

Doppler-guided hemorrhoidal dearterialization/transanal hemorrhoidal dearterialization: Technical evolution and outcomes after 20 years

Marleny Novaes Figueiredo, Fábio Guilherme Campos

Marleny Novaes Figueiredo, Department of Gastroenterology, University of São Paulo Medical School, São Paulo, PC 01411-000, Brazil

Fábio Guilherme Campos, Department of Gastroenterology, Hospital das Clínicas, University of São Paulo Medical School, São Paulo, PC 01411-000, Brazil

Author contributions: Both authors performed research and wrote the paper.

Conflict-of-interest statement: None of the authors have any conflict of interest.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Correspondence to: Fábio Guilherme Campos, MD, PhD, Associate Professor of Surgery, Colorectal Surgery Division Staff Surgeon, Department of Gastroenterology, Hospital das Clínicas, University of São Paulo Medical School, Rua Padre João Manoel, 222 - Cj 120 - Cerqueira César, São Paulo, PC 01411-000, Brazil. fgmcampos@terra.com.br
Telephone: +55-11-30610108
Fax: +55-11-30610108

Received: August 29, 2015

Peer-review started: September 7, 2015

First decision: December 7, 2015

Revised: December 19, 2015

Accepted: January 21, 2016

Article in press: January 22, 2016

Published online: March 27, 2016

Abstract

In the setting of Hemorrhoidal Disease treatment, the

option of conventional hemorrhoidectomy is highly effective, but it is still associated with postoperative pain and discomfort. For this reason, technical alternatives have been developed in order to reduce complications and to provide better postoperative recovery. To accomplish this aim, non-excisional techniques such as stapled hemorrhoidectomy and Doppler-guided hemorrhoidal ligation have been introduced into clinical practice with high expectations. The aim of this article is to revise the literature about transanal hemorrhoidal dearterialization technique in the treatment of hemorrhoidal disease, looking into its evolution, results and possible benefits over other modalities of surgical treatment. The literature review showed that Doppler-guided hemorrhoidal dearterialization is a safe and effective method to treat grades II to IV hemorrhoidal disease. Outcomes in patients presenting prolapse are satisfactory and the association of anopexy is an important aspect of this operation. Anal physiology disturbances are rarely observed and mainly transitory. This technique is an excellent option for every patient, especially in those with previous anal surgeries and in patients with previous alterations of fecal continence, when an additional procedure might represent a risk of definitive incontinence.

Key words: Doppler-guided hemorrhoidal dearterialization; Hemorrhoids; Transanal hemorrhoidal dearterialization

© The Author(s) 2016. Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: Management of hemorrhoidal disease is a tough task. First of all, because there are some technical alternatives that should be adequately indicated to different patients; secondly, because patients desire a good alternative associated with low morbidity, good long-term results and less postoperative pain. In this setting, the transanal hemorrhoidal dearterialization

(THD) technique is considered a safe and effective choice for internal hemorrhoids of grades II to IV. The present paper reviews technical aspects and literature results of THD in comparison to other operative techniques.

Figueiredo MN, Campos FG. Doppler-guided hemorrhoidal dearterialization/transanal hemorrhoidal dearterialization: Technical evolution and outcomes after 20 years. *World J Gastrointest Surg* 2016; 8(3): 232-237 Available from: URL: <http://www.wjgnet.com/1948-9366/full/v8/i3/232.htm> DOI: <http://dx.doi.org/10.4240/wjgs.v8.i3.232>

INTRODUCTION

For over 60 years, since the description of hemorrhoidectomy by Milligan and Morgan *et al.*^[1] and Ferguson *et al.*^[2], conventional hemorrhoidectomy (CH) has been the standard treatment for grades III and IV hemorrhoids. It is also indicated for grade II hemorrhoids refractory to conservative methods (such as rubber band ligation or infrared coagulation) or to those that have recurred. However, CH is still associated with postoperative pain and discomfort. Thus, technical alternatives to manage hemorrhoidal disease have been sought, in order to reduce complications and to provide better postoperative recovery, especially less pain.

