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ORIGINAL ARTICLE

A comparison of dynamic transperineal ultrasound (DTP-US) with dynamic evacuation proctography (DEP) in the diagnosis of cul de sac hernia (enterocele) in patients with evacuatory dysfunction

M. Beer-Gabel · Y. Assoulin · M. Amitai · E. Bardan

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Abstract
Background/Aims Cul-de-sac hernias (enterocele and peritoneocele) are difficult to diagnose in patients presenting with primary evacuatory difficulty. Failure to recognize their presence in patients undergoing surgery may lead to poor functional outcome. Accurate diagnosis requires specialized investigation including dynamic evacuation proctography (DEP) or dynamic magnetic resonance (MR) imaging. Recently, dynamic transperineal ultrasonography (DTP-US) has been used for this purpose. This study compares DEP with DTP-US for the diagnosis of cul-de-sac hernias in those patients presenting with evacuatory dysfunction.
Materials and methods Sixty-two female patients with chronically obstructed defecation underwent blinded clinical, DEP, and DTP-US assessment to define the accuracy of diagnosis of cul-de-sac hernias.
Results Both the DEP and the DTP-US techniques show concordance for the diagnosis of cul-de-sac hernias in an unselected patient cohort. Patients in both groups have the same duration of constipation with a greater likelihood of prior hysterectomy in those with cul-de-sac hernias. The diagnosis was established separately by DEP in 88% and in 82% of the cases by DTP-US. Transperineal sonography is discordant with DEP in 45% of cases once the diagnosis of cul-de-sac hernia is made, over the contents of the hernia and over the degree of transvaginal enterocele descent, where DTP-US tends to upgrade enterocele severity. Both techniques confirm the high incidence of concomitant pelvic floor compartment pathology.
Conclusions Both methods have accuracy for the diagnosis of cul-de-sac hernias in those patients presenting with evacuatory difficulty. Transperineal sonography tends to more readily diagnose peritoneocele and to upgrade enterocele extent. As an office procedure, it is a valuable adjunct to the clinical examination in the diagnosis of cul-de-sac hernia.

Keywords Outlet obstruction · Enterocele · Constipation · Cul-de-sac hernia · Perineal ultrasound

M. Beer-Gabel (✉) · Y. Assoulin · E. Bardan
Department Gastroenterology, Chaim Sheba Medical Center,
Tel Hashomer 52621, Israel
e-mail: marcobg7@gmail.com

M. Amitai
Department of Radiology, Chaim Sheba Medical Center,
Tel-Hashomer 52621, Israel

M. Beer-Gabel · E. Bardan
Sackler School of Medicine, Tel- Aviv University,
Tel Aviv, Israel

Introduction

Cul-de-sac hernias, (also known as hernias of the pouch of Douglas and incorporating both enteroceles and peritoneoceles), have been variably reported between 0.1% and 16% of women examined after gynecological surgery [1]. Preoperative diagnosis of a cul-de-sac hernia in patients with concomitant pelvic floor pathology is vital, as its recognition may significantly change the surgical approach in patients presenting with pelvic floor dysfunction and evacuatory difficulty [2, 3]. There are no specific symptoms of a cul-de-sac hernia, although these patients more often complain of post-evacuatory discomfort and pelvic pain as part of their constellation of evacuation difficulty [4]. The signs of a cul-de-sac hernia are also not definitive, although it may be suspected in the standing position by simultaneous

per-vaginal and per-rectal examination [5]; an impression which has a clinical sensitivity for the diagnosis of only 50% [6]. Because of the high association between cul-de-sac hernia and other significant pelvic floor disorders between 18% and 37% [7], imaging techniques which display a global view of the pelvic floor and perineal soft tissues are required for an extended clinical diagnosis.

