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Role of Endoanal Ultrasound in The Assessment of Causes of Anal Pain in Correlation with MRI

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ABSTRACT

Background: Anal pain is a frequent, non-specific symptom with diverse etiologies. Accurate imaging is critical for diagnosis and treatment planning. Endoanal ultrasound (EAUS) and magnetic resonance imaging (MRI) are commonly employed tools.

Aim: This study aimed to compare the diagnostic performance of EAUS and MRI in evaluating causes of anal pain, particularly perianal fistulas.

Methods: This prospective study, 30 patients presenting with anal pain were evaluated between March 2022 and November 2024. All patients underwent detailed history-taking, clinical examination, EAUS, and MRI fistulography. Diagnostic accuracy for identifying fistulous tracts, internal openings, and complications was assessed. MRI served as the reference standard, and EAUS results were compared using McNemar's test and diagnostic indices.

Results: Among the 25 patients ultimately diagnosed with anal fistula, EAUS detected primary tracts in 80% compared to 96% by MRI. Sensitivity and specificity of EAUS for detecting primary tracts were 83.3% and 100%, respectively. EAUS identified internal openings in 72% of cases with a sensitivity of 93.3%. Detection of complications such as abscesses showed 87.5% sensitivity and 100% specificity. EAUS had limited value in evaluating high or complex fistulas. In rare non-fistulous causes such as anal cancer and proctalgia fugax, both EAUS and MRI provided complementary insights.

Conclusion: EAUS offers high diagnostic accuracy in evaluating superficial anal pathologies and internal openings and is a valuable first-line, cost-effective imaging modality for anal pain, especially when MRI is contraindicated. However, MRI remains superior for detecting complex and high perianal fistulas.

Keywords: *Anal pain, Endoanal ultrasound, MRI, Perianal fistula*

1. INTRODUCTION

Anal pain is a common, nonspecific but potentially highly debilitating symptom, with significant impairment in quality of life, psychological distress, and inability to work. It affects between 6.6% and 11.6% of the population, though only about a third of patients consults a physician and it is present in a wide range of different disturbances and pathologies. It is frequently considered as an idiopathic problem but in some cases it could be due to nonfunctional or organic diseases, which can be identified in about 15% of patients (1).

There are 3 main diagnostic categories for chronic anal pain: local causes, functional anorectal pain, and neuropathic pain syndromes (2).

Anal fistula is one of the most common anorectal diseases. The prevalence is greater in men than women, with a rate of 12.3 cases per 100,000 and 5.6 cases per 100,000, respectively. The average age at diagnosis is 38 years, with most occurring between 20 to 40 years of age (3).

Ultrasound (US) and magnetic resonance imaging (MRI) are valuable tools for anal canal assessment. The US is a safe technique that can currently rely on three different approaches for evaluating anal canal, transperineal, endovaginal, andendoanal; however, its performance strictly depends on the operator's experience and it has a limited field of view. MRI

has become a cornerstone in the evaluation of the anal canal and the adjacent structures as it provides a multiplanar assessment with high spatial resolution (4).

With endoanal (EAUS), it has become possible to demonstrate clearly the morphology of the anal sphincter complex and to detect sphincter disruptions or defects (5).

The goal of this study was to compare the role of endoanal ultrasonography and MRI in evaluating causes of the anal pain. One of the most important causes is primary fistula, in which we evaluate tract, internal opening, secondary extensions, and complications of the perianal fistula.

2. PATIENTS AND METHODS

Patients: Between March 2022 and Nov 2024, 30 patients presenting with anal pain enrolled in this prospective study.

Inclusion criteria: Patient presenting with anal pain.

Exclusion criteria: Contraindications to MRI examination: Patients with heart pacemaker, Patients with severe claustrophobia and Patients with a metallic foreign body in their eye or an aneurysm clip in their brain.

Methodology:

Informed consent was obtained from the all patients and were subjected to the following:

History taking

Detailed history taking was obtained, every patient had to answer several questions as the following: Symptoms of perianal discharge, pain, discomfort and Possible risk factors as recent operation or previous perianal fistula.

Examination: All the patients were subjected to endoanal ultrasound followed by MRI fistulography.