In this scenario, stapled hemorrhoidectomy (SH) and Doppler-guided hemorrhoidal ligation have been introduced in our practice since the 90's^[3,4]. Whether called Doppler-guided hemorrhoidal artery ligation (DG-HAL) or transanal hemorrhoidal dearterialization (THD), it is a technique for the treatment of internal hemorrhoids and it was first described by Morinaga *et al.*^[3] in 1995. Few studies have addressed the technique until after the year 2000, with a lot of papers since then.

The aim of this article was to revise the literature about this technique in the treatment of hemorrhoidal disease, looking into its evolution, results and possible benefits over other modalities of surgical treatment.

A literature search was performed in PubMed, looking for "THD", "transanal hemorrhoidal dearterialization", "DG-HAL" and "Doppler guided hemorrhoidal artery ligation". References from the selected articles were also reviewed in order to find additional studies in the subject.

TECHNICAL ASPECTS

Before Morinaga's work for the surgical treatment of hemorrhoids with Doppler-guided ligation, Jaspersen *et al.*^[5] described the successful use of Doppler-guided location of hemorrhoidal vessels for phenol injection for treatment of 1st grade hemorrhoids.

Hemorrhoidal vessels are usually found in the mucosa within 2 cm up from the anorectal junction^[6]

and this is the place where the sutures should be made in this technique (the Dearterialization itself). In the case anopexy is also to be made, this is the position where the first ligation should be made, before the running suture for the anopexy is continued distally.

Different devices were developed to accomplish the location of vessels by Doppler signal as well as to permit the ligation at the same time. Morinaga *et al.*^[3] used a device called the Moricorn to find Doppler signal 2 cm above the dentate line and then ligate arterioles at this point. Afterwards, other proctoscopes were developed and nowadays most studies use THD (THD S.p.A. Correggio, Italy), DG-HAL/DG-RAR (Agency for Medical Innovations GmbH (AMI), Feldkirch, Österreich, Austria) or HAL-Doppler (AMI Dufour MedicalTM, Maurepas, France).

There does not seem to exist any difference in results according to the type of device used, since they operate in the same way despite the different appearance of each one.

Table 1 refers to difference in rates of success and recurrence for each technique used for the treatment of hemorrhoidal disease: conventional, stapled and dearterialization.

INITIAL RESULTS WITH THD/HAL

When we look at the studies published in the first 12 years following Morinaga's publication, only ligation was performed (without anopexy). It was only in 2007 when a modification of the technique was made, with additional anopexy for patients with prolapse^[7]. Morinaga *et al.*^[3] reported this first series with 112 patients, obtaining satisfactory results in 78% of patients with prolapse, as well as resolution of pain in 96% of patients and of bleeding in 95%.

After 6 years, Sohn *et al.*^[8] published another series of patients treated with hemorrhoidal ligation in 2001. Sixty patients were submitted to a procedure (THD) based on the principles described by Morinaga, and the authors achieved complete success in 92% of patients with prolapse, 88% of those with bleeding and 71% of those with pain. Early postoperative pain, precluding normal activities, was reported in only 8% of patients.

Giordano *et al.*^[9] published the first systematic review concerning THD/DG-HAL in 2009, analyzing 17 papers from 1995 to 2008. In all articles revised no anopexy was performed. The rate of recurrent prolapse varied between 0% and 37%. In the study where this recurrence rate of 37% was found, most patients were lost to follow up, which might have interfered in the results^[10]. The overall rate of prolapse, according to the review, was 9%. Regarding recurrent anal bleeding, the rates ranged between 0% and 21% in those 17 studies, with most papers reporting rates around 4% to 10%. The overall rate of recurrent bleeding, also according with this systematic review, is 7.8%. Early post-operative pain was reported in 18% of patients in

Table 1 Rates of success, post-operative pain and long-term recurrence after different techniques for treatment of hemorrhoidal disease

Technique	Symptom control	Post-operative pain	Recurrence
Conventional hemorrhoidectomy	95%	70%-75%	5%
Stapled hemorrhoidectomy	85%-90%	5%-20%	2%-24%
THD/DG-HAL	80%-95%	2%-20%	8%-10%
THD/DG-HAL + Anopexy	85%-95%	6%-50%	8%

THD: Transanal hemorrhoidal dearterialization; DG-HAL: Doppler-guided hemorrhoidal artery ligation.

the review.

