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Review Article

Latest Research Trends on the Management of Hemorrhoids

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Abstract

Hemorrhoids manifest with a range of symptoms and severities, prompting the development of various conservative, interventional, and surgical treatments. Selecting the most suitable treatment for each case is challenging, especially with the continuous evolution of new methods. This review aims to advance hemorrhoid treatment and research by exploring recent developments over the last five years. Conservative approaches have focused on isolating active ingredients from traditional herbal remedies to create new products and understand their mechanisms. In office-based treatments, advanced devices such as modified rubber band ligation and polymer clips with stronger binding forces have been introduced. Polidocanol in foam form has shown promise in sclerotherapy, while infrared coagulation is being replaced by alternative energy-based methods. Additionally, endoscopic office treatments and embolization of hemorrhoidal vessels via angiography are increasingly used as safer options for patients with high surgical risks or bleeding issues. Stapled hemorrhoidopexy has shifted to partial resection instead of complete circular resection, and hemorrhoidal artery ligation techniques have been reported to be effective when combined with stapled hemorrhoidopexy or excisional hemorrhoidectomy in severe cases. Evidence is growing that hemorrhoidal artery ligation remains effective even without Doppler guidance. With ongoing research into various methods, there is a need for scientific comparison and evaluation of their advantages and disadvantages, standardization of indicators and treatment protocols, and cost-effectiveness considerations. Surgeons should offer well-informed options and explanations to patients, based on a comprehensive understanding of available treatments.

Keywords

hemorrhoids, treatment, outcome, complication

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Introduction

Hemorrhoids are one of the most common conditions encountered by surgeons, with an estimated global prevalence of 2.9-29.7%[1], and approximately 10% of those cases receive surgical treatment[2]. Generally, hemorrhoidectomy is considered for Goligher classification[3] grade III-IV, and in some cases, grade II with symptoms or refractory to other treatments (The 'grade' mentioned later in this paper also refers to the grade in Goligher classification). Excisional hemorrhoidectomy (EH), either as open (Milligan-Morgan hemorrhoidectomy; MMH) or closed (Ferguson hemorrhoidectomy) fashion, is advantageous for rapidly improving symptoms like bleeding and protrusion and has a low recurrence rate. However, it is associated with significant postoperative pain and complications such as urinary retention, anal stenosis, and fecal incontinence. Consequently, alternative methods such as stapled hemorrhoidopexy (SH), hemorrhoidal artery ligation (HAL), rubber band ligation (RBL), and sclerotherapy have been proposed.

The Goligher classification, widely used as a guideline for treatment decisions, does not consider mixed forms of inter-

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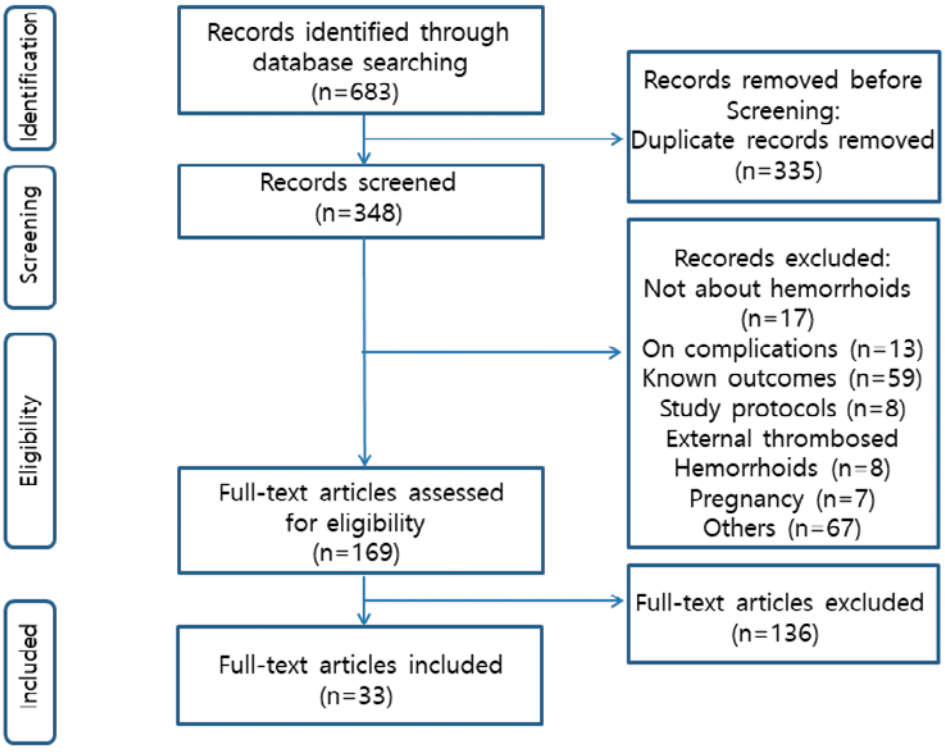

Figure 1. PRISMA flow diagram.

nal and external hemorrhoids or the number and size of hemorrhoidal piles[4,5], which limits its application. Therefore, even within the same grade, various presentations complicate the comparison of treatment effectiveness and side effects. Furthermore, guidelines may differ in recommendations or omit certain aspects, reflecting the variability among them[6]. Thus, clinicians tend to make treatment decisions based on scientific evidence, guidelines, the healthcare system of their society, cultural emphasis on treatment, and personal experience during their training[7].

