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Complex neurophysiological algorithm for pudendal nerve neuropathy for descending perineum syndrome

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ABSTRACT *AIM: to improve diagnostics for descending perineum syndrome.*
PATIENTS AND METHODS: the prospective cohort study included 127 patients (85 (66.9%) — females), aged 49.9 ± 14.4 years with descending perineum syndrome. All patients had proctogenic constipation, anal incontinence and/or chronic neurogenic pelvic pain. All patients underwent a neurophysiological examination according to the original complex pudendal nerve terminal motor latency (PNTML) method — neurophysiological protocol for detection of the pelvic floor muscles innervation disorders.
RESULTS: the latency of the M-response of the pudendal nerve increased on at least one side in 85 (66.9%) patients (50 women and 35 men). The use of a new complex neurophysiological diagnostic protocol made it possible to identify signs of pudendal neuropathy in 29.9% of patients. The incidence of neuropathy in patients with clinically significant perineal prolapse syndrome was 96.5% in females and 97.6% in males.
CONCLUSION: the new complex neurophysiological diagnostic algorithm made it possible to identify disorders of innervation along the efferent pathway in the Alcock's canal and distally in 85 (66.9%) cases, along the efferent pathway proximal to the Alcock's canal — in 23 (18.1%); a combination of efferent and afferent disturbances occurred in 15 (11.8%).

KEYWORDS: *proctogenic constipation, anal incontinence, neurogenic pelvic pain, PNTML, late phenomenon*

CONFLICT OF INTEREST: *the authors declare no conflicts of interest*

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INTRODUCTION

One of the most important links in the pathogenesis of perineal prolapse syndrome (PPS), characterized primarily by prolapse of the pelvic organs with rectocele, cystocele, sigmocele, enterocele, is neuropathy of nervus pudendus [1]. Pudendal nerve neuropathy is a mononeuropathy, and according to ICD-10 it has code G58.8 — Other specified types of mononeuropathies; according to ICD-11 it is 8C1Y — Mononeuropathy of another specified area [3].

The prevalence of PPS can reach 50% in the female population [2]. Taking this into account, in order to clearly determine the leading cause of the neurogenic pelvic pain, functional disorders of urination and defecation, it is necessary to implement high-tech functional diagnostic methods as much as possible, which will be the determining basis for the subsequent correction of manifestations of pudendal neuropathy [4].

The standard method of stimulation EMG using a St. Mark's electrode evaluates the latent period of excitation along the motor fibers of the pudendal nerve — the M-response of the external anal sphincter — and indicates the speed of excitation and, accordingly, the presence or absence of demyelination of the nerve axon in the distal section [5].

The existing method of studying the bulbocavernosus reflex (BCR) is used to analyze the correlation between the lumbar segments of the spinal cord and the afferent sensory and efferent motor pathways at the level of the sacral plexus. However, the data obtained from stimulation of sensory areas are quite subjective and not standardized; they may be accompanied by pain, especially when using a needle electrode, and psychological discomfort for the patient [6].

We invented a non-invasive neurophysiological protocol to identify disturbances in the innervation of the pelvic floor muscles and the obturator apparatus of the rectum not only in the distal part of the efferent pathway, but also in a complex manner — along the afferent sensory and efferent motor pathways at the level of the sacral plexus by recording the phenomenon of a late response (mixed reciprocal reflex response (MRR) and bulbocavernosus reflex (BCR) (Patent No. 2708052 dated September 17, 2019. "Method for determining the neurophysiological state of the pelvic floor muscles"), which has no Russian or foreign analogues. The use of this protocol, in our opinion, will make it possible to clearly identify patients with impaired innervation of the pelvic floor muscles.

AIM

To the diagnostics of functional disorders of the pelvic floor muscles in patients with perineal prolapse syndrome.

PATIENTS AND METHODS

The study included 127 patients with perineal prolapse syndrome (January 2022 — June 2023; 85 (66.9%) females, aged 49.9 ± 14.4 years). The clinical manifestations were proctogenic constipation, anal incontinence and/or chronic neurogenic pelvic pain.

