Electrophysiological study of the bulbocavernosus reflex: normative data

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Summary

In the clinical setting the bulbocavernosus reflex (BCR) is elicited by squeezing the glans penis and digitally palpating the contraction of the bulbocavernosus (BC) muscle. In neurophysiology the BCR is obtained by stimulating the dorsal nerve of the penis or clitoris and by recording the response from BC muscle and it should be performed in selected patients with suspected urinary, bowel, or sexual neurogenic dysfunction.
The BCR is considered one of the sacral neurophysiological tests of the greatest clinical utility. Previous normative data were obtained on small samples. The aim of this study was to determine normative values for the BCR in a large sample of men.
We studied a large population (105 men; mean age 53 years, range 19-73 years) without central or peripheral neurological diseases. In each subject the sacral reflex was elicited by electrical stimulation of the base of the dorsum penis and recorded using a surface electrode from the BC muscle. We recorded the latency, calculated at onset, and the maximal amplitude of response, calculated peak to peak.
We were able to detect the BCR in all the men. No correlation between BCR latency and age was found (r=0.136; p=0.160). The mean onset latency value was 33.0±4.85 ms (mean±2SD, range 26.8-39.4). The mean amplitude value was 16.53±12.21 μV (mean±2SD, range 4.2-43.6).
Our normative data on the BCR were similar to previously published data.

KEY WORDS: bulbocavernosus reflex, normative data, sacral reflex testing

Introduction

The bulbocavernosus reflex (BCR) is clinically elicited by squeezing the glans penis and digitally palpating the contraction of the bulbocavernosus (BC) muscle. Bors and Blinn (1959) first used this reflex for examination of the neurogenic bladder.
In neurophysiology, on the other hand, the BCR is obtained by stimulating the dorsal nerve of the penis or clitoris and by recording the response from the BC muscle (Rushworth, 1967). Krane and Siroky (1980) believed the BCR to be a specialized flexor reflex, similar to the blink reflex.
The afferent somatic sensory pathway is composed, from distal to proximal, of the dorsal penile nerve, pudendal nerve, sacral plexus, and sacral roots S2, S3 and S4. The efferent somatic motor pathway is composed, from proximal to distal, of Onuf's nucleus neurons, sacral roots S2, S3 and S4, the pudendal nerve, sacral plexus, pudendal nerve (deep branch) and BC muscle (Fig. 1). At the spinal level the stimulus is processed by interneurons. The reflex can be elicited by mechanical, electrical or magnetic stimulation.
Clinical neurophysiology is useful in confirming a diagnosis in patients in whom neurological disease is suspected. Neurophysiological evaluation of the sacral segments should be performed in selected patients with suspected urinary, bowel or sexual neurogenic dysfunction (Vodusek et al., 2009). In fact, the BCR is considered, together with pelvic floor and sphincter muscle EMG, one of the sacral neurophysiological tests of the greatest clinical utili-

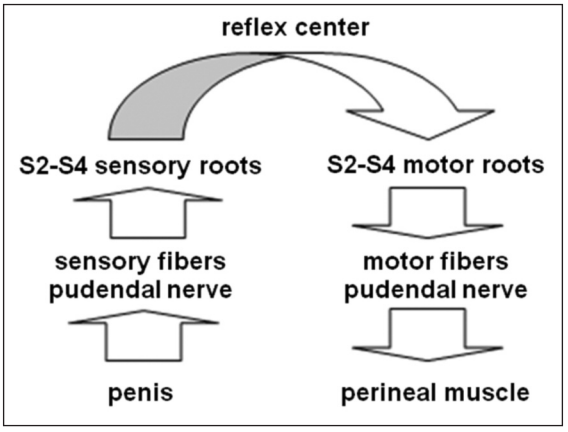

Figure 1 - Schematization of the afferent and efferent arcs of the bulbocavernosus reflex.

ty (Podnar, 2007a), and the sensitivity of the BCR in demonstrating the continuity of the S2-S4 reflex arc has been shown to be better than that of clinical evaluation of this response (Podnar, 2008). For these reasons it should be performed in every patient evaluated for a sacral nervous system dysfunction in whom the BCR cannot be found on clinical examination (Vodusek, 1997). Moreover, the BCR can demonstrate neuropathic abnormalities in patients with normal clinical findings, including normal anal sphincter squeeze and perianal sensation (Podnar, 2008).
Normative data on the BCR are available in the literature. However, these data were obtained on small samples of subjects (Podnar, 2007b).
The aim of this study was to determine normative values of the BCR in a large sample of men.

