3D Dynamic Ultrasound In Obstructed Defecation

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Introduction

- Pelvic floor is complex system, with passive and active components that :
  - provide pelvic support
  - maintain continence
  - coordinate relaxation during urination and defecation
- Obstructed defecation syndrome :
  - It is best defined as normal desire to defecate but inability to satisfactorily evacuate rectum.
  - It falls under more general term “constipation.”
- Constipation is a nationwide health problem that significantly impairs health-related quality of life
- The term constipation is all encompassing and portrays little information about underlying etiology or potential treatment options
- It is far better to divide patients with constipation into primary and secondary types

Constipation

- **Primary versus secondary constipation**

  Patient with symptoms of impaired evacuation must be evaluated for 2ry causes for constipation such as :
  - **Mechanical causes** e.g. Rectal or colon cancer
  - **Endocrine or metabolic disorders** e.g. Hypothyroidism, diabetes, hypercalcemia
  - **Neurologic diseases** e.g. Multiple sclerosis, parkinson's disease
  - **Medications** e.g. Opiates, analgesics, antidepressants
  - **History of sexual abuse** should be considered in women with anismus

- **Primary constipation due to physiologic dysfunction can be divided into**
  - Normal transit constipation
  - Slow transit constipation
  - Pelvic floor disorders

Subtypes of primary constipation

❑Normal transit constipation

patients have normal transit times through colon but have perception of constipation due to evacuation difficulties or due to hard stool.

❑Slow transit constipation

propulsion of intraluminal contents is delayed in portions of colon or throughout entire colon.

❑Pelvic floor disorders

•Functional disorders → Dyssynergic Defecation (Anismus)

•Structural disorders:

- ✓ Rectocele
- ✓ Rectal intussusception
- ✓ Enterocele
- ✓ Descending Perineum Syndrome

Rome III criteria for diagnosis of functional constipation

Criteria must be present for at least 3 months with symptom onset at least 6 months prior to diagnosis:

1. **Must include two or more of following:**
   - < 3 bowel movements / week.
   - Straining at ≥25% of defecations.
   - Lumpy or hard stools at ≥25% of defecations.
   - Sensation of anorectal obstruction at ≥25% of defecations.
   - Sensation of incomplete evacuation at ≥25% of defecations.
   - Manual disimpaction at ≥25% of defecations.

2**. Absence of loose stools without laxatives.**

3. **Inadequate criteria to diagnose constipation-predominant irritable bowel syndrome (IBS-C).**

Background & Rationale

- In ODS, clinical history & examination → mainstay of diagnosis
- To be combined with physiological tests and imaging techniques
- No clear recommended imaging guidelines for assessment of patients with ODS.
- Evacuation disorders are caused by morphologic & functional abnormalities → dynamic imaging techniques

Conventional defecography

- **Gold standard examination**
- **Pros & Cons**

✓Minimally invasive

✓Technically simple

✖ Radiation exposure

✖ Specific radiology environment

✖Doesn't show anatomical structures involved in defecation

✖Limited ability to detect anterior and middle compartment's abnormalities

- **Need to evaluate pelvic floor as a unit arised**

→ due to association of defecatory disorders with POP in females

- **Evaluation extended by opacifying S.bowel, vagina & U.B.**
  - Examination complexity
  - Procedural invasiveness
  - Time consuming
  - Poor tolerability
  - Considerable dose of radiation exposure
- **Recently, alternatives to defecography developed e.g.**
  - Dynamic MRI
  - Dynamic ultrasonography
- **Relative advantages**
  - Showing the entire pelvis
  - Ability to evaluate anal sphincter defects

Dynamic MRI:

- Open or closed-configuration unit.
- Open system is more physiological but not widely available.
- Avoids exposure to harmful ionizing radiation.
- Allows excellent visualization of surrounding soft tissues and support structures of pelvic organs
- The use of MRI is restricted by
  - availability
  - cost
  - supine position (less suitable for identifying abnormalities)
- It is not as dynamic as ultrasound imaging.