Endoanal ultrasound

All examinations were performed by BK medial systems scanner 1202 (BK, Herlev, Denmark) with a model 2052 transducer equipped with automated multifrequency crystals (11.9 MHz), with 360 mechanical rotations, Fractional band with 96.2 % and stainless steel reflector. Further 3D processing of the images was done using B.K 3D viewer software version 7.0.0.519. With no need for bowel preparation or anasethsia, all patients were evaluated in the lateral decubitus position. The transducer is inserted within the anal canal after being coated with a condom and properly lubricated. The transducer was advanced till the U-shaped sling of the puborectalis, then automatically withdrawn to the superficial perianal plane. The transducer should be positioned so that the anterior aspect of the anal canal is superior on the screen at the 12-o'clock position, the left aspect at 3 o'clock, the posterior aspect at 6 o'clock, and the right aspect at 9 o'clock.

Three scan planes were acquired:

The deep plane represents the anal canal's upper third, where the hyperechoic puborectalis muscle has a distinctive U-shaped sling appearnce. The iso to hyperechoic external anal sphincter (EAS) and inner hypoechoic internal anal sphincter (IAS), as well as the transverse perineal muscle markes the intermediate plane. The hyperechoic layer of the subcutaneous section of the external anal sphincter marks the superficial plane, which represented the lower extremity of the anal canal (EAS).

MRI examination

The MRI examinations were done in coronal and axial projections using an Achieva 1.5 Tesla MRI machine with a body coil (using a T2 weighted sequence and a long echo time fat suppressed IR sequence (T2 STIR). T1 & T2 and T2 STIR sequence parameters were used, with a FOV of 450, a 4 mm slice thickness, a 196x256 matrix, and 2 mm interslice gap. To delineate the anal canal and separate the mucosal walls, a small enema tip was used. For distension of the lower rectum, air was administered through this enema tip. The MR pictures were evaluated using the same criteria as the endoanal ultrasound images, but without knowing the EUS results. And then, correlation was made.

Statistical analysis

Statistical analysis was conducted using SPSS 27th edition, categorical variables were presented in count and percentage, while continuous variables were presented in mean, standard deviation, median, minimum and maximum. Comparison of MRI and ultrasound findings were compared using Mcnemar test. Any p value <0.05 was considered significant.

3. RESULTS

Table (1): Demographic characteristics and medical history among the included patients.

	Mean ±SD	**Median (Min-Max)**
Age (years)	41.7±16.2	42 (13-70)
	Count	%

Gender	Female	2	8%
	Male	23	92%
Co-morbidities	No	25	100%
	Yes	0	0%
Previous anal operations	No	17	68%
	Yes	8	32%

The final analysis included 25 patients suspected to have anal fistula and underwent MRI imaging and endoanal ultrasound assessment, they had a mean age of 41.7 years (±16.2), ranging from 13 to 70 years. The median age was 42 years. Most patients were male (92%, n=23), while only 8% (n=2) were female. None of the patients had co-morbidities. Regarding surgical history, 32% (n=8) had undergone previous anal operations, while the remaining 68% (n=17) had no such history.

Table (2): MRI findings among the included patients.

		Count	%
MRI Primary tract	No	1	4%
	Yes	24	96%
Secondary extensions	No	22	88%
	Yes	3	12%
Internal opening	No	10	40%
	Yes	15	60%
Relation to sphincter (location)	Extra-sphincteric	2	8%
	High anorectal	1	4%
	Inter-sphincteric	10	40%
	Trans-sphincteric	11	44%
	No	1	4%
Complication (abscess)	No	18	72%
	Yes	3	12%
	Levator ani extension and collection	1	4%
	Collection	3	12%
Complications	No	18	72%
	Yes	7	28%

MRI identified a primary tract in 96% (n=24) of cases, with secondary extensions present in 12% (n=3). An internal opening was observed in 60% (n=15). The relation of the condition to the sphincter showed the following distribution: 44% trans-sphincteric (n=11), 40% inter-sphincteric (n=10), 8% extra-sphincteric (n=2), and 4% high anorectal (n=1). Abscess-related complications were noted in 12% (n=3), with other complications, including levator ani tension and collection, present in 4% (n=1). Overall, complications occurred in 28% (n=7), while the remaining 72% (n=18) had no complications.

