Influence of Body Position on Anorectal Manometric Assessment in Functional Constipation

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Objective: *To date, there have been no studies to evaluate the influence of posture on anorectal manometric measurements in patients with functional constipation. The present study aimed to compare differences in anorectal manometric measurements in constipated patients when performing the test in the lying and sitting positions.*

Material and Method: *Anorectal manometry with a conventional solid state manometric catheter was performed in 30 constipated patients in both the lying and sitting positions. Anorectal manometric variables at rest and during attempted defecation with empty rectum were assessed in both positions. A colonic transit study using Sitzmarks radiopaque markers and a 50-mL water-filled balloon expulsion test was also performed in all patients. Patients exhibiting an abnormal manometric pattern of defecation in either the sitting or lying position proceeded to a simulated defecation test. The anorectal pressure parameters of resting and during attempted defecation of the both positions were compared.*

Results: *The resting rectal pressure, maximum rectal straining pressure, and defecation index during attempted defecation were significantly higher in the sitting position than the lying position. A dyssynergic manometric pattern during attempted defecation with empty rectum was seen in 46% of the patients in the lying position, not significantly different from the 56% in the seated position (p = 0.58). Most patients (71%) who exhibited manometric dyssynergia with an empty rectum could relax their anal sphincter during the simulated defecation test. Only six (20%) constipated patients had abnormal dyssynergic anal sphincter contraction confirmed by a simulated defecation test.*

Conclusion: *Body position affects the results of manometric measurements related to the defecation mechanism.*

Keywords: *Anorectal manometry, Functional constipation, Body position*

J Med Assoc Thai 2016; 99 (12): 1291-7
Full text. e-Journal: *http://www.jmatonline.com*

Dyssynergic defecation, a condition in which the pelvic floor muscles do not relax adequately or paradoxically contract during the act of defecation, is a major cause of laxative resistance constipation and affects about 20 to 75% of constipated patients in tertiary centers[1]. Anorectal manometry, a physiologic investigation can assess the pressure activity of the anorectum and provides comprehensive information regarding rectal sensation, rectoanal reflux, and anal sphincter function, is a well-accepted standard test to diagnose dyssynergic defecation[2]. For more details of the definition and clinical utility of each anorectal manometric parameters, readers should refer to the reference[3].

Anorectal manometry is normally performed with the patient in the left lateral position with flexed knees[4]. However, it has been reported that some asymptomatic subjects can show a manometric pattern of dyssynergic defecation when anorectal manometry is performed during attempted defecation in the lying position[5,6]. This posture may contribute to this false positive finding because the lying position is not the natural defecation position, which is usually done in a sitting or squatting position. Rao et al have demonstrated in healthy subjects that when the body position was changed from lying to sitting, the dyssynergic pattern observed during attempted defecation with an empty rectum significantly decreased from 36 to 20%[6]. Moreover, the measurements of anorectal motility parameters during the act of defecation were significantly different between the two body positions[6]. This evidence suggests that body position can influence anorectal manometric results. Whether body position influences the results of anorectal manometry in patients with constipation is an interesting question and should be given further consideration. To date, there have been no studies to explore this question. The objective of the present study was to examine differences in anorectal manometric measurements in constipated patients, particularly comparing measurement taken in the lying position with the sitting position.

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Material and Method

The study was conducted in 30 patients with constipation according to the Rome III criteria who did not respond to treatment with laxatives. Colorectal structural diseases and hypothyroidism were screened by colonoscopy and thyroid function test in all patients. Patients who had underlying intestinal diseases, metabolic diseases that could cause constipation, neuromuscular diseases, or taking medication known to cause constipation, were also excluded. All patients underwent the colonic transit study (Sitzmarks Radiopaque Markers, Konsyl Pharmaceutical Inc., Fort Worth, TX, USA), balloon expulsion test, and anorectal manometry. Abnormal colonic transit was diagnosed when the abdominal X-ray on the fifth day after ingestion of a Sitzmarker capsule showed more than four markers (20%) retained in the colon[7].

