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Can Puborectalis Muscle and Abdominal Subcutaneous Adipose Tissue Thickness Indicate Dyssynergic Defecation?

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Abstract: Chronic constipation (CC) is a common issue in primary care and gastroenterology. Defined variably by patients and clinicians, CC per Rome III criteria requires symptoms for six months, present three or more days per month for three months. Dyssynergic defecation (DD), a functional constipation type, involves the failure of pelvic floor muscles to relax during defecation. This study examines the relationship between DD, puborectalis muscle thickness, and subcutaneous adipose tissue thickness via MR defecography. After ethical approval, MR defecography images of 110 patients from Ankara Bilkent City Hospital were analyzed retrospectively. Exclusions included pelvic floor descensus, rectal mass, cystocele, rectocele, or movement artifacts. The study comprised 52 DD patients and 52 matched controls. Measurements of subcutaneous adipose tissue at L5-S1 and puborectalis muscle thickness were performed on T2-weighted images. DD patients had significantly higher abdominal subcutaneous adipose tissue and puborectalis muscle thickness than controls (p=0.021, p=0.001). No significant gender differences were noted. ROC analysis revealed cut-off values of 23 mm for adipose tissue and 4.8 mm for puborectalis muscle thickness. Positive predictive values for DD were 62% for adipose tissue >23 mm, 74% for puborectalis muscle thickness>4.8 mm, and 90% for both criteria. MR defecography is essential for diagnosing DD. This study is the first to investigate the link between DD and puborectalis muscle thickness. Increased abdominal subcutaneous adipose tissue suggests a connection between DD and obesity, possibly due to increased intra-abdominal pressure leading to higher puborectalis muscle tone. Puborectalis muscle thickness>4.8 mm and abdominal subcutaneous adipose tissue thickness>23 mm are key parameters for diagnosing DD in MR defecography. These findings underscore the importance of MR defecography in diagnosing and understanding DD, leading to more precise and individualized treatments. ©2024 NTMS.

Keywords: Puborectalis; Pelvic Floor; Defecation; Constipation; Adipose.

1. Introduction

Chronic constipation (CC) is among the most common issues in clinical practice [1]. The definition of constipation varies between patients and clinicians. To address this, an international committee has developed comprehensive criteria for the diagnosis of functional bowel dysfunction. It has been reported that to qualify

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as CC according to Rome III criteria, symptoms must have started six months prior to the aadministration and have been present for three or more days per month for three months [2]. Constipation can be divided into two main types: functional and structural. Functional constipation includes conditions such as slow transit constipation, evacuation disorders and irritable bowel syndrome with constipation. Dyssynergic defecation (DD) is a specific type of defecation disorder [3]. In 1985, Preston and Lennard-Jones identified symptoms in some constipated patients associated with a failure of the pelvic floor muscles to relax, resulting in a sustained contraction of the external anal sphincter during defecation, known as 'anismus' [4]. Over time, this condition has been referred to by various names, including anal sphincter dyssynergia, pelvic floor dyssynergia, paradoxical pelvic floor contraction and obstructive defecation.

Dyssynergic defecation is obstructive defecation due to asynchronous function of puborectalis muscle. Rectal pressure increases during straining, but at the same time pressure in the anal canal increases due to paradoxical contractions of the external anal sphincter, but faeces cannot be evacuated. Although the etiology of this disease is unknown, psychogenic factors, incorrect bowel habits and obesity have been implicated[5]. The initial step in diagnosing dyssynergic defecation (DD) is to rule out any underlying abnormalities. It is essential to remember that CC can result from insufficient fiber and fluid intake, lack of physical activity, colon cancer, medications, and various metabolic, neurological, or structural conditions. There is no one gold standard method for the diagnosis of DD. Anorectal manometry and magnetic resonance (MR) defecography are the most common modalities used to diagnose DD. However, because anorectal manometry is an invasive method, MR defecography has recently become increasingly important for diagnosis. MR defecography enables the simultaneous assessment of pelvic floor with dynamicly, and rectal evacuation. It delivers high-resolution images of pelvic floor muscles, anal sphincters and surrounding soft tissues, all without radiation. However, variations in methodology and poor interobserver agreement have limited its overall effectiveness [6].

We aim to determine the relationship between DD and puborectalis muscle thickness and subcutaneous adipose tissue thickness and whether they would be supportive parameters for diagnosing DD in MR defecography.

