Role of transperineal ultrasound in evaluation of patients with perianal inflammatory disorders

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Abstract

Background: The aim of this study was to study the degree of accuracy of transperineal ultrasound (TPUS) in pre-operative evaluation and follow-up of cases with perianal inflammatory disorders in relation to MRI findings. Thirty patients with symptoms and signs of perianal inflammatory disorders underwent TPUS and pelvic MRI examinations. The radiologist who performed the TPUS was blinded to MR findings and was asked to comment on the site of the internal opening and extension of the tract, any related side branches or collections.

Results: The overall accuracy of TPUS in detection of the site of internal opening of perianal tracts was 83.33%, with sensitivity of 91.30%. TPUS showed sensitivity, specificity and accuracy of 100% in detection of horseshoe collections. The overall accuracy of TPUS in detection of perianal abscesses was 93.33% with specificity of 100%. TPUS showed sensitivity of 50.00%, specificity of 92.31% and accuracy of 86.67% in visualization of side branches. TPUS showed sensitivity of 33.33%, specificity of 88.89% and overall accuracy of 83.33% in detection of supralevator extension of perianal tracts. TPUS correctly classified (23/30) perianal tracts with accuracy of 76.7%.

Conclusions: TPUS can be used as a first diagnostic tool in patients with perianal inflammatory disorders and related pathologies, particularly horseshoe collections which can change the operative decision made by the surgeon. TPUS can be used in repeated follow-up during the course of management of perianal inflammatory disorders or when other imaging modalities are unavailable or contra-indicated.

Keywords: TPUS, MRI, Perianal inflammatory disorders

Key points

- TPUS is considered an available and inexpensive imaging modality in pre-operative assessment and post-operative follow-up of cases with perianal inflammatory disorders.

- TPUS has high accuracy in detection of horseshoe collections which can change the course of management of perianal inflammatory disorders.

Background

Perianal inflammatory disorders are common in the clinical practice. They include perianal fistulas, ano-vaginal fistulas, perianal abscesses, and perianal subcutaneous sinuses [1]. Perianal fistula has an incidence rate ranging from 0.7 to 37%. Management of perianal fistula is challenging for surgeons owing to its high recurrence rate ranging between 7 and 50%, and the need for repeated

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post-operative follow-up to ensure healing of after surgery [2].

Pelvic MRI and endoanal ultrasound (EAUS) are considered the modalities of choice in assessing perianal inflammatory conditions, particularly in cases of perianal fistulas. Unfortunately, they have some limitations. MRI is expensive, relatively contra-indicated in cases of claustrophobia and cardiac devices, it is not widely available in many institutions, and it takes time for image acquisition and evaluation. On the other hand, EAUS is non-applicable in cases of anal stenosis and in cases with anal pain which is a common symptom in patients suffering from perianal inflammatory disorders. These limitations highlight the value of implication of transperineal ultrasound (TPUS) in the pre-operative assessment and follow-up of cases with perianal inflammatory disorders [3]. TPUS is a simple real-time imaging modality that can be safely applied for assessment of the perineal pathologies. [4].

Consequently, the aim of our study is to assess the accuracy of TPUS in diagnosis of perianal inflammatory disorders and their associated pathologies, in relation to pelvic MRI.

Methods

This prospective study was ethically approved by the institutional review board (IRB) of faculty of medicine, Cairo University hospitals, Number: I-191015.

Study population

Thirty adult patients with symptoms of perianal inflammatory disorders were presented between August 2019 and September 2020 and were referred to the Radiology department, Kasr Al-Ainy Hospital, Cairo University. An informed consent was taken from all the subjects before the study. The patient population (n = 30) consisted of: 25 (83.3%) males and 5 (16.7%) females with mean age 43.5 years (range 20–68 years). In this study, we included eligible adults of both sexes with clinically suspected perianal inflammatory disorders. We excluded patients contra-indicated to MRI as patients with cardiac pacemakers or claustrophobic patients. Besides, we excluded cases when time interval between TPUS and MRI was more than 2 weeks. The flow chart of our study is shown in Fig. 1.