In 2024, the American Society of Colorectal Surgeons (ASCRS) updated its Practical Guidelines for hemorrhoid treatment[8]. This review is designed to introduce recent (within the last 5 yrs) findings on hemorrhoid treatment methods referring to the organizational structure of this guidelines, highlighting current research trends and potential advancements in hemorrhoid care and research.

Methods

A literature search was performed to identify articles on the treatment of hemorrhoids. PubMed, Embase and Web of Science were searched electronically for articles published between 2019 and July 2024 using following search terms: (hemorrhoids, haemorrhoid, hemorrhoid, haemorrhoid, hemorrhoidal, haemorrhoidal) AND (treatment, management). Studies searched were limited to those written in English. All abstracts of these papers were reviewed, and following articles were excluded: papers on patients with hemorrhoids but not about hemorrhoids, papers on complications of hemorrhoidal treatment, studies on the effectiveness of conventional treatments with known outcomes, study protocols, papers on hemorrhoids in pregnancy and external thrombosed hemorrhoids. Among the remaining papers, those on new treatments were selected and discussed with other experienced colorectal surgeon (MK Kim) who was mentioned in the acknowledgement part. Figure 1 shows the PRISMA diagram for study inclusion.

Medical Treatment

For conservative treatment of hemorrhoids, topical agents such as creams, ointments, foams, and suppositories are used due to their low risk and potential for symptomatic relief. Phlebotonics, known for their efficacy in treating symptoms such as itching, bleeding, and discharge (excluding pain) through various RCTs[8], have been shown to be effective. Micronized purified flavonoid fraction, in particular, has demonstrated efficacy in preventing recurrence[9] and alleviating post-hemorrhoidectomy symptoms[10].

Recent research trends involve utilizing advanced techniques such as network pharmacology and transcriptomics to elucidate the mechanisms of traditional medicines and prove the efficacy of their processed products. For example, in India, AnoSpray, a polyherbal formulation made from seven plants mentioned in Ayurveda (a medical book written as a

compilation of Indian traditional medicine and ancient Hindu traditional medicine), has shown potential in suppressing inflammatory cytokines like COX-2, VEGF, and RANTES in cultured cells and human hemorrhoid specimens, indicating possible therapeutic benefits for hemorrhoids, anal fissures, and perineal wounds[11]. Similarly, in Yunnan, China, *Sageretia theezans*, traditionally used for various inflammatory and infectious diseases, has shown potential in affecting gene expressions such as GOT1, SLC25A10, SUCLG1, and CLEC4E, with middle doses demonstrating the greatest therapeutic effect for hemorrhoids[12].

At the 8th National Congress of the Italian Association of Colorectal Surgery (SICCR) in 2019, products that improved the limitations of existing drugs were introduced[9]. This include the first nanoemulsified sublinqual tablet that increases amount and speed of absorption of active compounds, and the first transparent liquid bandage as topical agent that can stay in situ for a prolonged time.

Office Treatment

The ASCRS guidelines introduce RBL, injection sclerotherapy, and infrared coagulation as office treatments, effective for grades I-II and some grade III cases. Recent studies primarily focus on modified or combined forms of sclerotherapy and RBL, with fewer reports on infrared coagulation.

RBL

RBL is known to be the most effective and popular office treatment. Jin et al.[13] conducted a randomized controlled trial (RCT) based on modified RBL, which differs from traditional RBL in that it suctions the mucosa and submucosa by applying negative pressure and an elastic coil rather than band. They reported that compared to MMH in patients with grade III hemorrhoids, modified RBL was more beneficial in terms of postoperative pain, bleeding, and urinary retention, with no difference in recurrence rate after 1 year. In Republic of Korea, a retrospective study[14] compared the outcome of a polymer clip (BANANA-Clip, Endovision) use with that of historical rubber band ligation cohort in grades I-III hemorrhoids. Results showed a significant advantage in delayed bleeding rates (0% vs. 3.5%, p=0.001) and higher success rates at one year (99.7% vs. 95.9%, p=0.005) with the polymer clip. The authors believed that the effect of longitudinal suture could be anticipated through the use of a wide and stable instrument, so that the possibility of anal stenosis after the procedure could be reduced, and the lifting effect of redundant mucosal tissue could also be obtained.

Sclerotherapy

Sclerotherapy is the office treatment that is in the spotlight after RBL. According to a systematic review and meta-analysis published in 2022[15], sclerotherapy showed no difference in recurrence rates compared to RBL at three months, and while post-procedure pain might be lower (especially in grade II according to their subgroup analysis), it was found to be inferior in controlling symptoms like bleeding or prolapse. However, we suggested that conclusions might change with the advent of new sclerosants, as none of the eight studies analyzed in the sclerotherapy group used polidocanol in foam form as a sclerosant in that report.