Balloon expulsion test (BET)

The BET test was performed with the patients in the seated position. A 4-cm-long latex balloon was mounted on the tip of a nasogastric tube and placed in the rectum of the patients while in a lying position. The rectal balloon was filled with 50 mL of warm water. The patients were then asked to sit on a commode in a private room and to expel the rectal balloon as if they were evacuating stool. The BET was considered failed if the patients could not expel the 50-mL water-filled balloon within three minutes[8].

Anorectal manometry

Anorectal manometry was performed using a 10 F-diameter solid state manometric probe (Unisensor AG, Attikon, Switzerland) containing four strain-gauge transducers with a 4-cm-long latex balloon fixed at the tip and a central lumen for balloon inflation. The most distal transducer was designed for recording rectal pressure and the remaining three transducers, oriented radially and 1 cm apart, were designed for recording anal pressure. The distance between the rectal transducer to the most proximal anal transducer was 5 cm. A commercial software program (Polygram NET™, Medtronic, Skovlunde, Denmark) was used to display and interpret the manometric data. With the patient lying in the left lateral position with knee flexed, a station pull-through technique withdrawn at increments of 1 cm was used to identify high pressure zones in the anal canal. The manometric probe was then taped with the patients in place such that the three anal pressure sensors were located in the anal canal and the most proximal sensor was at 1 cm from the anal verge. All patients underwent anorectal manometry to evaluate defecation dynamics and a rectal sensation test in both the left lateral position with knee flexed and the seated position in random order.

Rectal sensation was examined by inflating the rectal balloon with a hand-held syringe at a starting volume of 10 mL, which was increased to 20, 30, 40, and 60 mL, and then increased by 20 mL increments until the sensation of urgency to defecate was reached. Each inflation was maintained for one minute. After deflation, a rest period of two minutes was allowed before re-inflating the balloon[5]. During this test, the patient was blinded to the volume of air inflation, and asked to grade the perceived sensation as follows: first sensation, desire to defecate, and urge to defecate. Assessment of defecation dynamics was performed by asking the patients to bear down with an empty rectum as if to defecate for three separate attempts. Each attempt lasted 10 seconds with a longer than two minutes rest between attempts. The manometric data recorded from each patient included: maximum anal resting pressure (the mean of the three highest values observed at any site in the anal canal), resting rectal pressure, and rectoanal pressures during bearing down including maximum rectal straining pressure, percent anal relaxation (anal relaxation pressure/anal resting pressure x100), and defecation index (DI, maximum rectal pressure when straining/minimal anal residual pressure when straining). The mean value of rectoanal pressure recorded during three attempts of bearing down were used as representative data.

In the present study, an abnormal pattern of defecation was defined according to the criteria reported by Bharucha et al, namely, functional defecation disorder (FDD), dyssynergic defecation, and inadequate defecatory propulsion (Appendix)[9]. A patient was considered to have abnormal defecation when at least 2/3 manometric studies during successive straining showed the same abnormal patterns. Patients who had an dyssynergic manometric pattern of defecation with an empty rectum either in the sitting or lying in left lateral position proceeded to simulated defecation test, a recommended confirmatory test for dyssynergic defecation[3,4]. This test was to ask the patients sit on a commode with anorectal manometric recording and 60 mL of air or more was introduced into the rectal balloon to evoke a desire to defecate, then the patients were asked to bear down as if to defecate. This maneuver naturally allows the patients to simulate defecation in a more physiologically natural condition.

Rao et al have demonstrated in healthy subjects that the false positive dyssynergic manometric pattern when performing the study in the lying position with empty rectum was significantly reduced from 36% to only 8% by this test[6]. Again, this group of patients were asked to bear down with distended rectum in the seated position for 3 attempts.