Clinical assessment

A colorectal surgeon documented the symptoms and physical findings and examined all patients by digital rectal examination (DRE), and a clinical provisional diagnosis was given.
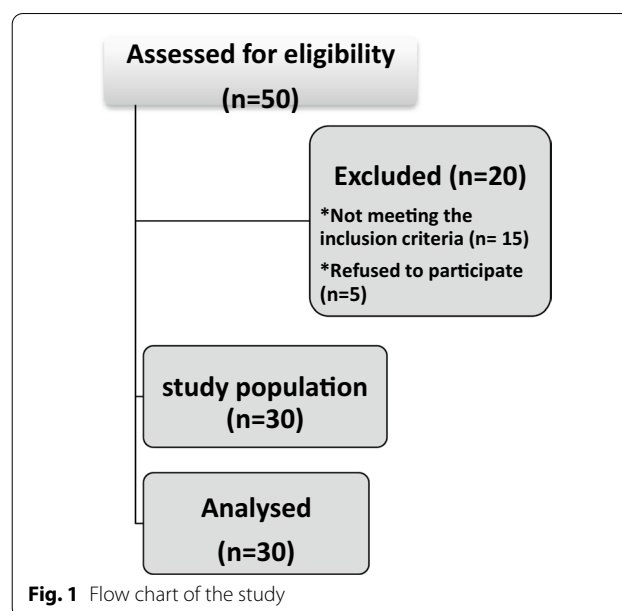
Fig. 1 Flow chart of the study

Examination using TPUS

A radiologist of 5 years experience, who was blinded to MRI findings, has performed all TPUS examinations. Ultrasound examinations were performed using Toshiba Aplio 500 ultrasound machine equipped with 8–5 MHz curvilinear and 12–5 MHz linear transducers. TPUS did not need prior preparations. Patients were asked to lie in the left lateral decubitus with semi-flexed knees, and some patients were asked to change into the lithotomy position when needed. Ultrasound gel was applied to the transducer, and a latex cover was wrapped on it for hygienic causes. The probe was placed near the anal verge and anterior to it. No injected materials were used except for a case of high tract in which saline was injected through the external opening for better delineation of its course.

Analysis of TPUS

Ultrasound signs of perianal inflammatory disorders were outlined in which, a perianal fistula was defined as a tubular hypoechoic tract extending from the anal canal to the perianal skin; and may contain either air bubbles or fluid within. An ano-vaginal fistula was defined as a tubular hypoechoic tract or a direct communication between the anal canal and the vagina. A subcutaneous perianal sinus tract is a blind-ended tract with a skin opening. The internal opening was labelled by the site where the internal anal sphincter is breached. The exact site of breaching of the internal anal sphincter was determined by using the anal clock. Inter-sphincteric tract was described as a tract extending deep to the external anal sphincter without breaching its fibres. Trans-sphincteric tract was

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defined as a tract breaching the fibres of the external anal sphincter. An abscess was described as a hypoechoic fluid-filled cavity. Horseshoe collection was described as a hypoechoic-free collection crossing the midline and communicating with the perianal tract. A side branch was defined as an emerging tract from the main perianal tract. Supra-levator extension was described as a tract seen breaching the ano-rectal junction (the assumed location of puborectalis muscle) or above in the sagittal images of TPUS examination [1, 3].

MRI acquisition

After examination by TPUS, all patients underwent MR examinations using a 1.5-T MRI scanner (ACHIEVA, PHILIPS Healthcare) using a phased-array body coil. Patients were asked to lie supine. No need for special preparations. Standard MRI protocol of the anal canal in our institution was applied as shown in Table 1. Oblique axial and oblique coronal MRI images were, respectively, planned perpendicular and parallel to the anal canal. In agreement with Cattapan et al. [5] and Baik et al. [6], no contrast was injected in assessment of perianal inflammatory disorders in our institution. MRI images were reported by an experienced radiologist in interpretation of MRI of the anal canal and pelvic floor, who was aware of the provisional diagnosis of each case. MRI report represented the standard reference for assessment of accuracy of TPUS findings. The time interval between TPUS and MRI examinations was less than 2 weeks.

Statistical analysis

Data were described in the form of frequencies (number of patients) and percentages. MedCalc® Statistical Software version 20.027 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2021) was used to statistically analyse the collected data.

Sample size estimation

All eligible cases who were referred to the Radiology department, Kasr Al-Ainy Hospital, Cairo University for 12 months were included in this study. When selecting our cases, it was expected to include cases with a rate of about 2 participants per month; at least 24 cases through the year of data collection.

Results

Demographic data

This prospective study included thirty adult patients with symptoms of perianal inflammatory disorders. As shown in Table 2, the patient population (n = 30) consisted of: 25 (83.3%) males and 5 (16.7%) females with mean age 43.5 years (range 20–68 years).

