

Recent advances in the management of hemorrhoids

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Abstract

Hemorrhoids are considered one of the most common anorectal diseases with a prevalence of 4.4% up to 36.4% of the general population, and a peak incidence between 45 and 65 years. Hemorrhoidal disease presents with a prolapsed lump, painless bleeding, discomfort, discharge, hygiene problems, soiling, and pruritus. Sliding anal canal lining theory is the most accepted theory as a cause of hemorrhoidal disease; however, it is also associated with hyper-vascularity, and, recently, with several enzymes or mediators involved in the disintegration of the tissues supporting the anal cushions, such as matrix metalloproteinase. A comprehensive search in published English-language literature till 2013 involving hemorrhoids was performed to construct this review article, which discusses advances in the management of hemorrhoids. This includes conservative treatment (life style modification, oral medications, and topical treatment), office procedures (rubber band ligation, injection sclerotherapy, infrared and radiofrequency coagulation, bipolar diathermy and direct-current electrotherapy, cryosurgery, and laser therapy), as well as surgical procedures including diathermy hemorrhoidectomy, LigaSure hemorrhoidectomy, Harmonic scalpel hemorrhoidectomy, hemorrhoidal artery ligation, stapled hemorrhoidopexy (SH), and double SH. Results, merits and demerits of the different modalities of treatment of hemorrhoids are presented, in addition to the

cost of the recent innovations.

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Key words: Hemorrhoids; Rubber band; Infrared; Photo-coagulation; Cryosurgery; LigaSure; Harmonic; Anopexy; Hemorrhoidal artery ligation; Stapled hemorrhoidopexy

Core tip: Patients with Grades I - II hemorrhoids can be treated with medical treatment or office procedures. For Grades III-IV, surgical treatment should be offered and individually tailored to each patient. Conventional hemorrhoidectomy is the gold-standard, albeit with severe post-operative pain. LigaSure and harmonic scalpel hemorrhoidectomy offer shorter operative time, less post-operative pain and less time off work. Stapled hemorrhoidopexy provides similar results. However, though rare, devastating complications may occur, and so, should be performed only by experienced surgeons. Hemorrhoidal artery ligation is a potential non-excisional technique for the treatment of Grades II - III hemorrhoids with minimal postoperative pain and quick recovery.

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INTRODUCTION

Hemorrhoids are one of the most common anorectal disorders with a reported prevalence of 4.4% up to 36.4% of general population^[1]. The peak prevalence occurs between 45 and 65 years of age^[2,3]. Approximately one-third of patients affected by hemorrhoids seeks medical advise^[4,5]. Different studies showed that about 5%-10% of patients suffering from hemorrhoids do not respond to conservative treatments, so surgical procedures become the treatment of choice in such cases^[6].

LITERATURE SEARCH

A comprehensive search in the literature for English-language articles dealing with hemorrhoids published till 2013 was performed. The Databases searched included MEDLINE, preMEDLINE, the Cochrane Database of Systematic Reviews, meta-analysis, and the Cochrane Database of Registry of Controlled Trials. Additional appropriate references were also retrieved from the bibliographies of selected recent articles.

CLINICAL PICTURE AND CLASSIFICATION

Hemorrhoids are presented clinically by a prolapsed lump which may require manual reduction or is constantly prolapsed. Other clinical manifestations include painless bleeding, discomfort, discharge, hygiene problems, soiling, and pruritus^[7-9].

Hemorrhoids can be classified according to their location and degree of prolapse. Internal hemorrhoids are located above the dentate line and covered by columnar epithelium. On the other hand, external hemorrhoids, are located below the dentate line and covered with squamous epithelium. Mixed hemorrhoids are known as “interno-external” hemorrhoids and are located both above and below the dentate line^[10].

Internal hemorrhoids are further graded according to Goligher's classification which depends on the degree of prolapse into: (1) Grade I hemorrhoids: Anal cushions bleed without prolapse; (2) Grade II hemorrhoids: Anal cushions prolapse on straining but reduce spontaneously; (3) Grade III hemorrhoids: Anal cushions prolapse on straining or exertion and require manual reduction; and (4) Grade IV hemorrhoids: The prolapse is irreducible and remains out all the time^[11].