To subjectively assess the severity of evacuation disorders, incontinence and pelvic pain syndrome (with pain in the dermatomes of the pudendal nerve), the following scales were used:

- a scoring system for disorders of the evacuation function of the colon (hereinafter referred to as SSD for evacuation disorders, maximum 22 points) [7],
- Wexner scale (maximum 20 points) [2.8],
- visual analogue scale (VAS, maximum 10 points) [9].

The presence of perineal prolapse syndrome was confirmed by defecography data in all patients: rectocele — in 40 (31.5%), rectal intussusceptions or excessive mobility of mucosal folds, including in combination with rectocele — in 87 (68.5%). In patients with pain syndrome, to verify the neurogenic nature of pain, proctological, gynecological, urological, vascular and neurosurgical pathologies were excluded.

All patients underwent a comprehensive neurophysiological checkupincludedoriginal method of stimulation ENMG of the pudendal nerve, neurophysiological protocol to identify disorders of the innervation of the pelvic floor muscles and the anal sphincters. A specially developed ENMG stimulation protocol included an assessment of the latency of the M-response of the pudendal nerve and, in the case of recording normal values on one or both sides, continued with the test of the late phenomenon of a mixed reflex response (deep pudendal reflex, DPR) and the bulbocavernosus reflex on both sides. or on the corresponding side (Fig. 1), first identified by Contreras Ortiz in 1994 with antidromic propagation of a stimulation signal with a latency of more than 20 ms (normal GPR — 36.18 ± 4.29 ms (25–42 ms), BCR — 34.88 ± 5.32 ms (21–41 ms) [10,11].

Stimulation ENMG technique according to a complex neurophysiological protocol

First, to assess the presence of an M-response and, accordingly, the latent period of excitation along the motor fibers of the *n.pudendus*, stimulation EMG is performed on an electroneuromyography device, including Neuro-EMG-Micro (Neurosoft) with an installed program for proctological

studies, using St. Mark's electrode on the right and left according to the following method:

The stimulating zones of the St. Mark's electrode are located at the tip of the doctor's finger, and the recording zones are located at the base of the finger. The patient is in the position for a gynecological chair. A ground electrode was in saline solution is placed on the patient's leg. The St. Mark electrode was inserted in the rectum or vagina for females, which is associated with less discomfort of the procedure. Find the anatomical point of electrode location in the area of the ischial spine. A series of electrical stimuli was carried out, with the response being recorded and its latency being calculated on the right and left. The latent period of excitation along the motor fibers of the pudendal nerve was recorded at supramaximal stimulation (20–30% higher than maximum stimulation). Maximum irritation was recorded at the strength of the impulse, when with a further increase in the intensity of the stimulus, the amplitude of the M-response stops increasing. Normally, the latency of the pudendal nerve was 1.8–2.2 ms for a rectal location and 1.55–2.54 ms for a vaginal location [12,13]. This method allows us to identify signs of pudendal neuropathy in the distal portion of the pudendal nerve.

Next, without changing the location point, using the same St. Mark's electrode, they switch to a program for recording reflex responses, for example, the H-reflex, with the ability to record late EMG phenomena in the latency zone of 20–50 ms. Stimulation was carried out sequentially in two modes: single stimulation with increasing stimulus power from submaximal to supramaximal and in F-wave mode. At the same time, reflex responses are noted at each stimulus strength.

It is this modification of the EMG stimulation technique using the St. Mark's electrode that implies sequential stimulation: first, from the distal part of the pudendal nerve to record the M-response from the pelvic floor muscles and external sphincter, then single stimulation with increasing strength of stimulation from submaximal to supramaximal with subsequent registration of the motor response from the pelvic floor muscles and external sphincter, and then — rhythmic stimulation of the pudendal nerve in the F-wave mode with supramaximal stimulus strength — which is a distinctive feature of the proposed method" (Patent No. 2708052 RU 09.17.19. "Method for determining neurophysiological state of the pelvic floor muscles." https://yandex.ru/patents RU2708052C1_20191203/doc/).