Analysis of the obtained data

Visualization of the site of the internal opening (Figs. 2, 3)

TPUS correctly detected the exact site of internal opening in (21/30, 70%) patients. TPUS agreed with MRI that the site of internal opening was not clearly seen in (4/30, 13.3%) patients. TPUS failed to detect the site of internal opening of perianal fistula in (2/30, 6.7%). The overall accuracy in detection of the site of internal opening was 83.33%, with sensitivity of 91.30%.

Detection of abscesses (Fig. 4)

By using TPUS, a case that was correctly diagnosed as a scrotal abscess was urgently drained by the surgeon. On MRI examination, the residual scrotal oedema was noted. TPUS failed to diagnose two (2/30, 6.7%) cases with abscesses. The overall accuracy of TPUS in detection of abscesses was 93.33% with specificity of 100%.

Table 2 Demographics of the study population

	Frequency	Percentage (%)
Male	25	83.3
Female	5	16.7
Total	30	100

Table 1 MRI protocol at our institution for assessing perianal inflammatory disorders

Process and position	TR (ms)	TE (ms)	FOV (ms)	Matrix	SL (mm)	NEX
T_2-weighted TSE sagittal	3000	90	290	320 × 320	4	3
T_2-weighted TSE axial	7228	100	260	384 × 384	3	3
FS T_2-weighted TSE axial	4899	80	260	288 × 288	3	2
T_2-weighted TSE coronal	3259	100	320	224 × 224	3	3
FS T_2-weighted TSE coronal	4355	80	320	288 × 288	3	2
T_1-weighted TSE axial	576	20	260	384 × 384	3	3

FOV field of view, *FS* fat-saturated, *NEX* number of excitations, *SL* slice thickness, *TE* echo time, *TR* repetition time, *TSE* turbo spin-echo

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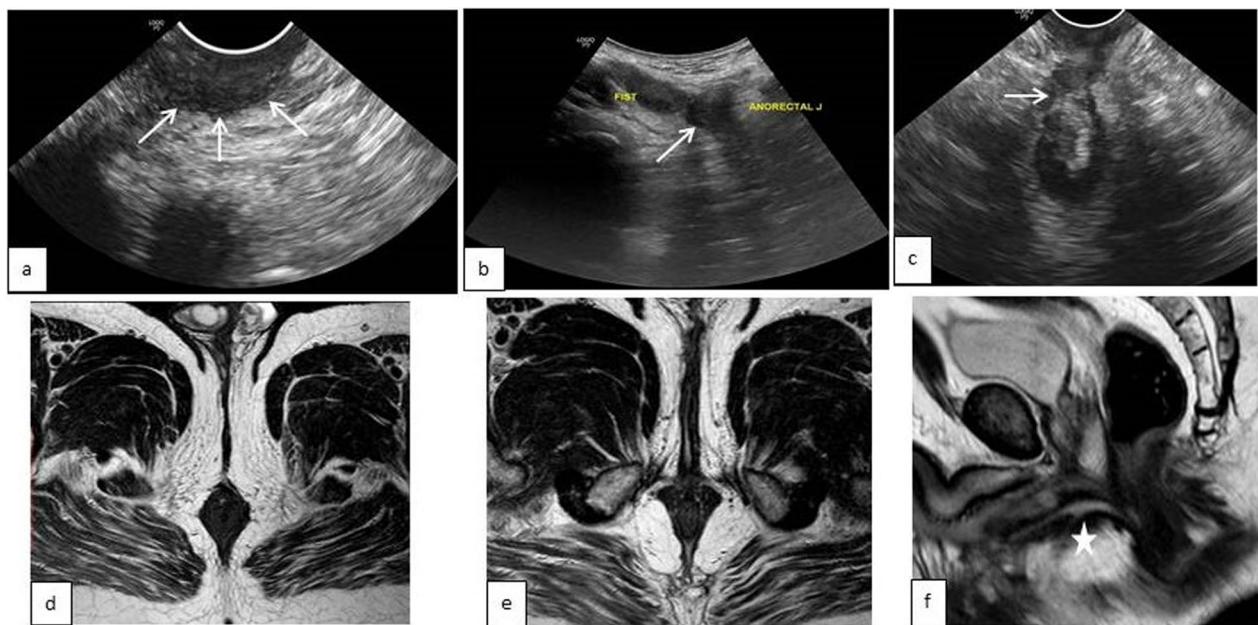
Fig. 2 A 50-year-old male patient presenting with recurrent high perianal fistula. TPUS with saline injection through the skin opening shows the external opening at the scrotal skin (**a**), sagittal plane shows the fistula joining the anal canal at the anterior aspect of the ano-rectal junction (**b**), leading to the internal opening at 12 o'clock (**c**). In oblique axial MRI T2WI (**d, e**), the internal opening is seen breaching the proximal part of the deep external anal sphincter to reach the anal canal (**d**) without breaching the puborectalis muscle (**e**). In sagittal T2 MR image (**f**), the tract is seen breaching the anal canal anteriorly. A small side branch is seen emerging from the under surface of the tract can be seen which was not detected by TPUS (star)

Detection of horseshoe collections (Fig. 6)

TPUS was capable to visualize horseshoe collections in (6/30, 20%) patients, with sensitivity, specificity and accuracy of 100%.