Table (3): Endoanal ultrasound findings among the included patients

Endoanal ultrasound		**Count**	**%**
Primary tract	No	5	20%
	Yes	20	72%
Secondary extension	No	22	88%

	Yes	3	4%
Internal opening	No	7	28%
	Yes	18	72%
Relation to sphincter (location)	No	6	24%
	Inter sphincteric	10	40%
	Trans sphincteric	9	36%
Complication (abscess)	No	18	72%
	Yes	7	28%

Endoanal ultrasound detected a primary tract in 80% (n=20) of patients, with secondary extensions present in 12% (n=3). An internal opening was identified in 72% (n=18). Regarding the location relative to the sphincter, 40% (n=10) were inter-sphincteric, 36% (n=9) trans-sphincteric, and 24% (n=6) had no detectable involvement. Complications such as abscesses were present in 28% (n=7), while 72% (n=18) had no complications.

Table (4): Paired comparison of MRI and Endoanal ultrasound in terms of primary tract detection.

Endoanal ultrasound		**MRI Primary tract**				
		No		**Yes**		**P value**
		Count	**%**	**Count**	**%**	
Primary tract	No	1	100%	4	16.7%	0.125
	Yes	0	0%	20	83.3%	

Among cases without a primary tract on MRI (n=1), 100% (n=1) also showed no primary tract on ultrasound. For cases with a primary tract detected on MRI (n=24), ultrasound identified the tract in 83.3% (n=20) with a p value 0.125. These results highlight a strong correlation between MRI and endoanal ultrasound for primary tract detection.

Table (5): Diagnostic indices of endoanal ultrasound in terms of detection of primary tract.

	Value	**95% CI**
Sensitivity	83.33%	62.616% to 95.265%
Specificity	100.00%	2.500% to 100.000%
AUC	0.917	0.735 to 0.989
Disease prevalence	96.00%	79.648% to 99.899%
Positive Predictive Value	100.00%	
Negative Predictive Value	20.00%	9.272% to 37.950%
Accuracy	84.00%	63.917% to 95.462%

The sensitivity and specificity of detecting a primary tract by endoanal ultrasound were 83.33% and 100%, respectively, with an AUC of 0.917. The positive predictive value (PPV) was 100%, and the negative predictive value (NPV) was 20%. The accuracy of detection was 84%. The low NPV suggests challenges in ruling out the condition when the ultrasound is negative.

Table (6): Paired comparison of MRI and Endoanal ultrasound in terms of internal opening detection.

Endoanal ultrasound		**Internal opening**				**P value**
		No		**Yes**		
		Count	**%**	**Count**	**%**	
Internal opening	No	6	60%	1	6.7%	0.375
	Yes	4	40%	14	93.3%	

MRI detected an internal opening in 15 patients. Among these, ultrasound confirmed the opening in 93.3% (n=14). For cases without an opening on MRI (n=10), ultrasound correctly ruled out an opening in 60% (n=6) with a p value 0.375. This suggests good agreement between the two modalities, with some discrepancies

Table (7): Paired comparison of MRI and Endoanal ultrasound in terms of detection of complications (abscess formation).

		MRI complications				P value
		No		Yes		
		Count	%	Count	%	
US complications	No	17	100.00%	1	12.50%	1.000
	Yes	0	0.00%	7	87.50%	

The table illustrates the relationship between MRI and ultrasound findings regarding complications. When MRI showed no complications (n=17), ultrasound consistently agreed, detecting no complications in 100% of these cases. However, for patients with complications identified by MRI (n=8), ultrasound detected complications in 87.5% (n=7), while it failed to detect them in 12.5% (n=1). The P-value is 1.000, indicating no statistically significant difference between the two modalities in detecting complications. This suggests a high level of concordance between MRI and ultrasound for identifying complications.

Table (8): Diagnostic indices of endoanal ultrasound in terms of detection of complications (abscess formation).