2. Material and Methods

2.1. Study Design

After ethics committee approval was obtained, the images of 110 patients who underwent MR defecography with a prediagnosis of constipation between March 2019 and October 2023 in the radiology clinic of Ankara Bilkent City Hospital and whose abnormalities were described in the report were retrospectively analyzed (Ethical committee number: E1-2022-2408). Nineteen patients had pelvic floor descensus, five patients had rectal mass, fifteen patients had prominent cystocele and thirteen patients had prominent rectocele were excluded from the study. Also, six patients were excluded due to intense movement artifacts. The study included fifty-two patients whose MR defecography findings were compatible with DD. Age and gender paired 52 patients who underwent MR defecography between the same dates but did not have any abnormality were selected as the control group.

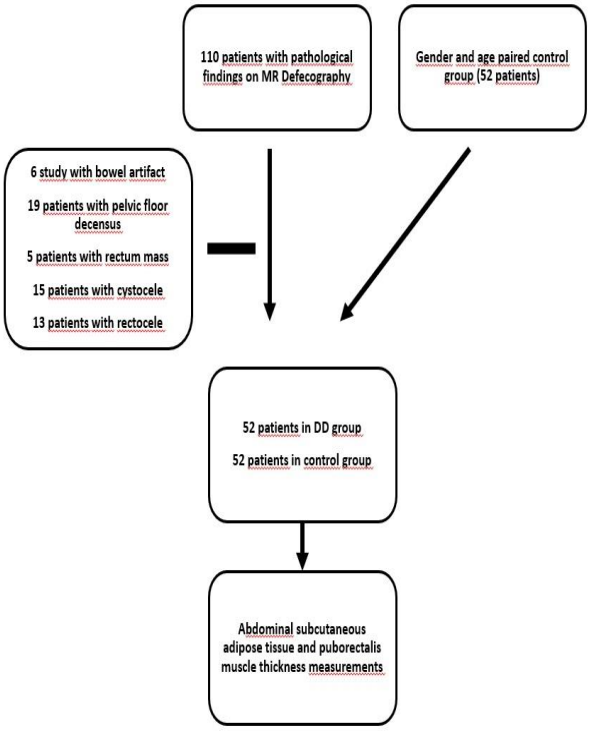

Figure 1: Flowchart of the study.

2.2. Image Acquisition

MR defecography was performed on a 1.5-T MR machine (Optima; GE Medical System, Milwaukee, Wisconsin, USA) using phased-array coils, with the patient in the supine position and knees slightly elevated on a pillow. For anatomical assessment, T2-weighted fast spin-echo images were acquired in the sagittal, axial and coronal planes at rest. Functional imaging was then performed using steady-state precession cine-type true fast imaging with steady-state precession (TrueFISP) or single-shot fast spin-echo (SSFSE) sequences in the midsagittal plane during the squeeze, stretch and defecation phases [7,8].

2.3. Image Evaluation

MR defecography images of 52 patients diagnosed with dyssynergic defecation were evaluated. To avoid measurement bias, images were anonymized and randomized prior to evaluation. Measurements were conducted by a radiologist (D.A.) with five years of experience in abdominal radiology. In both groups, the subcutaneous adipose tissue thickness at the L5-S1 intervertebral disc level was measured on T2-weighted

sagittal images. On T2-weighted axial images, the thickness of both puborectalis muscles was measured, and the mean of these measurements was recorded as "mean puborectalis muscle thickness.".

2.3. Statistical Methods

The data were processed utilizing IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA). Descriptive statistics were expressed in terms of number of units (n), Mean±Standard Deviation, median (M), minimum (min), and maximum (max) values. The Shapiro-Wilk test was employed to evaluate the normality of numerical variable distributions. The Mann-Whitney U test facilitated comparisons between two categorical groups. Linear regression analysis was conducted to assess the influence of independent variables. The ROC curve analysis method was used to compare the diagnostic performance of multiple diagnostic or measurement values. The relationship between two independent categorical variables and one dependent continuous variable was analyzed using two-way analysis of variance. Pearson and Fisher exact tests were applied for comparisons of categorical variables. A p-value of less than 0.05 was considered statistically significant.

3. Results

There were 31 male and 21 female patients in either DD group and control group. The mean age in DD group was 44.92±13.3 years and in control group 42.04±12.1 years (p>0.05) (Table 1).

Table 1: Gender and age comparison of DD group and control group.

	Groups		Test Statistics
	DD group (*n*=52)	Control group (*n*=52)	*P* value
Gender, *n* (%)			
Male	21 (%40.3)	21 (%40.3)	
Female	31 (%59.7)	31 (%59.7)	>0.999
Age			
Mean±SD			
Median	44.92±13.3	42.04±12.1	>0.999
(min-max)(mm)	44 (18-73)	43 (19-70)	

Abdominal subcutaneous adipose tissue and mean puborectalis muscle thickness were significantly higher in the DD group compared to the control group (p=0.021, p=0.001) (Table 2) (Figure 2,3). There was no significant difference in abdominal subcutaneous adipose tissue and mean puborectalis muscle thickness between genders in both groups (p>0.05).