Visualisation of side branches (Figs. 2, 6)

TPUS correctly detected the presence of side branches in (2/30, 6.7%) patients. In disagreement with MRI, TPUS declined the presence of side branches in two cases (2/30, 6.7%). TPUS showed sensitivity of 50.00%, specificity of 92.31% and accuracy of 86.67% in visualization of side branches.

Detection of supralevator extension (Fig. 2)

TPUS was able to correctly detect supralevator extension of perianal tracts in one (1/30, 3.3%) patient. On the other hand, TPUS reported the presence of supralevator extension of perianal tracts in (3/30, 10%) patients, in contrast to MRI which declined breaching of the levator ani muscle of these high perianal tracts. TPUS showed sensitivity of 33.33%, specificity of 88.89% and overall accuracy of 83.33% in detection of supralevator extension of perianal tracts.

### Determination of the type of perianal sepsis in relation to anal sphincter complex

TPUS detected 7 simple inter-sphincteric perianal tracts, 3 cases of complex inter-sphincteric tracts, 10 cases of simple tans-sphincteric tracts, 2 cases of complex trans-sphincteric tracts, 4 cases of high tracts with supralevator extension, a case of subcutaneous perianal sinus, and 3 cases of ano-vaginal fistula.

On the other hand, MRI classified the perianal tracts into: 6 simple inter-sphincteric tracts, 4 complex inter-sphincteric tracts, 10 simple trans-sphincteric tracts, 3 complex trans-sphincteric tracts, 3 cases of perianal tracts with supralevator extension, a case of subcutaneous perianal sinus and 3 cases of ano-vaginal fistula. TPUS correctly classified (23/30) perianal tracts with accuracy of 76.7%.

The detailed findings of the cases of our study are tabulated in the Additional file 1. The detailed findings of both TPUS and pelvic MRI of the study population are tabulated in Table 3.

Sensitivity, specificity, PPV, NPV and accuracy of TPUS in relation to pelvic MRI are shown in Table 4.