Dynamic US:

- **Advantages**
- Excellent efficiency in assessment of
  - ✓ Anal sphincter defects
  - ✓ Ano-perineal suppuration
  - ✓ Anal canal tumors
- Interesting results in evaluation of pelvic floor disorders
- Low cost, availability and simplicity
- **Different approaches are available** e.g.
  - Transperineal
  - Transvaginal
  - Transrectal (2D vs 3D endoprobe, injecting water vs gel)
- Studies using different approaches produced findings **consistent with defecography** in assess. ODS

Echodefecography:

- **Murad-Regadas et al.** Developed echodefecography, 3D dynamic anorectal ultrasonography technique
- Using a 360° transducer, automatic scanning and high frequencies for high- resolution images
- To evaluate evacuation disorders affecting :
  - Posterior compartment (rectocele, intussusception, anismus)
  - Middle compartment (grade II or III sigmoidocele/enterocele)
- The standardization of the technique, parameters, and values of echodefecography makes the method reproducible

Aim of the study

compare accuracy of

Dynamic Anorectal Endosonography

(Echodefecography)

with

1. Dynamic MRI defecography
2. Conventional defecography

in the diagnosis of pelvic floor disorders.

Echodefecoraphy Technique

- Patients are examined in the left lateral position after rectal enema.
- The endoprobe is inserted into the lower rectum and positioned 6–7 cm from the anal verge.
- Images are acquired by four automatic scans and analyzed in axial and 3D midline longitudinal (ML) planes

Scan 1

- **Transducer position:** 6cm from anal margin.
- **Structures scanned:** lower rectum, anorectal junction, anal canal→ **AT REST**
- **Aim:** 3D examination of anatomical configuration of anal canal for checking muscle injury.

Scan 2

•**Transducer position:** 6cm from anal margin.

•**Structures scanned:** lower rectum, anorectal junction, anal canal→ **AT REST&STRAINING**

- 15s. → ***at rest:*** lower rectum.
- 20s. → ***during straining:*** lower rectum, anorectal junction, upper & proximal mid-anal canal.
- 15 s. → ***at rest:*** distal mid & lower anal canal.

•**Aim:** Evaluation of PR movement during evacuation → normal relaxation or paradoxical contraction(anismus).

Scan 3

•**Transducer position:** 7cm from anal margin.

•**Structures scanned: the same as scan 2 but at 7 cm**.

•**Aim:** Scan is more proximal for dectection of rectal invagination. This is confirmed in next scan.

Scan 4

•**<u>Transducer position</u>:** 7cm from anal margin.

•**<u>Structures scanned</u>: the same as scan 3 but after injection of 120-180 ml gel into rectal ampulla.**

•**<u>Aim</u>:** Demonstrating & quantifying anatomical & functional changes of all structures (anal canal, anorectal junction and pelvic floor) associated with voiding.

- squatting position is most physiological but **inadequate and uncomfortable** for exam using a 3D endoprobe
- left lateral position & inserting endoprobe into rectum → **didn't prevent patients from evacuating intrarectal gel**
- Sufficient distension of anorectum by max. 180 ml gel → **induce voiding urge**
- **It keeps patient's privacy** → allows efficient evacuation (unlike evaluation by other modalities which is regarded embarrassing)

Image Interpretation
Anismus:

(1)Axial plane:

- Transducer position at PR level
- Angle is made by drawing 2 diagonal lines from 3 & 9 o'clock at internal circumference of transducer and converge at 6 o'clock at internal border of PR muscle.
- Angle is compared at rest & during straining.
- Normal: The angle is relatively closed due to PR relaxation.
- Anismus: ***The angle is wider*** due to paradoxical contraction of PR.


