each subject, and from these the mean motor unit potential duration (MUPD) was calculated for each subject. For analysis the subjects in each group were matched with regard to their ages and the difference in mean MUPD between the incon-

Address for reprint requests: Dr NW Read, Clinical Research Unit, Floor H, Royal Hallamshire Hospital, Sheffield S10 2JG, UK.

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Fig 1 The relationship between mean motor unit potential duration and age in 20 normal subjects showing a significant increase in MUPD with age ($r = 0.49$; $p < 0.05$).

Fig 2 An example of a motor unit potential of short duration.

tinant and control groups was assessed by both parametric and non-parametric methods. The statistical significance of the differences between age-matched subjects in the incontinent and control groups, quoted in the results, applies to both methods of statistical analysis.

Results

Effect of age and sex

There was a significant direct correlation between age and mean MUPD in control subjects ($r = 0.49$; $p < 0.05$) (fig 1). No such age correlation was

Fig 3 An example of a motor unit potential of long duration.

observed in incontinent patients. There were no significant differences in mean MUPD between age-matched male and female control or incontinent subjects.

Comparison of control and incontinent subjects

Motor units of widely differing sizes were seen; figs 2 and 3 show examples of short and long duration potentials respectively. Although the range of motor unit potential durations was large in both groups (fig 4), the longer duration potentials were more commonly seen in the incontinent patients (percentage of motor units above 10 ms: control 12%, incontinent patients 36%; $p < 0.001$). The mean MUPDs were also significantly longer in incontinent patients (9.3 ± 0.2 ms; mean $\pm$ SEM), compared with control subjects (6.9 ± 0.3 ms; $p < 0.001$) (fig 5). Prominent jitter and blocking were often seen in the records from the incontinent group (fig 6), though no attempt was made to quantitate these observations.

Discussion

The value of conventional EMG in diagnosing neurogenic change in skeletal muscle is well-established.^{9,10} More recently, SFEMG has been used to detect neurogenic change in the external anal sphincter.^{3,4} We have found that it is perfectly feasible to use conventional electromyographic techniques for the same purpose and our results, showing prolonged MUPDs in incontinent patients, correspond with single fibre recordings, showing

Fig 4 A histogram of the pooled motor unit potentials from the two groups, showing the distribution of motor unit potential durations in normal controls and in incontinent patients.

Fig 5 Comparison of the age matched mean motor unit potential durations from 16 controls and 18 patients with faecal incontinence.

Fig 6 Consecutive discharges of a motor unit potential, showing jitter and intermittent blocking of the second and third components.

increased fibre density.^{3,4} Thus either technique can be used to demonstrate motor nerve regeneration in the external anal sphincter of incontinent patients. We have also used conventional EMG to diagnose neurogenic change in puborectalis.¹¹

The reason why the mean MUPD that we measured in normal controls was greater than in earlier studies,⁵⁻⁷ can be explained by the advantages of trigger and delay facilities, which allow easier and more accurate measurement of MUPD, and in particular the recognition of late components.

There is abundant electrophysiological evidence to show that the incidence of neuropathic change in skeletal muscle increases with age.¹¹ A similar relationship in the case of the external anal sphincter muscle has been demonstrated using SFEMG¹² and confirmed in our study using conventional EMG. This correlation would explain the reduction in sphincter pressure that occurs with age.¹³ It is not known whether this change is simply due to the effects of ageing of the nerve supply to striated muscle in general^{9,14} or whether it is exacerbated by stretch injury to the pudendal nerve, produced by long term straining at stool.

Although SFEMG is the method of choice for recording jitter and blocking, the finding of prominent jitter and blocking by conventional EMG techniques in incontinent patients implies recent and perhaps continuing nerve injury.^{15,16} This observation would indicate that the pudendal nerves are being continuously subjected to damage, possibly by straining at stool,¹ and would be against the possibility that neuropathy in patients with idiopathic faecal incontinence is due to a single traumatic event, occurring, for example, during childbirth.

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