3D Dynamic Ano-rectal Ultra-sonography (Echodefecography) vs. Magnetic Resonance Defecography in Assessment of Obstructed Defecation

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ABSTRACT

Purpose:*Magnetic resonance defecography (MRD) has recently replaced conventional defecography (CD) which was, for decades, the mainstay exam for evaluation of obstructed defecation syndrome (ODS). Lack of widespread availability and high cost of MRD were major limitations that lead to intense need for other imaging alternatives. Echodefecography (EDF) is a recent imaging approach utilizing dynamic three-dimensional ultrasound with good diagnostic capabilities.* ***Methods:*** *A prospective study was held on 15 patients with mean age of 41.4 years ± 16.8 years suffering from ODS. All included patients were subjected to detailed history taking and thorough physical examination followed by EDF and MRD. Certain measurements were acquired from images of both exams for comparison.* ***Results:*** *Rectocele was detected in 9 patients by EDF and 8 patients by MRD (fair statistical agreement was demonstrated between both modalities [κ value 0.324]). 10 cases of anorectal descent were identified by EDF while MRD identified 14 cases (fair statistical agreement [κ value 0.250]). EDF detected 6 cases of anismus, 10 cases of anorectal intussusception and 4 cases of enterocele whereas MRD did not identify any of these diagnoses (no statistics were computed because MRD is constant), however MRD detected 7 cases of cystocele and 5 cases of uterocele which cannot be visualized by EDF.* ***Conclusion:*** *EDF is of great capability of detecting different disorders of posterior pelvic compartment associated with ODS compared to MRD.*

Keywords*: obstructed defecation, echodefecography, magnetic resonance defecography, rectocele, perineal descent*

INTRODUCTION

ODS is the term which describes different disorders of anorectum and pelvic floor that results in unsatisfactory evacuation of stool bolus after call for defecation. These disorders may be due to functional etiology as anismus which is inadequate relaxation or paradoxical contraction of puborectalis and anal sphincter complex, or structural etiology as rectocele, anorectal intussusception, enterocele or perineal descent resulting from weakness and loss of support of pelvic ligaments and fasciae [(1)].

Although history taking and physical examination is the cornerstone for assessment of patient with obstructed defecation however functional imaging of pelvic floor and anorectum is mandatory for proper operative decision making. For decades CD was the imaging tool of choice for evaluation of different defecatory disorders but it carries risk of radiation exposure and lacks visualization of anatomical structures involved in defecation process [(2)].

Recently, MRD has acquired reliability and almost replaced CD due to its great ability for assessment entire pelvic compartments with excellent resolution and avoidance of exposing patients to harmful ionizing radiation[(3-4)]. Unfortunately, it is not widely available, costly, not appropriate for patients with claustrophobia, metal implants or pacemakers, hence a need for alternative imaging tool with reliable diagnostic capabilities aroused [(5)].

Different techniques of dynamic ultrasonography were addressed by many experts for assessment of pelvic floor disorders including transperineal, transvaginal and transrectal approaches [(6-8)]. EDF is one of these trials that utilized modern technology enabling 3D imaging of posterior and middle pelvic compartments through transrectal approach [(9)].

The aim of the current study was to check reliability and demonstrate concordance of EDF and MRD in assessment of ODS.

MATERIAL AND METHODS

It was a prospective study carried out on 15 patients suffering from ODS recruited from Colo-rectal unit, General Surgery department, Kasr Al-ainy hospital, Cairo University. The study was performed between April 2014 and April 2016 after approving research protocol by ethical committee and obtaining informed written consent from all candidates.

ODS determined based on Rome III criteria was the only inclusion criterion. Secondary constipation, constipation predominant irritable bowel syndrome, organic pathology of colon and rectum, anal stenosis, metal implants and pacemakers were contraindications to inclusion in our study.

All included candidates undergone history taking, physical examination followed by EDF and MRD.