A


B

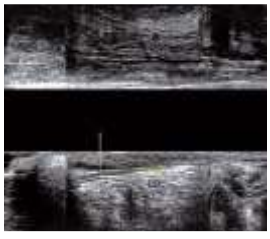
Patient with anismus (axial): A Resting. B Evacuatory effort→ **Increased angle**.

Anismus

(2)Sagittal plane:

- Angle is made by convergence of 1.5cm line parallel to internal border of PR muscle & vertical line perpendicular to axis of anal canal.
- Angle is compared at rest & during straining
- Normal: the angle is widened due to PR relaxation.
- Anismus: ***The angle is narrowed*** due to paradoxical contraction of PR.


A



Patient with anismus(sagittal): A Resting. B Evacuatory effort → **Decreased angle**.

Anorectocele:

- **Sagittal plane:→ Scan 4**

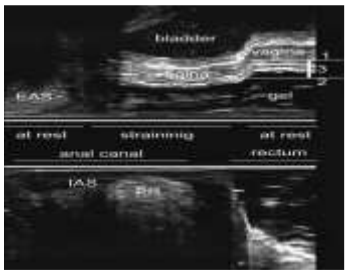
➢Normal: During straining the posterior vaginal wall displaces the anterior rectal wall, anorectal junction and upper anal canal backwards and downwards.

➢Anorectocele: during straining the anterior rectal wall, anorectal junction and upper anal canal displace the posterior vaginal wall forwards.

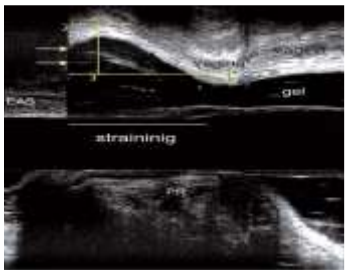
➢Distance is measured between 2 parallel lines drawn on the projection of posterior vaginal wall at initial straining and maximal straining (herniation)→ Size of anorectocele.

➢Echodefecographic classification:

- grade1: 0.2-0.6cm.
- grade2: 0.7-1.3cm.
- grade3: >1.3cm.

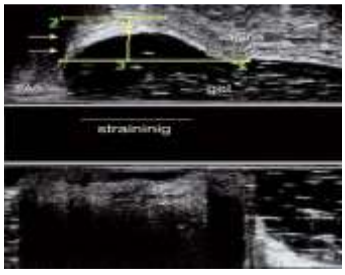


A



B

C



D

a Normal patient: Line 1: parallel with the vaginal wall at rest. **Line 2:** parallel with the vaginal wall during straining. **Line3:** distance between lines 1 and 2 (arrow).
b Patient with anorectocele grade III: c Patient with anorectocele grade I, d Patient with anorectocele grade II
Line 1: parallel with the vaginal wall during initial straining. **Line 2:** parallel with the vaginal wall at maximal herniation point. **Line 3:** distance between lines 1 and 2 (anorectocele size) (arrows).

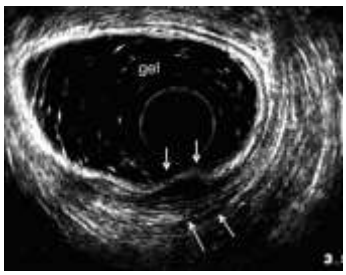
Intussusception:

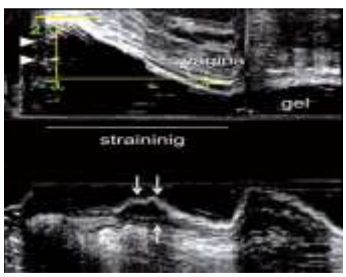
•Easily identified when two parallel muscle layers are visualized in the axial and longitudinal planes during straining without intrarectal gel → **Scan 3.**

•When intrarectal gel is employed the two muscle layers are seen projecting into the rectal lumen →**Scan 4.**

•Minor intussusception → small displacements with practically **parallel** muscle layers

•Severe cases → muscle layers are further displaced and appear **perpendicula**r to each other.