RESULTS

All 127 patients had complaints of difficulty in emptying; complaints of incontinence of intestinal components were noted in 81.9% (104/127) of cases, pain syndrome — in 85% (108/127) of observations (Table 1).

The score by Wexner's scale was 5.6 ± 4.6, which was manifested by incontinence of liquid feces and/or gases. Evacuation disorders — according to the SBS of evacuation disorders, the average score

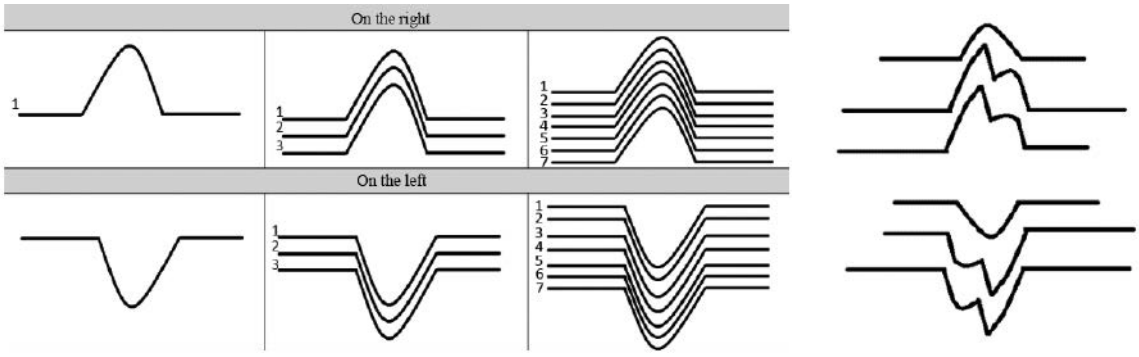

Figure 1. *Scheme of the neurophysiological protocol — M-response, mixed reciprocal reflex response (including deep pudendal reflex) and bulbocavernous reflex*

Table 1. *Results of the survey of patients (n-127)*

Gender	Age (years)	Wexner's scale, points	Evacuation disorders, points	VAS, points
F (*n* = 85)	51.5 ± 13.2	6.2 ± 4.8	10.4 ± 4.7	4.3 ± 2.0
M (*n* = 42)	46.6 ± 16.3	4.3 ± 3.7	8.1 ± 3.8	5.2 ± 2.1
Total	49.9 ± 14.4	5.6 ± 4.6	9.7 ± 4.6	4.6 ± 2.1

Table 2. *M-response latency in PNTML, ms (n = 127)*

Gender	Normal		Increased (uni- and bilateral)	
	Right	Left	Right	Left
F (*n* = 85)	2.1 ± 0.3	2.2 ± 0.3	2.8 ± 0.7	2.9 ± 0.7
M (*n* = 42)	0.9 ± 0.1	2.1 ± 0.2	3.0 ± 1.0	3.4 ± 1.1

Note: The norm of the M-response: for women — 1.55–2.54 ms (vaginal); for men -1.8–2.2 ms (rectal)

Table 3. *Latency of the deep pudendal reflex in complex PNTML, ms (n = 85)*

Gender	Normal		Increased (uni- andbilateral)	
	Right	Left	Right	Left
F (*n* = 67)	30.8 ± 5.1	30.8 ± 5.6	40.2 ± 8.8 (in 9 pts not found)	41.5 ± 10.7 (in 9 ptsnotfound)
M(*n* = 18)	36.4 ± 4.7	38.0 ± 6.1	46.6 ± 11.5 (in 7 pts not found)	49.3 ± 9.2 (in8ptsnotfound)

Note: The normal deep pudendal reflex — 36,18 ± 4,29 ms (25-42 ms) [11]