	Value	**95% CI**
Sensitivity	87.50%	47.349% to 99.684%
Specificity	100.00%	80.494% to 100.000%
AUC	0.938	0.764 to 0.995
Disease prevalence	32.00%	14.950% to 53.500%
Positive Predictive Value	100.00%	
Negative Predictive Value	94.44%	73.102% to 99.068%
Accuracy	96.00%	79.648% to 99.899%

Ultrasound demonstrated excellent diagnostic performance in identifying complications. Sensitivity was 87.5%, reflecting its ability to detect true positive cases. Specificity reached 100%, meaning no false positives were reported. The AUC (Area Under the Curve) was 0.938, signifying outstanding diagnostic accuracy. The Negative Likelihood Ratio was 0.125, suggesting a low probability of missing complications when the test result was negative. The Positive Predictive Value (PPV) was 100%, indicating that all positive ultrasound findings were accurate. The Negative Predictive Value (NPV) was 94.44%, demonstrating high reliability in ruling out complications. Overall accuracy was 96%, underscoring the strong diagnostic utility of ultrasound for detecting complications.

Case 1

Clinical data:

A -40- year old male patient presented with left perianal discharge.

MRI findings:

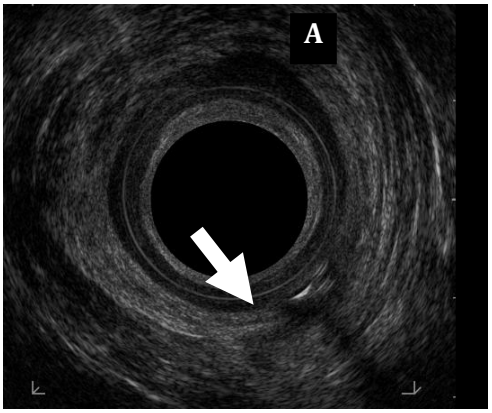

Fig. 40 (a): Axial STIR WI images showing fluid filled intersphincteric fistulous tracts eliciting high signal and abutting the internal sphincter at 5 o'clock (white arrows)

Endoanal ultrasound findings:

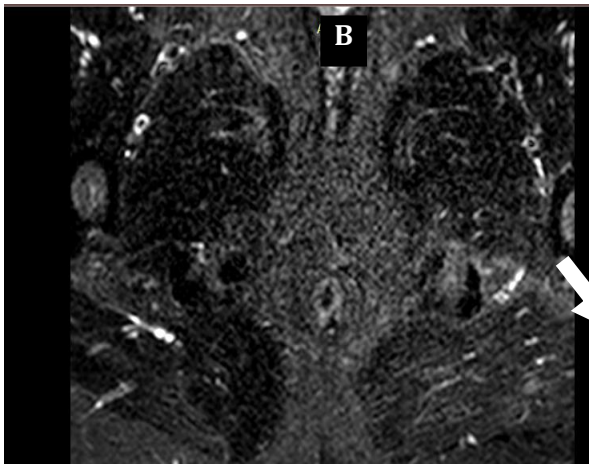

Fig. 40 (b): A hypoechoic fistulous tract is seen within the left posterior intersphincteric space abutting the internal anal sphincter (internal opening) opposite 5 o'clock (white arrow).

Figure 1: case 1

4. DISCUSSION

The distribution of fistula tracts relative to the anal sphincter, as determined by MRI in our study, was predominantly trans-sphincteric (44%) and inter-sphincteric (40%), consistent with the anatomical classifications described by Parks and emphasized by Alabiso et al., (6). EAUS results also show 40% inter-sphincteric and 36% trans-sphincteric. The accurate assessment of sphincter involvement is critical for surgical planning to minimize sphincter damage and prevent incontinence.

our results are in close similarity to Ahmed et al., (7), study published in 2015 including 60 patients that showed that ultrasound had accuracy of about 88.3 % in the diagnosis of the internal opening of the perianal fistula being 93 % in our work.

And also similar to Ashish Sharma et al., (8) which reported 93% accuracy in the detection of internal opening. In comparison, our work shows sensitivity for detecting an internal opening by endoanal ultrasound were 93.3 %.

In assessing the detection of internal openings, both our study and Li et al., (9) agree that EAUS has higher sensitivity and lower specificity for the diagnosis of the internal opening of anal fistulas the sensitivity and specificity are 97% and 61%,

respectively compared to 93.3 and 60 % respectively in our study.

Despite the differences, both our study and Sayed et al., (10) 's study demonstrate that ultrasound can effectively detect internal openings. However, the low specificity in our study suggests that relying solely on ultrasound may lead to false positive diagnoses in some cases, and further investigation with MRI or surgical exploration may be warranted to confirm the findings.