Magnetic Resonance Defecography:

It was performed using 1.5-T pelvic phased array coil (Gyroscan PowerTrak 6000; Philips Medical Systems, Best, the Netherlands). The study was done in supine position without using oral or intravenous contrast.

Static images were obtained using T2-W turbo spin echo (TR/TE, 5000/132 ms; FOV, 240-260 mm; slice thickness, 2-4 mm; gap, 0-0.5 mm; flip angle, 90; matrix, 512 x512) and T2-W balanced fast echo sequences (9.0/4.0; FOV, 220 mm; slice thickness, 3 mm; flip angle, 45; matrix 512x512) in axial, coronal and sagittal planes.

Dynamic images were acquired using balanced fast echo sequence (TR/TE, 5.0/1.6 ms; FOV, 300 mm; gap, 0.0-0.7 mm) in axial, coronal (at rest, during moderate and repeated maximum straining phases) and sagittal planes (at rest, during pelvic floor contraction, mild, moderate and maximum straining and evacuation phases)[10].

Rectocele was defined as protrusion of anterior rectal wall and its size is measured perpendicularly to the expected normal contour of rectal wall. Size of rectocele is classified into 3 grades: < 2cm, 2-4 cm and > 4 cm.

Different pelvic compartments are assessed for presence of perineal descent which is measured perpendicularly between pubococcygeal line (PCL) drawn from lower limit of symphysis pubis to last coccygeal joint and bladder neck for cystocele, uterine cervix for uterocele and anorectal junction for anorectal descent at rest, straining and evacuation phases. Length of descent in any compartment is classified into 3 grades: < 3cm, 3-6 cm and > 6 cm.

Anismus is diagnosed by evaluating anorectal angle (ARA) at rest and evacuation. ARA which is the angle between anal canal line drawn at longitudinal axis of anal canal and rectal line drawn at posterior rectal wall does not increase or even decrease in anismus. Infolding of rectal wall inside anal canal during evacuation is diagnosed as anorectal intussusception. Enterocele can be identified by presence of peritoneal sac containing bowel loops in rectovaginal or rectovesical pouch.

Echodefecography

It was performed using B & K Medical Systems Pro Focus 2202® scanner and B-K 2050® probe (B-K Medical, Herlev, Denmark) with automatic scanning (50s duration and 6.0 cm proximal to distal length); frequency, 10-16 MHz; and focal distance, 2.8-6.4 cm. The study was done in left lateral position 2 hours after rectal enema.

4 scans were performed following technique created by Murad-Regadas et al. [9, 11].

First scan is done with patient at rest and probe placed for 6 cm inside anal canal to inspect for occult injuries of anal sphincter complex.

The second scan is carried out with probe located proximal to PR muscle and patient is resting for 3 seconds then asked to strain. The scan is stopped when PR muscle appears again after straining to measure the distance of perineal descent with straining.

The third one is performed while the patient is resting for 15 s. then strain for 20 s. and lastly reverts to resting state for 15 s. and probe located 6 cm from anus to evaluate anismus by observing movements of puborectalis during rest and straining and also check for presence of anorectal intussusception.

The last scan is similar to previous scan regarding alternation between rest and straining but it is done after transanal injection of 120-180 ml of gel and probe inserted for 7 cm from anal verge to identify presence of rectocele and measure its size besides it confirms existence of other disorders identified by the former scan.

Rectocele is assessed in sagittal plane and its size is determined by measuring distance between 2 lines corresponding to anterior rectal wall during start of straining and maximal straining.