The gold standard diagnostic procedure still remains to be dynamic evacuation proctography (DEP), even though it may miss up to 20% of enteroceles [8, 9]. In many cases, conventional defecography must give way to an extended defecographic technique of colopocystodefecography and even to concomitant peritoneography for definitive diagnosis [10, 11]. This extended defecographic technique is relatively poorly tolerated and delivers a substantial ovarian irradiation dose in patients who are typically quite young [12]. The alternative of dynamic magnetic resonance imaging (MRI) is highly sensitive for the diagnosis of enteroceles, although it is an expensive technology which is generally limited to larger medical centers and is relatively restricted for use in patients presenting with pelvic floor pathology [13, 14]. Recently, our group has described the sensitive use of dynamic transperineal ultrasound (DTP-US) in unselected patients presenting with evacuatory dysfunction [15], where it has the advantage of being a noninvasive non-irradiating office procedure with a sensitivity comparable to that of dynamic proctography for the diagnosis of a range of pelvic floor disorders [16].

This study compares DTP-US with DEP specifically for the diagnosis of cul-de-sac hernias among patients presenting to a specialized pelvic-floor-dysfunction clinic principally with obstructed defecation.

Materials and methods

Sixty-two consecutive female patients referred to a specialized Pelvic Floor Unit, Chaim Sheba Tel-Hashomer Hospital, Israel with long-standing symptoms of obstructed defecation between August 2004 and October 2005 were assessed for analysis in this study. A thorough history of defecation difficulty and clinical examination were performed along with routine DEP, DTP-US, and anorectal manometry in all cases. The study was performed with informed consent from all patients. The clinical diagnosis of obstructed defecation was considered when the patients needed to strain in evacuation more than 25% of the time, in accordance with the ROME II criteria [17], and when there was an attendant feeling of incomplete defecation, repetitive attempts to defecate, and where these symptoms exceeded 6 months duration.

Dynamic evacuation proctography (DEP) was performed by two investigators (A.Y. and M.A.) blinded to the clinical and DTP-US results. Patients were given 10 mL of Gastrografin (Schering ®, UK) diluted with 150 mL of tap water and 50 mL of barium 30 min before the performance of the DEP to opacify the small bowel. The distal colon and rectum were filled with 150 mL of contrast medium using a mixture of barium with oatmeal powder (140 mL of barium sulphate with 20 g of oatmeal) so as to obtain a stool-like consistency. The vagina was opacified with 20 mL of barium paste. The patient was then seated on a dedicated commode with films being obtained at rest, during squeeze, and during maximal straining in accordance with standard techniques [18]. Both static views and video records were made for each patient. Enteroceles were diagnosed when a loop or loops of small bowel was detected in the territory between the rectum and the vagina compressing the anterior rectal wall as depicted in Fig. 1.

All examinations with DTP-US were performed by one of the authors (MBG) blinded to the DEP results. Dynamic transperineal ultrasonography (DTP-US) was performed in accordance with our prior reported technique [15, 19] using either a curvilinear C4–7 or a C8–12 transducer (Logiq 9, GE Healthcare UK). The transducer was protected with a latex condom, and images were routinely obtained from structures in the anterior compartment, (the pubis, urethra, and bladder), the middle compartment, (the vagina and the rectovaginal septum) and the posterior compartment, (the anal canal, the rectum, and the puborectalis muscle en face). Before the performance of the DTP-US, the rectum was instilled with 50 mL of ultrasonographic coupling gel (Ultragel Aquarius 101® Medilab, USA) using a standard Luer syringe with a soft-end catheter. Opacification of the vagina was routinely performed with 20 mL of acoustic gel. The patients were advised to avoid micturition for a 1-h period before the procedure, and 50 mL of Gastrografin (diluted 1:1

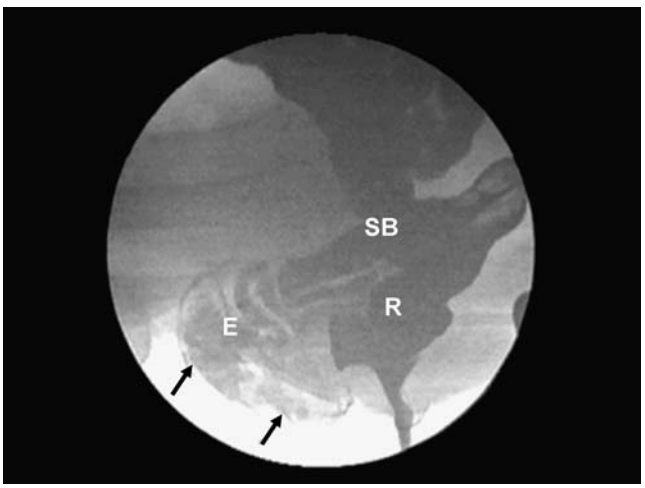

Fig. 1 Dynamic proctography. A large septal cul-de-sac hernia (*black arrows*) filled with opacified small-bowel loops of an enterocele (*E*) which is evident anteriorly to the rectum (*R*). The small bowel (*SB*) appears rostral to the rectum