PATHOGENESIS

Although hemorrhoidal cushions are normal anatomic structures, they are infrequently referred to until issues arise, and then the term hemorrhoid is meant as a pathologic process. The pathogenesis of hemorrhoids is not completely clear^[12]. Aigner *et al.*^[13,14], concluded that there is an association between hypervascularization and the incidence of hemorrhoidal disease as they reported that the terminal branches of the superior hemorrhoidal artery in patients with hemorrhoidal disease had a significantly larger diameter and greater blood flow, as well as higher peak velocity and acceleration velocity, when compared to those of healthy controls.

However, the sliding anal canal lining theory, which is the most accepted theory, stated that hemorrhoidal disease develops upon disintegration of the supporting tissues of anal cushions leading to their downward displacement. A number of possible contributing factors leading to migration of the hemorrhoidal cushions have been suggested, including lack of dietary fiber, prolonged

straining, spending excess time on the commode, constipation, diarrhea, pregnancy, sedentary lifestyle, and a family history. Apart from pregnancy, none of these etiologies are supported by good evidence^[15-17].

Recent studies examined the role of several enzymes or mediators which may be involved in the degradation of supporting tissues in the anal cushions like matrix metalloproteinase, which was found to be over-expressed in hemorrhoids. Since the discovery of increased microvascular density in hemorrhoidal tissue, neovascularization has been suggested as an important phenomenon in the pathogenesis of hemorrhoidal disease^[18,19].

TREATMENT OF GRADE I AND GRADE II HEMORRHOIDS

Conservative treatment

Life style modification: The first item of conservative treatment of hemorrhoid is to modify life style so that the patient can avoid prolonged straining mainly by decrease formation of hard stool, which can be achieved by increasing the intake of dietary fiber and oral fluids. Other factors that may help to decrease straining include improving anal hygiene, avoiding unnecessary straining and medications, which cause either constipation or diarrhea^[20-22].

Oral medications: The role of the drugs in management of hemorrhoids is either a defensive treatment for early grades where prolapse is not significant, or as a primary control of the acute bleeding till definitive office procedures or surgery can be done. Micronized Purified Flavonoid Fraction is composed of 90% Diosmin and 10% Hesperidin, and has demonstrated efficacy in the treatment of hemorrhoids. Although it has a phlebotonic activity, vasculo-protective effects, and antagonism of the biochemical mediators of inflammation, its precise mechanism of action remains unclear. Although flavonoid is the most commonly used drug for treatment of hemorrhoid, a meta-analysis of 14 randomized clinical trials (RCTs) regarding the role of flavonoids in the treatment of hemorrhoidal disease concluded that limitations in methodological quality, heterogeneity and potential publication bias raise questions about the apparent beneficial effects of flavonoids in the treatment of hemorrhoidal disease^[23-28]. Another venotonic drug is Calcium Dobe-silate. It improves the response of symptomatic acute attacks of first- and second-degree internal hemorrhoids when added to life style modification^[29,30].

Topical treatment: Chong *et al.*^[26] noted that well-designed studies have found no evidence to support the use of any of the myriad of over-the-counter topical preparations that contain low-dose local anesthetics, corticosteroids, keratolytics, protectants, or antiseptics. These agents are widely used to relieve symptoms; however, their long-term use, particularly steroid preparations, may be detrimental and should be discouraged.