Table 4. *Bulbocavernous reflex latency in complex PNTML, ms (n-85)*

Gender	Normal		Increased (uni- and bilateral)	
	Right	Left	Right	Left
F (*n* = 67)	37.1 ± 4.6	40.4 ± 2.6	53.7 ± 7.5	54.3 ± 6.8
M (*n* = 18)	1 patient– 33.61	1 patient — 31,1	49.5 ± 8.4 (notfoundin 1 patient)	50.1 ± 10.1

The norm of the bulbocavernous reflex — 34,88 ± 5,32 ms (21-41 ms) [11]

Table 5. *Results of complex PNTML (n-127)*

Gender	Neuropathy revealed			No neuropathy
	By M-response	By MRR	By DCR	
F (*n* = 85)	50 (39.4%)	19 (15.0%)	13 (102%)	3 (2.4%)
M (*n* = 42)	35 (27.5%)	4 (3.1%)	2 (1.6%)	1 (0.8%)
Total	85 (66.9%)	23 (18.1%)	15 (11.8%)	4 (3.2%)

was 9.7 ± 4.6, which characterizes the presence of moderately pronounced proctogenic (functional or structural) disorders. Pain syndrome in the pelvis and in the projection of the dermatomes of the pudendal nerve according to VAS was, on average, at the level of 4.6 ± 2.1 points, however, severe (from 7 to 9 points) and unbearable (10 points) pain was noted by 16 (12, 6%) patients, quite pronounced, "moderate in intensity" pain (from 4 to 6 points) — 58 (53.7%) patients.