Polidocanol was originally used for saphenous incompetence. Fernandes et al.[16] applied 2% polidocanol in foam form to consecutive 2,000 patients with Grade II-IV hemorrhoids, and in a telephone follow-up four weeks later, 98% of patients reported being ‘very satisfied,’ and 92% experienced no pain or only needed paracetamol for simple pain management.

Additionally, the safety and excellent sclerosing effect of 3% polidocanol foam for hemorrhoids continue to be reported in the randomised controlled trial or in the multicenter prospective study[17,18]. However, the Belgian guidelines[19] do not recommend use of polidocanol as a sclerosant due to the potential for anaphylactic shock, estimated at 1/10,000 or higher. Therefore, further validation is needed to assess the safety and efficacy of foam form compared to other treatment methods.

Sclerobanding

In Italy, sclerobanding, a combination of RBL and sclerotherapy, was studied in grade II-III hemorrhoids. Among 97 patients in whom anticoagulant users were excluded, no complications occurred during surgery, with a 4.1% complication rate within one month, all resolved within three months[20]. Additionally, when sclerobanding was applied to 51 patients (51% were undergoing dual anticoagulant therapy, and 21.6% were using non-vitamin K antagonist oral anticoagulants) on anticoagulants in a pilot study conducted by the same research team, this treatment also presented safety and efficacy. After the sclerobanding, only 7 patients (13.7%) reported pain and thrombosis resolved with conservative treatment, and only 2 (4%) recurrences were observed during a mean follow-up period of 23 months[21]. This suggests that the use of polidocanol might reduce the risk of bleeding, and that banding can limit excessive submucosal spreading of the sclerosant, potentially maximizing the benefits of both treatments while minimizing drawbacks such as recurrence[20]. Therefore, attention to further research results is warranted.

Infrared coagulation

The ASCRS guidelines used a meta-analysis reported in 2023[22] as the basis, but even the last paper on infrared coagulation (IRC) among the studies analyzed in that study

was published in 2008[23]. There was only one RCT[24] published in 2013, comparing IRC (n=129) to DG-HAL (n=116) in grade I and II hemorrhoids. However, IRC showed lower control of symptoms (81% vs. 96%, p<0.05), higher postoperative complication (13% vs. 2%, p<0.05) and required more repeated procedure (28% vs. 9%, p<0.05). Furthermore, radifrequency ablation (RFA), hemorrhoid energy therapy (HET), and laser hemorrhoidoplasty (LH) are receiving more attention as treatments that achieve hemorrhoid treatment effects, through the mechanism of necrosis and fibrosis through physical energy transfer as in IRC. It is also reported that those methods were usually performed in the operating room rather than at the bedside under a variety of anesthesia methods, ranging from locoregional block to general anesthesia[25-27]. Therefore, we propose to remove the "Infrared Coagulation" item from the guidelines and create a new item such as "Energy Therapy" in the operative treatment section.

Operative Treatment

The guidelines present EH, Doppler-guided hemorrhoidal artery ligation (DG-HAL), and SH as surgical options. EH is suitable for symptomatic external hemorrhoids or grade III-IV internal hemorrhoids but involves risks of pain, bleeding, anal stenosis, fecal incontinence, and recurrence. It is generally known that DG-HAL may have lower pain and higher recurrence rate than EH[8]. However, it appears that additional research results still need to be accumulated on this topic. In a prospective non-randomized study[28] comparing DG-HAL (n=120) and EH (n=167), there was no difference in recurrence rate (2.5% vs. 2.99%, p=0.802) after median follow up of 46 months (range 18-48), whereas in the study by Giuliani et al.[29], the recurrence rate was higher in the HAL group after 2 years of follow up (11.5% vs. 6.5%, p<0.0001). The two RCTs identified in the ASCRS guideline also presented conflicting conclusions regarding the difference in recurrence rates between the two treatment methods. Meanwhile, SH has less pain than EH, but may have a higher recurrence rate and may also cause some unique complications such as rectovaginal fistulas, staple line bleeding, and strictures, so it is not recommended as a first line treatment in the ASCRS guidelines[8]. Recent studies on these three operative Tx techniques show a tendency to supplement/improve existing techniques or to confirm the effectiveness by combining different techniques.

Modified SH

Since SH involves circular stapling, there is a potential risk of complications such as anastomosis stenosis, rectovaginal fistula, and rectal perforation. To address this, China introduced a tissue selecting technique (TST) in 2008, which avoids circular stapling by using an anoscope with bi- or tri-windows to staple two or three areas of mucosa and submucosa[30]. Yu et al.[31] adopted the TST concept, placing a brain spatula between the anal dilator and anal canal to prevent circular stapling. After placing a purse-string suture and firing the stapler, the mucosa and submucosa in the area where the brain spatula was located are preserved. This technique, named SH using a "large C suture" (where the stapler line forms a C shape rather than an O, with the ends of the C being sewn or ligated), was reported in 2021 to be applied to 126 grade III-IV patients. The authors emphasized that this technique, like TST, can reduce anal stenosis and intestinal perforation and can avoid rectovaginal fistula in women, especially when the anterior side has relatively mild hemorrhoidal pile.