Patient with anorectocele grade III (*arrowheads*) **with posterior rectal intussusception** (*arrows*).

a Axial image without gel.

b Axial image with gel

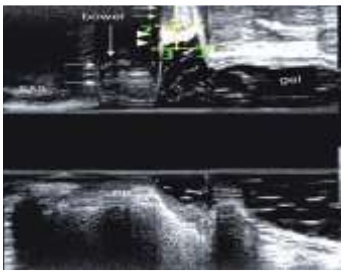
c Mid sagittal image with gel

Enterocele

•The intestinal loops are usually visualized on the projection of the anterior quadrant of the mid to lower rectum close to the bladder and the uterus, even during straining.

•Enterocele is identified by the presence of intestinal loops on the projection of the lower rectum and upper anal canal at the level of the PR muscle and is easily observed in the axial and longitudinal planes →**scans 2, 3&4.**

A



B

Enterocele (*arrows*) with anorectocele grade II (*arrowheads*).
a Axial image without gel. **b** Mid sagittal image with gel.

Perineal Descent

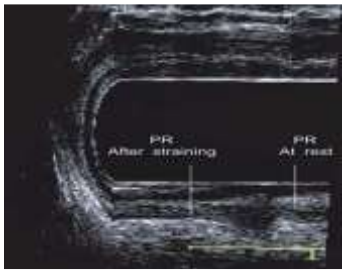
•The transducer is positioned proximally to the PR muscle.

•The PR muscle is initially scanned at rest (3 s), then during straining.

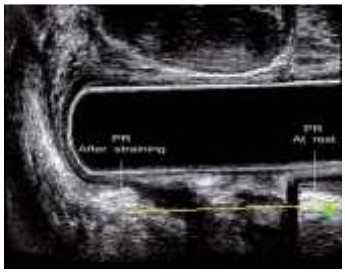
•The transducer does not follow the descending muscles of the pelvic floor but remains in the same position until the PR muscle becomes visible distally, then the scan is stopped.

•Straining time is directly proportional to the distance of perineal descent.

•The perineal descent length is quantified by measuring the distance between the position of the proximal border of the PR muscle at rest and at the point it is identified again after being displaced due to the evacuatory effort.



A



B

a Normal patient, mid sagittal plane.
b Patient with perineal descent. Increased distance between both positions of the puborectalis muscle

Patients & Methods

- Prospective randomized controlled study
- April 2014 - April 2016
- 30 patients (10 males and 20 females)
- Mean age of 39 years (14 – 76 years)
- Divided into 2 equal groups:
  - **Group A:**
    - 11 females & 4 males with a mean age of 41.4 years
    - underwent echodefecography and MR defecography
  - **Group B:**
    - 9 females & 6 males with a mean age 36.7 years
    - underwent echodefecography and cinedefecography.

Patients & Methods

➢**Inclusion criteria**

•Dyschezia for at least 6months

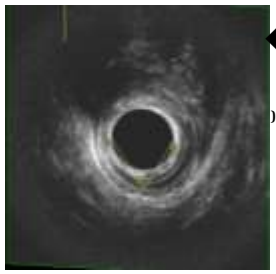
•Defined according to Rome III criteria

- ✓Excessive straining,
- ✓Lumpy or hard stools
- ✓Sensation of incomplete evacuation of stools
- ✓Sensation of anorectal obstruction
- ✓Manual disimpaction of stool, or vaginal maneuvers to assist defecation

➢**Exclusion criteria**

- Any organic pathology of the colon or rectum detected by clinical examination or colonoscopy
- Pregnancy
- Anal incontinence
- Refusal to undergo evaluations,
- Contraindications to performance of MRI E.G. Prothetic valve
- Contraindications to performance of EAUS E.G. Anal stenosis