Perineal descent is identified in sagittal plane by calculating length of > 2.5 cm between inner border of puborectalis at rest and after maximal straining (Figure 1)

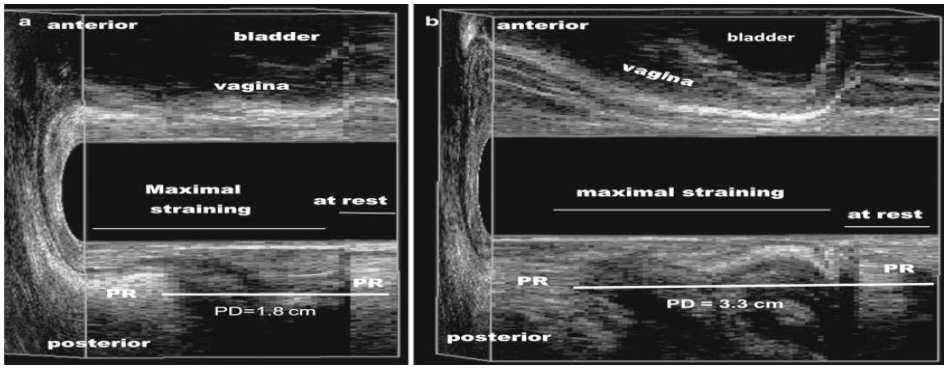

Fig. 1: Puborectal descent (PD) measured in the sagittal plane. (a) Normal perineal descent ≤2.5 cm; (b) pathologic perineal descent >2.5 cm. *PR* puborectalis. Scans obtained by 2050 transducer (B-K Medical)**.**[9]

Anismus is diagnosed by observing change between rest and straining of an angle drawn in axial plane between 2 lines starting at external border of probe at 3 & 9 o'clock and meeting at 6 o'clock at inner border of puborectalis which becomes more obtuse due to contraction of puborectalis which gets closer to the probe (Figure 2). Alternatively, it can be diagnosed in sagittal plane by drawing an angle between a horizontal line parallel to inner border of puborectalis and another vertical one which becomes more acute as puborectalis gets closer to the probe.

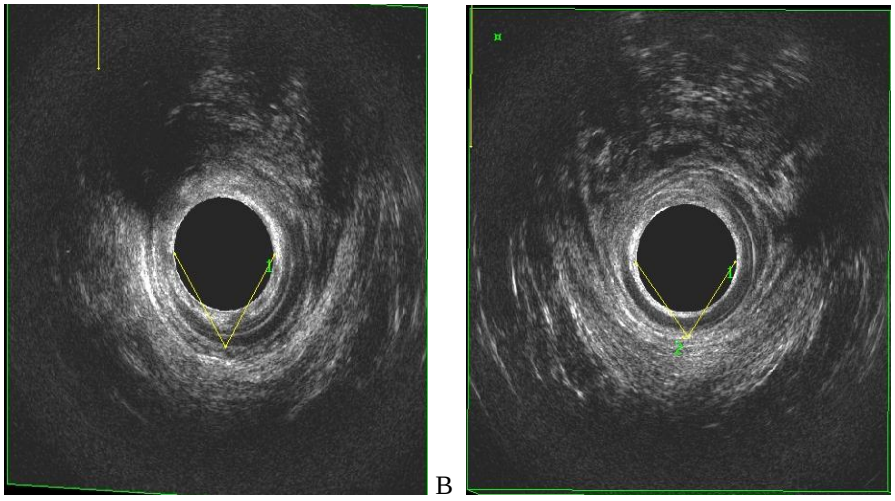

Fig. 2: Anismus: axial plane: A: at rest (Angle =63.5º), B: during straining (Angle = 72º) (case series)

Anorectal intussusception is determined by finding 2 parallel muscle layers in axial, sagittal or diagonal planes during straining (Figure 3).

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Visualization of bowel loops in front of anterior rectal wall in axial plane is diagnostic of enterocele