There have been intriguing reports on how outcomes vary depending on the difference of SH procedure. A RCT[32] published in 2020 examining results based on stapling height found that a height of 4.5 cm above the anal verge required additional stitches for the stapler line compared to 6.0 cm, but there were no differences in pain, anorectal disturbance, or recurrence rates. Conversely, regarding stapler compression time, it was reported that a 30-second compression before firing (n=275) resulted in significantly more postoperative bleeding (8.4% vs. 1.4%, p=0.030) and fecal urgency (5.1% vs. 0%, p=0.040) compared to a 2-minute compression (n=73)[33]. Although not statistically significant, there was a trend toward fewer complications with longer compression times for stapling site dehiscence (1.8% vs. 0% p=0.580) and stenosis (4.5% vs. 0%, p=0.070), indicating a need for well-designed randomized controlled trials on compression time.

Mixed operative treatments

For patients with significant internal and external hemorrhoids, symptom improvement is difficult with SH alone because of high probability of prolapse recurrence, and EH alone has a high risk of complications such as postoperative pain and bleeding or anal stenosis due to wide excision for external hemorrhoidal tissue[8,33]. Methods applying two or more surgical techniques have been reported for this situation.

Gefen et al.[34] compared 48 patients who underwent both EH (by Ferguson fashion) and SH to 215 patients who received SH alone and 99 patients who received EH for significant external hemorrhoids. They found that the combination approach did not increase complications (EH+SH vs. SH vs. EH: 4.2% vs. 4.7% vs. 11.1%, p=0.074), recurrent symptoms (45.8% vs. 54.9% vs. 56.6%, p=0.446), or incontinence (measured by fecal incontinence score, 0 vs. 0 vs. 0, p=0.096) and significantly improved quality of life (measured by customized questionnaire rated 1 to 10, 10.0 vs. 8.0 vs. 8.0, p=0.040).

HAL works by blocking the hemorrhoidal blood supply,

inducing localized chronic inflammation, and causing tissue fibrosis, thereby adhesion and fixation of the mucosa and submucosa. This reduces the potential for tissue swelling and bleeding postoperatively and alleviates pain. Results of attempts to improve treatment outcomes by adding HAL to excisional procedures like MMH or SH in grade III-IV hemorrhoids patients were reported in 2023[35,36]. Comparing 60 patients who had DG-HAL followed by SH with 56 patients who had only SH, the former group showed faster wound healing (16.88±4.09 vs. 22.68±3.78 days, p=0.003), shorter length of stay (6.83±3.55 vs. 11.61±4.19 days, p=0.004), and lower visual analogue scale (VAS) scores at 14 days post-surgery (2.03±0.65 vs. 3.50±0.89, p=0.002). Complication rates up to 3 months were also lower in the mixed technique group, with 3.3% vs. 17.9% (p<0.05)[35].

There are results showing that HAL, whether doppler-guided or not, showed no difference in treatment outcomes in terms of symptom improvement (6 months posttreatment by customized questionnaire using Likert score; for defecation problems, 4.52 vs. 4.27, p=0.167; for discomfort in daily life, 4.81 vs. 4.72, p=0.637)[37,38]. Therefore, HAL is used without doppler guidance in several studies recently. Long et al.[36] compared 53 patients who had non-doppler HAL added to MMH with 62 patients who had only MMH. The study found that the HAL-added group had lower pain levels (by visual analogue scale on 7th postoperative day, 2.00±0.80 vs. 2.33±0.76, p=0.023) and analgesic use up to 7 days postoperatively (0.71±0.20 vs. 0.80±0.24, p=0.037), with lower incidences of postoperative bleeding (1.87% vs. 12.90%, p=0.037), urinary retention (3.77% vs. 16.13%, p=0.031), and perianal incision edema (7.55% vs. 22.58%, p=0.027). At one year, the prolapse or bleeding recurrence rate was 0 vs. 9.68% (p=0.030), and patient satisfaction was significantly higher with the addition of HAL (96.23% vs. 82.54%, p=0.031).

Compared to MMH, which only ligates terminal feeding arteries, or SH, which only excises prolapsed tissue, HAL ligates three to six areas (mainly including lithotomy positions at 3, 7, and 11 o'clock), leading to reduced postoperative edema. Reduced edema could be related to decreased pain and the potential for lower recurrence rates due to reduced blood supply, as analyzed by the authors of the non-doppler HAL study[36]. However, in the author's personal opinion, since HAL also involves suturing approximately 2-3 cm above the dentate line[35,39] and SH is performed 2-4 cm above it[34,40], there may be a risk of breaking the sutures applied during HAL if SH is performed afterward. Additionally, since these studies are retrospective and small, further research is needed.