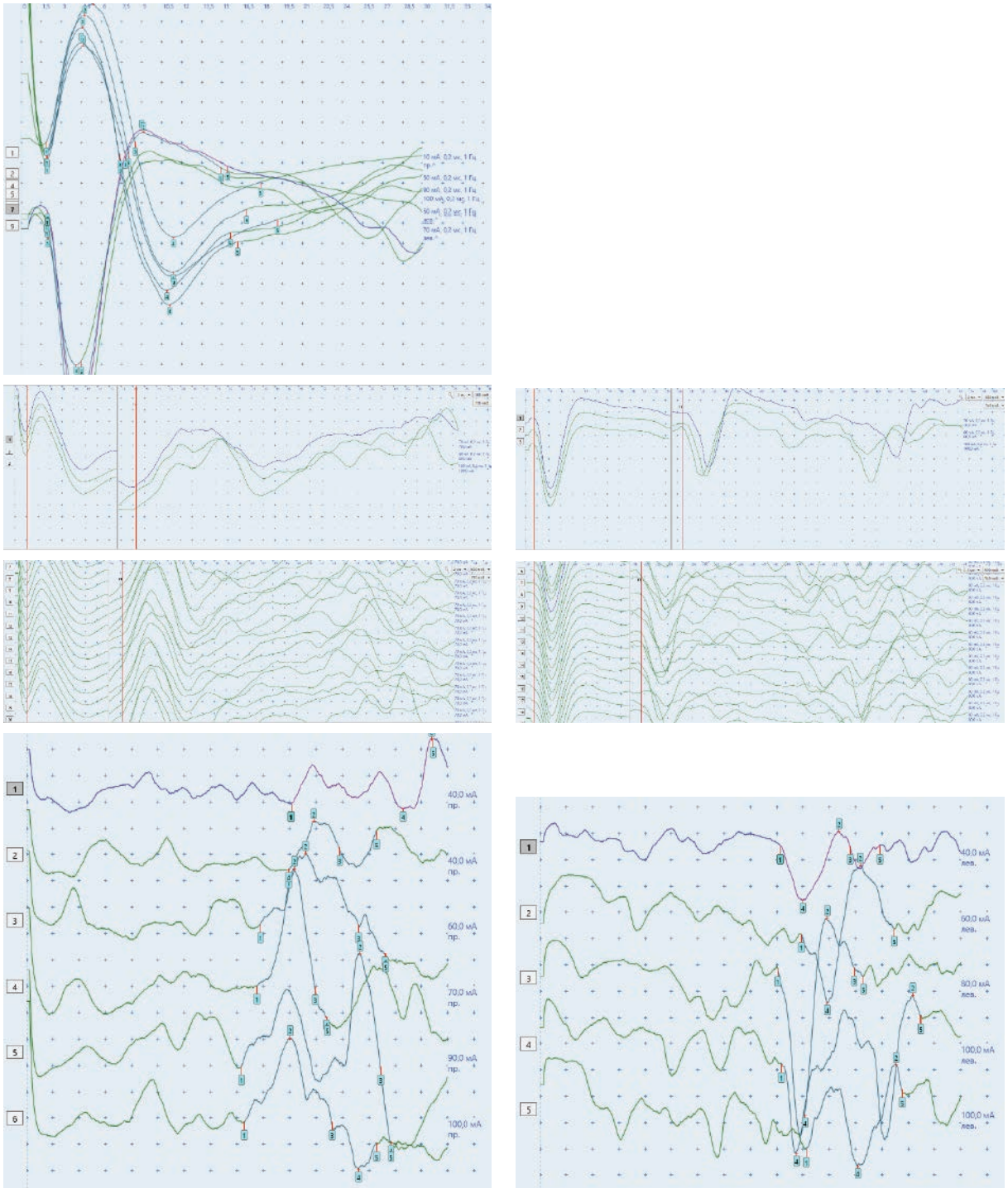

Figure 2. *M-responses, mixed reciprocal reflex response (with a gradual increase in stimulus power (deep pudendal reflex) and in the F-wave mode) and bulbocavernous reflex — on the right and left in the norm (example of the clinical study)*

Pain was located in the anus, rectum and coccyx in one or another combination in 108 patients; 18/108 (16.7%) of them also experienced pain in the genital area and urethra, 6/108 (5.6%) in the perineum and in the area of the inguinal folds. Dyspareunia was noted by 15/70 (21.4%) women with pain syndrome. Sensory disturbances such as numbness, burning, tingling, goose bumps, tingling, electric shock were noted by 43 (39.8%) patients.