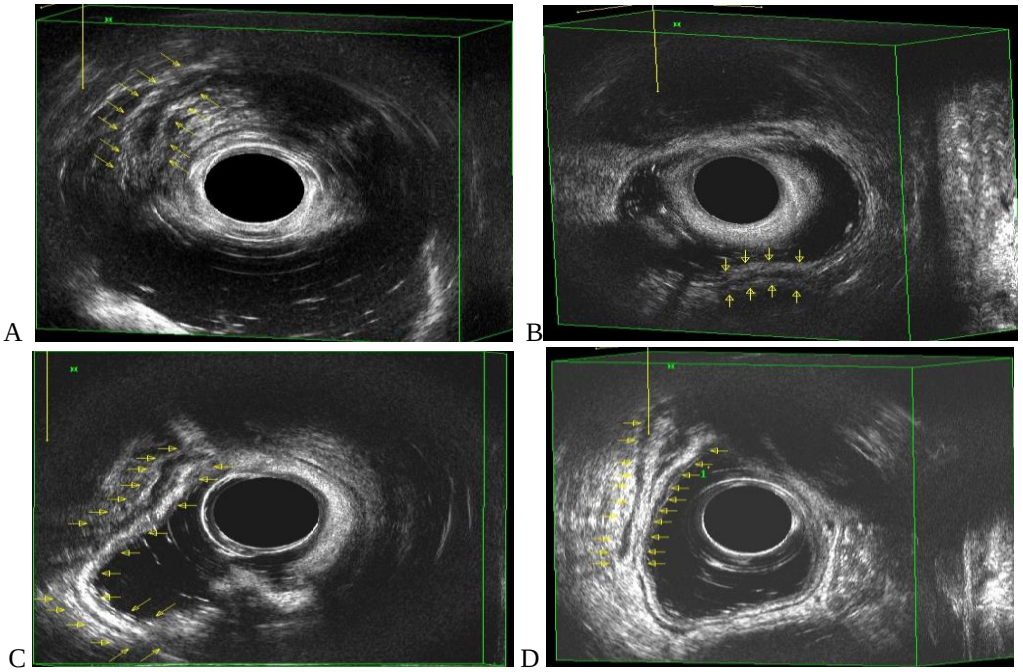

Fig. 3: Anorectal Intussusception (axial plane) A Anterior B Posterior C Hemi-circumferential D Circumferential

Kappa (κ) statistic was used to test agreement between both modalities. Strength of agreement was considered moderate, good and very good with κ value 0.41-0.60, 0.61-0.80 and 0.81-1.0 respectively. Sensitivity, specificity, +ve predictive value, -ve predictive value was calculated for evaluation of overall accuracy. Statistical comparisons were considered significant with P value less than 0.05. Computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006) was used for all statistical calculations.

RESULTS

Rectocele was detected in 11 patients (73.33 %) (6 cases [40%] were diagnosed by both modalities and 5 cases [33.33%] were diagnosed by only one modality) and 4 patients (26.67%) were considered normal by both modalities. Fair statistical agreement was shown between both modalities regarding detection of rectocele *(κ value 0.324*).

14 patients (93.33%) were diagnosed as having anorectal descent (10 cases [66.67%] were detected by both modalities and 4 cases [26.67%] were detected by only MRD) and 1 patient (0.06%) was normal at both modalities. Fair statistical agreement was demonstrated between both modalities regarding diagnosis of anorectal descent *(κ value 0.250*).

6 cases (40%) were identified as having anismus by EDF only and 9 patients (60%) were considered normal by both modalities. Anorectal intussusception was diagnosed in 10 cases (66.67%) by EDF only and 5 patients (33.33%) were considered normal by both modalities. 4 cases (26.67%) were diagnosed as having enteocele by EDF only and 11 cases (73.33%) were considered normal by both modalities. No statistics were computed regarding detection of anismus, anorectal intussusception or enterocele because MRD is constant.

MRD identified 7 cases of cystocele and 5 cases of uterocele but EDF did not detect any of them and no statistics were copmuted as EDF is constant.

Table (1) demonstrates comparison between the accuracy of EDF and that of MRD in detection of various defecatory disorders.

