



Original article

Comparison of hydrogen peroxide-enhanced ultrasound with surgery in the diagnosis of perianal fistulas

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Objetives: To evaluate the usefulness of hydrogen peroxide-enhanced ultrasound (H_2O_2) in the preoperative assessment of perianal fistulas and to compare these results with unenhanced ultrasound findings.

Material and Methods: All patients with surgically confirmed perianal fistula who underwent preoperative enhanced and unenhanced ultrasound were included. We compared enhanced and unenhanced ultrasound findings with surgical results (χ^2 and McNemar tests).

Results: A total of 44 surgically treated patients were analysed. Hydrogen peroxide-enhanced ultrasound correctly identified primary fistula tracts in 34 patients (sensitivity of 77%), 100% of abscesses and the internal opening in 29 out of 37 identified with surgery (sensitivity of 78% and specificity of 70%). The use of hydrogen peroxide provided additional information to the ultrasound performed without the use of contrast enhancement in 32 of the 44 patients (73%). H_2O_2 increased the number of fistula tracts correctly detected (77% vs 45%; $P<.003$), particularly suprasphincteric fistulas, as well as internal openings (78% vs 22%; $P<.001$) and secondary tracts (70% vs 0%). Additional detection of fistula tracts after H_2O_2 injection was higher in patients with previous surgery (68% vs 35%; $P<.05$).

Conclusions: Hydrogen peroxide-enhanced ultrasound shows good agreement compared with surgical findings in the assessment of perianal fistulas. H_2O_2 improves conventional ultrasound results, increasing the detection of fistula tracts and internal openings, and also providing additional information, particularly in previously operated patients.

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Comparación de la ecografía endoanal contrastada con la cirugía en el diagnóstico de las fistulas endoanales

R E S U M E N

Palabras clave:

Ecografía endoanal
Peróxido de hidrógeno
Fístula perianal

Objetivos: Evaluar la utilidad de la ecografía endoanal con peróxido de hidrógeno (H_2O_2) en el estudio preoperatorio de las fistulas perianales, así como comparar sus resultados con los de la ecografía endoanal sin H_2O_2 .

Material y métodos: Se incluyó a los pacientes con fístula perianal confirmada quirúrgicamente a quienes se había realizado previamente una ecografía endoanal con o sin instilación de H_2O_2 . Se compararon los hallazgos de la ecografía con y sin H_2O_2 con los resultados quirúrgicos (pruebas de la χ^2 y de McNemar).

Resultados: Se analizó a 44 pacientes tratados quirúrgicamente. La ecografía con H_2O_2 identificó correctamente el tracto fistuloso principal en 34 pacientes (sensibilidad del 77%); el 100% de los abscesos y el orificio interno en 29 de los 37 visualizados en cirugía (sensibilidad del 78%, especificidad del 70%). El empleo de H_2O_2 aportó información adicional a la ecografía no contrastada en 32 de los 44 casos (73%). El H_2O_2 aumentó el número de tractos fistulosos correctamente detectados (el 77 frente al 45%; $p < 0,003$), especialmente de fístulas supraesfinterianas, así como el número de orificios internos (el 78 frente al 22%; $p < 0,001$) y de tractos secundarios (el 70 frente al 0%). La detección adicional de trayectos fistulosos con la inyección de H_2O_2 fue mayor en casos con cirugía previa (el 68 frente al 35%; $p < 0,05$).

Conclusiones: La ecografía endoanal con H_2O_2 presenta buena correlación con los hallazgos quirúrgicos en la evaluación de las fistulas perianales. El uso de H_2O_2 mejora significativamente los resultados de la ecografía endoanal convencional, aumenta la detección de tractos fistulosos y orificios internos, y da información adicional en especial en pacientes operados previamente.

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Introduction

The anal fistula is a common illness defined as an abnormal perianal tract that connects 2 epithelised surfaces, frequently the anal canal with the perianal skin. It is composed by the internal opening orifice or primary orifice (located in the anal canal at the dentate line level), the fistulous tract and the external opening orifice or secondary orifice (in the perineal skin). It may have additional components such as secondary tracts or various internal or external openings, which can complicate treatment. In any manner, the 3 principal components must be present to establish the diagnosis of an anal fistula.

