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Does Patient Position Influence the Results of Three-dimension High Resolution Ano-rectal Manometry?

Alban Benezech[1,2*], Michel Bouvier[1,2], Nathalie Lesavre[3], Jean-Michel Gonzalez[1], Karine Baumstarck[4], Jean-Charles Grimaud[1,2] and Véronique Vitton[1,2]

[1]Service de Gastroentérologie, Hôpital Nord, Assistance Publique-Hôpitaux de Marseille, France.
[2]Plateforme D'interface Clinique, CRN2M CNRS UMR 7286, Aix-Marseille Université, France.
[3]Centre D'investigation Clinique 1409, Assistance Publique-Hôpitaux de Marseille, Aix-Marseille Université, France.
[4]Unité d'aide Méthodologique à la Recherche Clinique, EA 3279, Laboratoire de Santé Publique, Aix-Marseille Université, France.

Authors' contributions

This work was carried out in collaboration between all authors. Author AB wrote the paper, designed the research study, analyzed the data and contributed essential reagents or tools. Author MB designed the research study, contributed essential reagents or tools. Author NL designed the research study, analyzed the data. Author JMG contributed essential reagents or tools. Author KB designed the research study, analyzed the data (statistical analysis). Author JCG contributed essential reagents or tools. Author VV wrote the paper, designed the research study, analyzed the data and contributed essential reagents or tools. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Anorectal manometry is the current gold standard to explore anorectal functional disorders. Recently, three-dimensional high-resolution anorectal manometry (3DHRAM) was developed.

**Corresponding author: E-mail: benezech.alban@gmail.com;*

However, although procedures are usually performed in the left lateral decubitus position, anorectal symptoms usually occur in the erect or in the sitting position. Our aim was to prospectively compare the values obtained with 3DHRAM in the left lateral decubitus position versus the erect position.
Study Design and Setting: A monocentric prospective study was conducted at a tertiary referral center, in the Department of Gastroenterology, Hôpital Nord, Marseille, France.
Study Duration: Study was conducted from June 2013 to March 2014.
Methodology: All patients referred to our center for 3DHRAM and endoanal ultrasonography to explore faecal incontinence or constipation were eligible. The 3DHRAM was successively performed by the same operator in the left lateral decubitus and then in the erect position. For each patient, the body mass index, the values of the KESS score or of the Wexner score were systematically rated.
Results: Forty patients were included in this prospective study (20 with constipation, 20 with faecal incontinence). The median anal resting pressure was the only significantly different parameter between the left lateral decubitus and the erect position, both in patients suffering from constipation or from faecal incontinence ($p=0.02$ and $p<0.001$ respectively). All pressures values, as well as anismus diagnosis, were well correlated between the two positions, except the high-pressure zone, the sensation threshold and the need to defecate.
Conclusion: In this study, only the median anal resting pressure was significantly different between the two positions. The good correlation between anal pressures values obtained in the two positions allows achieving 3DHRAM in the left lateral decubitus.

Keywords: Three-dimensional high-resolution anorectal manometry; standing position; constipation; faecal incontinence.

ABBREVIATIONS

3DHRAM: Three-dimensional High-resolution Anorectal Manometry; EUS: Endoanal Ultrasonography. BMI: Body Mass Index.

1. INTRODUCTION

Anorectal manometry is the gold standard for the study of anorectal physiology [1]. However, despite a large number of studies, all the conventional techniques has the common limitation of a lack of standardization [2]. Recently, 3-dimensions high-resolution anorectal manometry (3DHRAM) was developed using a rigid probe that contains several pressure sensors. This increase of pressure sensors and their longitudinal and circumferential distribution throughout the probe probably allows more accurate measurement of anorectal pressures, improving the reliability and the reproducibility of this technique [3-5]. Several studies have also demonstrated the importance of morphological data obtained with this new probe. Whatever the technique used, anorectal pressures are recorded in the left-lateral decubitus position while main anorectal disorders usually occur in the sitting or in the erect position. With a conventional technique of anorectal manometry, Thekkinkattil et al. [6] compared the anorectal pressure values acheived in left-lateral decubitus position with those acheived in erect position and have found significant differences, particularly regarding anal resting pressure. The aim of our study was to compare measurements acheived with 3DHRAM in patients placed in left-lateral decubitus versus those achieved in erect position. Secondary objectives were to assess (1) the correlation between the measured pressure values and the severity of symptoms, (2) the correlation between the measured pressure values and the degree of sphincter rupture, (3) the relationship between differences of pressure values between the two positions and the patient's weight.