Statistical analysis

Data were analyzed using SPSS, Version 14.0 (SPSS, Chicago, IL, USA). The manometric data were expressed as mean ± SD. The measured anorectal manometric variables at rest and during attempted defecation with empty rectum in the lying position and sitting position were compared by paired t-test. McNemar Chi-square test (2-sided) was used to assess differences in the patterns of defecation between the lying and seated positions. Differences were considered statistically significant at $p<0.05$.

The Ethical Committee of the Faculty of Medicine, Prince of Songkla University, approved the present study. All patients were fully informed of the nature of the studies and gave written informed consent before enrollment.

Results

Of the 30 constipated patient, 28 patients (93.3%) were female. The mean age of the patients and the mean duration of constipation were 42.4±13.6 years (range 16 to 64 years) and 102.4±88.5 months (range 12 to 360 months), respectively. Ten patients (35.7%) were unable to expel a 50-mL water-filled balloon. Eight patients (32%) had an abnormal colonic transit study and three patients (10%) failed both the balloon expulsion test and the abnormal colonic transit study.

Anorectal manometric parameters in lying vs. sitting position

In a resting condition, the mean rectal pressure was significantly higher in the sitting position, whereas the mean maximum anal resting pressure and rectal sensory threshold were comparable between the two positions (Table 1). When the patients were asked to bear down with an empty rectum, significant increases in the maximum rectal straining pressure and DI were observed in the seated position. The number of patients who had DI greater than 1.2 significantly increased from 10 patients (33.3%) in the lying position to 21 patients (70%) in the sitting position ($p = 0.003$). However, posture did not have any effect on the percent of anal sphincter relaxation, which were comparable between the two positions (Table 1) and the number of patients who showed anal sphincter relaxation less than 20% was not significantly different between the lying and sitting positions (43.3% vs. 56.7%, $p = 0.38$).

Pattern of defecation in the lying vs. seated position

Table 2 showed the patterns of defecation of the 30 constipated patients classified according to Barucha et al. No statistical significance in the diagnosis of defecation disorder between the lying and seated position was observed. When the 21 patients who showed a dyssynergic manometric pattern with an empty rectum either in the lying or sitting were asked to bear down with a rectal balloon in the sitting position (simulated defecation test), most patients (15/21, 71.4%) could relax their anal sphincter. Only six (20%) constipated patients in our series had abnormal dyssynergic anal sphincter contraction confirmed by a simulated defecation test. In this group, four (13.3%) were FDD and two (6.7%) were dyssynergic defecation. Fig. 1 demonstrated an

Table 1. Anorectal manometric measurements with empty rectum in lying and sitting position (n = 30)

	Lying	Sitting	*p*-value*
Resting (mmHg), mean ± SD			
Rectal pressure	15.3±21.0	27.6±7.3	0.008
Maximum anal resting pressure	66.9±19.1	66.7±23.3	0.92
Threshold volumes (ml)			
- First sensation	35.8±29.5	41.7±33.8	0.11
- Defecation sensation	58.4±33.4	63.8±41.2	0.26
- Intolerance sensation	97.1±44.1	99.3±52.1	0.66
Straining with empty rectum (mmHg), mean ± SD			
Maximum rectal pressure	55.8±24.5	84.2±29.9	<0.001
% anal sphincter relaxation	23.0±18.2	20.2±21.3	0.43
Defecation index	1.2±0.9	1.6±1.0	0.01

* Paired t-test

Table 2. Comparison of defecation patterns according to body position (n = 30)

Defecation pattern	Lying (empty rectum)	Sitting (empty rectum)	*p*-value*
Normal, n (%)	16 (53.3)	13 (43.3)	
Abnormal, n (%)	14 (46.7)	17 (56.7)	0.58
FDD	9 (30.0)	7 (23.3)	0.67
Dyssynergic defecation	5 (16.7)	10 (33.3)	0.12
Inadequate defecatory propulsion	0	0	0

FDD = functional defecation disorder
* McNemar Chi-square test (2-sided)

example of anorectal manometric tracing of a patient in the present study.