Fistulae are classified according to their primary extension in relation with the external anal sphincter and the puborectalis muscle. The most frequently used classification is described by Parks et al¹ in 1979, that correlates the fistulous course in a coronal plane with the sphincter mechanism. This classification is useful to stratify patients regarding surgical treatment, which depends on the nature of the primary tract as well as the presence of secondary tracts and concomitant abscesses. Treatment success will depend on the correct identification and characterisation of all of the fistula tracts, as any fistula or unidentified or erroneously classified extension is the most important cause of recurrence.²

Since Law et al^{3,4} published their experiment in patients with recurrent perianal fistulae in 1989, the endoanal

ultrasound has been used increasingly in the evaluation of the perirectal inflammatory disease. However, the studies that have evaluated its use and efficacy present very different results. In 1993, Cheong et al⁵ described the use of hydrogen peroxide (H_2O_2) as a contrast agent in 2 patients with recurrent fistulae. The fistula tract, visualised as a hypoechoic lineal lesion in the conventional study, becomes hyperechogenic when H_2O_2 is introduced through the external opening. These authors demonstrated that the H_2O_2 increases the differentiation between layers of tissue in the tract, providing a method that improves the precision of the endoanal ultrasound in the evaluation of recurrent fistulae.

The main aim of our study was to compare the endoanal ultrasound with the injection of H_2O_2 with the findings in surgery in the study of perianal fistulae and, secondarily, to compare the results of the conventional endoanal ultrasound with the endoanal ultrasound after injecting H_2O_2 .

Material and methods

All patients with surgically confirmed perianal fistulae and a permeable external opening that would permit the injection of H_2O_2 were included in the study between February 2001 and March 2007. A study with endoanal ultrasound was performed on each patient before and after the injection of H_2O_2 .

The ultrasound equipment used was the Diagnostic Ultrasound System, B&K Medical (Nacrum, Denmark), with a multi-frequency rotating transducer of 5-10 MHz, type 1850, that provided axial imaging of 360°. The transducer was covered with a hard translucent cone filled with distilled water allowing for a perfect adaptation to the anal canal and was also covered by a latex wrap filled with ultrasound gel.

First of all, a conventional ultrasound study was performed without H₂O₂, with the patient in a left lateral position. The localisation of the principle fistulous tract and the internal opening were recorded (the fistulae were classified according to Parks et al¹), as well as the secondary tracts, abscesses, and other additional findings.

Next, the external fistulous opening was catheterised with the plastic cover of the 18 G abbocath and 2.5 mL of hydrogen peroxide diluted in saline solution was slowly injected, while continuing the ultrasound exploration.

The results obtained by ultrasound were compared with those obtained from surgery, which was considered as the reference test. The findings of the ultrasound with the injection of H₂O₂ were also compared to the conventional ultrasound and the additional value of the H₂O₂ injection was calculated. Lastly, the results of the patients with and without previous surgery were compared, where the fibrous tracts make difficult the prior interpretation. The amount of time elapsed between the ultrasound and surgery was recorded.

The sensitivity, the specificity, the positive predictive value, and the negative predictive value of the ultrasound with H₂O₂ were calculated regarding the surgical findings. The McNemar test was used for the comparative statistical analysis in the detection of the internal opening or the presence of abscesses. To compare the proportions of the findings in the ultrasounds with and without H₂O₂ with the surgical results, the χ^2 test was used. The information added after injecting H₂O₂ was also compared between the group of patients with or without previous surgery, with the χ^2 test. The SPSS® statistical software, version 13.0 for Windows, was used. A P value less than .05 was considered significant.

Table 2 – Comparison of the findings of the conventional endoanal ultrasound with the contrasted endoanal ultrasound and surgery in 44 operated patients

	Conventional ultrasound	Ultrasound with H ₂ O ₂	Surgery
Internal opening	10 (22%)	29 (78%)	37 (100%)
Primary tract			
Intersphincteric	5 (55%)	9 (82%)	11
Transsphincteric	11 (50%)	16 (73%)	22
Suprasphincteric	2 (22%)	7 (78%)	9
Extrasphincteric	2 (100%)	2 (100%)	2
Correct identification	20 (45%)	34 (77%)	
Secondary tract	0	9 (70%)	13

Results

During the period studied, we found 63 patients who had undergone the endoanal ultrasound and later were operated on. Of them, 19 patients were excluded that could not receive the H₂O₂ injection because they could not find the external opening or because it was not permeable. The study group included 44 patients, 37 (84%) men and 7 women, who underwent an endoanal ultrasound with and without the injection of H₂O₂. Of the 44 patients, 16 had a personal history of previous surgery.