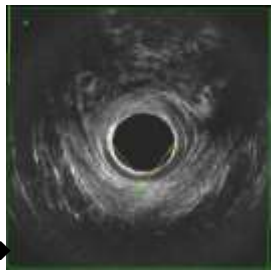
Anismus

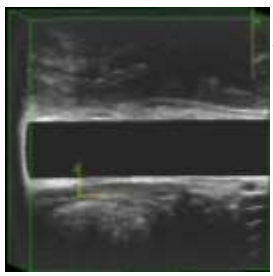


Angle at rest =**63.5**

Axial plane

Angle during straining = **72**

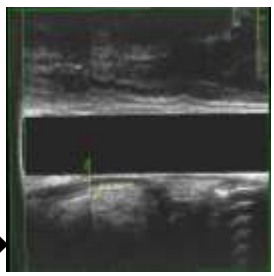




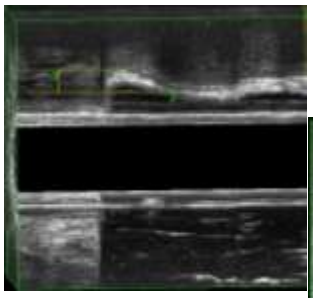
Angle at rest =**90.6**

Sagittal plane

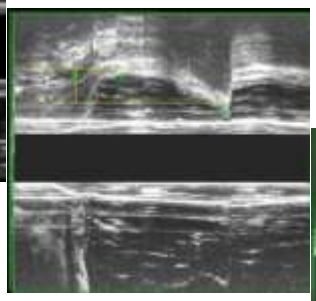
Angle during straining = **80.5**



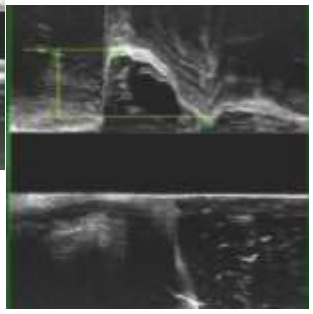
Rectocele



Grade 1
Size= 0.54 cm



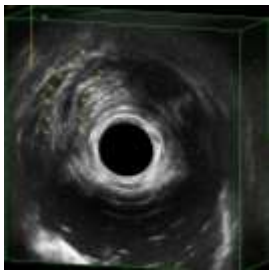
Grade 2
Size= 0.87 cm

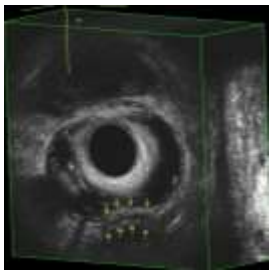


Grade 3
Size= 1.57 cm

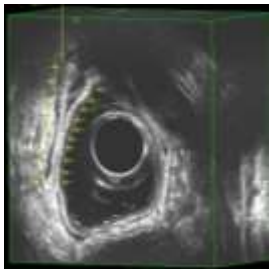
Intussusception

Anterior



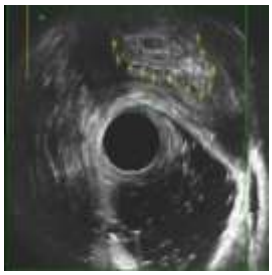


posterior



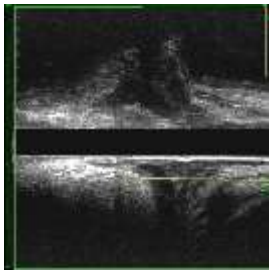
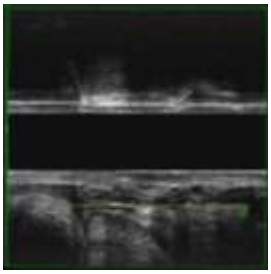
Circumferential