Office procedures

According to ASCRS Guidelines for Management of Hemorrhoids (2010), there is a strong recommendation based on moderate-quality evidence 1B that early grades including grade I, II and even III that do not respond to conservative treatment can be managed with office procedures, which aim to decrease blood flow to the hemorrhoid, reduce the redundant tissue and fix the hemorrhoid to the underlying tissue to reduce prolapse. Office procedures include the following: (1) rubber band ligation (RBL); (2) sclerotherapy; (3) infrared coagulation; (4) radiofrequency coagulation; (5) bipolar diathermy and direct-current electrotherapy; (6) cryosurgery; and (7) laser therapy. Although these procedures are all relatively well tolerated and cause minimal pain, they have variable rates of recurrence. A meta-analysis of 18 randomized trials showed that RBL is the most effective of all office procedures as it is associated with a lower rate of recurrence, albeit with a more overall pain than other procedures^[31].

RBL: RBL is the most commonly used office procedure in treating not only first- and second-degree hemorrhoids, but also selected cases with third-degree hemorrhoids. It represents about 80% of the office procedure with a success rate of 99% on short-term and 80% on long-term follow-up, and a low complication rate ranging from 1% to 3%. The banding process causes necrosis and sloughing of the banded tissue resulting in an inflammatory reaction that causes refixation of the mucosa and elimination of the hemorrhoidal prolapse. A single hemorrhoid or multiple hemorrhoids may be treated with RBL per session. In one study, multiple ligations per session were reported to have more vagal symptoms, more post-procedural pain, and a higher rate of recurrence. However, no increase in complications with multiple ligations was reported in other large series. The cause of intra- or post-procedural pain, which is rare, has been attributed to strangulation of the anoderm, inflammation and edema^[32,33]. Nazir *et al*^[34], in their study of 1500 patients with 2nd and 3rd degree hemorrhoids, found a significant increase of post-procedural pain when using multiple ligations in one session, which was also associated with increased incidence of spasm of the anal sphincter. In agreement with this, Mattana *et al*^[35], reported that, compared with multiple ligations, single RBL in one sitting was followed by a lower complication rate including pain. They also reported a significantly lower recurrence rate noted in patients with normal bowel habits, when compared with constipated subjects whose symptoms recurred in 85% probably due to prolonged straining. Thus, constipation may be considered a predictable factor for the outcome of RBL. In such cases, the rubber band may be removed. Other complications of RBL include late hemorrhage, thrombosed external hemorrhoid, ulceration, rubber band slippage, pelvic sepsis, and, though rare, Fournier's gangrene^[32,33].

Banding should be avoided in patients with coagulation disorders, either intrinsic, such as those with throm-

bocytopenia, or acquired, as seen with antiplatelet therapy (Plavix), or anti-coagulated with warfarin (Coumadin), or heparin products, because it may lead to bleeding. Such patients may be treated by other procedures including sclerotherapy and infrared coagulation. Immunocompromised patients or those with some cardiac disease like prosthetic cardiac valves, congenital cardiac malformation, and valvular dysfunction need special preparation with prophylactic antibiotics to avoid severe septic complications^[36].

Banding can be performed with a suction apparatus or a forceps ligator. Flexible endoscope used for banding allowed better visibility and yielded comparable results, albeit with increased time and cost and a higher incidence of pain^[37-43]. In a systematic review of RCTs comparing RBL with excisional hemorrhoidectomy^[31], the authors reported that hemorrhoidectomy has a better long-term efficacy for the treatment of third-degree hemorrhoids than RBL, but at the expense of more post-operative pain, a higher rate of complications, and more time required to return back to normal physical activity.

Injection sclerotherapy: Injection sclerotherapy has been used long ago for treatment of bleeding hemorrhoids. Several materials including Ethanolamine Oleate, 5% Phenol in Almond oil, Sodium Tetradecyl Phosphate, and Sodium Morrhuate have been used as sclerosant that obliterates the hemorrhoid vascularity and induces inflammation, which ends with fibrosis that fixes the hemorrhoids to the surrounding tissue. After injection sclerotherapy, the patient requires only mild analgesics. Proper education regarding the appropriate diet, bulking agents and stool softeners as well as sitz baths should also be provided to the patient.