ADDITIONAL ANOPEXY

In 2007, Dal Monte *et al.*^[7] were the first to describe a modification of THD/HAL, adding anopexy of the cushions where prolapse was found. They included patients with hemorrhoidal disease grades II to IV, and anopexy was performed in a group of patients with disease grades III and IV. They compared the latter with patients not submitted to anopexy and there was a tendency of worse prolapse relapse without anopexy, although not statistically significant.

Technical aspects of anopexy consist of extending the suture in a continuous manner after the first figure-of-eight stitch, involving mucosa more superficially than the first stitch, until above the pectinate line. The exact point where the suture is to be ended is identified with an audible Doppler signal before the sutures are done. The rationale of this modification was to treat prolapse at the same procedure.

Infantino *et al.*^[11] published a multicentric study showing results of the modified technique, treating grades II and III hemorrhoids. Their recurrence rate was 14.3% and patient satisfaction after 15 mo was 87%. Other 4 papers in 2009 and 2010 showed prolapse recurrence in 5%-17%^[12-15].

Several articles on THD/DGHAL with anopexy were published, and the reported prolapse recurrence rates ranged between 3% and 21% and satisfaction rates of 84% to 96%, with follow ups of until 3 to 37 mo^[12-14,16-24]. Scheyer *et al.*^[25] reported good results with Dearterialization and anopexy, but in their conclusion results were not good when prolapse was not the main complaint. In one of the most recent papers on the matter, Ratto *et al.*^[26] reported a recurrence of prolapse in only 6.3% and a satisfaction rate of 90% after a 11 mo follow up. In this series, 13% of patients suffered pain or tenesmus after surgery.

THD/HAL IN THE TREATMENT OF GRADE IV HEMORRHOIDAL DISEASE

Results of this treatment in patients with high-grade disease (grade IV) seem to be satisfactory in terms of

prolapse resolution.

Two series were published involving only patients with grade IV disease. In both studies anopexy was performed in addition of hemorrhoidal ligation. Giordano *et al.*^[19] found an incidence of pain in 70% of patients in the first postoperative day, tenesmus in 10%, but a recurrence of prolapse of only 3% after a follow up of almost 3 years. Faucheron *et al.*^[22] reported postoperative pain in only 6% of patients, tenesmus in 1% and recurrence of prolapse in 9% after 34-mo follow up.

COMPARATIVE STUDIES WITH SH

Ramírez *et al.*^[27] were the first to publish a randomized trial comparing THD and PPH in 2005. Several other studies compared both techniques from 2009 until 2014. Festen *et al.*^[28] published a series comparing 18 patients submitted to stapled hemorrhoidopexy and 23 patients submitted to THD. After a very short follow up of only 3 wk, THD patients had less pain in the first week, with similar results after 3 wk. Symptoms resolution was also similar between groups^[28].

Three studies found that THD patients had an earlier return to normal activities^[29-31]. Tsang *et al.*^[31] found similar complication rates and similar satisfaction rates but follow up after procedures was very different (8 mo after THD and 36 mo after SH). Verre *et al.*^[32] published a prospective randomized trial in 2013, with 7.9% bleeding rate after SH and none after THD. Postoperative pain was lower in THD group although not statistically significant.

Lucarelli *et al.*^[33] reported a randomized trial with long-term follow up, where recurrent prolapse was the primary outcome, after a follow up of 40-43 mo. The technique performed in their study was THD with anopexy vs stapled hemorrhoidopexy. The last follow up was done through a telephone interview, with reports of prolapse recurrence in 25% of patients in the THD group vs 8.2% ($P = 0.021$) in the SH group. In spite of that, patient satisfaction was 73% in THD group vs 86.9% in the SH group. One might argue about detecting recurrence of prolapse by phone interviews, when one study by Ratto *et al.*^[13] showed that patients misreported skin tags for prolapse, after a physical examination took place.

As in the study by Infantino *et al.*^[34], Lucarelli *et al.*^[33] did not find significant difference in levels of post-operative pain. Other studies have found lower pain levels after THD when compared to stapled hemorrhoidopexy^[30,31,35] while in some it was a trend in the group submitted to THD but did not reach statistical significance^[28,29,32].