The cut-off value for abdominal subcutaneous adipose tissue thickness was 23 mm and for mean puborectalis muscle thickness 4.8 mm in ROC analysis (p<0.05). The positive predictive value for dyssynergic defecation (DD) was 62% in patients with an abdominal subcutaneous adipose tissue thickness greater than 23 mm. In patients with mean puborectalis muscle thickness greater than 4.8 mm, the positive predictive value for DD was 74%. Notably, in patients with both abdominal subcutaneous adipose tissue thickness greater than 23 mm and puborectalis muscle thickness greater than 4.8 mm, the positive predictive value increased significantly to 90%.

4. Discussion

Several findings on MR defecography have been described for the diagnosis of DD, with varying specificity and accuracy[9]. Halligan et al. demonstrated that the most common finding in patients with DD was impaired evacuation. However, they observed that impaired evacuation has low specificity and a low positive predictive value for diagnosing DD [10]. Levator ani muscle forms the primary muscular support for the pelvic floor, with the puborectalis muscle being a component of it. During defecation, the external sphincter and pelvic floor muscles relax, which enlarges the hiatus and the anorectal angle (ARA), thereby aiding the defecation process [11]. In DD, puborectalis muscle does not relax during defecation, resulting in a smaller increase or even decrease in the ARA visible on MR defecography [12]. A study of dynamic MR imaging in pediatric patients with DD found significant differences in ARA during straining and ARA change during straining between patients with DD and control group. However, they noted that abnormal ARA changes alone are not reliable for diagnosing dyssynergic defecation, as they are seen in only 50% of patients with dyssynergic defecation [13]. Also narrowing of the anorectal junction as a result of paradoxical contraction of puborectalis muscle is another finding supporting DD and is described as "sandglass-like" appearance in the literatüre [12]. Studies have yielded inconsistent findings on the occurrence of paradoxical sphincter contraction in patients with dyssynergic defecation. Reiner et al. identified a significant correlation between paradoxical sphincter contraction during straining and decreased rectal evacuation. Conversely, another study detected paradoxical sphincter contraction in both controls and patients with chronic constipation, indicating that this phenomenon is not exclusive to DD [14, 15].

Although there is no agreement on the diagnostic value of measuring the anal canal diameter using MR defecography for DD, some studies suggest that a diameter of less than 15 mm during defecation could be indicative of an incompletely relaxed anal sphincter [16, 17]. As reported in the literature, the variable sensitivity

and specificity of MR defecography findings in the diagnosis of DD remains a challenge.

To our knowledge, our study is the first to highlight the relationship between DD and puborectalis muscle thickness. Unlike other causes of chronic constipation, the primary issue in patients with DD is the excessive and paradoxical contraction of puborectalis muscle [5, 18]. Due to this, we believe that hypertrophy of puborectalis muscle, which is a voluntary muscle, develops in patients with DD.

Table 2: Comparison of abdominal subcutaneous adipose tissue and mean puborectalis muscle thickness of DD group and control group.

	Groups		Test Statistics
	DD group (*n*=52)	Control group (*n*=52)	*p* value
Abdominal subcutaneous adipose tissue thickness			
Mean±SD(mm)	30.92±12.1	21 (%40.3)	
Median(*min-max*)(mm)	31.2 (15.2-45.3)	31 (%59.7)	
			p=0.021
Mean puborectalis muscle thickness *Mean±SD(mm)*	4.90±1.55	3.84±0.932	
Median(*min-max*)(mm)	4.4 (3.38-6.68)	3.6 (2.67-4.55)	p=0.001

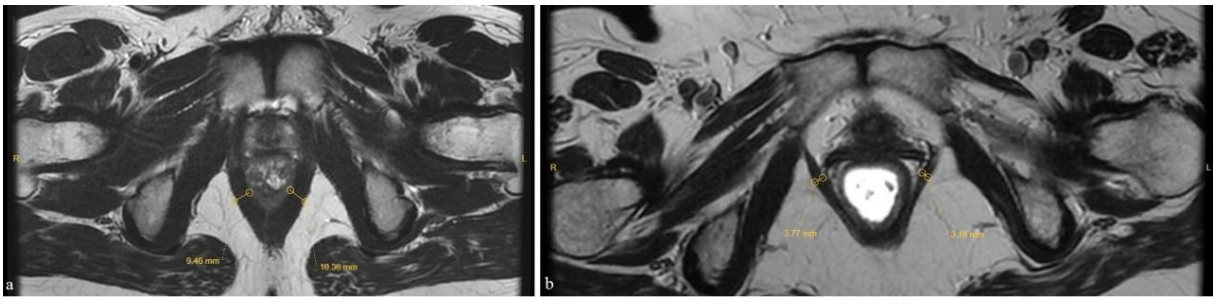

Figure 2: Mean puborectalis muscle thickness in DD group and control group (a: DD group, b: Control group).