Complications of this procedure include mainly anorectal abscess and other rare complications, which may be fatal like necrotizing fasciitis, retroperitoneal sepsis, oleogranuloma (with oil-containing solutions), and pulmonary allergic reaction. Some studies found that these complications can be reduced with keeping good results by using more physiological agents such as hypertonic saline and 50% dextrose^[44-47]. Concomitant anal diseases such as fistulas, tumors, anal fissures, and skin tags are a contraindication to treatment with sclerotherapy. Numerous studies that compared different treatment modalities for hemorrhoids showed that sclerotherapy seems to be a less effective option^[48,49].

Infrared coagulation: Infrared coagulation depends on applying a flat tip probe proximal to the hemorrhoidal tissue, not the hemorrhoid itself, giving three to four pulses of infrared energy to the normal mucosa to cause tissue destruction, protein coagulation, and inflammation, which then leads to scarring and tissue fixation. This procedure may need several visits at monthly intervals as only one section of the hemorrhoids is treated per visit. Advantages of infrared coagulation include being quick, painless, effective with a low rate of complications, and

with a rapid return to work^[50-53]. Two RCTs reported success rates of 67% and 96% of this procedure^[54,55]. A meta-analysis of 5 clinical trials evaluated the results of 862 patients presenting with grades I and to II hemorrhoids and treated with 3 different modalities; namely, infrared coagulation, RBL, or sclerotherapy. Although RBL showed the best long-term efficacy, it had a significantly higher incidence of post-procedural pain. The authors considered infrared coagulation the most appropriate procedure for the management of grades I and II hemorrhoids^[49].

Radiofrequency coagulation: The radiofrequency coagulation unit uses a disposable probe with an electrical current flowing between two flat electrodes (positive and negative) aligned at the tip, activating the unit for two seconds in three or four areas of hemorrhoid complex. This method results in reduction and subsequent fixation of the vascular components of the hemorrhoids to the underlying tissue by means of fibrosis. Acute urinary retention, wound sepsis, and peri-anal thrombosis are the most frequent complications reported after radiofrequency coagulation. Although it is a painless procedure, yet, it has been reported to have a higher recurrence rate of both bleeding and hemorrhoidal prolapse^[52,56,57].

Bipolar diathermy and direct-current electrotherapy: Bipolar diathermy and direct-current electrotherapy use local heat application to induce coagulation and fibrosis that results in hemorrhoidal fixation. The success rates of both methods have been reported by several studies to be comparable to those of infrared coagulation, and to have a relatively low rate of complications^[53,58].

Cryosurgery: Cryosurgery uses very low temperature to create water crystals within the cells resulting in destruction of the cell membrane and eventually the tissue. It was expected that cryosurgery will lead to less pain by freezing the sensory nerve endings and causing an immediate anesthetic effect, but clinical results have proved the opposite^[59]. In addition to being a lengthy procedure, other disadvantages included profuse discharge, prolonged recovery, and late return to work. Thus, cryosurgery does not seem offer the patient with hemorrhoidal disease any advantages over other treatment options^[5]. There are no recent publications in the literature assessing cryosurgery as a treatment option for hemorrhoidal disease.

Laser therapy: The Nd:YAG laser was first utilized in anorectal surgery in the 1960s. Senagore *et al*^[60], in their study on 86 patients, concluded that there are no patient care advantages associated with the use of the Nd:YAG laser for excisional hemorrhoidectomy compared with scalpel excision. However, outcomes have improved later with the advent of the CO₂ laser and the development of the pulsed and the scanned laser^[61,62]. Plapler *et al*^[63], in their study of 350 patients treated with CO₂ laser open hemorrhoidectomy reported that laser therapy resulted in

less postoperative pain and a better cosmetic scar when compared with conventional surgery. Similar results were also reported by Zahir *et al*^[64] in 2000 on 50 patients. Plapler *et al*^[65], studied 15 patients who underwent intra-hemorrhoidal laser therapy for grades II and III hemorrhoids, and reported that partial to complete resolution was associated with little pain and a shorter time as compared to open hemorrhoidectomy.

