ORIGINAL CONTRIBUTION

Prospective Multicenter Trial Comparing Echodefecography With Defecography in the Assessment of Anorectal Dysfunction in Patients With Obstructed Defecation

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BACKGROUND: Defecography is the gold standard for assessing functional anorectal disorders but is limited by the need for a specific radiologic environment, exposure of patients to radiation, and inability to show all anatomic structures involved in defecation. Echodefecography is a 3-dimensional dynamic ultrasound technique developed to overcome these limitations.

OBJECTIVE: This study was designed to validate the effectiveness of echodefecography compared with defecography in the assessment of anorectal dysfunctions related to obstructed defecation.

DESIGN: Multicenter, prospective observational study.

PATIENTS: Women with symptoms of obstructed defecation.

SETTING: Six centers for colorectal surgery (3 in Brazil, 1 in Texas, 1 in Florida, and 1 in Venezuela).

INTERVENTIONS: Defecography was performed after inserting 150 mL of barium paste in the rectum. Echodefecography was performed with a 2050 endoprobe through 3 automatic scans.

MAIN OUTCOME MEASURES: The κ statistic was used to assess agreement between echodefecography and defecography in the evaluation of rectocele, intussusception, anismus, and grade III enterocele.

RESULTS: Eighty-six women were evaluated: median Wexner constipation score, 13.4 (range, 6–23); median age, 53.4 (range, 26–77) years. Rectocele was identified with substantial agreement between the 2 methods (defecography, 80 patients; echodefecography, 76 patients; $\kappa = 0.61$; 95% CI = 0.48–0.73). The 2 techniques demonstrated identical findings in 6 patients without rectocele, and in 9 patients with grade I, 29 with grade II, and 19 patients with grade III rectoceles. Defecography identified rectal intussusception in 42 patients, with echodefecography identifying 37 of these cases, plus 4 additional cases, yielding substantial agreement ($\kappa = 0.79$; 95% CI = 0.57–1.0). Intussusception was associated with rectocele in 28 patients for both methods ($\kappa = 0.62$; 95% CI = 0.41–0.83). There was substantial agreement for anismus ($\kappa = 0.61$; 95% CI = 0.40–0.81) and for rectocele combined with anismus ($\kappa = 0.61$; 95% CI = 0.40–0.82).

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Agreement for grade III enterocele was classified as almost perfect ($\kappa = 0.87$; 95% CI = 0.66–1.0).

LIMITATIONS: Echodefecography had limited use in identification of grade I and II enteroceles because of the type of probe used.

CONCLUSIONS: Echodefecography may be used to assess patients with obstructed defecation, as it is able to detect the same anorectal dysfunctions found by defecography. It is minimally invasive and well tolerated, avoids exposure to radiation, and clearly demonstrates all the anatomic structures involved in defecation.

KEY WORDS: Ultrasonography; Defecography; Obstructed defecation; Rectocele; Anismus; Rectal intussusception.

Defecography has been used as the gold standard technique in assessing functional anorectal disorders.[1–8] However, defecography must be performed in a specific radiologic environment, exposes patients to radiation, and does not demonstrate all the anatomic structures involved in defecation. Additionally, conventional defecography is poorly tolerated by elderly patients, especially during extended exams. Techniques using dynamic anorectal ultrasonography (DAUS) using transperineal,[9,10] endorectal 2-dimensional endoprobe,[11] or transrectal approaches filling the rectal lumen with water[12] have been used to assess patients with obstructed defecation. However, such dynamic evaluations afford only longitudinal viewing of the entire pelvis and anorectal segment.

To be able to identify anorectal dysfunctions in different anatomic planes, Murad-Regadas et al[13,14] developed the echodefecography technique, which uses a 360° 3-dimensional transducer and defined measurements to quantify the dysfunctions compared with defecography. This technique appears to be useful in the evaluation of evacuatory disturbances affecting the posterior (rectocele, intussusception, mucosal prolapse, and anismus) and the middle (grade III enterocele) compartments. The aim of this study was to validate the echodefecography technique by evaluating its effectiveness and concordance with defecography in a prospective multicenter trial in women with obstructed defecation.