Energy therapies (laser hemorrhoidectomy, hemorrhoid energy therapy, radiofrequency ablation)

Following reports of IRC therapy's effectiveness for hemorrhoids, various modalities have been studied that aim to improve symptoms by inducing necrosis and fibrosis of hemorrhoidal tissue via energy delivery. Particularly, the energy source used has evolved based on how easy and safe the energy delivery device is. For example, the HET system, developed as a bipolar device, generates less heat compared to IRC, reducing the risk of heat-related collateral damage to nearby tissues. In the animal study by Piskun and Tucker[41], when HET and IRC were activated to induce similar mucosal and submucosal changes in swine colorectal tissue, the temperature of the treatment site was 50-55°C vs. 149.9±11.1°C, respectively. The proportion of specimens with damage to the muscularis layer was 100% vs. 25%. Clinical results for HET were published in 2021, showing reduced pain and hemorrhoid symptoms in grade I-II patients treated with local anesthesia or endoscopic procedures[26,42].

RFA, successfully used for varicose veins and Barrett's esophagus, transmits heat energy via radio waves to induce plication of anorectal mucosa and improve symptoms[43]. Among various RFA variants, the most recent is the Rafaelo technique, which uses a specially designed probe connected to a radiofrequency generator. A systematic review and meta-analysis of six non-randomized studies and 327 patients on the Rafaelo technique[25] reported an overall complication rate of 17.6% (95% CI 8.8-26.3%), reoperation and recurrence rates of 1.8% (95% CI 0.3-3.4%) and 4.8% (95% CI 1.2-8.4%), respectively, with high patient satisfaction (95% (95% CI 89.8-100%)). However, since RCTs were not included, heterogeneity was high, and the information size was small, the level of evidence was considered "very low."

Among energy therapies, laser hemorrhoidoplasty (LH) is currently the most actively researched technique. It involves inserting a 1.8 mm probe emitting 1470 nm diode laser through a space created by stab incision and blunt dissection between hemorrhoid tissue and the internal anal sphincter to coagulate hemorrhoid tissue[44]. Wee et al.[27] performed a meta-analysis of nine studies, including three RCTs, comparing LH (n=336) and conventional hemorrhoidectomy (n=325) outcomes in grade II and III patients. LH showed significantly shorter surgery time (mean difference[MD], -12.65 minutes; 95% CI, -16.00 to -9.29 minutes; p<0.001), less intraoperative bleeding (MD, -19.78 mL; 95% CI, -23.15 to -16.42 mL; p<0.001), and lower postoperative pain (VAS score on the first postoperative day; MD, -2.09; 95% CI, -3.44 to -0.75; p=0.002) and analgesic use (RR, 0.59; 95% CI, 0.42-0.81; p=0.001) compared to conventional hemorrhoidectomy. It also demonstrated significant advantages in terms of postoperative bleeding (RR, 0.18; 95% CI, 0.12-0.28; p<0.001) and return to daily activities (MD, -11.81 days; 95% CI, -19.39 to -4.23 days; p=0.002), though there was no difference in recurrence of bleeding or prolapse at 12 months. Jin et al.[45] compared LH and RBL in grade II

patients, showing significantly better results for LH in postoperative pain (on the operative day, on 1st, 3rd, 7th, 14th postoperative day, all p<0.01), bleeding (on 1st, 3rd, 7th postoperative day, all p<0.001), and earlier return to normal daily activities (days, 3.62±0.91 vs. 7.65±1.64, p<0.001), with no difference in recurrence rates at one year.

However, most studies report results only up to 1 year of follow-up and often use pudendal nerve block or more extensive anesthesia methods (compared to RBL, which is mostly office-based). While LH results in less analgesic use compared to hemorrhoidectomy, the difference in pain may be mitigated by simple NSAIDs[1]. Considering similar costs to RFA, it is debated whether LH offers a clear advantage over conventional hemorrhoidectomy.

In summary, it can be said that hemorrhoid symptom control through minimall invasive methods during a short treatment time is gradually becoming visible due to advancements in technology. However, standardization is still needed regarding how much energy should be delivered for safety and effectiveness, as well as standardizing anesthesia methods from local infiltration to general anesthesia. Consideration of cost-effectiveness is also necessary.

Interventional Treatment

While the ASCRS guidelines do not include a specific category for interventional treatments, the authors classified treatments that require settings other than outpatient or operating rooms as "interventional treatment."

With the proven efficacy of HAL, the "vascular theory" of hemorrhoid etiology has gained more traction, leading to the introduction of the Emborrhoid technique in 2014[46], which involves direct angiographic intervention on the superior rectal artery (SRA). In 2021, a meta-analysis[47] of 12 case series and 2 cohort comparative studies was published, examining catheter-directed hemorrhoidal dearterialization in patients with grade I-III chronic bleeding hemorrhoids (n=362). The studies reported an overall technical success rate of 97.8% (SD 3.5) and a clinical success rate of 78.9% (SD 10.5). The analysis found that using both coils and particles significantly reduced the rebleeding rate compared to using coils alone (10.05%, SD 21.5% vs. SD 18.2, p<0.0001). There were no cases of bowel ischemia/necrosis or anorectal complications during the mean maximum follow-up of 12.1 months (SD 7.31, median 12). Additionally, an RCT comparing 14 patients who underwent closed hemorrhoidectomy with 15 who underwent the Emborrhoid procedure[48] found no difference in complications or 12-month recurrence rates for bleeding, prolapse, pruritus, and mucus. However, pain during the first bowel movement was significantly lower in the Emborrhoid group compared to the hemorrhoidectomy group (visual analogue scale, 0 vs. 6.08±4.41, p=0.001), and the use of analgesics was significantly reduced (doses, 2.4±5.21 vs. 28.92±15.78, p<0.01). Nonetheless, in the embolization group, 3 patients had complete resolution of prolapse, pruritus, or mucus at 12 months, while 2 patients developed external hemorrhoids and prolapse within a year and required additional hemorrhoidectomy. Consequently, patient satisfaction at one year was significantly higher in the hemorrhoidectomy group.