Giamundo *et al*^[66], in 2010, used Doppler-guided hemorrhoidal laser for thermal occlusion of the hemorrhoidal arteries and reported that, at their institution, the total cost of the hemorrhoidal laser procedure is Eur700 per patient. These figures included the cost of the disposables, the fees of the health care workers, and the office occupancy. They also reported that the cost of EBL is approximately Eur230 per patient; however, without taking into consideration the potential need for multiple sessions per patient.

TREATMENT OF GRADE III AND GRADE IV HEMORRHOIDS

Standard treatment (Conventional hemorrhoidectomy)

Although some studies reported that RBL is a safe and effective method compared to open technique in third-degree symptomatic hemorrhoids^[67], it is stated in the revised practice parameters for the management of piles that patients with grades III-IV hemorrhoids should receive surgical treatment^[68].

Excisional hemorrhoidectomy is considered to be the most effective treatment modality for hemorrhoids with the lowest recurrence rate as compared to other modalities; however, the main drawbacks are the marked post-operative pain and the highest complication rate^[48]. Worldwide, the open (Milligan-Morgan) and closed (Ferguson) hemorrhoidectomy are the most commonly used procedures.

Post-operative pain is the most distressing concern for the patient after hemorrhoidectomy and may lead to delay of surgical treatment. Post-operative pain may result from sphincter spasm, damage to nerve endings, insertion of hemostatic gauzes and damage to the mucosa. Some authors attribute pain to suture at the pedicle. Many studies have evaluated various analgesic regimens, operative techniques, and surgical instruments to address this important issue^[69-76]. A systematic review of the topical drugs used for alleviation of post-hemorrhoidectomy pain included collected data from 24 relevant studies, between 1966 and 2012. The topical preparations used included Botulinum toxin, Calcium Channel Blockers, Glyceril Trinitrate (GTN), local anesthetics, Metronidazole, Opioids, and Sucralfate. Overall, topical preparations showed encouraging results in reducing pain and analgesic use and improving the wound after hemorrhoidectomy^[74]. Currently, the most common methods used to decrease post-hemorrhoidectomy pain include the application of GNT at the site of the wound, or injection of Botulinum toxin into the internal sphincter, or even internal sphincterotomy^[74].

Other postoperative complications have been reported after hemorrhoidectomy and include acute retention of urine, postoperative bleeding, sepsis, delayed healing or non-healing of the wound, mucosa prolapse, and anal stricture. The most troublesome complication, fecal incontinence, has been reported to occur in 2%-12% of patients^[75-83].

Diathermy hemorrhoidectomy

With diathermy hemorrhoidectomy, coagulation occurs at temperatures higher than 150 °C. This results in the formation of an eschar that seals the bleeding area. Compared with conventional hemorrhoidectomy (CH), diathermy hemorrhoidectomy has been shown to be associated with less bleeding, shorter operating time and lower postoperative analgesic requirement, but with similar post-operative pain^[84].

LigaSure hemorrhoidectomy

The LigaSure vessel sealing system[®] (Valleylab, Tyco Health Care Group) is a relatively recent method that uses a bipolar electrothermal device for without the need for sutures, *i.e.*, sutureless hemorrhoidectomy. It aims at avoiding painful diathermy burns in the richly innervated anal canal and allowing better tissue adhesions at the wound site, thus decreasing the incidence of postoperative hemorrhage. In a meta-analysis of articles published between January 2000 and September 2009, and RCTs showed superiority of LigaSure hemorrhoidectomy (LH) versus CH regarding operation time, the incidence of postoperative pain and urinary retention, as well as the time required to resume normal physical activity^[85-87]. Although Gentile *et al.*^[88], reported that the additional cost of the disposable device (approximately Eur230) is balanced by a shorter operative time, the possibility of a day-case surgery, and an earlier return to work, They, however, admitted that a limitation of their study can be identified in the small size of the sample and the limited follow-up, and concluded that the benefits of LigaSure as a low-pain and long-term effective technique need to be further evaluated in larger series.