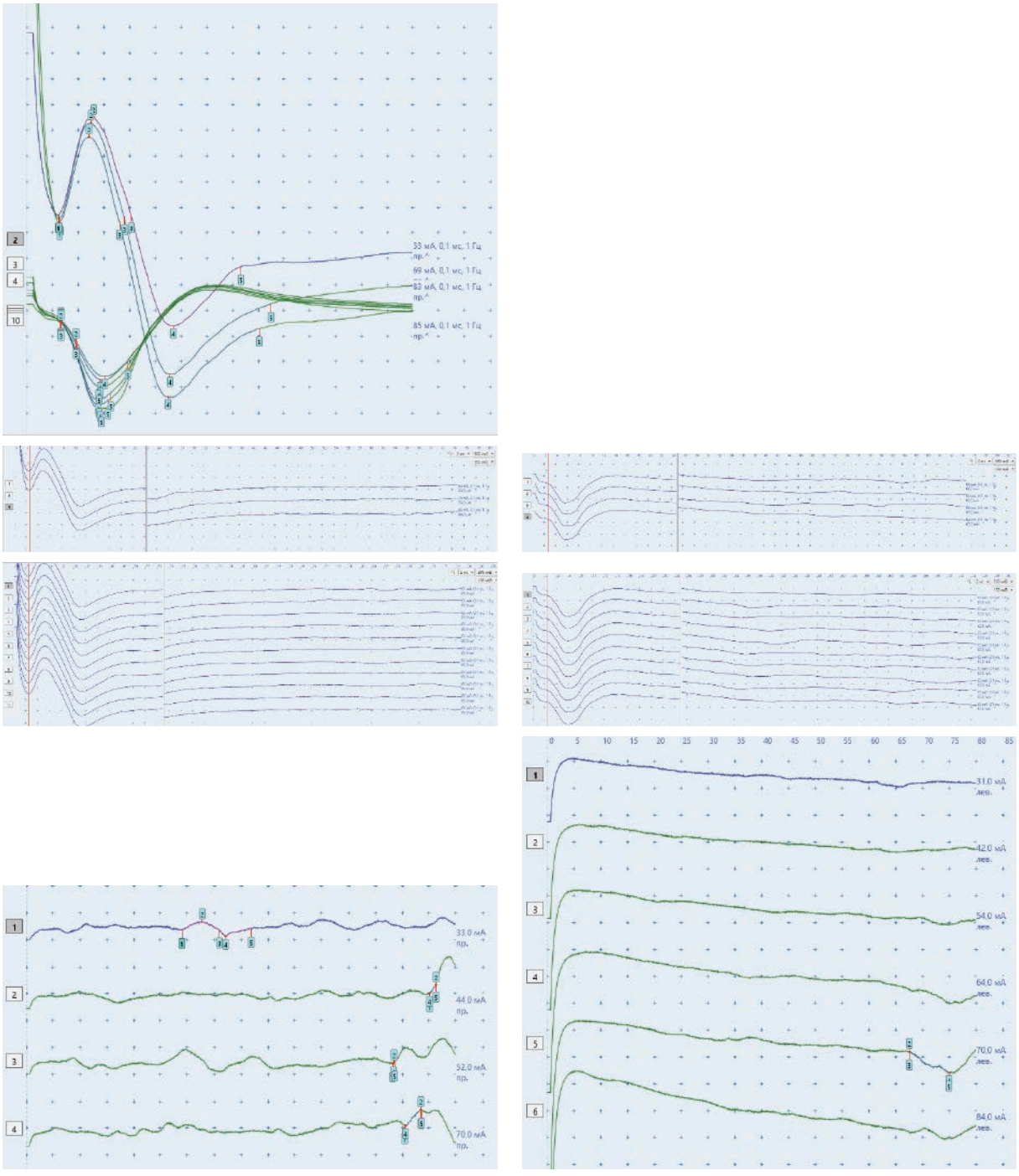

Рисунок 3. *М-ответы — в норме; смешанный возвратно-рефлекторный ответ (при постепенном нарастании мощности стимула и в режиме F-волны) и БКР — справа и слева нарушены (пример исследования)*
Figure 3. *M-responses — normal; mixed reciprocal reflex response (with a gradual increase in stimulus power (deep pudendal reflex) and in the F-wave mode) and bulbocavernous reflex — damaged on the right and left (example of the clinical study)*

With stimulation ENMG, the latency of the M-response of the pudendal nerve was increased on at least one side (right/left/right and left) in 85 (66.9%) patients (50 women and 35 men); in 42 (33.1%) patients (35 women and 7 men), the latency of the M-response was not changed (Table 2).

Due to the protocol for complex neurophysiological diagnostics, 85 patients with a normal M-response on one or both sides underwent an additional study of late phenomena (LTP) and BCR (Tables 3, 4).

At the same time, severe changes in the late phenomenon (MRR) in the form of a complete absence of BCR on at least one side were registered in 18 (21.2%) women and 15 (17.6%) men.

Similarly, severe changes of BCR (complete absence) on the right were detected in 1 (1.2%) male patient.

In total (Table 5), 85 (66.9%) patients with an altered (at least on one side) M-response, signs of neuropathy were also identified based on changes in MRR on at least one side in 23 (18.1%) patients. Neuropathy as a disorder predominantly along the afferent circuit of innervation was confirmed in another 15 (11.8%) patients.

Among 85 patients, in 43 the M-response was already increased on one side, that is, signs of unilateral neuropathy were confirmed at the first stage of the test. However, upon a detailed test of their further results, it turned out that only one did not have disturbances of the late phenomenon (MRR) and GPR, and in all the rest the bilateral nature of neuropathy was confirmed.

