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CONCENTRIC NEEDLE ELECTRODES ARE SUPERIOR TO PERINEAL SURFACE PATCH ELECTRODES FOR EMG DOCUMENTATION OF URETHRAL SPHINCTER RELAXATION DURING VOIDING

Hypothesis / aims of study

To compare external reviewer interpretation of electromyographic (EMG) recordings from perineal surface patch electrodes to urethral concentric needle during micturition.

Study design, materials and methods

Following IRB approval, consenting women underwent pressure-flow studies with simultaneous input from both surface patch and concentric needle electrodes. Paper copies of each recording were obtained at three time points: prior to voiding, during voiding attempts and following voiding attempts.

A 30-gauge, 1 ½ inch concentric needle electrode was placed 5mm ventral to the urethral meatus at the 12 o'clock position in the striated urethral sphincter muscle. Perineal surface patch electrodes were placed at the 2 and 10 o'clock positions around the anus and connected to a second amplifier channel. The Nicolet Viking IVp electrodiagnostic instrument (Nicolet Instrument Corporation, Madison, WI) was used to continuously record EMG activity throughout the urodynamic study.

Representative paper copies of de-identified EMG signals from both electrode types at each of the three time points were collected and assembled by electrode type and chronologically into two series of tracings per patient, creating 44 tracings total. Tracings were examined by 6 external reviewers who were not aware of the patient's clinical or urodynamic findings. Reviewers were asked to determine whether the tracing was interpretable and whether quieting occurred. Electromyographic quieting was defined as the absence of motor unit activation with voiding attempts. Reviewers were unaware of one another's interpretations.

The data were entered in an SPSS file (SPSS, Chicago, IL) and analyzed using McNemar and kappa statistics to determine the agreement between EMG tracings and examiner interpretations of each tracing.

Results

Twenty-two women participated in this study. The indications for urodynamic testing included: incontinence (16), voiding dysfunction (2), and urinary retention (4). Eight patients were unable to void in the urodynamic laboratory, including 4 with urinary retention, 1 with voiding dysfunction and 3 without prior voiding complaints

Concentric needle EMG tracings were consistently more interpretable than surface patch EMG tracings (Table 1). Eighty-eight percent of concentric needle EMG tracings and only 66.7% of perineal surface patch EMG tracings were considered interpretable. Among individual reviewers, significant variation existed concerning judgements about tracing interpretability. When tracings were considered interpretable, a significantly higher percentage of concentric needle EMG tracings (mean 78.8%) demonstrated quieting than perineal surface patch EMG tracings (mean 28.0%).

When both concentric needle and perineal surface patch tracings were interpretable for a patient, intra- and inter-reviewer variation in assessments of quieting was large (Table 2). Reviewers considered a range of 9.1 to 95.5% of patients to have interpretable tracing sets for both electrode types. When both tracings were interpretable, reviewers demonstrated significant variation in rates of agreement of their assessments of the two tracing sets for each of the 22 patients (range 2 to 13 tracings sets in agreement). Kappa values for agreement between interpretations of needle and patch EMG tracings for individual reviewers were highly variable and none were statistically significant.

Unanimous agreement between reviewer interpretations occurred in only 12 of the 44 tracings. Of these 12 tracings, 11 were from a concentric needle electrode and all demonstrated quieting.

Interpretation of results

Concentric needle EMG tracings are more frequently interpretable, demonstrate quieting more often and have greater inter-reviewer agreement when interpreted by reviewers. Urethral concentric needle electrodes are superior to perineal surface patch electrodes for the determination of motor unit quieting with micturition.

Concluding message

Our findings suggest that perineal surface patch electrodes are not an acceptable alternative to the "gold standard" urethral concentric needle electrodes for EMG determination of urethral relaxation during voiding. In accordance with good urodynamic practice of specifying EMG electrode type used, our results demonstrate that urethral concentric needle and perineal surface patch EMG electrode findings cannot be used interchangeably.

Table 1. Comparison of interpretations of tracings by examiner.

Examiner	Concentric Needle EMG			Perineal Surface Patch EMG		
	Interpretable		Not Interpretable	Interpretable		Not Interpretable
	EMG Quiets	Does not Quiet		EMG Quiets	Does not Quiet	
1	81.8%	18.2%	0	31.8%	45.5%	22.7%
2	68.2%	18.2%	13.6%	13.6%	63.6%	22.7%
3	63.6%	9.1%	27.3%	9.1%	0	90.9%
4	77.3%	0	22.7%	18.2%	27.3%	54.5%
5	95.5%	4.5%	0	54.5%	40.9%	4.5%
6	86.4%	9.1%	4.5%	40.9%	54.5%	4.5%

Table 2. Comparison by examiner of interpretability of both needle and patch electrode data for each patient and agreement of these interpretations.

Examiner	Both tracings interpretable (needle and patch EMG) (N = 22)	Agreement of needle and patch EMG interpretations when both interpretable	Kappa agreement between interpretations of needle and patch EMG
1	17 (77.2%)	8 (47.1%)	0.160
2	14 (63.6%)	4 (28.6%)	0.156
3	2 (9.1%)	2 (100%)	N/A
4	7 (31.8%)	3 (42.9%)	N/A
5	21 (95.5%)	13 (61.9%)	0.118
6	20 (90.9%)	9 (45.0%)	0.125