Giordano *et al.*^[29] compared THD vs SH for grades II and III, and reported a recurrence of symptoms recurrence of 14% vs 13%, while satisfaction was also similar between groups (89% vs 87%), respectively. THD technique comprised also anopexy in this study. There were no reports of fecal incontinence in both

groups.

A systematic review included 3 trials comparing these techniques, with a total of 150 patients concluded that both techniques were effective, but THD patients had less immediate postoperative pain^[36].

COMPARISON WITH CH

In our literature search, three studies were found comparing Dearterialization and CH.

In a non-blind randomized study, Elmér *et al.*^[37] compared 20 patients in each group. Although patients presented less postoperative pain after THD, symptoms were effectively controlled in both groups after long-term follow-up.

Bursics *et al.*^[38] randomized 60 patients in 2 groups and also showed similar results after 12 mo of follow up. THD group had an earlier return to normal activities ($P < 0.0005$) and less post-operative pain ($P < 0.005$). Another randomized trial was published recently, with a follow up of 24 mo, showing no difference between groups in terms of postoperative pain in the first month after surgery or regarding resumption of normal activities. Patient satisfaction in the end of follow up was also similar between THD and CH ($P > 0.05$)^[39].

Denoya *et al.*^[40] published the article with the longest follow up, 3 years. Forty patients were randomized in each group, and they also found similar results regarding resolution of symptoms and patient satisfaction.

RESULTS REGARDING ANAL PHYSIOLOGY

According to Walega *et al.*^[41], resting and squeeze pressures following DG-RAR were lower 3 mo after surgery comparing to pre-operative measures ($P < 0.05$) and this result was maintained after 12 mo after surgery.

In their comparative article, Giordano *et al.*^[29], found no complaint of incontinence after THD or SH. Only 2 patients in the SH group ($n = 24$) complained of transient urgency. Tsang *et al.*^[31] described 1 case of incontinence in SH group ($n = 37$) and none in THD group ($P = 0.111$).

In the systematic review by Giordano *et al.*^[9] the overall incontinence rate after THD was 0.4%.

IMPORTANT CONSIDERATIONS

Morinaga *et al.*^[3] described Doppler arterial hemorrhoidal ligation in 1995 as a novel treatment for hemorrhoids. This technique has become more popular and, nowadays, it is used worldwide. It is based on the premise that arterial ligation would lead to a lesser pressure on the vessels on the anal canal, thus relieving the symptoms as bleeding and prolapse. Initial articles reporting this technique showed satisfactory results.

On 2007 Dal Monte *et al.*^[7] were the first to publish a modification on the described technique, including anopexy in order to better treat prolapse for 3rd and 4th grade hemorrhoids. With this, treatment of prolapse associated with 3rd and 4th grade hemorrhoids was guaranteed and recurrence rates were better.

One of the main advantages of the THD/DG-HAL is the low morbidity rate. After CH pain can be an important distress for the patient, influencing return to normal activities. Postoperative pain seems to be lower after THD when compared to CH, as seen in comparative studies^[37,38,40]. In a systematic review concerning THD, 18.5% of patients suffered from pain in the first operative day^[9]. Although this review points out that published data on THD was low quality, thus low significance/power, many studies evaluating this technique showed good results in short-term follow-up, with immediate postoperative bleeding occurring in 0%-8% and recurrence of 3%-20%.

Some works show a high recurrence rate related to grade III or IV hemorrhoids^[10,42,43], but those studies were done before the anopexy was associated with the arterial ligation. The study with the longest follow up showed a trend to higher recurrence rate for grade III hemorrhoids compared to grade II after 5 years, but the difference was not statistically significant^[42]. Two studies involving patients only with grade IV hemorrhoidal disease showed a recurrence of 3%-9% after a follow up of almost 3 years.

SH was first described by Longo^[4] in 1998 and is also a non-excisional technique for the treatment of hemorrhoidal disease. As THD, the goal is to treat hemorrhoids without the risk of sphincter impairment and to reduce postoperative pain. However, serious complications after SH, such as major bleeding, rectovaginal fistulas and perianal sepsis, have been described^[44]. One study prospectively comparing SH and THD for grades II and III hemorrhoidal disease showed no difference regarding recurrent symptoms or patients' satisfaction with their results^[29].