2. MATERIALS AND METHODS

2.1 Patients

In this single-centre prospective study, all patients referred for investigations of faecal incontinence or constipation were eligible. The inclusion criteria were the following: age > 18 years, faecal incontinence or constipation. The exclusion criteria were the following: age < 18 years, organic pathology of the colon or rectum detected by clinical examination or colonoscopy,

previous surgery for pelvic floor disorders, or disability preventing the realization of 3DHRAM standing. All participants have signed written informed consent.

For all the patients, a detailed clinical history was recorded, including age, gender, indication of examinations and duration of symptoms. The severities of faecal incontinence and constipation were systematically evaluated using the Wexner Fecal Incontinence Scale [7] and the KESS score [8], respectively.

All the patients underwent 3DHRAM and endoanal ultrasonography (EUS). In our current practice, because of their specific expertise, two different operators performed the two procedures. 3DHRAM was realized either before or after EUS. However the two procedures were systematically performed successively on the same day.

According to the French law, this prospective study was approved by the Ethic Comittee (N° Eudract 2013-A00507-38, CPP Sud Méditerranée I 13 36); ClinicalTrials.gov number, NCT01946334.

2.2 Methods

2.2.1 Three-dimensional high-resolution anorectal manometry (3DHRAM)

Patients successively underwent 3DHRAM in left lateral position and in erect position. A digital rectal examination was systematically performed before introducing the probe. For each procedure, the lubricated probe was placed manually into the anorectum, and the first measurements were carried out after a resting period of 5 minutes. The anal canal pressures were calculated during rest and then during straining. The other measurements were the length of the high-pressure zone, the sensation threshold, the need to defecate, and the maximal tolerable volume. The 3-D high-resolution probe has a diameter of 10.75 mm and a length of 64 mm. It has 256 pressure sensors located in 16 rows, and in each row, there are 16 circumferentially oriented sensors. The probe has a central lumen for inflation and is covered for each procedure with a disposable sheath that includes a 3.3-cm-long balloon with a capacity of 400 cc. Manometric data were analysed using specific ManoViewTM analysis software (Sierra Scientific Instruments, Los Angeles, CA) [9].

2.2.2 Endoanal ultrasonography (EUS)

EUS was performed on patients in left lateral decubitus position. A rigid biplanar transrectal probe with a frequency of 7 MHz was used (model EUP-U533; Hitachi, Japan). The tip of the probe was covered with a water-filled balloon to maintain the acoustic window for the ultrasound waves. By slowly and manually rotating the linear probe 360°, the various layers of the anal wall (mucosa, internal anal sphincter, external anal sphincter), the rectal wall, and the perirectal tissues (m. puborectalis, bladder, vagina, or prostate) could be visualized. A defect of the IAS was defined as an echogenic interruption of the muscular ring, whereas an EAS defect was defined as a hypoechogenic interruption [10].

2.2.3 Statistical analysis

Continuous data were presented as medians (minimum and maximum) or means and standard deviations. In each group of patients (constipation and faecal incontinence), the relationship between the values measured in the left lateral decubitus position and in the erect position were tested using the t-test Student and correlations for paired samples. In each group, the relationship between all the variables of interest and the following parameters were assessed: i) anal sphincter defect using Mann-Whitney tests; ii) age, score of severity (KESS score for constipation, Wexner faecal incontinence scale for faecal incontinence), body mass index (using Spearman's correlations).

According to the previous reports [6], we expect to observe anal pressures, including anal resting pressure, increased in the erect position compared to the left lateral decubitus position. A sample of 34 subjects will detect a difference between the mean anal resting pressure in the left lateral decubitus and the mean anal resting pressure in the erect position of 10 mmHg, standard deviation set at 15, and power set at 80% (alpha 2.5%). So we will include 40 subjects to consider patients exclusion.

3. RESULTS AND DISCUSSION

3.1 Results

Forty patients (4 men and 36 women), 20 with constipation, 20 with faecal incontinence, were included in this study. Patient's characteristics are presented in Table 1.