Although most related papers reported the safety and effectiveness of the emborrhoid technique, there was a report indicated that a patient who received particles for superior rectal artery embolization developed rectosigmoid ischemia three days later, necessitating conservative treatment such as nil per oral with fluid therapy[49]. This condition led to stenosis, requiring three endoscopic dilatations, and prolapsed hemorrhoids reoccurred two months later, ultimately requiring MMH. Physicians must be aware of and inform patients about these potential complications.

Kodilinye and Kalloo[4] published a review in 2023 on endoscopic treatments for hemorrhoids. According to the authors, flexible endoscopy offers enhanced flexibility and imaging, allowing for more precise interventional procedures and potentially reducing iatrogenic risks. A key advantage is the ability to simultaneously treat a lesion once identified as a hemorrhoid. Endoscopic treatments, including office-based methods or energy therapies such as RBL[50], sclerotherapy[51], and HET[26], have been recently reported. However, Tomiki et al.[51] retrospectively compared Aluminum Potassium Sulfate and Tannic Acid injection sclerotherapy for grade II or III hemorrhoids with standard (n=33) and endoscopic treatments (n=48) and found no significant difference between them. Additionally, no reports were found that demonstrated a practical superiority of endoscopic methods over existing treatments. It is also worth noting that endoscopic procedures may have limitations in directly inspecting and treating surrounding tissues compared to traditional methods according to the author's personal experience on the colonoscopic intervention. A few case reports presented postprocedural submucosal thrombosis with worsened hemorrhoidal symptoms after endoscopic sclerotherapy[52] and massive rectal bleeding due to band slippage after endoscopic RBL[53].

Summary

Table 1 summarizes characteristics of several novel hemorrhoids treatment methods reviewed in this paper. The primary symptoms of hemorrhoids are bleeding or prolapse, and the effectiveness of treatments varies based on their underlying mechanisms. Therefore, to help in considering a treatment method, the level and circularity of vascular control and degree of hemorrhoidal mass control for each treatment were organized based on each representative references. Advances in techniques, medications, or tools may

Table 1. Summary of Therapeutic Mechanisms and Possible Indications of Representative Treatment Methods of Hemorrhoids.

Category		Treatment	Difference from the original technique	Height of vascular control	Circularity of vascular control	Degree of mass control	Advantage	Disadvantage	Possible Indications
Office-based	Modified RBL	Modified RBL [13]	applying negative pressure, elastic coil rather than band	feeding artery (1-3 cm above the dentate line)	for each lesion	ligation including mucosa	lower postoperative pain, bleeding and urinary retention compared to MMH		I-III
		BANANA clip [56]	applying non-absorbable polymer ligating clip	more than 1-2 cm proximally from the dentate line	for each lesion	ligation including mucosa	lower postoperative pain, delayed bleeding and 1yr recurrence rate		I-III
	Sclerotherapy	Polidocanol foam sclerotherapy [16,19,57]	use polidocanol foam as sclerosant	above the dentate line	for each lesion	by submucosal physical and chemical reactions	lower postoperative pain than RBL, can be applied to patients with bleeding tendency comparatively safely	potential for anaphylactic shock	I-IV
	Sclerobanding	(endoscopic) Sclerobanding [21,58]	polidocanol foam sclerotherapy followed by RBL	the submucosa under the pedicle of the hemorrhoids or around the prominent red signs above the dentate line	for each lesion	by submucosal physical and chemical reactions + ligation including mucosa	lower hemorrhoidal severity symptom score, postoperative pain, and recurrence compared to (endoscopic) RBL, can be applied to patients with bleeding tendency comparatively safely		II-IV
Interventional	Interventional	Emborrhoid technique [47,48]	using both coils and particles can significantly reduce rebleeding rate	mid-third to the distal superior rectal artery	circumferential (both right and left branches are all embolized)	no	less postprocedural pain compared to EH	posibility of bowel ischemia	I-III bleeding hemorrhoids
		Endoscopic RBL/Sclerotherapy [4]	using endoscope for the procedure	same as each original procedure using anoscope			provides added flexibility, controllability, and enhanced imaging, allowing for greater interventional precision and reduced iatrogenic risk	needs enough experience on endoscopic procedure	I-IV
Operative	Energy therapy	LH [27,44]	energy source (1470 nm diode laser)	aroud the hemorrhoidal pile level	for each lesion	by submucosal physical and chemical reactions +/- mucopexy	no damage to surrounding tissue, lower postoperative pain and bleeding, quicker return to daily activities with similar 12 month recurrence compared to EH		I-IV
		RFA [25]	energy source (Rafaelo probe)			by submucosal physical and chemical reactions	low complication and recurrence rate with high patient satisfaction (mostly results of case series)		I-IV
		HET [59, 60]	energy source (biopolar)	1 cm above the proximal extent of the internal hermorrhoids	for each lesion or three major feeding direction	by mucosal and submucosal physical and chemical reactions	lower postopertive pain compared to RBL		I-II