Regarding anal physiology, it seems reasonable to believe that hemorrhoidal dearterialization may contribute with only minor disruption of continence, since there is no risk of anal sphincter damage. On the other hand, the technique affects hemorrhoidal cushions in the anal canal, which play a role in anal continence as well. At the same time, all techniques interfere with the cushions, since it is the goal of the treatment. Maybe due to the fact that THD is a non-excisional technique, the impact after surgery might be reduced compared to excisional techniques.

Incontinence is rarely described, and when it happens it is transitory. More important is the complaint of tenesmus after THD surgery, which is rather common, in about 10% of patients, but also transitory. In a study by Ratto *et al.*^[13], tenesmus was reported by 24% of patients but symptoms disappeared 10 d following surgery. Even though alterations in resting

and squeeze anal pressures might be seen in anorectal manometry after THD, there is no evidence of risk of incontinence with this procedure^[41].

In conclusion, Doppler-guided hemorrhoidal dearterialization is a safe and effective method to treat grades II to IV hemorrhoidal disease. Outcomes in patients presenting prolapse are satisfactory and the association of anopexy has become an important aspect of this operation, contributing to a higher success rate. Anal physiology disturbances are rarely observed and are transitory. This technique is an excellent option for every patient, especially in those with previous anal surgeries and in patients with previous alterations of fecal continence, when an additional procedure might represent a risk of definitive incontinence.