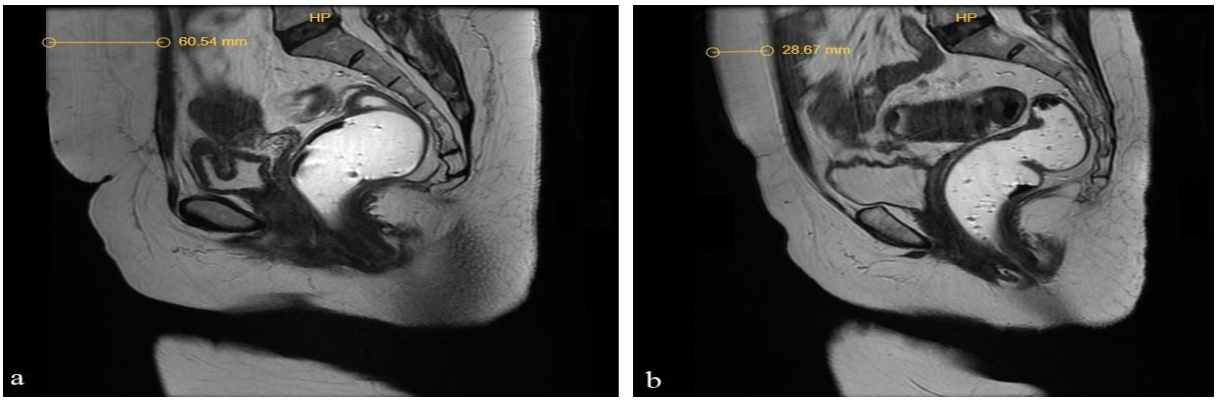

Figure 3: Abdominal subcutaneous adipose tissue thickness in DD group and control group (a: DD group, b: Control group).

Another result of our study was that abdominal subcutaneous adipose tissue thickness was higher in patients with DD. The relationship between obesity and pelvic organ disorders-prolapse (POD) remains uncertain and requires further research. While most studies suggest an association between obesity and POD, some don't show a statistically significant difference. In a study of 16.608 women, Kudish et al found that POD progression was correlated with increasing body weight. Similarly, in Wasserberg's study of 358 morbidly obese women, over 90% had pelvic floor disorders, and 50% reported that these symptoms affected their quality of life [19–21]. Although there are studies in the literature linking obesity to pelvic organ disorders, no study has investigated the relationship between obesity and DD. In our study, we observed that patients with DD had a greater thickness of abdominal subcutaneous adipose tissue, suggesting

a possible association between DD and obesity. We hypothesize that the increased abdominal subcutaneous adipose tissue leads to a continuous increase in intra-abdominal pressure, resulting in a higher tone of the puborectalis muscle to maintain continence. We also believe that the puborectalis muscle is thicker in these patients due to the increased tone. However, further studies are needed to support these hypotheses.

This study has several limitations. The relatively small number of patients and the retrospective nature of the study limit the accuracy of our results. In addition, the fact that the measurements were performed by a single radiologist may have led to measurement errors. In order to prevent this, measurements were performed after the patient images were anonymized and randomized.

5. Conclusion

In conclusion, mean puborectalis muscle thickness greater than 4.8 mm and abdominal subcutaneous adipose tissue thickness greater than 23 mm in patients with suspected DD support the diagnosis of DD.

Limitations of the Study

This study has some limitations. The relatively small number of patients and the retrospective nature of the study limit the accuracy of our results. In addition, the fact that the measurements were performed by a single radiologist may have led to measurement errors. In order to prevent this, measurements were performed after the patient images were anonymized and randomized.

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Conflict of Interests

The authors declare that there is no conflict of interest and this study was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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Author Contributions

Eren Çamur: Materials, Analysis and /or Interpretation, Literature Review, Writing, Critical Review.

Dilek Acar: Conception, Design, Supervision, Data Colletion and/or Processing.

Ethical Approval

The study was approved by Ankara City Hospital, Ethics Committee 1 with approval number E1-2022-2408.

Data sharing statement

All data underlying the results are available as part of the article and no additional source data are required.

Consent to participate

No consent to participate is required for this study.

Informed Statement

No informed statement is required for this sutdy.

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