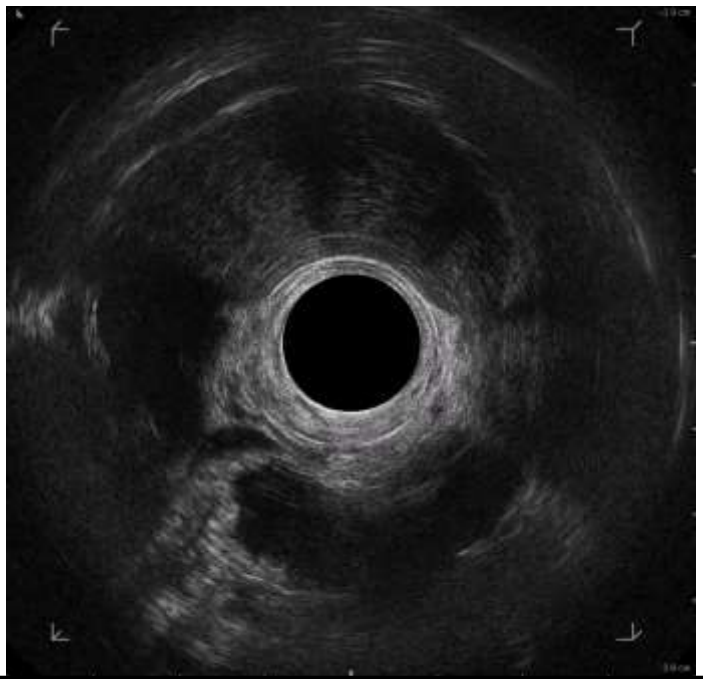
Hemi-circum

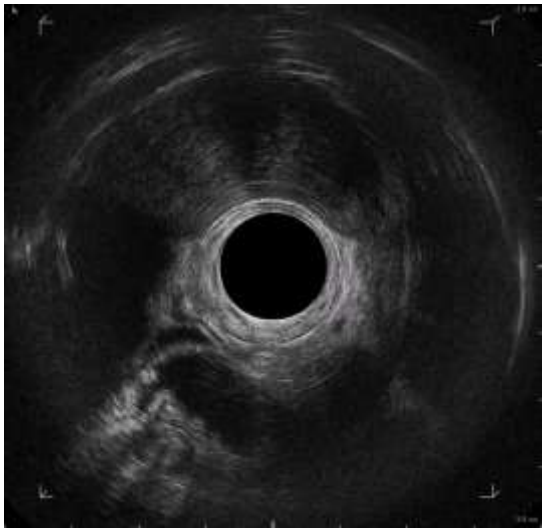


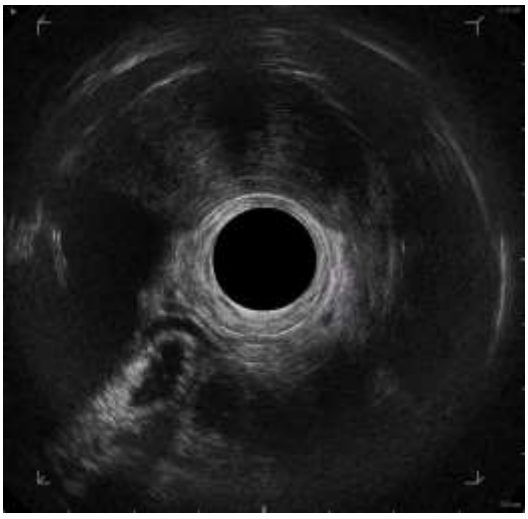

← **Enterocele**

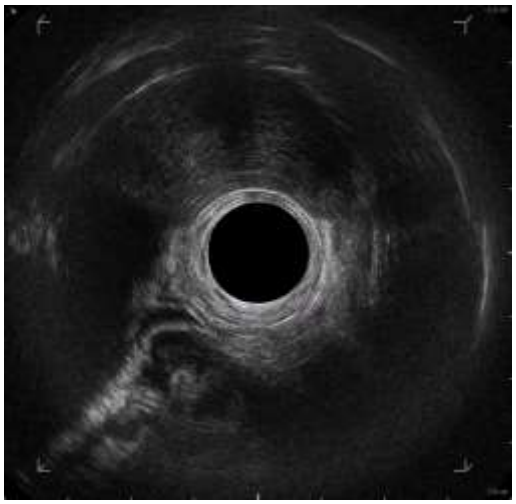
Anorectal Descent➔

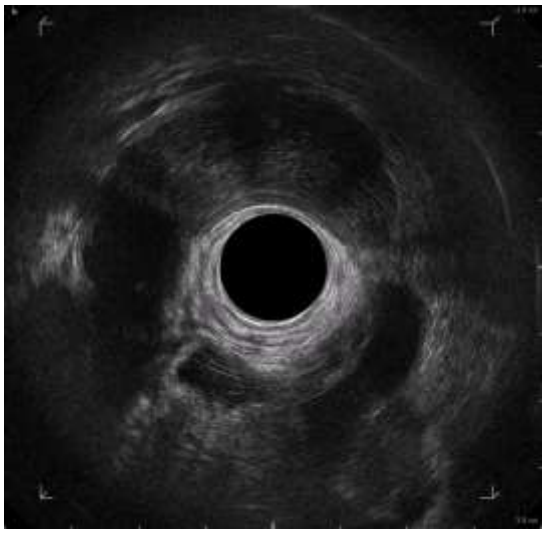













Results → Group A

Echodefecography (EDF) identified

- Anismus in **6** cases (40%)
- Rectocele in **9** cases (60%)
- Intussusception in **10** cases (66.7%)
- Enterocele in **4** cases (26.7%)
- Anorectal descent in **10** cases (66.7%)

MR defecography (MRD) identified

- Rectocele in **8** cases (53.3%)
- Anorectal descent in **14** cases (93.3%)
- Cystocele in **7** cases (46.7%)
- Uterocele in **5** cases (33.3%)
- No anismus, intussusception or enterocele were detected