REFERENCES

- 1 **Milligan E**, Morgan C, Jones L, Officer R. Surgical anatomy of the anal canal and the operative treatment of haemorrhoids. *The Lancet* 1937; **2**: 1119-1123 [DOI: 10.1016/S0140-6736(00)88465-2]
- 2 **Ferguson JA**, Heaton JR. Closed hemorrhoidectomy. *Dis Colon Rectum* 1959; **2**: 176-179 [PMID: 13652788]
- 3 **Morinaga K**, Hasuda K, Ikeda T. A novel therapy for internal hemorrhoids: ligation of the hemorrhoidal artery with a newly devised instrument (Moricorn) in conjunction with a Doppler flowmeter. *Am J Gastroenterol* 1995; **90**: 610-613 [PMID: 7717320]
- 4 **Longo A**. Treatment of hemorrhoidal disease by reduction of mucosa and hemorrhoidal prolapse with a circular-suturing device: a new procedure. Proceedings of the 6th World Congress of Endoscopic Surgery. Italy: Rome, 1998: 777-784
- 5 **Jaspersen D**, Koerner T, Schorr W, Hammar CH. Proctoscopic Doppler ultrasound in diagnostics and treatment of bleeding hemorrhoids. *Dis Colon Rectum* 1993; **36**: 942-945 [PMID: 8404386]
- 6 **Ratto C**, Parello A, Donisi L, Litta F, Zaccone G, Doglietto GB. Assessment of haemorrhoidal artery network using colour duplex imaging and clinical implications. *Br J Surg* 2012; **99**: 112-118 [PMID: 22021046 DOI: 10.1002/bjs.7700]
- 7 **Dal Monte PP**, Tagariello C, Sarago M, Giordano P, Shafi A, Cudazzo E, Franzini M. Transanal haemorrhoidal dearterialisation: nonexcisional surgery for the treatment of haemorrhoidal disease. *Tech Coloproctol* 2007; **11**: 333-338; discussion 338-339 [PMID: 18060529]
- 8 **Sohn N**, Aronoff JS, Cohen FS, Weinstein MA. Transanal hemorrhoidal dearterialization is an alternative to operative hemorrhoidectomy. *Am J Surg* 2001; **182**: 515-519 [PMID: 11754861]
- 9 **Giordano P**, Overton J, Madeddu F, Zaman S, Gravante G. Transanal hemorrhoidal dearterialization: a systematic review. *Dis Colon Rectum* 2009; **52**: 1665-1671 [PMID: 19690499 DOI: 10.1007/DCR.0b013e3181af50f4]
- 10 **Scheyer M**, Antonietti E, Rollinger G, Mall H, Arnold S. Doppler-guided hemorrhoidal artery ligation. *Am J Surg* 2006; **191**: 89-93 [PMID: 16399113]
- 11 **Infantino A**, Bellomo R, Dal Monte PP, Salafia C, Tagariello C, Tonizzo CA, Spazzafumo L, Romano G, Altomare DF. Transanal haemorrhoidal artery echodoppler ligation and anopexy (THD) is effective for II and III degree haemorrhoids: a prospective multicentric study. *Colorectal Dis* 2010; **12**: 804-809 [PMID: 19508513 DOI: 10.1111/j.1463-1318.2009.01915.x]
- 12 **Walega P**, Krokowicz P, Romaniszyn M, Kenig J, Salówka J, Nowakowski M, Herman RM, Nowak W. Doppler guided haemorrhoidal arterial ligation with recto-anal-repair (RAR) for the treatment of advanced haemorrhoidal disease. *Colorectal Dis* 2010; **12**: e326-e329 [PMID: 19674029 DOI: 10.1111/j.1463-1318.2009.02034.x]
- 13 **Ratto C**, Donisi L, Parello A, Litta F, Doglietto GB. Evaluation of transanal hemorrhoidal dearterialization as a minimally invasive therapeutic approach to hemorrhoids. *Dis Colon Rectum* 2010; **53**: 803-811 [PMID: 20389215 DOI: 10.1007/DCR.0b013e3181cdafa7]
- 14 **Satzinger U**, Feil W, Glaser K. Recto Anal Repair (RAR): a viable new treatment option for high-grade hemorrhoids. One year results of a prospective study. *Pelviperroneology* 2009; **28**: 37-42
- 15 **Testa A**, Torino G, Gioia A. DG-RAR (Doppler-guided recto-anal repair): a new mini invasive technique in the treatment of prolapsed hemorrhoids (grade III-IV): preliminary report. *Int Surg* 2010; **95**: 265-269 [PMID: 21067008]