Our work demonstrated sensitivity of 83.3 % for detecting primary fistula tracts using EAUS compared to 84% in a comparative study Naseri et al., (10).

Despite the relatively high accuracy and specificity, the low NPV (20%) in our study highlights a significant limitation of EAUS: its limited ability to confidently exclude the presence of a primary fistula tract. This suggests that in patients with a high clinical suspicion of anal fistula, a negative EAUS result should be interpreted with caution, and further imaging (e.g., MRI) may be warranted.

Both our work and Sayed et al., (10) 's study agree that MRI demonstrates superior overall accuracy in detecting secondary extensions, supporting its use as the preferred imaging modality for detailed pre-operative fistula mapping.

Our study demonstrated excellent diagnostic performance of EAUS in identifying perianal collections, a common post-operative complication. We observed a sensitivity of 87.5%, a specificity of 100%, and an overall accuracy of 96% compatable with Sayed et al., (10) yielding an estimated accuracy of approximately 96.6%.

Our study couldn't properly assess the deep and high fistulous tracts by endo-anal ultrasound. Varsamis N et al., (12), agreed with our study results explaining that MRI is superior to EAUS for the evaluation of high perianal fistulas (especially for supralevator and extrasphincteric type). And also Li et al., (9) agreed with our study that there is low diagnostic accuracy for suprasphincteric and extra-sphencteric fistula.

EAUS has also a good reputation in showing the topography of the sphincter complex which allows detection of any sphincteric defects that have no clinical manifestations, thus aid in the planning of fistula surgery according to the obtained findings Farag et al., (13).

It may be sufficient as a preoperative diagnostic tool, providing a better image of the internal and external sphincters as well as the intersphincteric plane Alabiso et al., (6).

In addition to anal fistula, our study included a smaller number of patients with other causes of anal pain including anal cancer, proctalgia fugax and anal fissure. Because their small number, we can't properly correlate them and need further workup and research.

However, anal cancer was diagnosed in two patients (6.7%) in our series. In both cases, MRI demonstrated the presence of an ill-defined lesion or mass involving the anal sphincters, findings that were corroborated by EAUS. Anal ultrasound helps in the detection of tumor infiltration into the anal sphincters and the perianal tissues, and can also help clinicians judge the tumor response to chemoradiotherapy. The detection sensitivity of 3D endonal ultrasound was 97.1% for T1 rectal tumor, 94.3% for T2 rectal tumors, 95.7% for T3 tumors, and 98.5% for T4 tumors. Thus, 3D TRUS can be used as a guide on whether or not to apply radiation and chemotherapy prior to surgery according to Youssef et al., (17).

Two patients (6.7%) in our series were diagnosed with proctalgia fugax. Interestingly, both cases demonstrated thickening of the internal anal sphincter on both MRI and EAUS, with measurements ranging from 5 to 8 mm. While proctalgia fugax is primarily a clinical diagnosis, The presence of thick internal anal sphincter measuring >3.5 mm in thickness at its lateral aspect can be linked up with anal pain with no abnormality can be observed with clinical examination or anoscopy; however, anal manometry may show an increased resting pressure of the anal canal, Youssef et al., (17). The thickened sphincters observed in our cases may reflect this potential pathophysiology, warranting further investigation with larger studies and techniques such as anal manometry. With regard to proctalgia fugax, different pathophysiological mechanisms have been considered: spasm of the IAS, pudendal neuralgia, anal paroxysmal hyperkinesia, myopathy of the IAS, and psychological factors, but its pathogenesis remains unknown according to Vieira et al (15). Other causes of functional proctalgia (e.g perineal descent, rectocele, dyssynergia, abnormal puborectalis relaxation, proctalgia fugax. These causes would give abnormal results at different MRI modality (defecography) (15)

5. CONCLUSION

Endoanal ultrasonography was more accurate in assessment of anal canal compared to MRI, while MRI was more effective as in diagnosing deeper pathologies and complications.

As a result, we can recommend endoanal ultrasound as the preferred examination technique in the study of causes of anal pain, especially because it is cost-effective and can be used for patients who cannot undergo MRI, such as those with metallic implants such as pacemakers or those who are claustrophobic.

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