When comparing measurements obtained in the left lateral position versus erect position, only the median anal resting pressure (absolute value) was significantly different both in constipated and faecal incontinent patients (*P*=.02 and *P*<.001 respectively). No other measurement was significantly different between the two positions. All measurements are presented in Table 2.

Table 1. Patients characteristics

Age	
Mean±SD	50.25±16.30
Median (min-max)	52.50 (19-78)
BMI	
Mean±SD	24±4.33
Median (min-max)	23.43 (17.5-36)
KESS	
Mean±SD	20.6±8.4
Median (min-max)	20 (4-33)
Wexner	
Mean±SD	11±5
Median (min-max)	9 (5-25)
Duration of symptoms (months)	
Mean±SD	97±106
Median (min-max)	60 (6-480)

In the constipated patient's group, all parameters were well correlated except the high-pressure zone, the sensation threshold and the need to defecate. In the faecal incontinent patient's group, all parameters were well correlated except the high-pressure zone and the sensation threshold. All the correlation coefficients and p values are presented in Table 3.

Considering EUS results, an anal sphincter defect was diagnosed in 8 patients with constipation (2 external anal sphincter, 5 internal anal sphincter, 1 both sphincters) and in 10 patients with faecal incontinence (1 internal anal sphincter, 9 both sphincters).

The difference of measurements between the two positions was influenced by none the following parameters: anal sphincter defect, age, and body mass index (BMI). Moreover, whatever the posture, the pressure values were not correlated with the severity of anal incontinence or constipation, or the degree of anal sphincter defect.

Forty patients had dyssynergia in the left lateral position. In erect posture, the same forty patients showed a dyssynergic pattern. The percentage of anal relaxation was not significantly different between the two positions. However, in the subgroup of incontinent patients, this percentage seemed halved (10.55±2.91 vs 5.35±1.1, *P* = .07 NS).

3.2 Discussion

The current study is, to our knowledge, the first one comparing anorectal values acheived with 3DHRAM in left lateral decubitus position vs erect position. In comparison to conventional techniques usually using perfused catheter probes, the 3DHRAM probe has a higher number of pressure sensors with a longitudinal and circumferential distribution throughout the probe. This probably allows more accurate measurement of anorectal pressures, as well as achieving morphological data. However, so far, all data published with high resolution anorectal manometry were achieved in left lateral decubitus position while main anorectal disorders occur in sitting or in erect positions. Our results show that only the median anal resting pressure was significantly different between the two positions, being higher in erect position. However, although this data confirms that has previously been demonstrated, the cause of this increase is not clearly explained. The purpose of this pressure increase is likely an additional mechanism to maintain faecal continence. Indeed, in erect position, the gravity increases the pressure exerted by the abdominal content on the perineum and may thus alter the continence. Moreover, in this position, the faecal continence is partly maintained by the closure of the anorectal angle secondary to the lifting of the pelvic floor [11]. As suggested by Thekkinkatil et al., the anal cushions, engorged and thus bulkier in erect position may not only partially contribute to the maintenance of faecal continence, but could also explain the increase of the anal resting pressure. Our results are consistent with the literature since studies using conventional techniques of anorectal manometry had already reported this increase of anal resting pressure in erect position [6,12]. As also described, there was no difference between continent patients and incontinent patients in the changes observed (or not) in the two positions.

In our study, the median anal pressure values in the two positions were well correlated, even when they were significantly different. This correlation indicates that conventional left lateral decubitus position remains adapted to the study of the anorectal physiology by manometry, as described by Yoshioka et al. [13].