PATIENTS AND METHODS

From January 2009 through October 2009, women presenting with obstructed defecation symptoms at 6 centers for colorectal surgery (3 in Brazil, 1 in Texas, 1 in Florida, and 1 in Venezuela) were initially and prospectively evaluated with a clinical examination consisting of a full proctologic evaluation, followed by defecography and echodefecography performed by different examiners across the 6 centers. Patients with previous anorectal and vaginal surgery, fecal incontinence, and/or previous anorectal radiation were excluded.

Findings on defecography and echodefecography were compared regarding identification of rectocele, intussusception, anismus, and grade III enterocele. Other dysfunctions of the middle or anterior pelvic compartments were not included in this study.

The clinical protocol was previously approved by the research ethics committees or institutional review boards of all participating institutions, and all patients provided informed written consent.

All examiners involved in the study had previous experience with anorectal ultrasound and had participated in a 3-day training session on echodefecography. The training course included presentations of the technique and the anorectal dysfunctions involved in this study, followed by performance of at least 10 echodefecography examinations under the supervision of an experienced examiner (S.M.M.R.).

Defecography

A Fleet enema was initially administered. After vaginal opacification with a mixture of iodine and ultrasound gel, 150 mL of barium paste was inserted into the rectum. The patient was seated parallel to the x-ray table for lateral visualization of the anal canal and rectum. Images were taken both at rest and during straining. The coccyx, sacrum, head of the femur, posterior wall of the rectum, and anal canal were identified. A normal defecogram at rest showed the rectum angled posteriorly and parallel to the presacral space. The patient was asked to contract the pelvic floor musculature and empty the rectum as completely as possible.

Quantitative measurements were made during defecography for comparison with echodefecography measurements. From the proctographic film, the anorectal junction angle was measured at the junction of the axis of the anal canal and the rectal ampulla. Angle sizes were compared between the resting and straining positions to determine the occurrence of normal relaxation or paradoxical contraction (anismus). Rectocele, defined as outpouching of the anterior upper anal canal or rectal wall occurring during straining, was measured perpendicularly to the expected contour of the anterior rectal wall and classified as grade I (<2.0 cm), grade II (2.0–4.0 cm), or grade III (>4.0 cm).[15] Intussusception was defined as invagination of the rectal wall occurring during straining but not passing through the anal canal. Enterocele and sigmoidocele were diagnosed as herniations of the peritoneum (containing the small bowel or sigmoid colon) into the pelvis. Extension of the loop of

