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Comparison of anorectal manometry testing in left lateral and lithotomy positions

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Abstract

Objectives: Anorectal manometry (ARM) is typically performed in left lateral position, but many practitioners are more familiar with the lithotomy position. We aimed to evaluate agreement between anorectal manometry performed in left lateral and lithotomy positions and patient preference for testing position.

Methods: We performed a prospective comparison study of left lateral versus lithotomy position for women undergoing ARM for the evaluation of fecal incontinence. Women were randomly assigned to undergo testing in either left lateral first followed by lithotomy position, or vice versa. Women then completed a survey assessing preference of position. We performed Bland-Altman analysis to measure the level of agreement between anorectal measurements obtained in the two positions.

Results: Twenty-one women were enrolled (mean age 65 ± 2.2 years). We noted an acceptable level of agreement between anal pressure values obtained in left lateral vs. lithotomy positions: anal resting pressure (mean difference 0.9mmHg, 95% limits of agreement 30.2 and -28.5) and anal squeeze pressure (mean difference 1.8mmHg, 95% limits of agreement 54.3 and -50.7). The level of agreement for sensory values was outside the predetermined clinical acceptability range. Most women (17/21, 81%) reported a “good” or “very good” experience in both positions.

Conclusion: ARM testing in the two positions can be used interchangeably for anal resting and squeeze pressures, but not for anorectal sensation. This modification can be introduced into

clinical practice to accommodate the preference of women and practitioners who favor lithotomy position.

Single Sentence Summary:

Anorectal manometry in lithotomy and left lateral can be used interchangeably for anal resting pressure and anal squeeze pressure, but not for anorectal sensation.

Keywords

anorectal manometry; fecal incontinence; Bland-Altman; lithotomy; left lateral

Introduction

Fecal incontinence (FI), the involuntary passage of stool, is a common condition with a prevalence of 3 to 22% in community-dwelling women [1, 2]. Anorectal manometry (ARM) is a diagnostic tool used to assess anal sphincter function and rectal sensation that may help better understand the underlying cause of FI [3, 4]. ARM has also been used during biofeedback treatment for FI, and manometry values may predict response to treatment [3, 4].

ARM testing is traditionally performed in left lateral position [5–8]. Colorectal practitioners commonly perform office evaluation in this position as well [9]. Since pelvic exams are typically performed in lithotomy position, this position offers a more comfortable and familiar position for both women and gynecologic practitioners [10, 11]. Additionally, biofeedback using ARM is commonly performed in lithotomy position [12]. However, limited data is available on ARM measurements in lithotomy position [13]. Furthermore, it is unknown how ARM values in lithotomy position compare to values in left lateral position.

The aim of our study was to determine agreement between ARM testing performed in left lateral and lithotomy positions. Our secondary aim was to assess patient preference for performance of ARM in left lateral vs. lithotomy position. We hypothesized that there is significant agreement between the results of anorectal manometry in lithotomy and left lateral positions.

Methods

We conducted a prospective comparison study of women presenting to the Urogynecology office for evaluation of FI and undergoing ARM testing. Institutional Review Board approval was obtained and women provided written consent. Women with at least monthly FI over the last three months were eligible for participation. We excluded women with fistula, rectal prolapse, colorectal or gastrointestinal malignancy, history of colorectal surgery, radiation, flatal incontinence only, fecal impaction, or neurologic disorders. We determined FI subtype (urgency vs. passive) by answers questions from the Fecal Incontinence and Constipation Assessment survey [14]. Patients also completed the St. Mark's Vaizey scale to assess clinical severity [15]. A clinical examination was performed using the pelvic organ prolapse quantification system to document presence and extent of

prolapse [16]. When women presented for ARM testing, they were randomly assigned a sequence of ARM testing via generation of a random sequence using “Sealed Envelope”, an online randomization tool [17]. Testing was then performed in left lateral followed by lithotomy, or vice versa. Lithotomy position was achieved by placing the patient in stirrups and reclining at a 45-degree angle on the examination table.

