Electromyography of the External Anal Sphincter

Comparison Between Needle and Surface Electrodes

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PURPOSE: Electromyography of the external anal sphincter is frequently used when investigating patients with defecation disorders. Investigations are often performed using an invasive technique by perineal insertion of a needle or wire electrode. The aim of the present study was to investigate whether surface electromyography, with electrodes applied to the perineal skin, is a reliable method in the diagnosis of paradoxical anal sphincter reaction. METHODS: Seventy-one patients with defecation disorders participated in the present study. They were investigated with electromyography of the external anal sphincter using surface and needle electrodes. RESULTS: In 65 of 71 (92 percent) patients the electromyography recording showed the same result during straining using surface electrodes when compared with needle electrodes. Twenty-two of these 65 patients had paradoxical anal sphincter reaction, and 43 patients had decreased electromyography activity. In 6 of 71 (8 percent) patients the electromyography recording showed a different pattern during straining using surface electrodes when compared with needle electrodes. CONCLUSION: The present study demonstrates a good correlation between surface electrodes applied to the perineal skin and concentric needle electrodes in the diagnosis of paradoxical anal sphincter reaction. Noninvasive electromyography recordings of the external anal sphincter are often preferred in the diagnosis of paradoxical anal sphincter reaction. [Key words: Paradoxic sphincter reaction; Anismus; Electromyography; Defecation disorders; Surface electrode]


Patients with defecation disorders are often subjected to several investigations to increase understanding of the underlying pathogenesis and to tailor optimal treatment. Investigation in the perineal region is a source of distress to many patients, and it is therefore important to minimize discomfort.

The striated muscles in the anal sphincter are continuously active at rest.1 Normally, this activity decreases during straining. In some patients, however, contraction in the muscles tend to increase rather than decrease.2 This phenomenon usually is called paradoxical sphincter reaction (PSR),3 anismus,4,5 or spastic pelvic floor syndrome.2

Electromyography of the external anal sphincter is used in the assessment of patients with defecation disorders to diagnose this condition. Several studies are performed using an invasive technique by perineal insertion of a needle or wire electrode.6-9 This technique is, however, associated with pain during the insertion of the electrode. It may therefore be difficult for the patient to agree on repeated measurements if they are required.10-12

Surface electrodes applied to the perineal skin were used by Floyd and Walls13 in 1953 to describe EMG activity in the anal sphincters and in some recent studies on the diagnosis of PSR14 and on biofeedback therapy.15,16 Surface electrodes are easy and painless to apply and therefore well tolerated by the patient.17,18 They can also be used for ambulatory studies and during simultaneous rectal emptying. However, the reliability of surface electrodes when investigating EMG activity from the anal sphincters has been little studied.19 The aim of the present study was to investigate whether surface EMG, with electrodes applied to the perineal skin, is a reliable method in the diagnosis of PSR, compared with conventional needle EMG.

PATIENTS AND METHODS

Patients referred to the Department of Neurophysiology at Söder Hospital in Stockholm for EMG investigation of the external anal sphincter because of defecation disorders were asked to participate in the present study. Seventy-one patients, including 68 females, agreed. Mean age was 47 (range, 21-78) years.
The indication for the investigation was fecal incontinence in 41 patients, constipation in 25 patients, rectal prolapse in 4 patients, and perineal pain in 1 patient.

Twenty of 41 patients had fecal incontinence after previous obstetric injury. Two patients were previously operated on for hemorrhoids, one patient had had a perianal abscess incised, and one patient had received radiation therapy because of endometrial cancer. The study was approved by the Local Ethics Committee at Karolinska Hospital, Karolinska Institute, Stockholm.

All patients were investigated with EMG of the external anal sphincter using surface and needle electrodes at the same outpatient visit. EMG was performed with the patient in the right lateral position. The perianal area was cleaned with alcohol. Two surface electrodes (Nihon Kohden NE 121 J, Nihon Kohden Corp., Tokyo, Japan) with conducting paste were then placed on the skin over the subcutaneous part of the external anal sphincter 1 cm lateral to the anal verge at 3 and 9 o’clock. They were secured to the skin by adhesive tape. A ground electrode was placed on the patient’s left buttock. Recordings were made using Nihon Kohden Neuropack 2° equipment (Nihon Kohden Corp., Tokyo, Japan). The patient was carefully instructed and then requested to squeeze and strain while electromyographic activity was recorded. The surface electrodes were then removed.

Electrophysiological assessment was then performed according to our routine method described by Neill and Swash and Kiff and Swash. A concentric needle electrode (Nicolet 019-761400, Nicolet Biomedical Inc., Madison, WI) was inserted into the left superficial part of the external anal sphincter without local anesthesia. Recordings were made on the same equipment. Care was taken to keep the needle in the same position during the entire investigation. The patient was again carefully instructed and then requested to squeeze and strain while electromyographic activity was recorded. The needle electrode was then removed.