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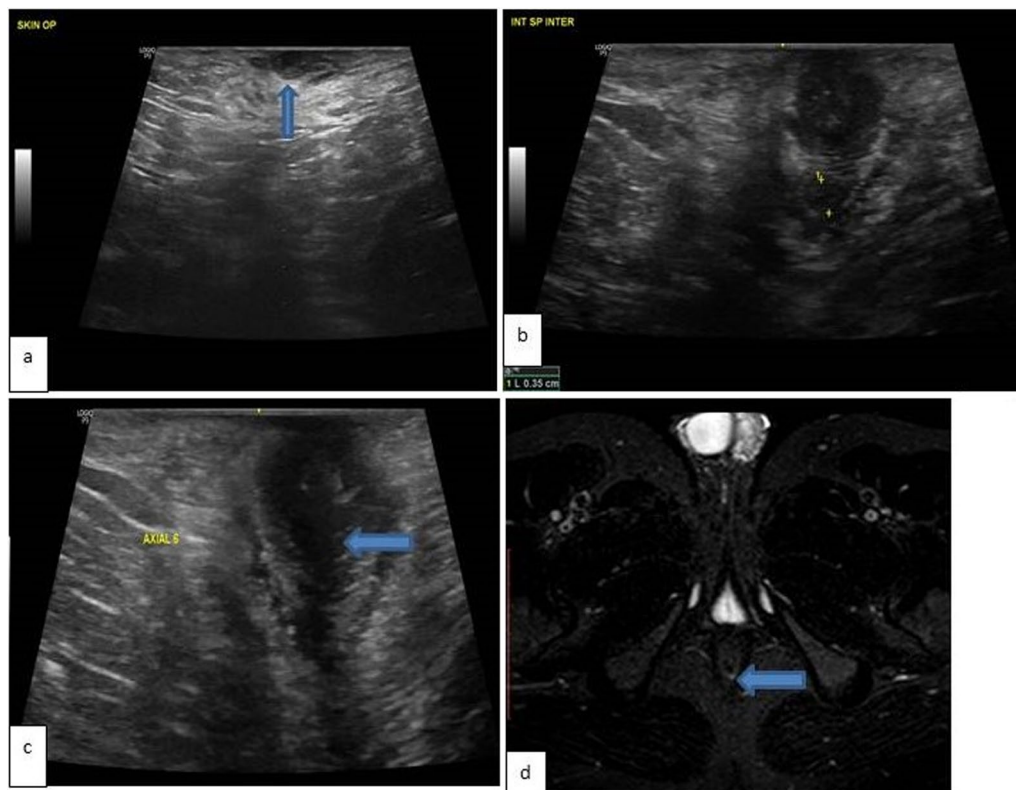
Fig. 3 A 20-year-old male presented with perianal discharge. TPUS shows the skin opening (**a**), axial images show the tract extending along the inter-sphincteric plane midline posteriorly (**b**), with internal opening seen at 6 o'clock (arrow) (**c**). Oblique axial T2 FS MR image shows the inter-sphincteric tract with the site of internal opening at 6 o'clock (**d**)
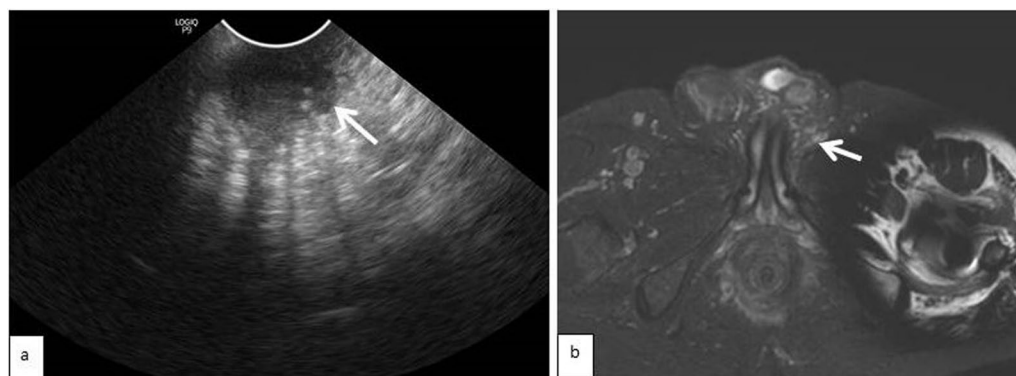
Fig. 4 A 50 years old male, with history of perianal abscess drainage, presented with recurrent perianal discharge. TPUS shows a scrotal abscess cavity (**a**). Oblique axial T2 FS image, after abscess drainage, showed the expected scrotal oedema (**b**). NB: the artefact seen at the left side is due to an intramedullary nail of the left femur

Discussion

Perianal inflammatory disorders include perianal fistulas, ano-vaginal, rectovaginal fistulas, perianal abscesses, and perianal sinus tracts. These inflammatory conditions are in fact very challenging for surgeons as they have high tendency to resist treatment, recur after surgery and transform into a chronic inflammatory condition, which results in subsequent multiple surgeries, associated morbidities to the patient and high cost of recurrent hospitalizations [7].

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Table 3 Findings of TPUS in relation to pelvic MRI

a Findings of TPUS with MRI regarding the presence of abscesses, horseshoe collections and side branches

	TPUS		MRI	
	Number of cases	Percentage (%)	Number of cases	Percentage (%)
Abscesses	1	3.3	3	10
Horseshoe collections	6	20	6	20
Side branches	2	6.7	4	13.3

b Findings of TPUS with MRI regarding the type of the tracts in relation to the anal sphincter

TPUS	MRI						
	Simple inter-sphincteric tract	Complex inter-sphincteric tract	Simple trans-sphincteric tract	Complex trans-sphincteric tract	Supralevator tract	Perianal sinus	Ano-vaginal fistula
Simple inter-sphincteric tract	6	1					
Complex inter-sphincteric tract		3					
Simple trans-sphincteric tract			8		2		
Complex trans-sphincteric tract			1	1			
Supra-levator tract			1	2	1		
Perianal sinus						1	
Ano-vaginal fistula							3

Although MRI of the anal canal is the modality of choice in cases of perianal inflammatory disorders, it remains difficult to be applied in the necessary regular follow-up of these cases because of its high cost and limited availability in many centres [8]. Besides, despite EAUS is recommended in these cases, it is unsafe to be used in patients with anal strictures or anal pain which are considered frequent symptoms in these patients. Furthermore, EAUS is unable to assess pathologies away from the anal canal such as gluteal or scrotal lesions [3].