Table 1: Accuracy of EDF compared to MRD in assessment of ODS

	Sensitivity	Specificity	+(ve) PV	-(ve) PV	Accuracy
Rectocele	75	57.14	66.67	66.67	66.67
Anorectal Descent	71.43	100	100	20	73.33
Anismus	---	60	0	100	60
Intussusception	---	33.33	0	100	33.33
Enterocele	---	73.33	0	100	73.33

DISCUSSION

Dynamic imaging of pelvic floor and anorectum represents an integral part of assessment and decision making in patient suffering from ODS. MRD superseded CD which was the gold standard exam for long period due to the ability of the former to depict all anatomical structures concerned with defecation and avoidance of exposure to ionizing radiation.

Lack of availability, high cost and inappropriateness of MRD to some patients with claustrophobia or those with metal implants and pacemakers induced experts to use ultrasonography in assessment of ODS. Many ultrasonographic techniques were described including trans-perineal, trans-vaginal and trans-rectal approaches. EDF is transrectal exam utilizing 3D automatically scanning probe that allows for dynamic evaluation of posterior and middle pelvic compartments.

The current literature contains many studies comparing diagnostic capabilities of EDF or MRD in relation to CD. Most of previous studies comparing MRD to CD or cystocolpoproctography (CCP) showed similar detection rates of different defecatory disorders including rectocele, perineal descent and anismus but superior diagnostic capability of MRD regarding global assessment of entire pelvic compartments [(12-14)].

Other trials compared different approaches of dynamic ultrasonography of pelvic floor to CD or CCP revealed good agreement between dynamic ultrasound whether transperineal or transvaginal and CD for the diagnosis of rectocele, rectoanal intussusception, and rectal prolapse [(15, 16)].

Dynamic transrectal ultrasound was described using different generations of machines (2D or 3D) and filling rectal lumen with water or US gel. Trials addressing transrectal ultrasonography vs. CD demonstrated reliability of different techniques in detection of posterior pelvic floor disorders [(9, 17, 18)].

The only study that studied dynamic 2D anorectal ultrasonography and MRD was in comparison to CD as the gold standard exam demonstrated equivalent diagnostic performance of both modalities in comparison to CD [(5)].

To the best of our knowledge, this is the first study to directly compare reliability and concordance of EDF and MRD. The present study demonstrated fair agreement and comparable accuracy between EDF and MRD regarding diagnosis of rectocele and anorectal descent.

On the contrary, MRD detected 7 cases of cystocele and 5 cases of uterocele while EDF did not detect any of these cases as the probe even with using the maximum focal distance is incapable of visualizing the anterior pelvic compartment, however EDF showed greater sensitivity for detection of anismus, anorectal intussusception and enteroceles.

This may be explained for anismus by the more objective way of ultrasonography for following movements of puborectalis muscle. Difference in position of the patient during exam and better delineation of rectal wall layers may be the reasons for higher sensitivity of EDF for detection of enteocele and intussusception respectively.

Performing exam in left lateral position and using US gel which has a different consistency from that of stools were claimed to be non-pysiological conditions of EDF however all patients experienced sufficient defecation urge after injection of US gel and were able to evacuate it even with the probe is intrarectal. All patients were more satisfied and less embarrassed with EDF than MRD as it preserves the patient's privacy.

The probe used in our study differs from previous generations of ultrasonographic probes as it enables scanning of lower rectum and anal canal without much manipulations and records

about 300 axial images then reconstructs them in 3D cube that can be analyzed in sagittal, coronal and diagonal planes after ending the exam.

Although EDF is incapable of examining anterior pelvic compartment, it can be used as screening exam of middle and posterior compartments and other modalities as transperineal ultrasonography can be combined with it depending on patient complaints and clinical examination.

Interobserver agreement for EDF has to be evaluated in future studies however it is a simple exam and can be easily grasped provided that prior expertise of basics of transrectal ultrasonography and various pelvic floor dysfunctions does exist.

Availability of this modality to be used by colorectal surgeons has a great privilege of judging radiological data based on intraoperative findings.

CONCLUSION

EDF showed reliable detection of rectocele and anorectal descent and higher sensitivity for diagnosis of anismus, intussusception and enteroceles compared to MRD. It has optimal cost-benefit with high patient tolerance, safety and widespread availability.

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