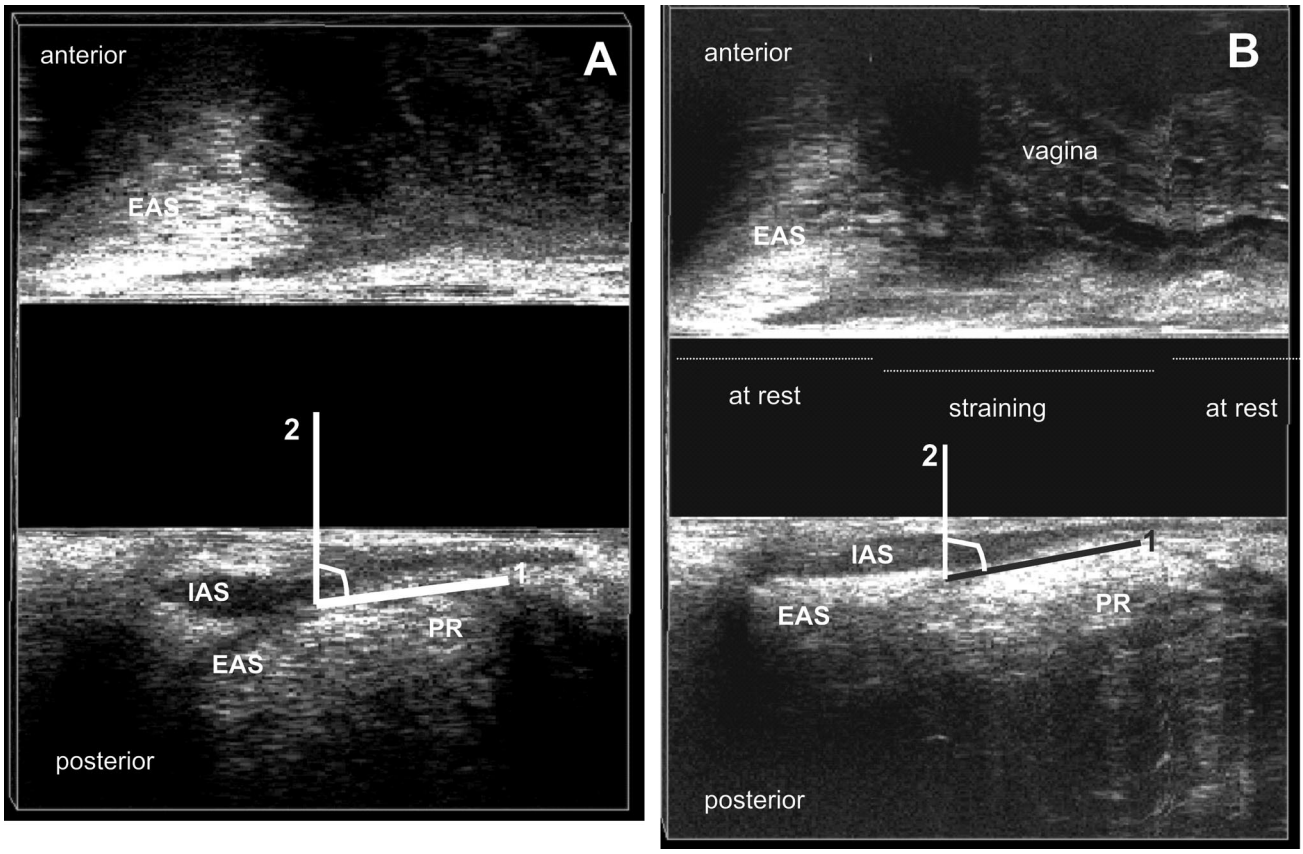

FIGURE 1. A, Scan 1 (sagittal plane). Angle measured at rest position. A horizontal line (1) is traced along the internal border of the EAS/PR muscles, and the angle relative to another line (2) perpendicular to the anal canal axis is measured. B, Scan 2 (sagittal plane). Decreased angle (anismus) during straining between the internal border of the EAS-PR (line 1) and the perpendicular line 2. EAS = external anal sphincter; IAS = internal anal sphincter; PR = puborectalis.

the small bowel or sigmoid below the ischiococcygeal line was considered significant (grade III).[16]

Echodefecography

Patients were examined in the left lateral position after rectal enema. Echodefecography was performed with a Pro Focus 3-dimensional ultrasound scanner (B-K Medical, Herlev, Denmark) using a 2050 endoprobe with 55-second proximal-to-distal 6.0-cm automatic scanning, a frequency range of 10 MHz to 16 MHz, and a focal distance of 2.8 cm to 6.4 cm. With the probe positioned in the rectum at 6.0 cm to 7.0 cm from the anal verge, 3 automatic scans (50-second duration each) were performed to identify the anatomic changes during straining (20-second interval). Images were analyzed in the axial and sagittal planes by an examiner blinded to the defecography findings.

Scan 1 (at rest position without gel) was performed to visualize the anatomic integrity of the anal sphincter musculature and to evaluate the position of the external anal sphincter and puborectalis muscles at rest. The angle formed between a line traced along the internal border of the external anal sphincter/puborectalis muscles (Fig. 1A, line 1), and a line traced perpendicular to the axis of the anal canal (Fig. 1A, line 2) was measured, as previously reported.[13,14] Scan 2 (at rest–straining–at rest without gel) evaluated voluntary muscle movement during the evacuatory effort to identify the presence of normal relaxation. The patient was asked to rest during the first 15 seconds, strain maximally for 20 seconds, and rest again during the remaining 15 seconds of the scan. The resulting positions of the external anal sphincter/puborectalis muscles (represented by the angle size) were compared between scans 1 and 2 (Figs. 1A and B). Normal relaxation was recorded if the angle increased by a minimum of 1 degree, whereas paradoxical contraction (anismus) was recorded if the angle decreased by a minimum of 1 degree, as previously reported.[13,14]

For scan 3, 120 mL to 180 mL of ultrasound gel was inserted into the rectum and the rest–strain–rest sequence, identical to scan 2, was performed. In normal patients, the posterior vaginal wall displaces the lower rectum and upper anal canal inferiorly and posteriorly but maintains a straight horizontal position during defecatory effort (Fig. 2). If an anorectocele was identified, it was classified as grade I (<6.0 mm), grade II (6.0–13.0 mm), or grade III