- 16 **LaBella GD**, Main WP, Hussain LR. Evaluation of transanal hemorrhoidal dearterialization: a single surgeon experience. *Tech Coloproctol* 2015; **19**: 153-157 [PMID: 25637412 DOI: 10.1007/s10151-015-1269-6]
- 17 **Deutsch CJ**, Chan K, Alawattagama H, Sturgess J, Davies RJ. Doppler-Guided Transanal Haemorrhoidal Dearterialisation Is a Safe and Effective Daycase Procedure for All Grades of Symptomatic Haemorrhoids. *Surgical Science* 2012; **3**: 542-545 [DOI: 10.4236/ss.2012.311107]
- 18 **Ratto C**. THD Doppler procedure for hemorrhoids: the surgical technique. *Tech Coloproctol* 2014; **18**: 291-298 [PMID: 24026315 DOI: 10.1007/s10151-013-1062-3]
- 19 **Giordano P**, Tomasi I, Pascariello A, Mills E, Elahi S. Transanal dearterialization with targeted mucopexy is effective for advanced haemorrhoids. *Colorectal Dis* 2014; **16**: 373-376 [PMID: 24460621 DOI: 10.1111/codi.12574]
- 20 **Ratto C**, Giordano P, Donisi L, Parello A, Litta F, Doglietto GB. Transanal haemorrhoidal dearterialization (THD) for selected fourth-degree haemorrhoids. *Tech Coloproctol* 2011; **15**: 191-197 [PMID: 21505901 DOI: 10.1007/s10151-011-0689-1]
- 21 **Szumlowicz UM**, Gurland B, Garofalo T, Zutshi M. Doppler-guided hemorrhoidal artery ligation: the experience of a single institution. *J Gastrointest Surg* 2011; **15**: 803-808 [PMID: 21359596 DOI: 10.1007/s11605-011-1460-7]
- 22 **Faucheron JL**, Poncet G, Voirin D, Badic B, Gangner Y. Doppler-guided hemorrhoidal artery ligation and rectoanal repair (HAL-RAR) for the treatment of grade IV hemorrhoids: long-term results in 100 consecutive patients. *Dis Colon Rectum* 2011; **54**: 226-231 [PMID: 21228673 DOI: 10.1007/DCR.0b013e318201d31c]
- 23 **Theodoropoulos GE**, Sevrissarianos N, Papaconstantinou J, Panoussopoulos SG, Dardamanis D, Stamopoulos P, Bramis K, Spiliotis J, Datsis A, Leandros E. Doppler-guided haemorrhoidal artery ligation, rectoanal repair, sutured haemorrhoidopexy and minimal mucocutaneous excision for grades III-IV haemorrhoids: a multicenter prospective study of safety and efficacy. *Colorectal Dis* 2010; **12**: 125-134 [PMID: 19055522 DOI: 10.1111/j.1463-1318.2008.01739.x]
- 24 **Testa A**, Torino G. Doppler-guided hemorrhoidal artery ligation (DG-HAL): a safe treatment of II-III degree hemorrhoids for all patients. Could it be potentially also good prophylaxis? *Minerva Chir* 2010; **65**: 259-265 [PMID: 20668415]
- 25 **Scheyer M**, Antonietti E, Rollinger G, Lancee S, Pokorny H. Hemorrhoidal artery ligation (HAL) and rectoanal repair (RAR): retrospective analysis of 408 patients in a single center. *Tech Coloproctol* 2015; **19**: 5-9 [PMID: 25407664 DOI: 10.1007/s10151-014-1246-5]
- 26 **Ratto C**, de Parades V. Doppler-guided ligation of hemorrhoidal arteries with mucopexy: A technique for the future. *J Visc Surg* 2015; **152**: S15-S21 [PMID: 25262549 DOI: 10.1016/j.jvisurg.2014.08.003]
- 27 **Ramírez JM**, Aguilera V, Elia M, Gracia JA, Martínez M. Doppler-guided hemorrhoidal artery ligation in the management of symptomatic hemorrhoids. *Rev Esp Enferm Dig* 2005; **97**: 97-103 [PMID: 15801885]
- 28 **Festen S**, van Hoogstraten MJ, van Geloven AA, Gerhards MF. Treatment of grade III and IV haemorrhoidal disease with PPH or THD. A randomized trial on postoperative complications and short-term results. *Int J Colorectal Dis* 2009; **24**: 1401-1405 [PMID: 19798507 DOI: 10.1007/s00384-009-0803-2]
- 29 **Giordano P**, Nastro P, Davies A, Gravante G. Prospective