The findings of the ultrasound with H₂O₂ were compared with surgery as the standard. The average time elapsed between the ultrasound and the surgical intervention was 138 days (interval, 15-300). Eleven intersphincteric fistulae, 22 transsphincteric fistulae, 9 suprasphincteric fistulae, and 2 extrasphincteric fistulae were detected in the surgical exploration. Thirteen secondary fistulous tracts and 12 abscesses were diagnosed, and in 37 cases the internal opening of the fistula was found (Tables 1 and 2).

The ultrasound with H₂O₂ made at least 1 fistulous tract visible in all patients (Figures 1-3), and the principle fistulous tract was correctly classified in 34 of the 44 patients (77%

Table 1 – Comparison of the findings of the endoanal ultrasound with H₂O₂ with surgery in the classification of perianal fistulae in 44 operated patients

	Intersphincteric	Transsphincteric	Supra/ extrasphincteric	Secondary tracts	Abscesses	Internal openings
Surgery	11	22	11	13	12	37
Endoanal ultrasound with H ₂ O ₂						
TP	9	16	9	9	12	29
FN	2	6	2	4	0	8
FP	2	4	4	6	2	3
Sensitivity	82%	73%	82%	69%	100%	78%
Specificity	94%	82%	88%	81%	96%	70%
PPV	82%	80%	69%	60%	86%	91%
NPV	94%	75%	94%	86%	100%	33%

FN indicates false negative; FP, false positive; NPV, negative predictive value; PPV, positive predictive value; TP, true positive.

Figure 1 - Posterior intersphincteric fistula. A. Initial endoanal ultrasound without any findings. B. After injecting H_2O_2 a fistulous tract is observed in the posterior middle line (arrow) limited by the external anal sphincter.

Figure 2 - Transsphincteric fistula with intersphincteric abscesses and in ischio-rectal space. A. Conventional endoanal ultrasound with a hypoechoic image in the intersphincteric area and the right ischio-rectal area (arrows). B. After the injection of H_2O_2 , a connection is observed with the intersphincteric and ischio-rectal abscesses and with a secondary intersphincteric tract that extends itself forward (head of the arrow). Internal opening (curved arrow).

sensitivity). The results of each type of fistula are broken down in Table 1. The type of fistula identified in the ultrasound did not coincide with the principal tract in surgery in 2 patients, but it did coincide with the secondary tract visualized in the operating room. The average time elapsed between the ultrasound and the intervention in these 2 patients was 180 days; 12 (86%) of the 14 collections that the ultrasound identified were surgically confirmed ($P<.005$, McNemar test). The other 2 coincided with the fistulous tract visualised in the operating room, although they did not meet the collection criteria (Table 1).

The ultrasound with H_2O_2 correctly identified the internal opening in 29 (78%) patients, of the 37 that were visualized in surgery, without observing any significant differences when comparing the ultrasound and surgical results ($P=.388$, McNemar test). The other 3 cases of the 32 identified by ultrasound were not surgically confirmed and 8 of those visualized in the operating room were not identified by ultrasound (Tables 1 and 2). The time elapsed between the

diagnostic test and the intervention in all of the discordant cases was long (200 days).

Nine of the 13 fistulae with secondary tracts were correctly identified in the ultrasound with H_2O_2 . In the other 4 patients, the ultrasound with contrast only enabled the identification of the principal tract. The ultrasound with contrast enabled the visualisation of 6 other secondary tracts that were not surgically confirmed, in 3 cases they were found in patients with personal history of previous surgery and the other 3 presented concomitant collections.

When comparing the results between ultrasounds without or with the use of H_2O_2 , the second option ("with") provided all or part of the information in 32 of the 44 cases (73%). When comparing the findings of the ultrasound without and with H_2O_2 , significant statistical differences in the identification of fistulous tracts were found ($P=.003$; χ^2 test) (Table 2). Significant differences were also found between the ultrasound without contrast and the ultrasound with the injection of H_2O_2 in detecting the internal opening and between the results of