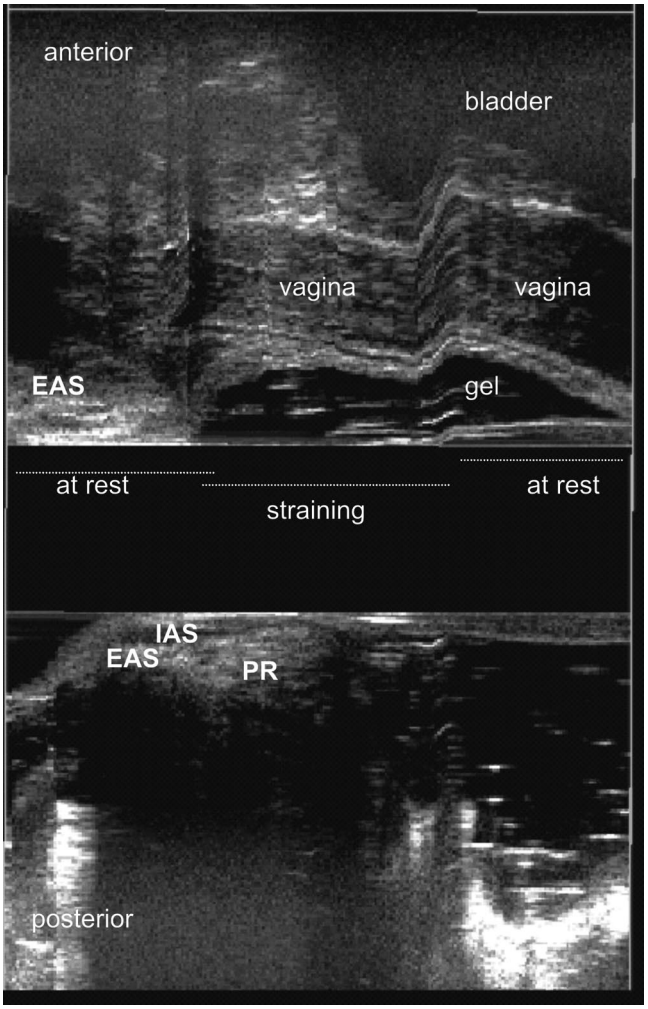

FIGURE 2. Scan 3 with gel inserted into the rectum (sagittal plane). Normal examination. Vagina is pushed downwards and backwards. EAS = external anal sphincter; IAS = internal anal sphincter; PR = puborectalis.

