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ORIGINAL ARTICLE

Anal sphincter function as assessed by 3D high definition anorectal manometry

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Summary

Purpose: High resolution anorectal manometry has been developed over the past years, as well as 3D high definition manometry (HDARM). However, the clinical impact of the results obtained with these new technologies remains to be determined. We thus analyzed various HDARM parameters of anal sphincter function and tested their capacity to discriminate between patients with constipation and those with fecal incontinence.

Methods: One hundred and fourteen consecutive patients underwent the same HDARM protocol (Medtronic), including 2 short duration voluntary anal contractions (5 seconds) and 1 sustained (as long as possible) contraction. Various parameters evaluating the anal sphincter function were measured, based on automatic software analysis and Smartmouse™ item of the software; resting anal pressures, anal pressures and incremental pressures during voluntary squeeze and cough anal reflex. The ability of these parameters to discriminate between patients with fecal incontinence and chronic constipation was assessed using areas under the curves of ROC curves. **Results:** All parameters were highly correlated. The most discriminant variable was found to be the mean anal pressure during sustained squeeze. The 3D lambda aspect of the anal sphincter during voluntary contraction was as frequently absent in both groups of patients (13% in patients with chronic constipation, versus 23% in those with fecal incontinence, $P=0.18$). There was a significant correlation between the fecal incontinence Wexner score and the voluntary anal contraction variables.

Conclusions: Several parameters to assess the quality of voluntary anal contraction have been proposed. We observed with HDARM that the most discriminant parameter was the mean anal pressure during sustained squeeze. This may help to standardize and simplify HDARM protocols. © 2018 Elsevier Masson SAS. All rights reserved.

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Anorectal manometry has been used for decades to evaluate anorectal function in patients with constipation or fecal incontinence. Experts recommended the exploration of anal function with anal resting tone, maximal pressure during sustained voluntary contraction, duration of sustained voluntary contraction and maximal anal pressure during cough reflex [1,2]. Various parameters have been established to describe anorectal function with the recently introduced high resolution or 3D-high definition anorectal manometry (HDARM) [3–6]. However, various protocols have been used, several parameters have been described, but the clinical relevance of these various protocols and measurements has not been established. Our goal was to analyze consecutive HDARM performed with the same protocol for patients complaining of fecal incontinence and/or chronic constipation (with or without dyschesia) and to try to identify the most discriminant parameters and the diagnostic accuracy of this test.

Methods

One hundred and fourteen consecutive patients (97 women, mean age 55 (range: 18–83)) sent to our lab between November 2015 and February 2016 for anorectal manometry testing in relation with constipation and/or fecal incontinence underwent the same protocol. Because this protocol was standard clinical practice, ethical committee approval was not required according to French Law.

Study design

All subjects responded to a structured questionnaire including medical and surgical history, the Jorge and Wexner score for fecal incontinence [7], and the KESS score for constipation [8]. They underwent anorectal clinical examination, HDARM and balloon evacuation test [9] on the same day. Patients were classified as fecal incontinence (FI) or chronic constipation (CC) according to the definitions proposed by the Rome IV classification for anorectal disorders [10]. Patients with CC were classified as slow transit constipation or rectal evacuatory disorder according to the KESS score.

HDARM protocol

HDARM was performed, using a rigid probe (Medtronic, Shoreview, MN, USA) with 256 pressure sensors spread over the whole circumference (10 mm) and length (64 mm) in the supine left lateral position without previous enema or bowel preparation. The usual treatment for bowel dysfunction was not modified before the explorations. A disposable sheath with a rectal balloon covering the probe was used. After the anal insertion of the probe, a 2-min resting period was observed before starting measurements. Then anal and rectal pressures were recorded during a 30-s resting period, during 2 short 5-s voluntary squeeze periods and one sustained anal contraction (voluntary squeeze as long as possible), with a 30-s period of rest between each contraction. The voluntary contraction sequences were followed by 2 consecutive anal cough reflexes, and 2 simulated defecation

maneuvers. Rectal sensitivity testing was performed by progressive rectal balloon inflation up to 300 ml.

The balloon expulsion test was performed as described by Chiaroni et al. [9], after removal of the HDARM probe.

We report here only the results of the parameters evaluating anal sphincter function (resting pressure, voluntary squeeze and the anal cough reflex).

HDARM data analyses

Firstly, the automated analysis proposed by the software was recorded as follow, by 2 authors experienced in 3DARM (FM and AG) blinded from clinical data:

- for the resting period, the anal mean pressure (e-sleeve, absolute reference), with the limits defined as the mean pressure above 25% of the mean maximal pressure;
- for each squeezing period (2 short and 1 sustained), the maximal mean pressure during a 1-s period.

Secondly, the Smartmouse™ item of the software was then applied to calculate:

- the anal mean resting pressure for a period of 20 seconds, with the limits of the HPZ corresponding to the 20 mmHg isobaric contour;
- the mean pressure during sustained squeeze, and the duration of the sustained voluntary contraction.

Incremental pressures during voluntary contraction periods were computed as the difference between maximal or mean pressures during squeezing and resting periods. The presence or absence of the 3D lambda aspect during voluntary squeeze, as described by Li et al. [11], was assessed in all patients. For the anal cough reflex, the maximal anal pressure was measured [12].

Statistical analyses

Data were expressed as mean or median (range or standard deviation). Comparisons between the FI and CC groups and between manometric data were performed using Chi-square, Fisher exact test and one-way analysis of variance when appropriate. A *P*-value < 0.05 was considered as significant. The performance of different manometric variables to distinguish fecal incontinence from constipation was evaluated by comparing areas under the curve (AUCs) of Receiver Operating Characteristics (ROC) curves. The sensitivity measured the ability of the parameter to identify FI patients, while the specificity tested the capacity of the parameter to correctly classify CC patients. The combined performances of these manometric variables were analyzed by logistic regression.

Results

Seventy-nine patients complained predominantly of CC (22 rectal evacuatory disorder according to the KESS questionnaire (28%), 18 slow transit constipation (23%) and 40 mixed

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