Harmonic scalpel hemorrhoidectomy

The harmonic scalpel[®] (Johnson and Johnson Medical KK, Ethicon Endo-Surgery, Cincinnati, OH) is an ultrasonically-activated instrument, which vibrates at a rate of 55000 MHz per second. It is known for its ability to coagulate small- and medium-sized vessels by converting electrical energy to a mechanical one. There is less lateral thermal damage, with no passage of electricity to or through the patient, resulting in greater safety for the patient.

There have been several randomized trials to date comparing harmonic scalpel hemorrhoidectomy (HSH) with other various open and closed techniques and the results were inconstant. Some studies showed clear-cut benefit of HSH with respect to operative time, blood loss, postoperative pain, length of hospital stay, and re-

turn to normal activity^[89-92], whereas others showed no advantages, with even increased cost^[89].

Semi-closed hemorrhoidectomy

The technique of Reis Neto involves the pectineal line repair, in which the internal hemorrhoid is forced outwards, becoming fully exposed; and then for the repair of rectal mucosa, in the upper limit of the internal hemorrhoid; three or four full-thickness sutures are made radially, involving the mucosa and submucosa, along the craniocaudal length of the hemorrhoid to be resected. The mucosa and submucosa are cut between the ligations; the external part of the skin plexus is removed until the pectineal line with a V-shaped incision or a racket incision with an external base. This technique is perfect for voluminous and proximally extended internal hemorrhoids, whose full dissection would cause a very high resection of the rectal mucosa^[93].

Submucosal hemorrhoidectomy (technique of parks)

This procedure was developed by Parks^[94], who published results and details of the technique in 1956. It was designed to reduce postoperative pain and avoid anal and rectal stenosis. It is indicated for second- to fourth-degree hemorrhoids. This technique includes hemorrhoidectomy with preservation of the anal canal mucosa, reducing the surgical wound dimensions and leading to a shorter healing time, as well as lower stenosis index than those with conventional techniques. The surgery starts with the application of Parks retractor and injection of adrenaline solution at the dilution of 1:250000 to reduce bleeding. A Y-shaped incision is then made at the mucocutaneous junction, between the upper mucosa of the anal canal and the anorectal junction, as an inverted racket incision. The vascular pedicle is separated from the mucosa and the sphincter plane, connecting it afterwards. The mucosa is then closed with running suture, leaving a small area open in the perianal region for drainage. The largest series with this technique (1315 patients) was reported by Milito *et al.*^[95], who reported 82 cases with recurrence (7%), 75 cases of anal skin tag (6.5%), 19 cases of anal stenosis (1.6%), 36 cases of gas incontinence (3.2%). The fact that the mucosa is not included in the ligation leads to reduced postoperative pain. However, the surgical time is longer, the recurrence rate is higher and it involves greater risk of bleeding during the surgery and postoperatively.

Hemorrhoidal artery ligation

Hemorrhoidal artery ligation (HAL) with or without anopexy is a non-excisional procedure aiming at reduction of symptoms of hemorrhoidal disease by reducing the blood flow to the hemorrhoids. Localization of the hemorrhoidal arteries may facilitated by using the Doppler probe; however, this increases the cost of the procedure^[96].

A systematic review of 17 studies on 1996 patients with hemorrhoidal disease treated with HAL showed

recurrence of bleeding and prolapse in 6.3% and 7.8% of patients respectively, in 9 studies with a follow-up of less than 1 year, and 9.7% and 10.8% respectively, in the remaining 8 studies with a follow-up of 1 year or more. Out of 17 studies in this systematic review only one study performed also anopexy, which may explain this high rate of recurrence^[96]. Excision of skin tags (external piles) may be associated with HAL, with an increase in success rate albeit with a slight increase of complication rate^[97,98].

The incidence of reported complications included fever in 3.9% of patients (15/383), thrombosed hemorrhoids in 1.8% (25/1386), anal fissure in 0.8% (14/1695), urinary retention in 0.7% (10/1468), incontinence in 0.4% (3/693), anal fistulas in 0.4% (3/815), and stool retention in 0.1% (1/711). The study stated that bleeding requiring blood transfusion occurred in only three patients^[96].