Table 1. Summary of Therapeutic Mechanisms and Possible Indications of Representative Treatment Methods of Hemorrhoids (continued).

Category		Treatment	Difference from the original technique	Height of vascular control	Circularity of vascular control	Degree of mass control	Advantage	Disadvantage	Possible Indications
Operative	SH	Modified SH (tissue selection therapy, large C suture) [30, 31, 61]	the pursestring is segmental rather than circumferential	1-4 cm above the dentate line (according to the various references)	for each lesion	mucosal and submucosal resection	superior in terms of urinary retention, fecal incontinence, anal stenosis and recurrence compared to conventional SH and MMH		II-IV
	Miexed operative treatment	EH + SH [34]	combined procedure	2-4 cm above the dentate line (highest level is same as in SH)	circumferential	mucosal and submucosal resection + external hemorrhoid resection	higher self-assessed improvement in quality of life with comparable complication and recurrence rate to EH or SH alone	possibly be more painful, and needs more time to heal	significant internal as well as external hemorrhoids
		HAL + EH/SH [35, 36]	combined procedure	2-3 cm above the dentate line	can be circumferential (with HAL or SH)	mucosal and submucosal resection	lower postoperative pain levels, analgesic use, postoperative bleeding, incision site edema, shorter healing time and hospital stay, and recurrence compared to EH/SH alone		III-IV

RBL, rubber band ligation; LH, laser hemorrhoidoplasty; RFA, radiofrequency ablation; HET, hemorrhoid energy therapy; SH, stapled hemorrhoidopexy; MMH, Milligan-Morgan hemorrhoidectomy; EH, excisional hemorrhoidectomy; HAL, hemorrhoidal artery ligation

also change these assessments.

For instance, both sclerotherapy and energy therapy induce vascular coagulation and fibrosis through tissue necrosis, leading to minor effects on prolapse. However, their vascular control capacity is inherently weaker than HAL, which ligates vessels from three or more directions, or Emborrhoid therapy, which blocks the entire SRA. Stronger vascular control generally improves bleeding symptoms and reduces rebleeding risk. Conversely, SH and EH target only the terminal branches of the SRA, which means their vascular control is less effective, but they provide significant mass removal, making them more effective for prolapse or spillage. EH, which can also remove external hemorrhoids, is particularly effective in this regard. Postoperative pain can be related to both mechanisms. Larger and more extensive mass removal generally results in more pain, but effective vascular control can reduce postoperative edema and inflammation, potentially decreasing pain.

Based on these concepts, treatment effects and side effects can be anticipated. For example, Jeong et al.s' analysis[54] of 2176 cases of semi-closed hemorrhoidectomy identified obesity, the number of excised lesions, and analgesic use as risk factors for urinary retention. This suggests that higher blood flow due to obesity and increased pain from more excised lesions are contributing factors.

Hemorrhoid symptoms and severity vary by case, and patient preferences and situations differ. Therefore, surgeons should consider the mechanisms and relative strengths of various treatment options and provide patients with the most effective and least invasive options available.

This review examined recent papers from the past five years on hemorrhoid treatments. Recent studies show trends toward introducing new substances or devices, expanding the range of existing treatments, and combining treatments to enhance effectiveness while minimizing side effects. Although new treatments hold promise for reducing complications and improving effectiveness, many methods still require sufficient validation as shown in Table 2.

There are still significant challenges in hemorrhoid treatment research. Protocol standardization is needed, as recent studies report variations in anesthesia methods and patient positioning for the same treatment. Anesthesia methods are related to postoperative pain and recovery time, while patient positioning can affect procedure duration and accuracy[55]. Without standardized protocols, it is difficult to accurately assess or compare the effectiveness of these treatments.

Comparing study results is challenging due to varying definitions of conditions, recurrences, and adherence to postoperative lifestyle modifications and conservative treatments. Additionally, there is a lack of research on cost-effectiveness. Evaluating whether the use of advanced technologies justifies the expense for similar outcomes is neces-

Table 2. Major Ongoing Trials on the Treatment of Hemorrhoids.