Discussion

Information concerning the influence of body position on anorectal manometric studies for evaluation of defecation dynamics is very limited. To date, there has been only a report by Rao et al who evaluated the influence of body position in healthy subjects and there have been no studies in patients with chronic constipation[6]. Our study reported herein therefore gave more information about the use of anorectal manometry to evaluate the defecation mechanism of patients with chronic constipation when tested in different body positions.

We found that the resting rectal pressure, maximum rectal straining pressure, and DI were significantly higher in the sitting position, whereas the maximum anal resting pressure, percentage of anal relaxation, and rectal sensation threshold were comparable between the two positions. The results observed in the present study were mostly similar to those of Rao et al in healthy subjects, except the finding of anal resting pressure which Rao et al reported to be higher in the sitting position[6]. To date, there have been two studies reporting contradicting results about the influence of body position on the anal canal pressure[10,11]. Yoshioka and Keighley, in an anorectal manometric study comparing patients with chronic constipation and with fecal incontinence, and normal subjects, reported comparable values of the maximum anal resting pressures between the left lateral and sitting positions[10]. However, in contrast, Thekkinkattil et al found that patients with fecal incontinence had a higher maximum anal resting pressure when anorectal manometric measurements were done in the sitting position[11]. The disagreements between the two studies may be explained by different definitions used in these studies and different study populations.

We found that the prevalence of a dyssynergic pattern of defecation detected by anorectal manometry were not significantly different when asking the patients to bear down with an empty rectum in the sitting and lying position, although the prevalence was higher in the sitting position (sitting 56.7% vs. lying 46.7%, $p = 0.58$) (Table 2). Our finding is contrary to the study in healthy volunteers by Rao et al who demonstrated that the prevalence of dyssynergia was

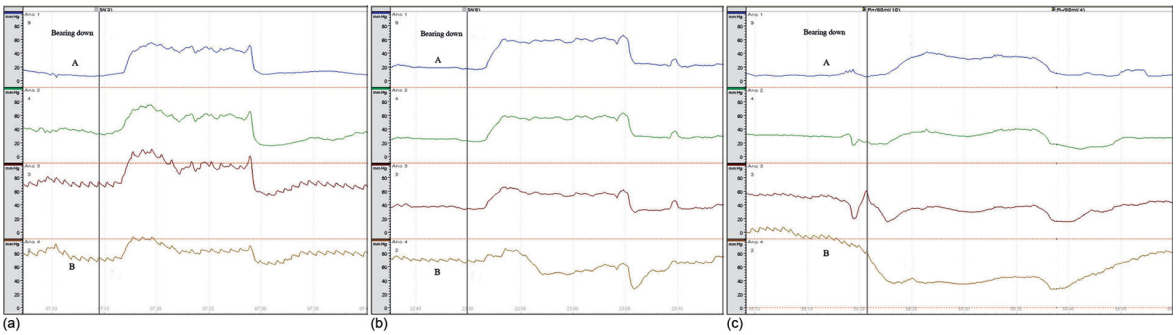

Fig. 1 Paradoxical contraction of anal sphincter during bearing down with an empty rectum (a dyssynergic manometric pattern) in the lying position (a). Of the same patient, normal anal sphincter relaxation is shown during bearing down with an empty rectum (b) and distended rectum with a rectal balloon (a simulated defecation test) (c) in the sitting position (A = rectal pressure; B = anal sphincter pressure).

significantly lower when the subjects attempted to defecate with an empty rectum in the sitting position (sitting 20% vs. lying 36%, $p<0.05$)[6]. The influence of body position on the prevalence of manometric dyssynergic pattern was not observed in our study, may be explained by the type II error due to the small number of study population and the subjects in our study were constipated patients, some of them already had underlying abnormal defecation dynamics that could obscure the influence of body position on anorectal manometric assessment when bearing down with an empty rectum. The latter explanation was supported by the finding that among the six patients who had a definite dyssynergic defecation confirmed by a simulated defecation test, five of them showed a dyssynergic manometric pattern with an empty rectum in both the sitting and lying position.