➢ **No significant statistical difference between EDF and MRD**
→ Rectocele and anorectal descent *(P* value **0.205**, **0.143** respectively)

➢ **No statistics were computed in comparing EDF and MRD**
→ Anismus, intussusception and enterocele as MRD was constant

Results → Group B

➢ **Echodefecography (EDF) identified**
- Anismus in **3** cases (20%)
- Rectocele in **13** cases (86.7)
- Intussusception in **12** cases (80%)
- Enterocele in **2** cases (13.3%)
- Anorectal descent in **7** cases (46.7%)**.**

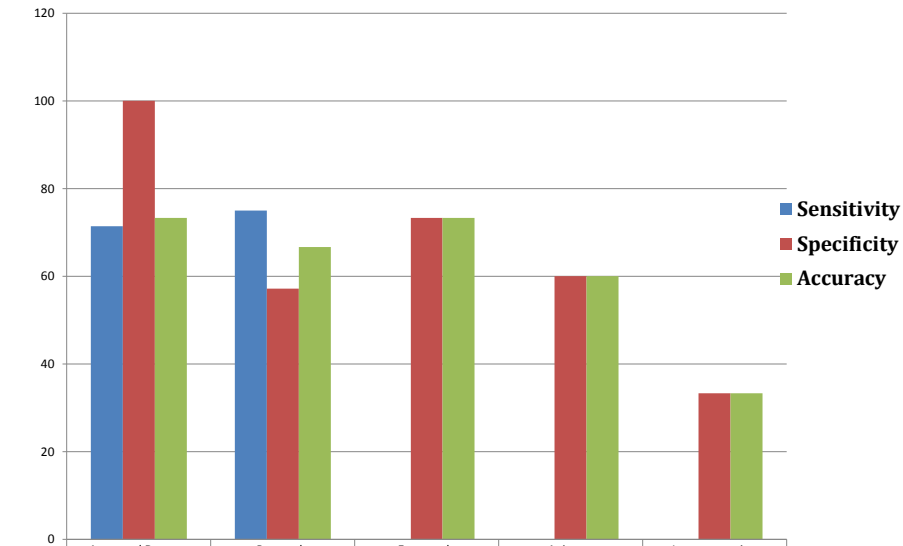
➢ **Cinedefecography (CDF) identified**
- Anismus in **2** cases (13.3%)
- Rectocele in **14** cases (93.3%)
- Intussusception in **1** case (6.7%)
- Anorectal descent in **11** cases (73.3%)
- No enterocele was detected.