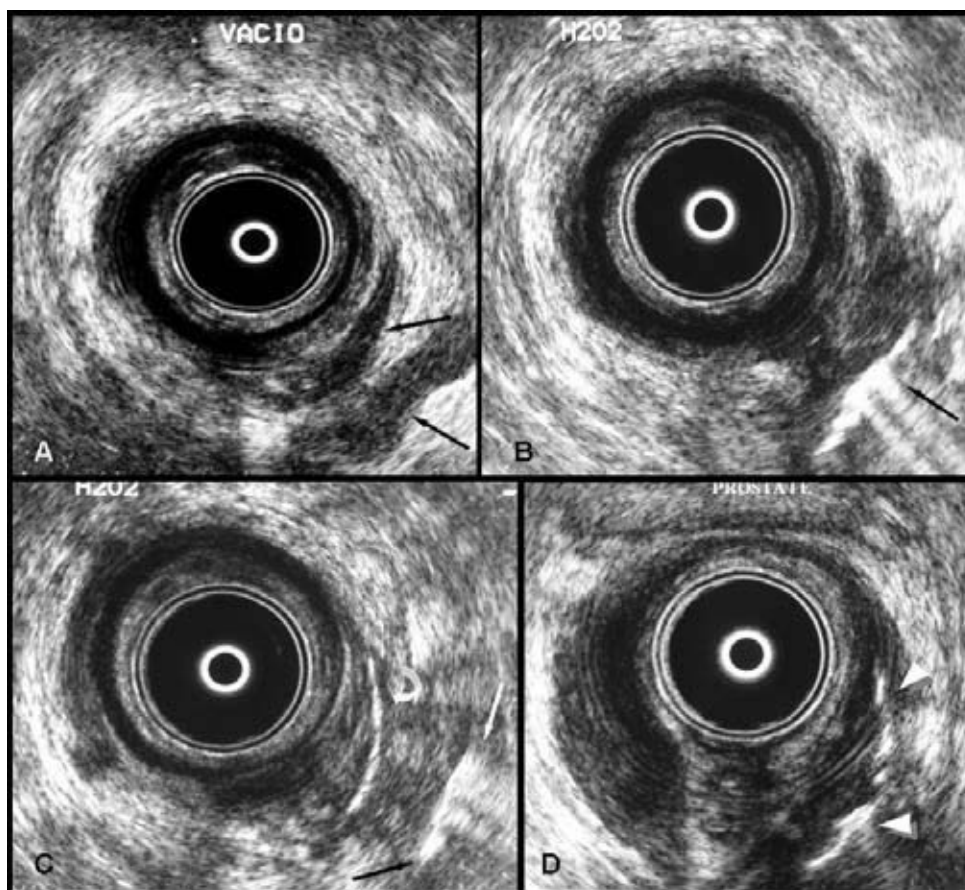


Figure 3 - Suprasphincteric fistula. A. Conventional endoanal ultrasound with hypoechoic lesion in the back-lateral intersphincteric plane and left ischio-rectal area (arrows). B. After injecting H_2O_2 , a connection with the abscess located in the ischio-rectal area (arrow) is observed. C and D. An intersphincteric tract (curved arrow at C) and the fistulous extension above the insertion of the elevator muscle of the anus close to the base of the prostate (head of arrow at D) are shown.

Table 3 - Findings in endoanal ultrasound regarding the surgical history and use of H_2O_2

	With previous surgery (n=16)		Without previous surgery (n=28)	
	Without H_2O_2	With H_2O_2	Without H_2O_2	H_2O_2
Normal	6	0	8	0
Simple fistula	3/11 (19%)	10/11 (91%)	12/20 (60%)	19/20 (95%)
Secondary tracts	0/5 (0%)	4/5 (80%)	0/8 (0%)	3/8 (37%)
Internal opening	1/14 (7%)	9/14 (64%)	8/23 (35%)	21/23 (91%)
Additional findings	12/16 (75%)		20/28 (71%)	

the non-contrasted endoanal ultrasound and the surgical findings ($P<.0001$; McNemar test).

The additional information provided by the H_2O_2 in detecting fistulous tracts showed significant differences between the patients with previous surgery and those that had not been operated on before (68% in patients with previous surgery compared with 35% of patient without previous surgery) ($P<.05$) (Table 3). The added information was similar in simple fistulae and fistulae with secondary tracts (increase in the detection of fistulae with secondary tracts from 37% to 80% and in simple fistulae, from 35% to 72%) (Table 3).