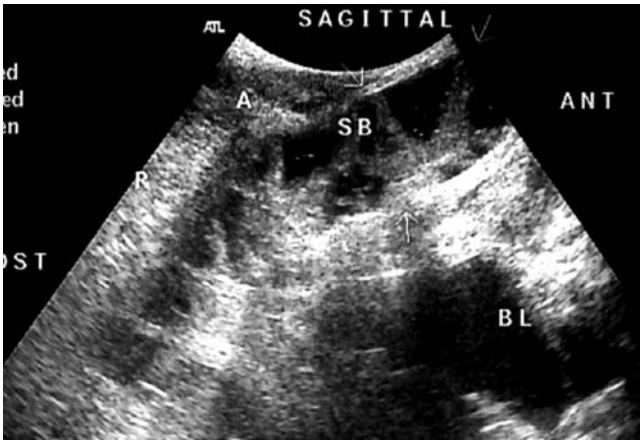

Fig. 2 Enlarged mid-sagittal view using DTP-US of a cul-de-sac hernia filled with a small-bowel loop (*SB*) in the same patient as seen in Fig. 1. The enterocele is evident between the rectum (*R*) and the bladder (*BL*). The ingested water and gastrografin appears as hypoechoic content within the small bowel

with tap water) was ingested by the patient 1 h before the DTP-US. The images were obtained in the mid-sagittal plane and at various transverse points of the posterior compartment and the perineal body at the mid-anal canal level at rest, during maximal straining and squeeze, and in some cases, during rectal evacuation. Enteroceles were readily identified as small bowel loops visible in the region of the rectovaginal septum as shown in Fig. 2. Peritoneoceles were defined as an enlarged rectovaginal septum without visible small-bowel loops being present.

In evaluation of the films, (either DEP or DTP-US), a cul-de-sac hernia was considered to be present when there was prolapse of the posterior vaginal wall (or of the vaginal vault) during straining. The type of hernia was defined by its content where it was considered an enterocele when a small bowel loop was demonstrated in the rectovaginal and as a peritoneocele when the rectovaginal space was enlarged (>2 cm in depth) between the posterior wall of the vagina and the anterior wall of the rectum [10]. The depth of an enterocele was measured according to the level of the vagina that was reached by the most distal part of the herniated intestinal loop; the vagina being divided into three levels. The most vertical part of the vagina was described as the distal third, the horizontal vagina being divided into two parts, the mid- and the proximal thirds based on the clinical definitions of DeLancey [20]. When a redundant sigmoid loop (devoid of gastrografin and saline) was detectable in the herniated sac, this was designated as a sigmoidocele [21]. During DTP-US, differentiation of a sigmoid loop from an enterocele was made on the basis of the anatomy of the loop(s) in the pouch of Douglas, the presence or absence of typical small-bowel contraction, and by the hyperechoic contrast detectable in the prolapsed small bowel intestinal loop.

The position of both the anorectal and urethrovesical junctions in DTP-US has been previously described by our group [15, 16] and was assessed in relation to its distance from a horizontal line passing through the inferior pubis.

Statistics Two tailed Fisher's exact test was used for comparisons of categorical variables. Student *t* test or Mann–Whitney *u* test were used where appropriate for continuous variables. *P* values <0.05 are reported and were considered to be statistically significant.

Results

Of the 62 patients, the mean age was 56.2 years, (range 21–90 years) with those patients with a cul-de-sac hernia being slightly older than those without such hernias. In 24 patients (38.7%), obstructed defecation was part of an irritable bowel syndrome, whereas 22 patients (35.5%) had functional constipation, and 16 patients (25.8%) concomitant fecal incontinence associated with their constipation (Table 1).