Materials and methods

Our study, performed from 2008 to 2010, included a total of 105 men. None of the enrolled subjects reported neurogenic urinary problems. They all had a diagnosis of urethral stenosis caused by injury or disease such as urinary tract infections or other forms of urethritis. An extensive neurological examination of reflex, sensory (including the perineal region) and motor functions was performed in order to exclude subjects with possible peripheral or central nervous system diseases. Moreover, clinical examination was supplemented by a small neurophysiological protocol, composed of motor and sensory nerve conduction studies. The motor nerve conduction study included evaluation of the peroneal, tibial and ulnar nerves, while the sensory nerve conduction study included evaluation of the sural, radial, median and ulnar nerves. The BCR was elicited by single-pulse electrical stimulation with a 1.5 Hz frequency. The BCR was recorded only on the right side of each patient. We used a Dantec Keypoint EMG/NCS/EP Workstation (Medtronic Functional Diagnostics, Skovlunde, Denmark). A surface stimulation electrode was applied to the base of the dorsum penis with the cathode proximal in order to stimulate the dorsal penile nerve. A surface recording electrode was placed over the BC muscle. In particular, we placed the electrode 1 cm laterally to the midline drawn from the base of the penis to the anus. The position of the recording electrode was adjusted if no satisfactory response was obtained.
The electrical stimulus was progressively increased as far as the patient's sensory threshold. The stimulus intensity was then increased to threefold the patient's sensory threshold. The average response of 100 consecutive stimulations was acquired and then analyzed. For each subject, we recorded the latency, calculated at onset, and the maximal amplitude of response, calculated peak to peak.
Statistical analysis was performed with SPSS 18.0. The correlation between age and BCR latency was calculated using the Spearman rank correlation coefficient (r).

Results

We were able to detect the BCR in all the men. An example of the BCR is given in figure 2. The subjects had a mean age of 53 years (range 19-73). No correlation between BCR latency and age was found (r=0.136; p=0.160). The mean onset latency value was 33.0±4.85 ms (mean±2SD, range 26.8-39.4). The mean amplitude value was 16.53±12.21 μV (mean±2SD, range 4.2-43.6).

Discussion

Our study provides normal BCR latency and amplitude values obtained using surface electrode recording and single-pulse electrical stimulation. To our knowledge normative data on the BCR were previously provided in eight studies, only two of which recorded the BCR by means of the surface electrode technique (Ghezzi et al., 1991; Perretti et al., 2003). Both these studies analyzed very small samples of subjects, 17 and 14 respectively. In another study (Opsomer et al., 1989), the type of recording electrode was not clearly specified; in this paper only 10 subjects were analyzed. In the remaining five studies (Galimberti et al., 2001; Amarenco et al., 2003; Ertekin and Reel, 1976; Vodusek et al., 1983; Podnar, 2007b) the reflex was assessed using needle electrode recording. The samples analyzed in the first four studies were small,

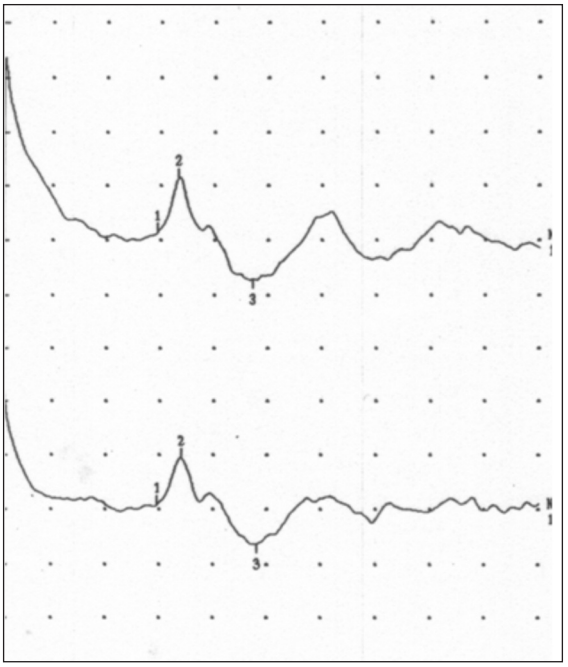

Figure 2 - Example of the bulbocavernosus reflex.
Two traces obtained from the same subject. Note the reproducibility of the response.

respectively 28, 22, 14 and 26 subjects. The study by Vodusek et al. (1983) is the only one that provided normal BCR values based on a larger sample of subjects (60 men).

We herein reported data obtained in our lab from an even larger sample of men (105 subjects). Comparing our data with those previously published it emerged that the BCR latency values in our study were similar to the ones previously reported. Obviously the studies in which the BCR was recorded using needle electrodes (Galimberti et al., 2001; Amarenco et al., 2003; Ertekin and Reel, 1976; Vodusek et al., 1983; Podnar, 2007b) did not report the mean amplitude. Of the two studies in which the BCR was recorded with surface electrodes (Ghezzi et al., 1991; Perretti et al., 2003), only the one by Perretti et al. (2003) reported the mean amplitude of the BCR response. Compared to this study we found a lower mean amplitude value, but confirmed the finding of a high standard deviation. This observation probably indicates that the amplitude value may not be a reliable parameter for assessing axonal loss in sacral lesions. Further studies focused on this topic would probably be useful. We confirmed the previously reported absence of correlation between age and BCR latency.

The main limitations of our study were that we did not analyze the inter-side latency difference, the BRC threshold (the minimal intensity of electrical current that elicited the reflex) or the sensory threshold (the minimal intensity of electrical current perceived by the subject). As suggested by Podnar (2007b), BCR threshold evaluation might be helpful in diagnosing increased or reduced excitability of the medullaris neurons in epiconus lesions in order to demonstrate an association of upper and lower motor neuron lesions in the lower sacral segments, difficult to demonstrate clinically. This observation should be considered relevant for treatment and prognosis of bladder and bowel dysfunction in upper and lower motor neuron lesions (Podnar, 2007b).

In conclusion, considering the difficulty in recruiting subjects in this field, our study has the merit of providing normative values for BCR neurophysiological evaluation in a sample larger than those previously reported.

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