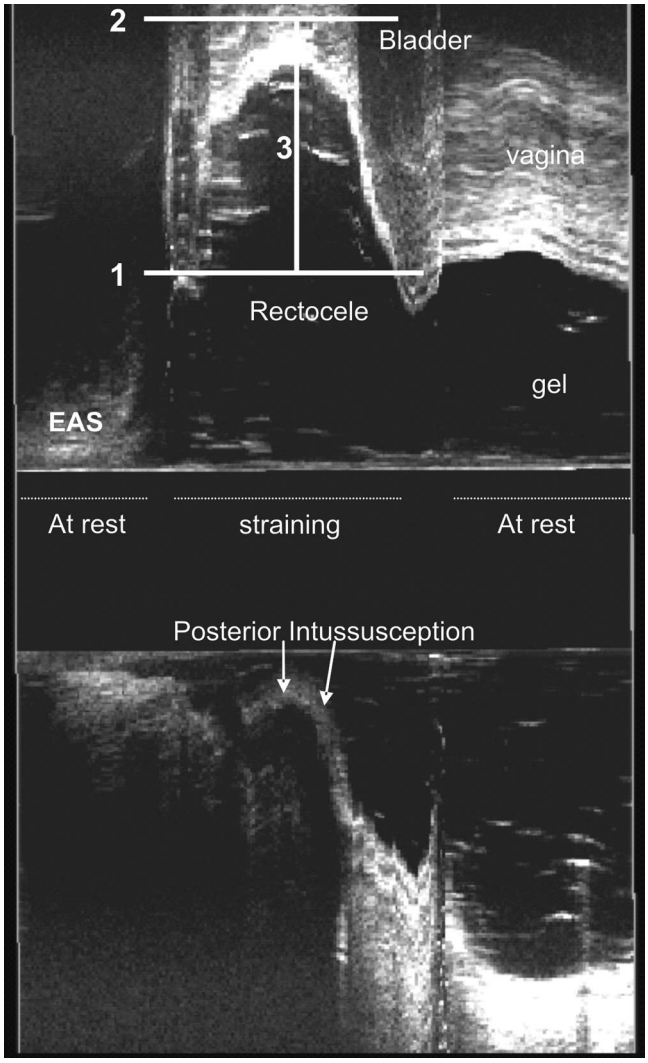

FIGURE 3. Scan 3 (Sagittal plane). Anterior grade III rectocele, posterior intussusception (posterior white arrows). Line 1 (lower horizontal line) = parallel with the vagina wall during initial straining. Line 2 (upper horizontal line) = parallel with the vagina wall at maximal herniation point. Line 3 (vertical line) = rectocele size. EAS = external anal sphincter.

(>13.0 mm). Measurements were calculated by first drawing 2 parallel horizontal lines along the posterior vaginal wall, with 1 line placed in the initial straining position (Fig. 3, white line 1), and the other line drawn at the point of maximal straining (Fig. 3, white line 2). The distance between the 2 vaginal wall positions determined the size of the anorectocele[14] (Fig. 3, white arrows between lines 1 and 2). Intussusception was clearly identified on echodefecography by observing the rectal wall layers protruding through the rectal lumen (Fig. 3, white arrows in the posterior quadrant). No classification was used to quantify intussusception. Grade III enterocele was recognized when the small bowel was positioned below the pubococcygeal line (Fig. 4).

Statistical Analysis

The Lee κ (κ) coefficient was used to verify agreement between defecography and echodefecography.[17,18] Value were classified as follows: <0, no agreement between the 2 techniques; 0.00 to 0.19, poor agreement; 0.20 to 0.39, fair agreement; 0.40 to 0.59, moderate agreement; 0.60 to 0.79, substantial agreement; and 0.80 to 1.00, almost perfect agreement.

RESULTS

A total of 86 women were evaluated. The median validated Wexner constipation score[19] was 13.4 (range, 6–23). The median age was 53.4 (range, 26–77) years; 13 patients (15.1%) were under the age of 50 years. Among the patients, 16 (18.6%) were nulliparous, 40 (46.5%) had had

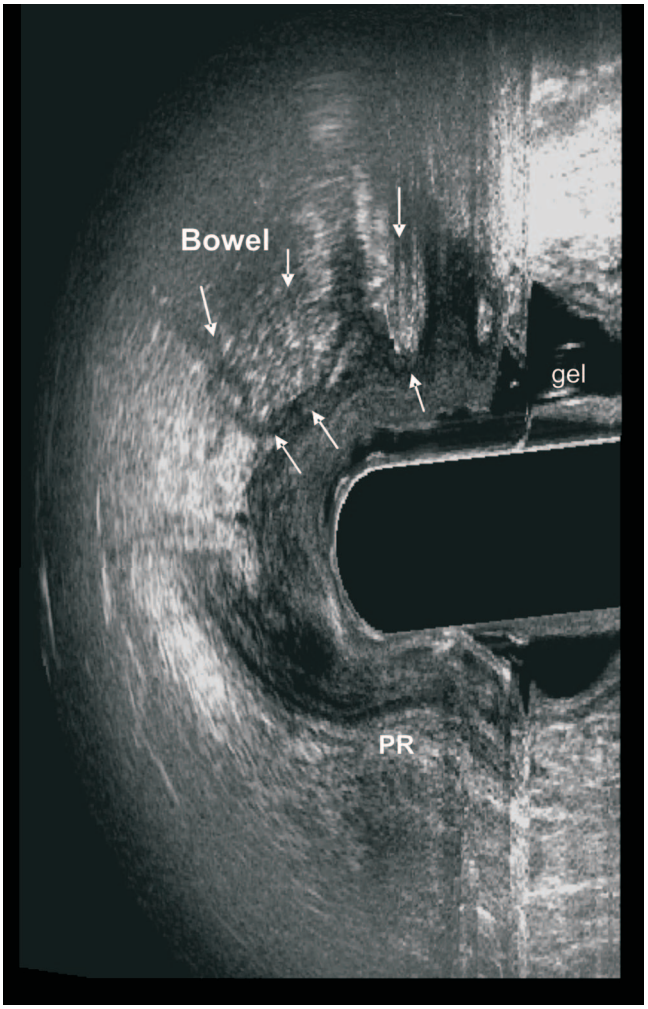

FIGURE 4. Scan 3 (axial sagittal plane). Enterocele (white arrows) visualized at the anorectal junction and upper anal canal. PR = puborectalis.

vaginal deliveries, and 30 (34.9%) had undergone Cesarean section.