Table 1 Clinical characteristics of the population of 62 female patients presenting with chronic obstructive constipation

	No Cul-de-sac	Cul-de-sac	*P* value
Number of patients	45	17	
Mean Age years (SD)	56 (15)	55(14)	*P*=0.889
Mean duration of constipation in years (SD)	6 (5)	5 (3.4)	*P*=0.691
Median number of deliveries	2	3	
Delivery complications (%)	11 (24)	3 (18)	
Forceps	3	1	
Vacuum	3	0	
Prolonged labor	5	2	
Prior hysterectomy (%)	11 (24.4)	7 (63.6))	*P*=0.222
Diagnosis			
Irritable bowel syndrome (%)	18 (40)	6 (35.3)	
Functional constipation (%)	16 (35.6)	6 (35.3)	
Fecal incontinence (%)	11 (24.4)	5 (29.4)	

There was no statistical difference in these subgroups between those with or without a cul-de-sac hernia. The overall mean duration of the complaint of constipation among all patients was about 5 years, (range 1–30 years), and this symptom was generally of the same duration in those patients with a concomitant cul-de-sac hernia (Cul-de-sac patients 6 vs 5 years in no cul-de-sac patients; P= 0.691). There was no difference in the average number of deliveries between those with and without a cul-de-sac hernia (3 vs 2, respectively) and no difference between the groups in those reporting a complicated delivery. Complicated deliveries in the patient cohort included one case of forceps and two cases of prolonged labor in the cul-de-sac hernia group and three cases of forceps utilization, three of vacuum extraction, and five cases of prolonged labor in the group without a detectable cul-de-sac hernia. Eighteen patients (30%) had undergone a prior hysterectomy with 13 (22%) having previous abdominal surgery and 5 (8%), anal surgery. Of those patients presenting with a cul-de-sac hernia, there was a threefold likelihood of a prior hysterectomy than in those patients without such a hernia (63.6% vs 22.4%, respectively, P=0.222), which was not statistically significant.

Cul-de-sac hernia was diagnosed with either technique to define sensitivity where both modalities made the diagnosis of 71% (12 of 17 patients). DTP-US made the diagnosis of cul-de-sac hernia in 82% of the cases (14 of 17) with DEP supporting the diagnosis in 88% (15/17) of cases (Fig. 3). When both techniques contributed to the diagnosis, there was concordance of the hernia content and extent (demonstrable vaginal level of descent) in 50% (6 of 12 patients). In the remainder of cases where a cul-de-sac hernia was diagnosed by both techniques, DTP-US showed a more advanced grade of enterocele (Grade 1 on DEP upgraded to grade II by DTP-US in four cases) or the presence of an enterocele as opposed to a peritoneocele in two further cases. In the five cul-de-sac hernias diagnosed by only one of the modalities, DTP-US failed to show the diagnosis reported by the other modality (two enteroceles and one peritoneocele), and in two further patients, the diagnosis was missed by DEP but diagnosed with DTP-US (one enterocele and one sigmoidocele).

We were able to demonstrate additional pelvic floor pathology in all three compartments in this group of 17 patients with cul-de-sac-hernia. Thirteen rectoceles were seen by both techniques. The agreement between them was in nine patients (70%). DT-PUS alone showed three (24%) more rectoceles. DEP demonstrated one (8%) rectocele, which was not seen by the DT-PUS. Eleven cystoceles could only be diagnosed by DT-PUS because of the anechoic aspect of urine in the bladder on ultrasound. Descending perineum was diagnosed with DTP-US by measuring the descent of the perineum below a vertical line passing through the long axis of the pubis. Descending perineum was present in all cases of cul-de-sac-hernia. In nine patients (53%), there was a complete agreement between the two techniques, whereas DEP diagnosed the descent of the pelvic floor in another five patients (29%). The DT-PUS showed three patients with a descent of the perineum not demonstrated by the DEP. Each technique alone diagnosed three out of four rectal prolapse. Agreement was present in two of four patients (50%). Altogether, DT-PUS could diagnose 92% of the rectoceles, 100% of the cystoceles, 71% of the descent of the perineum at straining, and 75% of the rectal prolapse. (Table 2)