Discussion

The use of the conventional endoanal ultrasound in the study of perianal fistulae varies widely between series. Some of them show superiority in comparison with digital exploration,⁶⁻⁸ while others provide very little information.⁹ Since the publication of a study by Cheong et al,⁵ the use of H_2O_2 has led to greater precision in the visualisation of fistulous tracts and collections as well as of internal openings. In our study, the correlation between the endoanal ultrasound with H_2O_2 and surgery to identify the principal tracts was 77%, with

better results in the intersphincteric fistulae (82%) and those located above the elevating muscle of the anus (82%). Other authors have published similar rates: Navarro-Luna et al¹⁰ obtained a correlation in the identification of the principal tract in 85% of 80 patients that were operated on; Gordon et al,⁷ in 81% of 80 cases; Ratto et al,⁶ in 77%; Sudol-Szopinska et al,¹¹ in 95% of their 22 patients, and Ortiz et al,¹² in 87% of their 128 patients.

Regarding the detection of the internal opening, we observe a high correlation with the surgical findings, with visualisation in 29 of the 37 internal openings identified by surgery (78%). These numbers are similar to certain published studies where H₂O₂ was used: Gordon et al⁷ and Navarro-Luna et al,¹⁰ 91% in 104 and 78 patients, respectively, and Sudol-Szopinska et al,¹¹ 81 % in 22 patients. Other studies have shown inferior results, such as Ortiz et al,¹² that detected 62.5% of the internal openings, or Moscowitz et al¹³ in 61%. The relatively low published figures in certain series are probably due to the fact that H₂O₂ was not used or that the H₂O₂ was injected before and not while the test was being carried out, although it could also be related to the different experience levels of the ultrasound technicians.¹⁴ On the other hand, in our study, a high percentage was also detected of secondary tracts (70%) and all of the abscesses (100%) found in surgery.

The use of H₂O₂ significantly improved the results of the conventional endoanal ultrasound in our study, as 77% of the fistulous tracts were correctly identified compared to 45% from conventional studies, demonstrating 19 more internal openings (78% compared to 22%), and, lastly, all of the fistulae with secondary tracts visualised with ultrasound were detected (70% compared to 0%). For that reason, corroborating previous publications,⁷ our results demonstrate that the endoanal ultrasound without the injection of H₂O₂ is a very limited technique to study perianal fistulae, and therefore it should not be used in cases where the external opening is not identified or not permeable. In these cases, the MR represents the first alternative. There are various studies¹⁵⁻¹⁷ that have evaluated its precision with high values of sensitivity, specificity and positive predictive values, as well as a concordance with surgery.¹⁸⁻²⁰ However, the MR is more expensive, it requires more exploration time and less availability, which converts the endoanal ultrasound in the most-accessible imaging technique for the initial pre-surgery study of anal fistulae.

Different authors^{9,13,21} have demonstrated a greater precision of the endoanal ultrasound with H₂O₂ to identify and classify transsphincteric and intersphincteric fistulae (Figure 1 and 2), in detriment of the suprasphincteric and extrasphincteric (high fistulae), and they consider that these present a higher difficulty to be characterised. However, in our study, the use of H₂O₂ allowed for a high level of detection and the correct classification of these fistulae (82%). We visualised an additional 66% of the high fistulae compared with the conventional ultrasound (Figure 3), a higher percentage than that for other types of fistulae (36% and 23% in intersphincteric and transsphincteric fistulae, respectively). The use of MR is recommended in existing literature for high fistulae, as it enables the visualisation in the coronal plane of the elevating muscle of the anus, which facilitates the diagnosis of the affection of the supralevator space.

The improvement in the ultrasound results with the use of H₂O₂ was more evident in those patients that had previously been operated on, as a greater additional percentage of fistulae was visualised, both simple as well as those with secondary tracts, than in those patients that had not previously been operated on. The precision of the conventional endoanal ultrasound is greatly reduced in the identification of recurrent fistulae^{6,1,9,11,15,16,22} due to the scarring changes that produce alterations in the echogenicity of the tissues. The H₂O₂ acts like a contrast medium in the interior of the tract (small hyperechoic bubbles of air) and it transforms the hypoechoic fistulous tract in a lineal hyperechoic image, and thus allows for an increased diagnostic precision.

To conclude, the endoanal ultrasound with H₂O₂ presents a high correlation with surgical findings in the evaluation of perianal fistulae. Our results confirm that the use of H₂O₂ improves the results of the conventional endoanal ultrasound, as it detects a greater number of internal openings, presents a greater precision in the differentiation of simple fistulae and those with secondary tracts, above all in patients that have previously been operated on, and also, it especially increases the detection of high fistulae (suprasphincteric).

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