We performed ARM using the MCompass Anorectal Manometry System (Medspira, Minneapolis, MN). Testing was performed by clinical fellows in female pelvic medicine and reconstructive surgery who had received training in performing manometry. A single-use catheter was inserted into the anal canal 0cm from the anal verge. The balloon at the tip of the catheter was primed with 3cc of air. We then measured resting anal pressure with the catheter inserted 0cm, 1cm, and 2cm from the anal verge. The high pressure zone was defined as the distance from the anal verge with the highest anal resting pressure; the remainder of testing was then performed at this location. To measure the anal squeeze pressure, women were asked to squeeze their anal muscles around the catheter and maintain this for 20 seconds; this was repeated a total of three times. We then evaluated anorectal sensation by slowly inflating the balloon using a 60cc syringe to a maximum of 180cc of air. Overall, the following values were recorded: mean anal resting pressure (mmHg), mean anal squeeze pressure (mmHg), volume at first sensation (cc), volume at normal urge sensation (cc), volume at strong urge sensation (cc), and maximum tolerated volume capacity (cc). We then repeated this testing sequence in the alternate position.

After testing, we administered a survey to assess preference of position for testing. The survey asked women to rate the level of pain or discomfort they experienced in both positions as well as to rate their overall experience in each position on a Likert scale. The survey also requested women list their preference (if any) for one position over the other and reasons for this preference.

Demographic data were reported as means or medians as appropriate. Normality of the data was assessed using the Shapiro-Wilk test and histograms.

The primary outcome was level of agreement between anal pressure values. Secondary outcomes were level of agreement between anorectal sensation as well as patient preference of position. The paired t-test was used to assess for differences between the ARM parameters performed in lithotomy and left lateral positions. The Bland-Altman statistical analysis tool was used to graphically evaluate the level of agreement between values obtained in both positions [18]. The Bland-Altman test allows quantification of the agreement between two measurements by examining the mean difference between two measurements and calculating limits of agreement using the mean and standard deviation of the difference between the two measurements [19]. The goal is to determine whether the two methods agree adequately enough to be substituted for each other. The mean of the anorectal manometry values in lithotomy and left lateral position were plotted on the x-axis and the difference between values for each subject obtained in left lateral and lithotomy positions was plotted on the y-axis. The mean difference was calculated and represented as a horizontal line on the plot. A small mean difference with horizontal line close to $y=0$ indicates lack of bias. The 95% limits of agreement were calculated and denoted on the plot

as horizontal lines, defined as mean difference ± 1.96 SD of the differences of the value in left lateral and lithotomy positions. The 95% limits of agreement represent the range of values within which 95% of the differences between the two measurements will fall, under the assumption of normality. Clinical acceptability of these limits is determined by the clinician's discretion based on whether the specified values are impactful clinically and must be defined a priori.

We defined the clinically acceptable level of agreement a priori as ± 30 mmHg for mean anal resting pressure, ± 55 mmHg for mean anal squeeze pressure, ± 10.0 cc for volume at first rectal sensation, volume at normal urge sensation, and volume at strong rectal urgency, and ± 20 cc for maximal tolerable volume. We chose these criteria based on the available range of published values that we deemed would not significantly alter clinical management [5–7].

Multivariable regression was performed to assess the relationship of patient characteristics (age, race, body mass index (BMI), parity, FI subtype, and Vaizey score) to differences in ARM measurements in left lateral and lithotomy positions.

Prior data indicate that the difference in the response of matched pairs for resting pressure is normally distributed with standard deviation of 10 [20]. Our sample size was based on finding a true difference in the mean response of matched pairs of 7.5 mmHg, which is about half the standard deviation of values obtained in lateral position. With a type I error rate of 5% and power of 90%, we required 21 subjects to reject the null hypothesis that this response difference is zero.

Results

Twenty-one women were enrolled with an average age of 65 ± 2.2 years; other demographics are displayed in Table 1.

There were no significant differences between ARM values obtained in left lateral vs. lithotomy positions for any ARM measurements (Table 2). We noted an acceptable level of agreement between pressure values obtained in left lateral vs. lithotomy positions, with differences falling within the predetermined clinically acceptable limits: mean anal resting pressure (mean difference 0.9mmHg, 95% limits of agreement 30.2 and -28.5) and mean anal squeeze pressure (mean difference 1.8mmHg, 95% limits of agreement 54.3 and -50.7). Bland-Altman plots revealed no pattern with constant variance for these values (Figure 1), with small mean differences and the line of agreement close to $y=0$, indicating near perfect agreement. The 95% confidence intervals about the mean differences contained $y=0$, indicating no systematic bias.