Previously, dyssynergic defecation has been reported as varying between 20% and 75% in patients with chronic constipation[1]. We believe that these figures may be an overestimation because these studies evaluated defecation dynamics of the patients in the left lying lateral position while attempting defecation with an empty rectum. The present study found that many patients who showed a dyssynergic defecation pattern during anorectal manometric recording with this position and an empty rectum had a normal manometric study when reevaluated with the simulated defecation test. An abnormality in defecation dynamics was evident by this confirmatory test in only six patients (20%), significantly different when compared with bearing down with an empty rectum in the lying position (46.7% vs. 20%, $p = 0.02$) and with an empty rectum in the sitting position (56.7% vs. 20%, $p = 0.001$).

Recently, high resolution and 3-D high definition anorectal manometry have been developed, which provide more detailed studies of anorectal function and have been increasingly investigated for their clinical utility. However, we did not use these new techniques in our study because they were not available in our institute during the study period. To date, there been no data concerning the use of high resolution/3-D high definition anorectal manometry for evaluating the influence of body position on anorectal manometric assessment in constipated patients such as our study. Whether the results of studies using these new techniques will be similar to our study is an interesting question. Previous comparative studies have shown a good correlation in anorectal pressure data between conventional water-perfused anorectal manometry and high resolution and 3-D high definition anorectal manometry[12-14]. Interestingly, the number of patients who had dyssynergic manometric patterns detected by the two techniques were comparable[13,14]. Based on these facts, we expect that the results of a study using high resolution anorectal manometry to evaluate the influence of body position on anorectal manometric assessment of constipated patient would be similar to the present study. However, this hypothesis should be confirmed by further studies.

In conclusion, the results of the present study suggest that when anorectal function is evaluated in a resting condition, conventional anorectal manometry with a solid-state catheter can be performed either in the lying or sitting position because no significant differences in manometric variables between the two positions were observed. In addition, during attempted defecation with an empty rectum, the prevalence of dyssynergic manometric patterns were comparable between the two positions, however, the DI and maximum rectal straining pressure were significantly higher in the seated position. A simulated defecation test should be performed in patients exhibiting manometric dyssynergia during straining with an empty rectum to eliminate false positives due to laboratory artifacts, as found in the present study that most patients could relax their anal sphincter during this test.

What is already known on this topic?

Anorectal manometry is a standard test for the diagnosis of defecation dyssynergia. In healthy subjects, the body position influences anorectal manometric measurements and false positive dyssynergic manometric pattern recorded during attempted defecation with empty rectum in lying position is significantly reduced when measurements are taken in the sitting position. There have been no studies to evaluate the influence of posture on anorectal manometric assessment in constipated patients.

What this study adds?

1. In patients with functional constipation, the body position affects the results of manometric measurements related to the defecation mechanism.

2. The prevalence of a dyssynergic manometric pattern during attempted defecation with an empty rectum are comparable between the two positions, however, most patients exhibiting a dyssynergic defecation pattern during attempted defecation with

empty a rectum showed normal defecation dynamics when given a simulated defecation test.

Acknowledgements

The present study was supported by the Institutional Grant from the Faculty of Medicine, Prince of Songkla University. The authors would like to thank Mrs. Areerak Peutpaiboon for her excellent assistance and advice with statistical and data analysis.

Potential conflicts of interest

None.

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Appendix.