Although all patients had presented with symptoms of obstructed defecation, 7 patients were classified as normal on defecography and 6 patients were classified as normal on echodefecography. Four patients were classified as normal by both methods. Defecography identified grade II rectocele in 2 patients classified as normal on echodefecography, and echodefecography identified intussusception in 3 patients classified as normal by defecography.

Rectocele was identified in 80 patients by defecography and in 76 patients by echodefecography. Agreement for individual rectocele grades is shown in Table 1. Overall, agreement between the 2 methods was classified as substantial (κ = 0.61; 95% CI = 0.48–0.73). When κ was calculated for each rectocele grade, substantial agreement was also found for patients without rectocele (κ = 0.73; 95% CI = 0.52–0.93), for those with grade I (κ = 0.61; 95% CI = 0.40–0.81), and for those with grade III (κ = 0.62; 95% CI = 0.42–0.82); moderate agreement was found for grade II rectocele (κ = 0.56; 95% CI = 0.36–0.76).

Defecography identified rectal intussusception in 42 patients, with echodefecography identifying 37 of these cases, plus 4 additional cases of intussusception (Table 2). Absence of intussusception was noted by both methods in 40 patients, with agreement classified as substantial (κ = 0.79; 95% CI = 0.57–1.0). Rectocele associated with intussusception was found by both methods in 28 patients (Table 3), with substantial agreement (κ = 0.62; 95% CI = 0.41–0.83).

Anismus was identified by defecography in 19 patients and by echodefecography in 26 patients (Table 4). Normal relaxation was recognized by both methods in 57 patients, and anismus was recognized by both methods in 16 patients. Agreement between the 2 techniques regarding anismus was classified as substantial (κ = 0.61; 95% CI =

TABLE 1. Agreement between echodefecography and defecography regarding rectocele diagnosis

	Echodefecography				
Rectocele on defecography	*No rectocele*	*Rectocele I*	*Rectocele II*	*Rectocele III*	*Total*
No rectocele	6[a]	0	0	0	6
Rectocele I	3	9[a]	3	1	16
Rectocele II	1	2	29[a]	12	44
Rectocele III	0	0	1	19[a]	20
Total	10	11	33	32	86

[a]Concordant findings.

TABLE 2. Agreement between echodefecography and defecography regarding diagnosis of rectal intussusception

	Echodefecography		
Defecography	*No intussusception*	*Intussusception*	*Total*
No intussusception	40[a]	4	44
Intussusception	5	37[a]	42
Total	45	41	86

[a]Concordant findings.

TABLE 3. Agreement between echodefecography and defecography regarding diagnosis of associated rectocele and intussusception

	Echodefecography		
Defecography	*No rectocele + intussusception*	*Rectocele + intussusception*	*Total*
No rectocele + intussusception	42[a]	7	49
Rectocele + intussusception	9	28[a]	37
Total	51	35	86

[a]Concordant findings.

TABLE 4. Agreement between echodefecography and defecography regarding diagnosis of anismus

	Echodefecography		
Defecography	*Normal relaxation*	*Anismus*	*Total*
Normal relaxation	57[a]	10	67
Anismus	3	16[a]	19
Total	60	26	86

[a]Concordant findings.

TABLE 6. Agreement between echodefecography and defecography regarding diagnosis of enterocele grade III

	Echodefecography		
Defecography	*No enterocele III*	*Enterocele III*	*Total*
No enterocele III	76[a]	1	77
Enterocele III	1	8[a]	9
Total	77	9	86

[a]Concordant findings.

0.40–0.81). Rectocele combined with anismus was found by both methods in 14 patients (Table 5), and agreement was classified as substantial ($\kappa = 0.61$; 95% CI = 0.40–0.82).

Defecography identified 3 cases of grade I, 8 cases of grade II, and 9 cases of grade III enterocele. Echodefecography found 8 of the 9 cases of grade III enterocele identified by defecography, and found an additional subject with grade III enterocele, for a total of 9 grade III enteroceles (Table 6). Agreement for grade III enterocele was classified as almost perfect ($\kappa = 0.87$; 95% CI = 0.66–1.0).