- evaluation of stapled haemorrhoidopexy versus transanal haemorrhoidal dearterialisation for stage II and III haemorrhoids: three-year outcomes. *Tech Coloproctol* 2011; **15**: 67-73 [PMID: 21318581 DOI: 10.1007/s10151-010-0667-z]
- 30 **Avital S**, Itah R, Skornick Y, Greenberg R. Outcome of stapled hemorrhoidopexy versus doppler-guided hemorrhoidal artery ligation for grade III hemorrhoids. *Tech Coloproctol* 2011; **15**: 267-271 [PMID: 21678068 DOI: 10.1007/s10151-011-0699-z]
- 31 **Tsang YP**, Fok KL, Cheung YS, Li KW, Tang CN. Comparison of transanal haemorrhoidal dearterialisation and stapled haemorrhoidopexy in management of haemorrhoidal disease: a retrospective study and literature review. *Tech Coloproctol* 2014; **18**: 1017-1022 [PMID: 24906978 DOI: 10.1007/s10151-014-1170-8]
- 32 **Verre L**, Rossi R, Gaggelli I, Di Bella C, Tirone A, Piccolomini A. PPH versus THD: a comparison of two techniques for III and IV degree haemorrhoids. Personal experience. *Minerva Chir* 2013; **68**: 543-550 [PMID: 24193286]
- 33 **Lucarelli P**, Picchio M, Caporossi M, De Angelis F, Di Filippo A, Stipa F, Spaziani E. Transanal haemorrhoidal dearterialisation with mucopexy versus stapler haemorrhoidopexy: a randomised trial with long-term follow-up. *Ann R Coll Surg Engl* 2013; **95**: 246-251 [PMID: 23676807 DOI: 10.1308/003588413X13511609958136]
- 34 **Infantino A**, Altomare DF, Bottini C, Bonanno M, Mancini S, Yalti T, Giamundo P, Hoch J, El Gaddal A, Pagano C. Prospective randomized multicentre study comparing stapler haemorrhoidopexy with Doppler-guided transanal haemorrhoid dearterialization for third-degree haemorrhoids. *Colorectal Dis* 2012; **14**: 205-211 [PMID: 21689317 DOI: 10.1111/j.1463-1318.2011.02628.x]
- 35 **Béliard A**, Labbé F, de Faucal D, Fabreguette JM, Pouderoux P, Borie F. A prospective and comparative study between stapled hemorrhoidopexy and hemorrhoidal artery ligation with mucopexy. *J Visc Surg* 2014; **151**: 257-262
- 36 **Sajid MS**, Parampalli U, Whitehouse P, Sains P, McFall MR, Baig MK. A systematic review comparing transanal haemorrhoidal dearterialisation to stapled haemorrhoidopexy in the management of haemorrhoidal disease. *Tech Coloproctol* 2012; **16**: 1-8 [PMID: 22183450 DOI: 10.1007/s10151-011-0796-z]
- 37 **Elmér SE**, Nygren JO, Lenander CE. A randomized trial of transanal hemorrhoidal dearterialization with anopexy compared with open hemorrhoidectomy in the treatment of hemorrhoids. *Dis Colon Rectum* 2013; **56**: 484-490 [PMID: 23478616 DOI: 10.1097/DCR.0b013e31827a8567]
- 38 **Bursics A**, Morvay K, Kupcsulik P, Flautner L. Comparison of early and 1-year follow-up results of conventional hemorrhoidectomy and hemorrhoid artery ligation: a randomized study. *Int J Colorectal Dis* 2004; **19**: 176-180 [PMID: 12845454]
- 39 **De Nardi P**, Capretti G, Corsaro A, Staudacher C. A prospective, randomized trial comparing the short- and long-term results of doppler-guided transanal hemorrhoid dearterialization with mucopexy versus excision hemorrhoidectomy for grade III hemorrhoids. *Dis Colon Rectum* 2014; **57**: 348-353 [PMID: 24509458 DOI: 10.1097/DCR.000000000000085]
- 40 **Denoya P**, Tam J, Bergamaschi R. Hemorrhoidal dearterialization with mucopexy versus hemorrhoidectomy: 3-year follow-up assessment of a randomized controlled trial. *Tech Coloproctol* 2014; **18**: 1081-1085 [PMID: 25248418 DOI: 10.1007/s10151-014-1219-8]
- 41 **Walega P**, Romaniszyn M, Kenig J, Herman R, Nowak W. Doppler-guided hemorrhoid artery ligation with Recto-Anal-Repair modification: functional evaluation and safety assessment of a new minimally invasive method of treatment of advanced hemorrhoidal disease. *ScientificWorldJournal* 2012; **2012**: 324040 [PMID: 22547979]
- 42 **Avital S**, Inbar R, Karin E, Greenberg R. Five-year follow-up of Doppler-guided hemorrhoidal artery ligation. *Tech Coloproctol* 2012; **16**: 61-65 [PMID: 22190190]
- 43 **Conaghan P**, Farouk R. Doppler-guided hemorrhoid artery ligation reduces the need for conventional hemorrhoid surgery in patients who fail rubber band ligation treatment. *Dis Colon Rectum* 2009; **52**: 127-130 [PMID: 19273967 DOI: 10.1007/DCR.0b013e3181973639]
- 44 **Pescatori M**, Gagliardi G. Postoperative complications after procedure for prolapsed hemorrhoids (PPH) and stapled transanal rectal resection (STARR) procedures. *Tech Coloproctol* 2008; **12**: 7-19 [PMID: 18512007 DOI: 10.1007/s10151-008-0391-0]

P- Reviewer: Widmann G, Zampieri N **S- Editor:** Ji FF
L- Editor: A **E- Editor:** Wu HL





Published by **Baishideng Publishing Group Inc**

8226 Regency Drive, Pleasanton, CA 94588, USA

Telephone: +1-925-223-8242

Fax: +1-925-223-8243

E-mail: bpgoffice@wjgnet.com

Help Desk: <http://www.wjgnet.com/esps/helpdesk.aspx>

<http://www.wjgnet.com>