Discussion

In this small study, both the DEP and the DTP-US techniques accurately diagnose cul-de-sac hernias in a group of female patients suffering from chronically obstructed defecation. In general, those patients with cul-de-sac hernias tend to have a longer duration of constipation symptoms with a much greater likelihood of prior hysterectomy than those without demonstrable cul-de-sac hernias. Transperineal sonography tends to be moderately discordant with DEP, (once the diagnosis of cul-de-sac

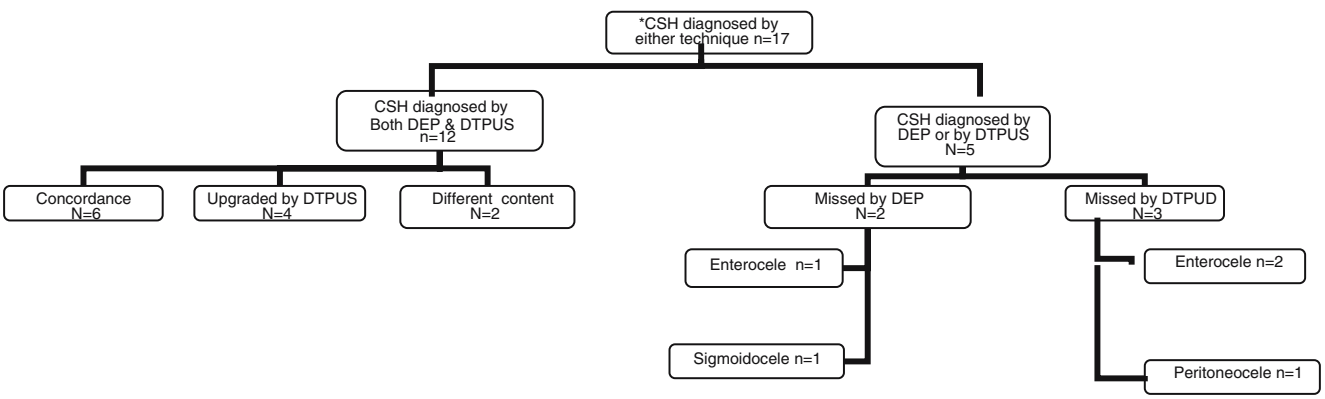

Fig. 3 Algorithm of diagnosis of cul-de-sac hernia as detected by both imaging techniques (DEP and DTP-US)

Table 2 Associated pelvic floor/visceral pathology in patients with cul-de-sac hernia as demonstrated by DEP or DTP-US

	Rectocele *n* (%)	Cystocele *n* (%)	Descending perineum *n* (%)	Rectal prolapse *n* (%)
Patients total (17)	13	11	17	4
Agreement between both techniques	9 (70)	0	9 (53)	2 (50)
DEP alone	1 (8)	0	5 (29)	1 (25)
DT-PUS alone	3 (24)	11 (100)	3 (18)	1 (25)

hernia is made), over the contents of the hernia (enterocele versus peritoneocele) and over the degree of transvaginal enterocele descent, where DTP-US tends to upgrade the enterocele severity. Both techniques confirm the high incidence of concomitant pelvic floor compartment pathology; most notably, rectal prolapse, rectocele, descending perineum syndrome, and cystocele.

The diagnosis of concomitant cul-de-sac hernia in patients presenting with evacuatory difficulty is vital, particularly when rectocele is the dominant clinical finding and where surgery is contemplated, [22] as any operative approach will need to be modified [23]. This point is of considerable importance, where, as in our study and those of others, [6] the vast majority of patients present with a multiplicity of pelvic floor pathologies even when one imaging or clinical diagnosis is most dominant. As in other studies, there were no clinical discriminating features in chronically constipated patients for the potential diagnosis of a cul-de-sac hernia [24]. The greater likelihood of a prior hysterectomy in those patients presenting with chronic evacuatory difficulty combined with a cul-de-sac hernia has also been found by others, [25] where it is postulated that enterocele and peritoneocele may result because of a variable policy among gynecologists towards sacrocolpopexy of the vaginal vault [26, 27]. This approach is also adopted in the operative prevention of delayed vaginal vault prolapse which may be associated in some cases with evacuatory dysfunction [28].