Consequently, a simple available and cheap diagnostic tool is mandatory for precise diagnosis and regular follow-up along the course of management of the perianal inflammatory disorders to ensure good healing, reduce the rate of recurrence, comorbidities and costs of repeated hospitalizations. Accordingly, the aim of our study was to assess the accuracy of TPUS in evaluation of perianal inflammatory disorders, helping the surgeon in decision of the appropriate surgical procedure and regular follow-up along the course of their management.

Regarding our approach, the radiologist who performed TPUS examination was blinded to MRI findings, in contrast to Fateh MS who declared that both TPUS and MRI examinations were interpreted by the same radiologist [9].

In our study, we have not instilled any injectable materials except for a case of high tract in which we injected only saline via the skin opening to distend the tract and visualise site of the internal opening (Fig. 2). Some researchers recommended the instillation of hydrogen peroxide through the skin opening of perianal fistula for better visualisation of its internal opening and side branches [3]; however, we preferred to avoid injection of hydrogen peroxide because it was reported by some authors that injection of hydrogen peroxide may cause series of artefacts degrading the image quality [10]. Besides, Nevler A. et al. concluded in their study that instillation of hydrogen peroxide have not improved visualisation of the side branches of perianal tracts [11].

Regarding our results in detection of the exact site of the internal opening of perianal tracts, which is considered one of the important risk factors of recurrence [2]; TPUS correctly detected the exact site of internal opening in (21/30, 70%) patients, which is comparable with Nevler A. et al., who reported that TPUS correctly predicted the presence and location of the internal opening of perianal tracts in 16/22 (72.3%) patients [11].

Our study showed that TPUS showed accuracy of 83.33%, with high sensitivity of 91.30% in detection of the internal openings of perianal tracts (Fig. 3). This is in agreement with a systemic review and meta-analysis by Maconi et al. [12], who reported sensitivity of 90.6% in detection of the internal openings of perianal tracts as well as Domkundwar et al. [13], who confirmed a sensitivity of 90–95% in identification of the site of the internal openings. On the other hand, Fateh SM [9] showed relatively lower overall accuracy of TPUS in detection of internal openings was 82%, with sensitivity of 85%.

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Table 4 Sensitivity, specificity, PPV, NPV and accuracy of TPUS in relation to pelvic MRI

	Site of the internal opening		Abscesses		Horseshoe collections		Side branches		Supralevator extension	
	Value (%)	95% CI	Value (%)	95% CI	Value (%)	95% CI	Value (%)	95% CI	Value (%)	95% CI
Sensitivity	91.30	71.96–98.93	33.33	0.84–90.57	100.00	54.07–100.00	50.00	6.76–93.24	33.33	0.84–90.57
Specificity	57.14	18.41–90.10	100.00	87.23–100.00	100.00	85.75–100.00	92.31	74.87–99.05	88.89	70.84–97.65
Positive Predictive Value	87.50	74.67–94.32	100.00		100.00		50.00	16.07–83.93	25.00	4.64–69.52
Negative Predictive Value	66.67	31.47–89.70	93.10	85.85–96.78	100.00		92.31	81.74–96.99	92.31	84.21–96.43
Accuracy	83.33	65.28–94.36	93.33	77.93–99.18	100.00	88.43–100.00	86.67	69.28–96.24	83.33	65.28–94.36

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Concerning the detection of perianal abscesses, a patient was diagnosed with a scrotal abscess by TPUS and was urgently drained by the surgeon. MRI images revealed the expected residual scrotal oedema (Fig. 4). TPUS failed to detect two (2/30, 6.7%) cases with abscesses. In the first missed case, MRI revealed a high left obturator externus abscess cavity; that is because TPUS has a limited penetration capability to see deep pelvic pathologies (Fig. 5). In the second missed case, the patient was in pain, and the radiologist could not proceed in the TPUS examination. In our study, the overall accuracy of TPUS in detection of abscesses was 93.33% with specificity of 100%, which agreed with Mallouhi et al. [14] who declared specificity of 94–100% in visualisation of perianal abscesses. Our study showed that TPUS had PPV of 100% in detection of perianal abscesses, while Maconi et al. [12] showed PPV of 88.4%.

Regarding horseshoe collections, TPUS showed sensitivity, specificity and accuracy of 100%. This emphasises the ability of TPUS to detect horseshoe collections, which can change the surgical plan (Fig. 6). On the other hand, Nevler et al. [11] declared that two out of 27 patients had horseshoe collections, but TPUS failed to diagnose both of them.