➢ **No significant statistical difference between EDF & CDF**
→Anismus (*P* value **0.225**)

➢ **Statistical agreement between EDF & CDF**
- Good → rectocele (κ value 0.634)
- Moderate → anorectal descent (κ value 0.483)
- Poor → intussusception (κ value 0.035)

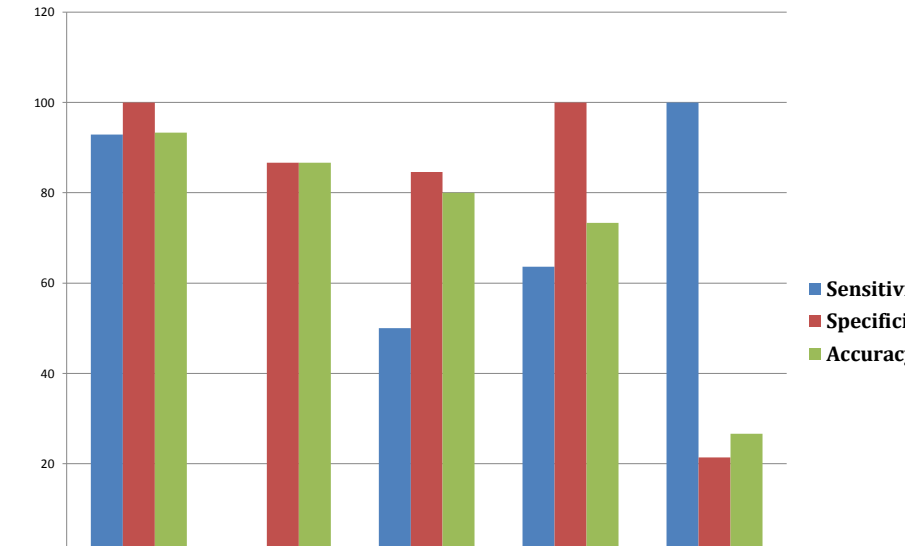
➢ **No statistics were computed in comparing EDF & CDF**
→enterocele as CDF was constant

Accuracy of EDF in comparison to MRD



	Anorectal Descent	Rectocele	Enterocele	Anismus	Intussusception
Sensitivity	71.43	75	0	0	0
Specificity	100	57.14	73.33	60	33.33
Accuracy	73.33	66.67	73.33	60	33.33

Accuracy of EDF in comparison to CDF



	Rectocele	Enterocele	Anismus	Anorectal Descent	Intussusception
Sensitivity	92.86	0	50	63.64	100
Specificity	100	86.67	84.62	100	21.43
Accuracy	93.33	86.67	80	73.33	26.67

Conclusion

- Echodefecography has good accuracy of detection of rectocele and anorectal descent when compared with cinedefecography and MR defecography.
- It identified more cases of anismus, intussusception and enterocele than did the other 2 modalities.
- It has the advantages of being
  - simple
  - inexpensive,
  - available
  - easy to perform with fast learning curve
  - well tolerated by patients
- It is better than cinedefecography
  - visualize all anatomic structures involved in defecation
  - avoid exposing patients to harmful radiation.
- Also, it is superior to MR defecography in detection of anal sphincter complex defects which is important to be assessed before surgical management.

THANK YOU