In our study, concordance for the actual diagnosis between the two imaging techniques was relatively good, although concordance for the content of the detected hernia and its extent (grade) was relatively poor. There are many potential explanations for this finding. One of the principal explanations for the missed enterocele using either DTP-US or MR imaging when compared with DEP, is that in these first two modalities, simulated rectal emptying occurs in a nonphysiological position. In this setting, diagnoses which occur during maximal straining or at the end of contrast evacuation, (such as descending perineum syndrome, rectal prolapse, and rectoanal intussusception), are more likely to be under diagnosed [29, 30]. This is particularly evident in differences in patient position between techniques which assess the anterior perineal and pelvic compartments where the bladder neck at rest tends to be located at a higher level with DTP-US when compared with DEP, [31–33] but where position has little effect on pelvic floor descent during maximal straining [34]. As similar diagnostic sensitivities for a range of pelvic floor pathologies in patients with symptomatic obstructed defecation have been reported between open architecture and conventional MR imaging techniques, [35] the conclusion is that the left lateral decubitus position utilized in DTP-US has minimal diagnostic difference with DEP, although static and dynamic measurements and the determined extent of pelvic floor descent will differ.

Another explanation for differences in diagnostic sensitivity between techniques is as a result of the use of variable quantities of contrast material in the two protocols. In general, DEP utilizes about three times more intra-rectal contrast than DTP-US, and this has the potential of compressing the rectovaginal space by over-distension of the rectum. In this respect, Bremmer and colleagues showed that the instillation of more than 250 mL of barium into the rectum with distension of the viscus to >10 cm in diameter could diminish the diagnosis of enterocele by up to 50% [10]. The reason for this finding is the potential creation of a "crowded pelvis syndrome" where space competition within the rigid pelvis inhibits diagnosis of visceral descensus [36]. Here, some have recommended plain radiology either before the rectum is distended [37] or after the rectum and the bladder have both been emptied [38] to define visceral position and to prevent visceral over-distension during image assessment.

In our study, DTPUS missed a cul-de-sac hernia in 18% of the cases diagnosed by DEP. In one case, patient obesity was a contributory factor, whereas the other two cases of enterocele were not diagnosed early in the patient cohort as part of the learning curve of the technique and probably consequent upon reticence by the patients in forceful straining and contrast evacuation during the sonogram in proximity to the examiner's hand. It is felt that enterocele upgrading with DTP-US is probably dependent upon the smaller volume of intrarectal acoustic gel used with this technique as already outlined. The discordance in two cases where DTP-US showed an enterocele which were called peritoneoceles on DEP, is probably a result of an easier detection of small bowel loops located in the vicinity of the rectovaginal septum with DTP-US particularly when the enterocele is small. This may also be attributed to the extent of straining during the procedure where so-called 'floating' or 'sinking' enteroceles may only appear at the end of a forced Valsalva maneuver.

The separation of peritoneocele from enterocele is somewhat academic as is the radiologic grading of an attendant enterocele, as these represent progressively more significant hernial defects of the rectogenital septum [39]. The importance is in the diagnosis of a cul-de-sac hernia which may, in its own right, necessitate repair in selected cases and which will govern the operative approach. It is likely that more standardized protocols of DTP-US and DEP with regard to the timing of images taken during maximal straining maneuvers will reduce the incidence of false-negative investigations. Other sonographic methods have been used to diagnose enteroceles. Anal endosonography has been compared favorably with DEP for the diagnosis of enteroceles in a nonrandomized study by Karaus et al. [40], and endorectal ultrasound has also shown high operative concordance for enterocele location particularly when the enterocele is small [41].

In conclusion, although this study did not have operative enterocele comparison for the true calculation of diagnostic sensitivities, it does show that there is a similar diagnostic ability of DTP-US and DEP for the demonstration of cul-de-sac hernias in patients presenting with evacuatory dysfunction. This information may be critical in operative decision making in some cases, where the advantages of DTP-US are its simplicity, wide availability, low cost, patient tolerance, and lack of radiation exposure. Dynamic transperineal sonography is more likely to be complementary in some patients to conventional DEP, having the further advantage of avoiding more extended, relatively poorly tolerated defecographic techniques when there is a multiplicity of pelvic floor pathology. Its ability to define the dynamic interaction of the anterior pelvic soft tissues is of added noninvasive advantage in directing either further radiology or delineating the appropriate surgical approach.

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