Concerning detection of side branches of perianal tracts (Fig. 6), TPUS was able to detect the presence of side branches in (2/30, 6.7%) patients, comparable with Nevler et al. [11] who identified (2/27, 7.4%) patients with side branches. In disagreement with MRI, TPUS declined the presence of side branches in two cases (2/30, 6.7%) of our patients (Fig. 2). TPUS showed sensitivity of 50.00%, specificity of 92.31% and accuracy of 86.67% in detection of side branches.

Considering the visualization of supralevator extension, according to Lavazza et al. [3], we defined the presence of supralevator extension by the site at which the perianal tract breaches the anorectal junction or above, corresponding to the site of puborectalis muscle. TPUS reported the presence of supralevator extension of perianal tracts in (3/30, 10%) patients, in contrast to MRI which reported the absence of breaching of the levator ani muscle although these perianal tracts were high (Fig. 2).
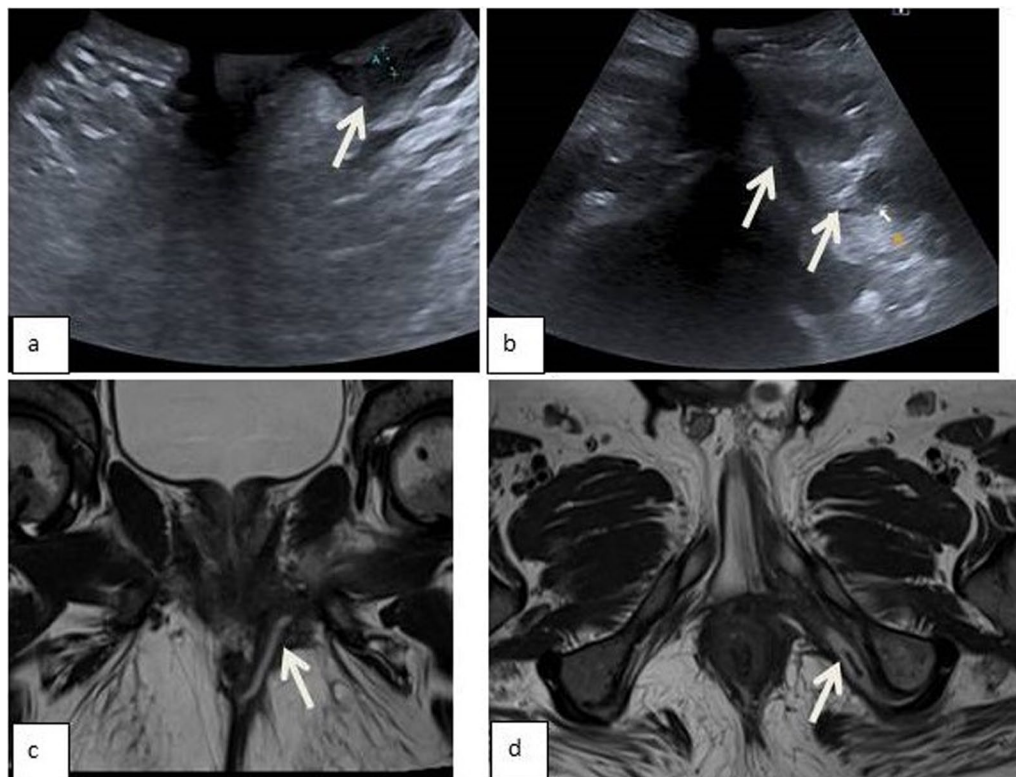
Fig. 5 **a** 29-year-old male patient, with history of recurrent perianal fistula. TPUS in axial plane (**a**) shows a left-sided trans-sphincteric perianal tract, breaching the distal part of the deep external anal sphincter, crossing the left ischio-anal fossa. On coronal ultrasound images (**b**), the proximal extension of the left-sided tract could not be detected. In T2 oblique coronal image (**c**), the left trans-sphincteric tract is seen crossing the left ischio-anal fossa. In T2 oblique axial image (**d**), it was noted that it forms an intra-muscular abscess involving the left obturator internus muscle
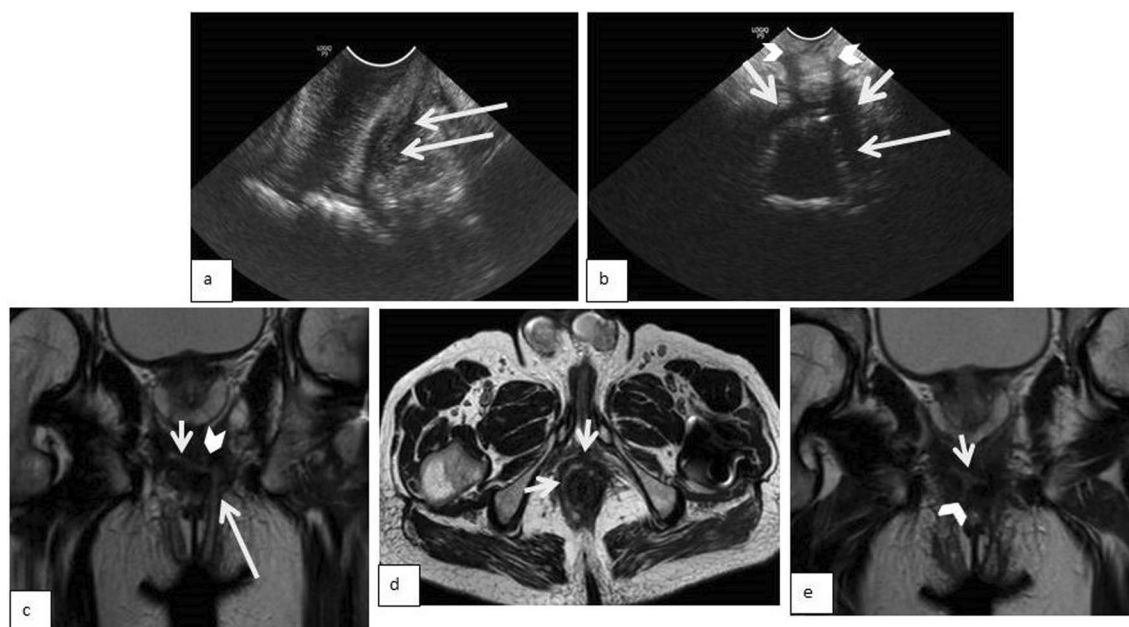
Fig. 6 a 60 years old male, with history of recurrent perianal fistula, presented with perianal pain and discharge. TPUS in oblique coronal plane (**a**) shows a left-sided perianal tract (long arrow), in oblique axial ultrasound image (**b**), such tract forms an anterior horseshoe collection (short arrows) from which two small side branches are noted emerge (arrowheads). In T2 coronal oblique MR image(**c**, **e**) and T2 oblique axial T2 image (**d**), the left-sided trans-sphincteric tract is seen (long arrow) forming an anterior horseshoe collection (short arrows) with two small side branches are noted (arrowheads in **c**, **e**)