Although this report stated that no studies compared HAL versus sclerotherapy, HAL versus RBL, or HAL performed with versus without Doppler guidance, it concluded that HAL appears to be a potential non-excisional procedure for the treatment of grades II and III hemorrhoids with minimal postoperative pain and rapid recovery^[96].

Giamundo *et al*^[66], in 2010, reported that, at their institution, the total cost of HAL is Eur1900 (approximately US\$ 2400). This included the cost of one-day hospital admission, as well as the costs of anesthesia, consumables during surgery and operating theatre occupancy.

Farag procedure

There are several methods to ligate hemorrhoidal artery without Doppler guidance like pile suture which is a simple method (introduced by Farag^[99] in 1978) in which three interrupted sutures are used to interrupt the blood flow to the prolapsed hemorrhoids. The first suture is passed through the mucosa at the proximal end of the internal hemorrhoids to occlude the superior rectal vessels. The second suture is passed into the distal end of the internal hemorrhoids above the pectinate line to interrupt the connection between the internal and external hemorrhoidal plexuses. A third suture is then introduced between the previous two. However, this technique and its modifications, were not widely accepted because of the initial painful congestion that resulted from interruption of the blood flow to the hemorrhoidal cushions, though it was followed by gradual shrinkage of the prolapsed piles.

Anopexy

Anopexy is a simple technique for the treatment of advanced hemorrhoidal disease. It results in control of bleeding, reduction hemorrhoidal prolapse and fixation of the hemorrhoid cushions to the underlying tissues. This technique is based on two facts, namely: (1) constant anatomical location of the hemorrhoidal vessels such that a stitch placed at the base of the hemorrhoidal cushion significantly reduces the blood flow to the hemorrhoidal

plexus; and (2) development of the hemorrhoids upon disintegration of the tissues supporting the anal cushions leading to their downward displacement (sliding anal canal lining theory). This can be corrected by fixation of the hemorrhoidal cushions to the underlying internal sphincter^[100].

Several names have been coined to this procedure including “pile suture”, “suture ligation”, “obliterative suture technique”, “ligation and anopexy”, and ligation and mucopexy^[99-102].

Stapled hemorrhoidopexy

In 1998, Longo^[103] proposed the use of a specially designed circular stapler (Ethicon Endo-Surgery, Inc) for treatment of grade III and grade IV hemorrhoids. Stapled hemorrhoidopexy (SH) (also named procedure for prolapse and hemorrhoids) aims at reducing the hemorrhoidal prolapse by excising a complete ring of mucosa above the dentate line and fixing the hemorrhoids to the distal rectal muscular wall leading to repositioning the hemorrhoids into the anal canal. This technique also involves transecting the superior hemorrhoidal arteries, which reduces the venous engorgement by transection of the feeding arteries resulting in reduction of the size of the hemorrhoids. The main advantages of this procedure is the absence of perianal wounds and the reduction of pain as compared to CH, since the stapled mucosa anastomosis in the rectum is performed at least 3 cm above the dentate line, where sensitive receptors are few^[104,105].

Burch *et al*^[106], in a systematic review and economic evaluation, searched databases up to July 2006 and reviewed 27 RCTs that compared SH with CH technique in patients with prolapsing hemorrhoids for whom surgery is considered a relevant option. They concluded that SH was associated with less postoperative pain albeit with an increased rate of prolapse (residual or in the long-term), and reintervention. The two techniques were similar regarding the rate and type of complications, but the rates of recurrence and reintervention for both techniques are still uncertain.

Jinn *et al*^[85], in a systematic review and meta-analysis, concluded that advantages of SH over CH are a shorter operation time, less postoperative pain and urinary retention, and a faster return to normal physical activity. Despite the several short-term benefits of SH, the long-term outcome is relatively poor when compared with CH, mainly regarding residual skin tags and recurrent prolapse^[107]. With SH, the persistence of hemorrhoids causes recurrence of symptoms in the long-term up to five times more than after CH. Accordingly, SH is not advisable for patients with symptomatic external hemorrhoids as skin tags and enlarged external hemorrhoids are not removed^[104].