Although the mean differences for volume indices were small and the Bland-Altman plot demonstrated the mean differences near $y=0$, the limits of agreement for sensation parameters fell outside of the predetermined clinically acceptable thresholds: volume at first sensation (mean difference -7.5 cc, 95% limits of agreement 31.1 and -46.1), volume at normal urge sensation (mean difference -5.0 cc, 95% limits of agreement 33.9 and -43.9), volume at strong urge sensation (mean difference -10.5 , 95% limits of agreement 39.9 and -60.9), and maximum tolerated volume capacity (mean difference -5.8 cc, 95% limits of

agreement 41.9 and -53.5) (Figure 2 and Table 3). Overall, higher values for sensation parameters were observed in lithotomy than left lateral. The 95% confidence intervals for the mean difference contained zero, indicating non-significance. Multivariable regression analysis revealed that the mean difference in anal squeeze pressure between positions decreased as BMI increased ($p=0.02$). Age, race, FI subtype, and parity were not associated with ARM value discrepancies. The sequence of testing was not associated with ARM value discrepancies.

The majority of women (17/21, 81%) reported a “good” or “very good” experience with testing performed in lithotomy position; the same proportion of women reported a “good” or “very good” experience with testing performed in left lateral position. Overall, 8/20 (38%) women expressed a preference for testing in left lateral position, 4/20 (19%) preferred lithotomy, and 8/20 (38%) reported no preference. Of women who underwent testing in left lateral first, 4/10 (40%) expressed a preference for testing in left lateral, 1/10 (10%) preferred lithotomy position, and 5/10 (50%) reported no preference. In those women who underwent testing in lithotomy first, 3/10 (30%) preferred lithotomy, 4/10 (40%) preferred left lateral, and 3/10 (30%) reported no preference. The order of testing did not affect patient preference ($p=0.5$). Reasons provided for preference for left lateral position included comfort from sleeping in this position at night and less stress felt in legs, whereas reasons for preference for lithotomy included increased comfort lying on the back and ease of testing in this position due to left-sided weakness. Despite this, the majority of women did not report pain in either lithotomy (19/20, 95%) or left lateral (18/20, 90%; $p=0.6$).

Discussion

We found that the level of agreement between resting anal pressure and anal squeeze values in left lateral and lithotomy positions was clinically acceptable. Though we did not observe a significant difference in sensory values between left lateral and lithotomy positions, the level of agreement for the sensation values did not fall within our predefined clinical acceptability limits. Our findings indicate that ARM testing in lithotomy and left lateral can be used interchangeably for anal resting pressure and anal squeeze pressure, but not for anorectal sensation. Finally, both positions are reasonably comfortable, with most women not expressing a preference for anorectal manometry performed in either position and no association of preference with order of testing.

Of the several ARM variables reported in the literature, anal resting and squeeze pressures are likely the most reproducible and clinically useful. Low anal resting pressure and low anal squeeze pressure have good intra-individual reliability and are useful in the diagnosis of FI [6, 20–24]. Additionally, these values are helpful in the prediction and monitoring of response to treatment with biofeedback [3, 12, 23, 25]. While ARM testing is commonly performed in left lateral position, anorectal biofeedback is performed in lithotomy position. Our findings indicate that ARM testing and biofeedback could both be performed in lithotomy position without compromising the measurement of at least two anorectal manometry variables, anal resting and squeeze pressures.

While we observed acceptable clinical agreement for anorectal pressure values in lithotomy and left lateral positions, the 95% limits of agreement for anorectal sensation values fell outside of the predetermined criteria, suggesting that anorectal sensation measurements in the two positions are not interchangeable. Additionally, all values for sensation were higher in lithotomy than left lateral position. Prior studies suggest that there is wide variation in sensory values, as numerous variables can affect sensory volumes including type and speed of inflation, distention medium, distance of balloon from anal verge, and position of the patient [4]. Bharucha et al also reported greater intra-individual variability in the measurement of sensory volumes than anal pressures [24]. While the utility of sensory values in the diagnosis of FI has not been clearly elucidated, some studies suggest that sensory values may be helpful in monitoring response to biofeedback in patients with sensory deficit [3, 21]. Our findings suggest that if sensory volumes are being used to measure response to treatment, in a given patient, volumes should be measured in the same position, either lithotomy or left lateral, throughout the course of treatment.

A prior study has reported that anorectal squeeze pressures increase with increasing BMI, possibly due to greater recruitment of muscle fibers to maintain fecal continence [26]. Such a finding raises concern about greater variability in anorectal pressure measurements with change in position for obese women. We observed that the difference between anorectal pressure measurements between lithotomy and left lateral positions decreased as BMI increased. Therefore, our study indicates that anorectal manometry with or without feedback could be performed in either lithotomy or left lateral position even for obese women.

Patient preference is of considerable importance for anorectal manometry because anorectal testing can be a source of significant anxiety. Most women did not express a strong preference for one position over the other and did not experience pain in either position. Given that anorectal ultrasound and biofeedback are performed in lithotomy position, practitioners may prefer to perform all anorectal testing in lithotomy position.