Table 2. Patients measurement values

Variable	Constipation		*P* value	Faecal incontinence		P value
	Left lateral decubitus	Erect		Left lateral decubitus	Erect	
Anal resting pressure (mmHg) absolute value						
Mean±SD	101.6±27.2	112.2±27.3	*P*=.02	65.6±23.8	77.7±26.6	*P*<0.001
Median (min-max)	96 (51-165)	111 (67-171)		66 (31-98)	75 (35-117)	
Anal squeeze increment (mmHg) absolute value						
Mean±SD	188.15±42.5	190.7±40.6	*P*=.69	167.9±89.9	167.35±81.2	*P*=.91
Median (min-max)	183.5 (107-281)	189.5 (132-297)		152 (58-392)	147.5 (61-365)	
High Pressure Zone (cm)						
Mean±SD	3.1±0.6	2.9±0.8	*P*=.50	2.9±1.1	3±1	*P*=.77
Median (min-max)	3 (2-4)	3 (1-4)		3 (0-5)	3 (1-4)	
Sensation threshold (ml)						
Mean±SD	12±5.2	12±7	*P*=.99	12.5±3.4	13.5±7.4	*P*=.63
Median (min-max)	10 (10-30)	10 (10-40)		10 (10-30)	10 (10-40)	
Need to defecate (ml)						
Mean±SD	77±19	94±48	*P*=.10	87.5±37.5	95.5±40	*P*=.28
Median (min-max)	75 (50-130)	80 (50-250)		70 (50-180)	90 (50-200)	
Maximal Tolerable Volume (ml)						
Mean±SD	161.5±47.5	162±57	*P*=.56	166.5±57.5	171±65.4	*P*=.56
Median (min-max)	155 (90-300)	170 (80-280)		165 (80-300)	170 (90-300)	

Table 3. Correlation between values obtained in left lateral vs erect posture

		Correlation coefficient (Pearson)	P value
Constipation	Anal resting pressure (absolute value)	0.77	P<0.0001
	Anal squeeze increment (absolute value)	0.77	P<0.0001
	High pressure zone	0.1	P=0.6
	Sensation threshold	0.029	P=0.9
	Need to defecate	0.23	P=0.3
	Maximal tolerable volume	0.7	P<0.0001
Faecal incontinence	Anal resting pressure (absolute value)	0.89	P<0.0001
	Anal squeeze increment (absolute value)	0.97	P<0.0001
	High pressure zone	0.09	P=0.7
	Sensation threshold	0.14	P=0.56
	Need to defecate	0.65	P<0.0001
	Maximal tolerable volume	0.85	P<0.0001

In a sample of 172 patients including 135 patients suffering from faecal incontinence Thekkinkatil et al. had demonstrated a significant negative correlation between severity of anal incontinence and anal resting pressure in erect position, but not in left lateral position [6]. In our work, there was a lack of correlation between the values of anal pressure and the severity of symptoms or the presence of an anal sphincter rupture. This is probably related to the lack of power due to the small sample size. The sample size is a limitation of our study and a larger cohort will be indeed of interest. However, it is not necessarily easy to make the patient accept a 3DHRAM in erect posture, thus we intended to limit the number of patients by statistically calculating our sample size (power at 80% and α risk at 2,5%). Similarly, there was no correlation between the BMI and the pressure variations between the two positions. The relative homogeneity of the sample in terms of BMI probably explains this result.

With a six-sensor solid-state manometry probe, Rao et al. [14] demonstrated that the lying position tended to excessively diagnose defecatory disorders like dyssynergia. In our work, using 3DHRAM, dyssynergia was present in all patients and was not affected by the patient's position. The high prevalence of dyssynergia in our study is in accordance with the literature since the main cause of chronic constipation in tertiary referral centers is outlet constipation often associated with pelvic floor disorders [15,16]. However, in the subgroup of incontinent patients, the percentage of relaxation in standing position seemed to be lower than in erect posture, although the difference was not significant. The fear of incontinence episodes in these patients may explain this result. In the erect position, attempted defecation could be difficult to achieve in this subgroup, and therefore difficult to interpret. However, although symptoms (especially faecal incontinence) are mainly experienced by the patients in erect posture, the pressure values achieved with 3DHRAM are correlated in the two evaluated positions. This good correlation is clinically relevant, confirming that the left lateral decubitus position does not induce any significant difference in terms of physiological defecation mechanisms compared to the erect one.

4. CONCLUSION

In conclusion, in this study, as previously described, the anal resting pressure was the only significant difference found in 3DHRAM between left lateral decubitus and erect positions. However, the good correlation of the pressure values between the two positions confirms the possibility to perform measurements in the left lateral position, even if it is not the physiological position for defecation.

CONSENT

All authors declare that 'written informed consent was obtained from the patient for publication of this study.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee (N° Eudract 2013-A00507-38, CPP Sud Méditerranée I 13 36) and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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