Thus, using a comprehensive neurophysiological diagnostic protocol, signs of impaired innervation along the pudendal nerve in patients with prolapsed perineum syndrome with anal incontinence, proctogenic constipation and chronic neurogenic pelvic pain were recorded in 96.8% of cases (n = 123) (Fig. 2, 3).

A change in the M-response, which we interpreted as a violation of the innervation of the anal sphincter and pelvic floor muscles due to pathological changes in the distal part of the efferent motor pathway, was detected in 85 (66.9%) patients. The most likely cause of these disorders was compression of the nerve in the Alcock's canal.

A change in MRR, which we regard as a violation of signal transmission along the efferent motor pathway proximal to the Alcock's canal (at the level of the sacral plexus or above), was noted in 23 (18.1%) cases.

Combined efferent and afferent sensory disorders, whichwas evidenced by changes in the BCR, were identified in 15 (11.8%) cases.

DISCUSSION

We have previously studied on pelvic organ prolapse and written about the role of the deep pudendal reflex and/or bulbocavernosus reflex for neuropathy. However, it should be noted that only women were included in the study groups. Thus, in a study of 2017 in 18 patients with rectocele, the incidence of neuropathy, identified by changes in the M-response, was 77.8% [14]. Changes in the M-response were determined in all patients (n = 40) with a severe degree of genital prolapse (including complete prolapse of the uterus and vagina) and anal incontinence [15] and in all with external rectal prolapse (n = 27) [16].

Using a complex protocol of stimulation ENMG with assessment of late phenomena (MRR) in 69 patients with pelvic organ prolapse, the latency of the M-response on at least one side was increased in 68.1% of cases; in all remaining cases (31.9%), MRR was changed or absent [5].

We also noted that a number of patients with PPS in combination with pudendal nerve neuropathy, in addition to typical clinical symptoms, have complaints of chronic pelvic pain in the absence of any organic cause. In a 2019 study, in 44 patients with a combination of SOP and pelvic pain syndrome (average VAS score 6.3), neuropathy was diagnosed by an increase in M-response latency and changes in BCR/GPR indices in 65.9% of cases. The remaining patients (34.1%) had violations of the parameters of GPR and/or BCR [17]. We obtained almost similar results in another study, which included 56 patients with pelvic organ prolapse and

chronic neurogenic pelvic pain (VAS score — 6). Thus, signs of impaired innervation along the pudendal nerve based on changes in the BCR were also detected in all patients, although normal M-response latency was noted in 19 (33.9%) cases [6].

An important feature of the study is the inclusion of male patients. For the first time, the results of a trial of 42 men with perineal prolapse syndrome with impaired continence and emptying functions and neurogenic pelvic pain are presented. The severity of pain according to VAS (5.2 ± 2.1 points) in them is comparable to the score in women — 4.3 ± 2.0, as well as the frequency of diagnosed neuropathy — 97.6% (41/42) vs. 96.5% (82/85) in women.

Thus, specially developed algorithms for neurophysiological diagnostics can allow us to clearly determine the level of disruption of afferent and/or efferent innervation, which, undoubtedly, is extremely important for determining the tactics of pathogenetically based treatment.

CONCLUSION

A new protocol for complex neurophysiological diagnostics makes it possible to identify signs of pudendal nerve neuropathy in an additional 29.9% of patients compared to standard EMG stimulation.

This protocol made it possible to identify the pathophysiological mechanism and level of innervation disturbance — along the efferent path in the Alcock's canal and distally in 85 (66.9%) patients, along the efferent path proximal to the Alcock's canal — in 23 (18.1%), according to the mechanism combined efferent and afferent disorders — in 15 (11.8%).

The incidence of detection of neuropathy in patients with clinically significant perineal prolapse syndrome and neurogenic pelvic pain does not depend on gender, amounting to 97.6% in men; for women — 96.5%.

AUTHORS CONTRIBUTION

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