Our study has several strengths. We used a randomized design to compare anorectal measurement variables in lithotomy and left lateral positions. Additionally, we employed rigorous testing with Bland-Altman analysis to determine if the two positions were in fact similar. In addition to manometry values, we also report on patient reported preference. Our sample size was powered to detect a $\frac{1}{2}$ SD difference between anorectal pressure measurements in lithotomy and left lateral. We observed a larger than anticipated standard deviation for sensation parameters, reflecting large variation among subjects in our sample. This is in keeping with the aforementioned high inter-individual variation of sensory parameters. We speculate that large deviations of one or two individuals beyond the mean widened the 95% limits of agreement in the Bland-Altman analysis to the point that it was too wide to be clinically acceptable for sensory values, despite detecting no difference in the mean values for individual participants. Perhaps with a larger sample size, this variation could be better accounted for to yield narrower 95% limits of agreement.

In conclusion, ARM testing in lithotomy position can be performed in lieu of left lateral position with good agreement for the values of anal resting pressure and anal squeeze pressure, which are common targets of biofeedback therapy. The ability to perform ARM

testing in lithotomy position can accommodate the preferences of women and improve ease of diagnostic testing and biofeedback treatment for FI.

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Bland-Altman	
Mean Difference	0.9
Std Dev.	15.0
Upper Limit	30.2
Lower Limit	-28.5
95% CI	(-6.0 - 7.7)

Bland-Altman	
Mean Difference	1.8
Std Dev.	26.8
Upper Limit	54.3
Lower Limit	-50.7
95% CI	(-10.4 - 14.0)

Figure 1:

Bland-Altman plots for anal pressures in lithotomy and left lateral positions show an acceptable level of agreement. Small mean differences between the two positions are noted with the line of agreement close to $y=0$, indicating near perfect agreement. Differences between measurements in the two positions fall within the 95% limits of agreement (i.e., clinically acceptable limits).

Figure 2:

Bland-Altman plots for rectal sensory values obtained in left lateral vs. lithotomy positions show that mean differences exceeded the 95% limits of agreement despite mean differences near $y=0$. Lithotomy position overestimates left lateral, as seen by the negative value of the mean difference.

Table 1:

Demographics

Age (mean±SD)	65.8±2.2
Race	
White	12 (57%)
Black	4 (19%)
Missing	5 (24%)
BMI (mean±SD)	29.7±1.6
Parity (median, range)	2 (0-5)
Fecal incontinence subtype	
Urge (n, %)	12 (57.0%)
Passive (n, %)	9 (43.0%)
POP-Q stage: anterior	
0	11 (52.4%)
1	3 (14.3%)
2	3 (14.3%)
3	4 (19.1%)
POP-Q stage: apical	
0	16 (76.2%)
1	2 (9.5%)
2	2 (9.5%)
3	1 (4.8%)
POP-Q stage: posterior	
0	16 (76.2%)
1	1 (4.8%)
2	4 (19.1%)
3	
Vaizey Score	
Mean (±SD)	9.2±5.8
Median (range)	9 (0-19)

Table 2:

Anorectal Manometry Values in Left Lateral vs. Lithotomy Position

Anorectal Manometry Values	Left Lateral (mean±SD)	Lithotomy (mean±SD)	P value
Mean anal resting pressure (mmHg)	53.4±3.6	52.5±3.6	0.8
Mean anal squeeze pressure (mmHg)	72.7±3.7	70.9±5.2	0.8
Volume at first sensation (cc)	35.3±4.9	42.75±6.4	0.1
Volume at normal urge sensation (cc)	59.1±6.9	64.1±7.8	0.3
Volume at strong urge sensation (cc)	89.5±7.5	100.0±8.6	0.1
Maximum tolerated volume capacity (cc)	130.0±9.6	135.8±10.8	0.3

Table 3:

Bland-Altman results for rectal sensory values obtained in left lateral vs. lithotomy positions

	Volume at first sensation (cc)	Volume at normal urge sensation (cc)	Volume at strong urge sensation (cc)	Maximum Tolerated Volume capacity (cc)
Mean Difference	-7.5	-5.0	-10.5	-5.8
Std Dev.	19.7	19.8	25.7	24.3
Upper Limit	31.1	33.9	39.9	41.9
Lower Limit	-46.1	-43.9	-60.9	-53.5
95% CI	(-16.7 - 1.7)	(-15.2 - 5.2)	(-22.9 - 1.9)	(-17.5 - 5.9)