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LETTERS TO THE EDITOR

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Perineal nerve stimulation for urinary sphincter control. Experimental study

The author describes electrical stimulation of the perineal nerve as a treatment for urinary incontinence which would be an easier and more direct approach in comparison to sacral root stimulation.

In the introduction the author states "...the overall clinical results of electrostimulation, especially in the long run, have been less satisfactory" [3]. However, causes for the unsatisfactory results are not given. The two papers he refers to also do not elucidate this. In addition, the author fails to indicate why the proposed stimulation method would be more successful.

The presented results differ from what one may expect regarding existing physiological knowledge and contradict the literature on functional electrical stimulation. Surprisingly these results are not discussed.

If one electrically stimulates a nerve bundle containing afferent and efferent fibres one can expect two muscle responses, firstly, a direct response due to activation of the motor fibres and, secondly, a reflex response due to activation of sensory fibres. Using a suprathreshold stimulus, the direct response is the strongest as all motor units are simultaneously activated. The reflex response is smaller as (a) less motor units are activated and (b) the motor units are not simultaneously activated. In addition, the reflex response arrives after some delay.

Remarks

1. The EMG recordings in Fig. 2 appear to be traces of spontaneous muscle activity, evoked by stimulation of the perineal nerve. Each stimulus pulse evokes reflex activity for at least 100 ms (Fig. 2a), which seems rather long. Schmidt et al. [1] measured a reflex response of 30 ms when stimulating a dorsal sacral root. The major point is the following: why do the recordings not contain the direct response (with large amplitude). These responses should occur at 100-ms intervals in recording b and at 33- and 20-ms intervals in recordings c and d, respectively.

2. It is unclear what Fig. 4 shows. Is this the average value of the rectified EMG signal?

3. Figure 6 shows a decrease of the latency between a stimulus pulse and the external urethral sphincter response with increasing stimulus frequency. The author fails to describe which sphincter response was used (EMG or pressure) and how this latency was measured. However, the reported latency of 1.4–2.5 ms might indicate that the EMG response was used. This can only be the latency between a stimulus pulse and the direct response as the reflex response latency would be more than 10 ms [1]. But as mentioned above, direct responses are not present in the recordings (Fig. 2).

The latency between the stimulus pulse and direct response, however, should be independent of the frequency because the latency is determined by the average propagating velocity of the action potentials and the distance between stimulation and recording site [2]. So the presented decrease of the latency is rather puzzling and is not addressed in the paper.

4. For investigations regarding artificial electrical stimulation it is essential that the used stimulation parameters (voltage or current pulse, pulse shape, pulse amplitude) are well defined. However, this is not the case in this paper. The author finds it sufficient to mention that Avery radiofrequency receivers were used in combination with an external adjustable stimulator. Although we are not familiar with this stimulator we have the impression that in this system the stimulus amplitudes are largely influenced by the coupling between the internal receiver and the external transmitter. Since this coupling depends on the distance between the transmitter coil and the receiver coil, the stimulus amplitude is unknown. To prevent this, one should connect the electrode with a transcutaneous cable directly to a stimulator. Another solution would be the use of a more complex implantable stimulator in which the coupling does not influence the stimulus parameters.

In conclusion, the paper is unclear. The "Methods" section lacks a description of the stimulation method and it is unclear how some results are derived from the recorded data (e.g., Figs. 4 and 6). In addition, the results are curious but are not discussed. We hope that you will invite the author to respond to our remarks so that he is able to elucidate the above-mentioned points.

References

1. Schmidt RA, Tanagho EA (1979) Feasibility of controlled micturition through electric stimulation. Urol Int 34:199.
2. Schoonhoven R, Stegeman DF (1991) Models and analysis of compound action potentials. Crit Rev Biomed Eng 19:47
3. Shafik A (1994) Perineal nerve stimulation for urinary sphincter control. Experimental study. Urol Res 22:151

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Reply

Referring to the letter to the editor from Dr. Rijkhoff and Wijkstra regarding the article: A. Shafik (1994) Perineal nerve stimulation for urinary sphincter control. Experimental study. *Urol Res* 22:151, I appreciate the opportunity to respond to the points raised.

My paper presents the results achieved with our technique of perineal nerve stimulation. It was not intended to be a comparative study and therefore does not discuss the causes of the "less satisfactory results" of other authors. Twenty-six of the cited references deal with different methods of electrostimulation and their results and can easily be consulted.

With our method we obtained satisfactory results, "especially in the long run", by establishing an adequate stimulus frequency and stimulation off-time to allow for an unlimited restimulation without fatigue, as described in the "Discussion" on p. 154.

As to the remark that our results differ from what may be expected regarding existing physiological knowledge, I would like to point out that it is the purpose of any research to add to existing knowledge and that it is quite normal that any such additional results may not comply with those in the literature. It is left to other investigators – and time – to prove or disprove the validity of these studies. The literature is full of contradictions which, however, I believe are the driving force for the progress of science.

In response to the "Remarks"

1. Figure 2a does not represent a reflex activity but shows the basal activity of the external urethral sphincter as indicated in the legend. The large-amplitude potentials representing the direct response do exist in Figs. 2b–d and they occur at variable intervals.

2. As indicated in its legend, Fig. 4 represents the mean value of the motor unit action potentials of the external urethral sphincter upon perineal nerve stimulation with different frequencies.

3. Figure 6 represents the EMG response of the EUS to perineal nerve stimulation. The latency was measured from the onset of the stimulus to the onset of the response as mentioned in the paper on p. 152, last paragraph before "Results". The mentioned latencies represent those of the direct response that is recorded before the reflex response. The latency seems to depend not only on the velocity of the action potentials and the distance between stimulation and recording site but also on the frequency and intensity of the stimulus [1, 3].

4. The combination of Avery radiofrequency receivers and external adjustable stimulators is used by investigators all over the world [2]. Stimulation was done using coupled pulses with a pulse width of 200 μs. The range densities applied to the nerve varied from 2 to 6 $\mu C/cm^2$ per phase, as calculated from direct current measurements on the electrode cables.

References

1. Pedersen E, Harving H, Klemar B, et al (1978) Human anal reflexes. J Neurol Psychiatry 41:813
2. Thuroff JW, Bazeed MA, Schmidt RA, Wiggin DM, Tanagho EA (1982) Functional pattern of sacral root stimulation in dogs. I. Micturition. J Urol 127:1031
3. Wright AL, Williams NS, Gibson JS, et al (1985) Electrically evoked activity in the human external anal sphincter. Br J Surg 72:38

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