Recently, a systematic review, a Cochrane meta-analysis and the practice parameters of the American Society of Colon and Rectal Surgeons^[4,108,109] mentioned the rare incidence of devastating complications after SH. Although the most recent systematic review attributed all

major complications to surgical errors, they remain a major life-threatening^[110]. In fact, several deaths have been reported^[111]. These complications included rectal bleeding (1%-11%), and recto-vaginal fistula (0.2%, 1/449)^[112]. Complete rectal obliteration has been reported after SH. It may result from erroneous placement of a purse string, or to firing the stapler outside the purse string in a blind pocket from redundant rectal mucosa^[113]. Post-SH complications included also retro-rectal hematoma^[114], retro-pneumoperitoneum and pneumo-mediastinum^[115] that may result from either filtration of air through the staple line to the extra-peritoneal space or bacterial leakage causing pelvic sepsis and requiring a diverting stoma. Rectal perforation, pelvic sepsis, rectal hematoma leading to intestinal obstruction and other life-threatening complications were also reported after SH^[116].

Other minor complications include residual skin tags, thrombosed piles, fecal impaction, proctitis, anal fissure, stricture, local abscess and fistula formation. Severe chronic proctalgia after SH is rarely reported and is either post-defecatory or accompanied by urgency^[117,118].

In a systematic review, Giordano *et al*^[119] concluded that SH is a safe technique for the treatment of hemorrhoids but carries a significantly higher incidence of recurrences and additional operations compared with CH. This is also confirmed by the reports of Tjandra *et al*^[110] and Jayaraman *et al*^[112]. In order to decrease the rate of recurrence after SH, a modified technique was introduced by using double stapled hemorrhoidopexy for huge degree of prolapse. However, this technique depends on intra operative assessment to select patients that may get benefit from this modification^[120,121].

Regarding the cost of SH, Vito *et al*^[122] reported that SH is more expensive than CH because of the cost of the stapler device, which is not offset by other costs such as operation time, shorter hospital stay, and earlier resumption of normal activities. Ho *et al*^[123], in a study on total of 119 consecutive patients with prolapsed irreducible hemorrhoids found that with conventional open diathermy technique, patients resumed work later (mean 22.9 d *vs* 17.1 d), but the total costs incurred were less (\$921.17 *vs* \$1283.09).

Since SH does not remove the source of infection, it is contraindicated in presence of anal abscess or gangrene. Also, since the insertion of a circular anal dilator is essential during SH, anal stenosis is another contraindication to the procedure. Complete rectal prolapse is also considered a contraindication, because it is not adequately treated with SH.

CONCLUSION

Hemorrhoidal disease is one of the most common ano-rectal conditions. Non-operative measures, whether medical treatment or office procedures, can be offered to patients with Grade I and Grade II hemorrhoids. However, when these measures fail, surgical treatment should be considered. For patients with Grade III and Grade IV

hemorrhoids, surgical treatment should be offered and tailored to each patient according to the severity of symptoms and the extent of external ano-rectal component, in addition to coexisting ano-rectal diseases. Currently, there are several surgical procedures available to treat prolapsing hemorrhoidal disease, and most of them yield similar success rates. CH, whether open or closed, is considered the gold-standard for surgical treatment of hemorrhoids, albeit with severe post-operative pain, especially with defecation. LH and harmonic scalpel hemorrhoidectomy seem to offer shorter operative time, less post-operative pain and less time off work as compared to CH. SH provides also less post-operative pain, shorter hospital stay and recovery time, and a complication rate generally comparable to that with CH. However, though rare, devastating complications have been reported with SH, so it should be only performed by experienced surgeons. HAL appears to be a potential non-excisional technique for the management of grades II and III hemorrhoids, with the advantages of minimal postoperative pain and quick recovery.

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