The striated muscles in the anal sphincters are continuously active at rest. This activity was registered as ongoing baseline EMG activity. EMG activity during straining was classified as follows: 1) decreased activity during straining or 2) PSR, defined as increased activity during straining or unchanged activity during straining and no closing reflex appearing after completed straining.

Statistical Analysis
The statistical method for measure of agreement, kappa (κ), was used, where κ = 0 indicates no agreement better than chance, κ < 0.5 indicates poor agreement, κ > 0.81 indicates very good agreement, and κ = 1 indicates perfect agreement.

RESULTS
In 65 of 71 (92 percent) patients the EMG recording showed the same result during straining using surface electrodes when compared with needle electrodes. Of the 65 patients with concordant EMG results, 22 had PSR and 43 had decreased EMG activity during straining (Table 1).

In 6 of 71 (8 percent) patients the EMG recording showed a different pattern during straining using surface electrodes when compared with needle electrodes. In five patients the EMG showed decreased activity with needle electrodes but PSR with surface electrodes. In one patient the EMG recording showed PSR with needle electrodes but decreased activity with surface electrodes (Table 1). Kappa (κ) was estimated to 0.83, using the statistical method for measure of agreement.

DISCUSSION
The present study demonstrates that EMG recordings from the external anal sphincter during straining, using surface electrodes applied to the perineal skin, correlate well with the result from needle electrodes inserted into the muscle. This confirms the results of a previous smaller study where EMG, using surface electrodes applied to the perineal skin, showed identical results when compared with needle electrodes during cough and voluntary contraction.

Whereas the surface electrode provides an average or composite picture of muscle activity, the needle electrode is influenced primarily by electrical activity.

<table>
<thead>
<tr>
<th>Needle Electrode</th>
<th>Surface Electrode</th>
<th>PSR</th>
<th>Decreased Activity</th>
<th>Total</th>
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<td></td>
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<td>PSR</td>
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<tr>
<td>PSR</td>
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<td>1</td>
<td>23</td>
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<td>Decreased activity</td>
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<tr>
<td>Total</td>
<td>27</td>
<td>44</td>
<td>71</td>
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PSR = Paradoxical sphincter reaction. Figures are number of patients.
within a short radius of the tip. The latter restricts the recording to a few motor units. The present study shows similar results in the diagnosis of PSR despite this difference.

Surface electrodes are easy and painless to apply and therefore are preferred when diagnosing PSR. However, the amplitude of the activity is often lower with surface electrodes when compared with needle electrodes, which might make the interpretation of the investigation more difficult. However, this difficulty was manageable.

In the present study six patients had a different EMG pattern with surface electrodes when compared with needle electrodes. This difference might be because of one or more reasons. Surface electrodes are more vulnerable to movement artifacts and interference from external electrical sources. Artifacts such as electrical activity generated by other striated muscles than the one studied should always be kept in mind. However, the muscle sample examined by the needle electrode also might not be representative for the whole muscle.

In five of these six patients EMG activity decreased using a needle electrode, whereas EMG showed PSR during straining with surface electrodes. This is in contrast to a previous study where the inability to relax the sphincters was considered to be a response to fear of pain caused by the needle electrode. In one patient, however, the EMG showed decreased activity with surface electrodes but increased activity with a needle electrode, which might have been because straining was not appropriately accomplished.

PSR can also be detected with an anal plug electrode. Anal plug electrodes record electrical activity from the striated muscles through the rectal mucosa and are often used in biofeedback therapy. Previous studies show that EMG using an plug electrodes correlates well with anal manometry and with wire electrodes during rest, squeezing, and straining. Eisem and Tries showed that activity from multiple sites in the anal canal can be measured by an anal plug with two pairs of longitudinal electrodes. This is not possible with surface electrodes applied to the perineal skin. However, if the purpose is to detect PSR, surface electrodes applied to the perineal skin are preferred. They are easy and painless to apply, they do not influence the anatomy in the anal canal, and they can be used during simultaneous rectal emptying.

When investigating the perineal region it is desirable to use methods that give as little discomfort to the patient as possible to improve the reliability of the results by the method itself and by increased patient compliance. In biofeedback therapy anal plug electrodes are often used. When mapping anal sphincter defects, endoluminal ultrasound was shown to be associated with less pain and to be preferable to needle EMG. The present study shows that noninvasive surface electrodes applied to the perineal skin detect PSR accurately, and they have been shown previously to be reliable when recording EMG during rest and voluntary contraction.

CONCLUSION

This study demonstrates a good correlation between surface electrodes applied to the perineal skin and concentric needle electrodes in the diagnosis of PSR. We therefore conclude that noninvasive EMG recordings of the external anal sphincter are often preferred in the diagnosis of PSR.

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