Trial No.	Title	Summary	Grade	Primary outcome	Estimated enrollment	Estimated study completion	Study design	Country
NCT06079892	Evaluation of Radiofrequency Efficiency in the Treatment of Hemorrhoid Pathology	RFA efficiency		Procedural efficiency rate on prolapse (using Goligher Score=1) and bleeding (using Hemorrhoidal bleeding score=0) 3 months after the procedure	80	1/1/2025	Retro-spective cohort	France
NCT04896268	Prospective, Multicentric, Randomized, Open-label Study Comparing the Efficacy, in Terms of Quality of Life, and Safety of RAdiofrequency Versus HAL-RAR DOppler in Hemorrhoidal Pathology	RFA vs. HAL-RAR	II-III	Quality of life measured by The Haemorrhoidal Disease and Anal Fissure questionnaire 1 month postoperatively	100	8/x/2025	single center RCT	France
NCT05959577	A Randomized Prospective Clinical Trial Comparing the Surgical Outcomes of Traditional Ferguson Hemorrhoidectomy Versus Stapled Hemorrhoidopexy With Anoplasty for Patients With Grade III/IV Hemorrhoids	EH (Ferguson) vs. SH	III-IV	Visual analogue scale 6 moths postoperatively	200	12/16/2024	single center RCT	Taiwan
NCT06170736	Radiofrequency Haemorrhoidal Thermoablation Versus Doppler-guided Haemorrhoidal Artery Ligation With Mucopexy in the Treatment of Haemorrhoidal Disease: a Multicenter Randomized Non-inferiority Trial	RFA vs. HAL-RAR	II-III	Failure rate at one year postoperatively	168	09/15/2028	multi center RCT	France
NCT04329364	A Randomised Controlled Trial Comparing Conventional Open Haemorrhoidectomy and Laser Haemorrhoidoplasty in the Treatment of Symptomatic Haemorrhoids: COHLAH Trial	EH (MMH) vs. LH	II-IV	pain scores 10 days postoperatively	128	06/30/2025	single center RCT	Singapore
NCT05697562	A Randomized Comparative Evaluation of Superior Rectal Arterial Embolization in Hemorrhoidal Disease	anticoagulant DG-HAL vs. anticoagulant SRA embolization vs. no anticoagulant RBL vs. no anticoagulant SRA ebolization	I-III	symptom control estimated by Hemorrhoidal Bleeding Score 3 months postoperatively	80	12/15/2026	single center RCT	Belgium

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Table 2. Major Ongoing Trials on the Treatment of Hemorrhoids (continued).

Trial No.	Title	Summary	Grade	Primary outcome	Estimated enrollment	Estimated study completion	Study design	Country
NCT06106269	Hemorrhoidal Embolization Trial-1 (HEMBO-1)	efficiency and safety of rectal artery embolization	II-III	Change in French bleeding score (FBS), Adverse Events, Diagnostic accuracy of pre-embolization Computed Tomography Angiography	20	12/x/2026	Prospective cohort	USA
NCT04169152	Cap-assisted Endoscopic Sclerotherapy for Internal Hemorrhoids and Rectal Prolapse: a National Multi-centre Prospective Cohort Study	efficiency and safety of CAES	I-III	recurrence rate 1st to 24th week post-procedure	10000	06/30/2028	Prospective cohort	China
NCT05807425	Sclerotherapy With Polidocanol Foam in the Treatment of First, Second and Third-Grade Hemorrhoidal Disease in Patients With Liver Cirrhosis: A Prospective, Cohort Trial	efficiency and safety of sclerotherapy	I-III	therapeutic success rate and Incidence of adverse events 9 weeks postoperatively	40	12/31/2023	Prospective cohort	Portugal
NCT05782010	SCI-Pex, a Multi-center, Prospective, Non-controlled Investigation to Evaluate the Safety and Performance of PexyEazy®, a Device for Treatment of Hemorrhoidal Disease	efficiency and safety of SCI-Pex	II-III	surgical results, validation of device, postoperative complication, etc.	35	11/30/2028	Prospective cohort	Sweden

RFA, radiofrequency ablation; HAL-RAR, hemorrhoidal artery ligation and rectoanal repair; RCT, randomised controlled trial; EH, excisional hemorrhoidectomy; SH, stapled hemorrhoidopexy; MMH, Milligan-Morgan hemorrhoidectomy; LH, laser hemorrhoidoplasty; DG-HAL, doppler-guided HAL; SRA, superior rectal artery; RBL, rubber band ligation; CAES, cap-assisted endoscopic sclerotherapy

sary.

New treatments may emerge without adequate validation and could be misleadingly presented as more effective due to technology. In the absence of a single best treatment for hemorrhoids, it is crucial to approach existing treatments conservatively while carefully evaluating and scientifically validating new options. Developing a new classification system for hemorrhoids, standardized indicators for complications and recurrences, establishing treatment protocols, detailing primary and adjunctive treatments, and considering costs will be essential for distinguishing effective treatments from less effective ones.

Conclusion

Numerous new methods for treating hemorrhoids continue to be researched due to the variety of symptoms and conditions. Colorectal surgeons should understand the mechanisms of different treatments to provide patients with options that align with their preferences and needs. Researchers must strive to standardize protocols to establish a scientific basis for comparing the efficacy and side effects of various treatments.

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Conflicts of Interest

There are no conflicts of interest.

Author Contributions

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