Regarding the classification of perianal inflammatory disorders in relation to the anal sphincter, our study showed that TPUS correctly classified 23/30 (76.7%) patients, comparable with Nevler et al. [11] who correctly classified 23/27 (85.2%) patients of perianal inflammatory disorders.

Our study has points of strength, the radiologist who performed TPUS examination was blinded to MRI findings, to ensure the possible highest accuracy of our results. The time interval between TPUS and MRI examinations was less than 2 weeks, to avoid the expected changes of the radiological findings in case of long time interval between both imaging modalities.

Our study has limitations. TPUS is an operator dependant technique. TPUS examination may be limited by patient's pain.

Conclusions

This study showed that TPUS reported high degree of accuracy in detection of horseshoe collections, in which their presence can change the surgical decision regarding management of perianal tracts. MRI can be kept for cases of suspected supralevator extension or side branches in which TPUS is relatively limited.

We recommend implication of TPUS as a first diagnostic tool in assessment and diagnosis of perianal inflammatory disorders, as it is considered an inexpensive and available imaging modality. We also recommend TPUS in cases of repeated follow-up along the course of management of perianal inflammatory disorders to ensure healing or when other imaging modalities are unavailable or contra-indicated.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s43055-022-00812-1.

Additional file 1: Master table of cases. The file shows the detailed data of our patients regarding their demographic data and their radiological imaging findings for TPUS and pelvic MRI as well.

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methods and revised the manuscript critically for important intellectual content. R.F.E.S. and H.A.S.S. supervised the work. All authors provided critical feedback and helped shape the research, analysis, and the final version of the manuscript. All authors read and approved the final manuscript.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This prospective study was ethically approved by the institutional review board (IRB) of faculty of medicine, Cairo University hospitals (Approval Number I-191015). An informed consent was obtained from all patients.

Consent for publication
An informed consent was obtained from all the participants before the study.

Competing interests
The authors declare that they have no competing interests.

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