Diagnostic criteria for functional defecation disorders

1. The patient must satisfy diagnostic criteria for functional constipation
2. During repeated attempts to defecate must have at least 2 of the following:
   a. Evidence of impaired evacuation, based on balloon expulsion test or imaging
   b. Inappropriate contraction of the pelvic floor muscles (i.e., anal sphincter or puborectalis) or less than 20% relaxation of basal resting sphincter pressure by manometry, imaging, or EMG
   c. Inadequate propulsive forces assessed by manometry (intrarectal pressure <45 mmHg) or imaging

Diagnostic criteria for dyssynergic defecation

Inappropriate contraction of the pelvic floor or less than 20% relaxation of basal resting sphincter pressure with adequate propulsive forces (intrarectal pressure ≥45 mmHg) during attempted defecation

Diagnostic criteria for inadequate defecatory propulsion

Inadequate propulsive forces (intrarectal pressure <45 mmHg) with or without inappropriate contraction or less than 20% relaxation of the anal sphincter during attempted defecation

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อิทธิพลของท่าตรวจต่อผลตรวจ anorectal manometry ในผู้ป่วยท้องผูกไร้โรคทางกาย

เสกสิต โอสถากุล, โสภา บุญวิริยะ, ศุลี แสงนิล, บัญชา โอวาทพารพร

วัตถุประสงค์: *ในปัจจุบันยังไม่มีการศึกษาเพื่อประเมินอิทธิพลของท่าตรวจต่อผลตรวจ anorectal manometry ในผู้ป่วยท้องผูกไร้โรคทางกาย การศึกษานี้ต้องการเปรียบเทียบผลตรวจ anorectal manometry ระหว่างท่านอนและท่านั่งในผู้ป่วยท้องผูกไร้โรคทางกาย*

วัสดุและวิธีการ: *ผู้ป่วยท้องผูกไร้โรคทางกาย 30 ราย ได้รับการตรวจประเมินกลไกการขับถ่ายอุจจาระโดยวิธี anorectal manometry ด้วยเทคนิคการใช้สาย solid state ในท่านอนตะแคงซ้ายชันเข่า 2 ข้าง 90 องศา และท่านั่ง ผู้ป่วยทุกรายได้รับการตรวจ balloon expulsion test เพื่อทดสอบความสามารถในการเบ่งขับถ่ายอุจจาระ และตรวจ colonic transit โดยการกลืนแคปซูล Sitzmarks เปรียบเทียบผลตรวจ anorectal manometry จากการตรวจใน 2 ท่า ทั้งในระยะพักและเมื่อเบ่งถ่ายอุจจาระในขณะไส้ตรงว่างเปล่า ผู้ป่วยที่ผลตรวจ anorectal manometry บ่งบอกถึงกลไกการขับถ่ายผิดปกติไม่ว่าจากการตรวจในท่านอนหรือท่านั่งในขณะไส้ตรงว่างเปล่า จะได้รับการตรวจทดสอบ simulated defecation test เพิ่มเติมเพื่อยืนยันกลไกการขับถ่ายที่ผิดปกติ*

ผลการศึกษา: *ค่าเฉลี่ย resting rectal pressure, maximum rectal straining pressure และ defecation index จากการตรวจ anorectal manometry ในท่านั่งมีค่าสูงกว่าท่านอนอย่างมีนัยสำคัญทางสถิติ พบกลไกการถ่ายผิดปกติเมื่อเบ่งถ่ายอุจจาระในขณะไส้ตรงว่างเปล่าในผู้ป่วยร้อยละ 46 เมื่อตรวจในท่านอนซึ่งไม่แตกต่างอย่างมีนัยสำคัญกับร้อยละ 56 เมื่อตรวจในท่านั่ง (p = 0.58) ผู้ป่วยร้อยละ 71 ที่พบกลไกการขับถ่ายอุจจาระผิดปกติจากการตรวจ anorectal manometry เมื่อเบ่งถ่ายในขณะไส้ตรงว่างเปล่า ไม่พบกลไกการขับถ่ายผิดปกติเมื่อตรวจยืนยันด้วยวิธี simulated defecation test พบผู้ป่วยเพียง 6 ราย (ร้อยละ 20) ที่มีความผิดปกติในกลไกการขับถ่ายเมื่อยืนยันด้วยวิธีตรวจดังกล่าว*

สรุป: *ท่าตรวจมีผลต่อตัวแปรที่เกี่ยวข้องกับกลไกการขับถ่ายในการตรวจ anorectal manometry*