DISCUSSION

The use of defecography for diagnosing functional anorectal disorders is limited by the need for a specific radiologic environment, exposure of patients to radiation, and inability to show all the anatomic structures involved in defecation. Echodefecography was developed in part to overcome these limitations and to provide comparable rates of identification of rectocele and anismus and enhance recognition of intussusception. Our previous comparative studies[13,14] suggested that echodefecography facilitates visualization of the different positions of the anorectal viscera involved in defecation and can identify the full extent of anorectal dysfunctions, including rectocele, anismus, intussusception, and grade III enterocele. In the present study, defecography and echodefecography showed similar results in the evaluation of the main anorectal dysfunctions, including rectocele, intussusception, and anismus, as well as grade III enterocele.

The left lateral position used during echodefecography was comfortable for the patients and did not prevent evacuation of the ultrasound gel during straining in most patients. In addition, the ultrasound gel in the rectum during scan 3 was sufficient to induce the voiding urge despite differences in fecal consistency. It is not necessary to insert gel into the rectum during scan 2, because the muscle borders are better visualized without it. As the ultrasound gel expands the rectum, the layers of the rectal wall protrude through the rectal lumen during patient straining. It was better to evaluate the external anal sphincter/puborectalis muscle movements during scan 2 than during scan 3, because elimination of the gel normally present during scan 3 would have prevented clear visualization of the muscle borders during the evacuatory effort.

TABLE 5. Agreement between echodefecography and defecography regarding diagnosis of associated rectocele and anismus

	Echodefecography		
Defecography	*No rectocele + anismus*	*Rectocele + anismus*	*Total*
No rectocele + anismus	60[a]	8	68
Rectocele + anismus	4	14[a]	18
Total	64	22	86

[a]Concordant findings.

Various techniques and approaches using ultrasound in the evaluation of pelvic floor dysfunctions have shown good correlation with defecography or with symptoms.[9–14,20–22] The probe type, the patient's position, and the technique adopted each demonstrate certain advantages and disadvantages; however, the acquisition of optimal results is primarily correlated with the examiner's experience. Echodefecography is technically straightforward to perform, with a short learning curve of about 10 supervised examinations. However, the examiner must have previous experience with anorectal ultrasonography technique and be aware of all potential evacuatory disturbances that may be revealed. In the current study, even although the echodefecography training course for examiners did not take place until just before commencement of the trial in 3 centers, substantial agreement between echodefecography and defecography was achieved for grade I and III rectoceles, and moderate agreement was achieved for grade II rectocele.

Four subjects in this study were identified as normal by both methods. Two patients with grade II rectocele identified by defecography were classed as normal by echodefecography. The difference in classification, which resulted in only moderate agreement for this rectocele grade, may have been due to insufficient straining by these 2 patients during echodefecography.

Good visualization of anatomic structures appeared to make echodefecography more effective than defecography in the identification of some problems. Echodefecography found 37 of the 42 cases of rectal intussusception previously identified by defecography and revealed 4 additional

cases. Anismus was identified in 19 patients by defecography and in 26 patients by echodefecography (resulting in moderate agreement).

In the case of grade III enterocele, there was almost perfect agreement between the 2 methods. However, grade I and II enteroceles are not routinely visualized by echodefecography because the scanned area starts below the ischiococcygeal line. Echodefecography has limited use in assessment of the anterior compartment of the pelvic floor and in identification of grade I and II enteroceles because of the type of probe used (2050) and its position in the rectum during each scan. However, if the transperineal ultrasound[20,21] method is used, the dysfunctions of all compartments can be assessed. Defecography and MRI could eventually be considered for cases where the clinical symptoms do not correspond with the ultrasound findings.

The main advantage of echodefecography is the ability to simultaneously verify the anatomic integrity of all anorectal structures while visualizing their movement during straining. In addition, the cube image acquired during the automatic scan is recorded in real time for subsequent analysis, as may be necessary in many cases. Echodefecography was also found to be a simple and minimally invasive examination because the endoprobe was kept stationary during image acquisition.

In conclusion, echodefecography may be used to assess patients with obstructed defecation symptoms, as it is able to detect the same anorectal dysfunctions found by defecography. It is minimally invasive and well tolerated, avoids exposure to radiation, and clearly demonstrates all the anatomic structures involved in defecation.

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