Hemorrhoids: From basic pathophysiology to clinical management

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Abstract

This review discusses the pathophysiology, epidemiology, risk factors, classification, clinical evaluation, and current non-operative and operative treatment of hemorrhoids. Hemorrhoids are defined as the symptomatic enlargement and distal displacement of the normal anal cushions. The most common symptom of hemorrhoids is rectal bleeding associated with bowel movement. The abnormal dilatation and distortion of the vascular channel, together with destructive changes in the supporting connective tissue within the anal cushion, is a paramount finding of hemorrhoidal disease[1]. An inflammatory reaction[2] and vascular hyperplasia[3,4] may be evident in hemorrhoids. This article firstly reviewed the pathophysiology and other clinical backgrounds of hemorrhoidal disease, followed by the current approaches to treatment.

Several surgical approaches for treating hemorrhoids have been introduced including hemorrhoidectomy and stapled hemorrhoidopexy, but postoperative pain is invariable. Some of the surgical treatments potentially cause appreciable morbidity such as anal stricture and incontinence. The applications and outcomes of each treatment are thoroughly discussed.

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Key words: Hemorrhoids; Pathophysiology; Treatment; Management; Outcome

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INTRODUCTION

Hemorrhoids are a very common anorectal condition defined as the symptomatic enlargement and distal displacement of the normal anal cushions. They affect millions of people around the world, and represent a major medical and socioeconomic problem. Multiple factors have been claimed to be the etiologies of hemorrhoidal development, including constipation and prolonged straining. The abnormal dilatation and distortion of the vascular channel, together with destructive changes in the supporting connective tissue within the anal cushion, is a paramount finding of hemorrhoidal disease[5]. An inflammatory reaction[6] and vascular hyperplasia[7] may be evident in hemorrhoids. This article firstly reviewed the pathophysiology and other clinical backgrounds of hemorrhoidal disease, followed by the current approaches to...
non-operative and operative management.

PATHOPHYSIOLOGY OF HEMORRHOIDAL DISEASE

The exact pathophysiology of hemorrhoidal development is poorly understood. For years the theory of varicose veins, which postulated that hemorrhoids were caused by varicose veins in the anal canal, had been popular but now it is obsolete because hemorrhoids and anorectal varices are proven to be distinct entities. In fact, patients with portal hypertension and varices do not have an increased incidence of hemorrhoids.[6]

Today, the theory of sliding anal canal lining is widely accepted.[8] This proposes that hemorrhoids develop when the supporting tissues of the anal cushions disintegrate or deteriorate. Hemorrhoids are therefore the pathological term to describe the abnormal downward displacement of the anal cushions causing venous dilatation. There are typically three major anal cushions, located in the right anterior, right posterior and left lateral aspect of the anal canal, and various numbers of minor cushions lying between them[7] (Figure 1). The anal cushions of patients with hemorrhoids show significant pathological changes. These changes include abnormal venous dilatation, vascular thrombosis, degenerative process in the collagen fibers and fibroelastic tissues, distortion and rupture of the anul subepithelial muscle (Figure 2). In addition to the above findings, a severe inflammatory reaction involving the vascular wall and surrounding connective tissue has been demonstrated in hemorrhoidal specimens, with associated mucosal ulceration, ischemia and thrombosis.[2]

Several enzymes or mediators involving the degradation of supporting tissues in the anal cushions have been studied. Among these, matrix metalloproteinase (MMP), a zinc-dependent proteinase, is one of the most potent enzymes, being capable of degrading extracellular proteins such as elastin, fibronectin, and collagen. MMP-9 was found to be over-expressed in hemorrhoids, in association with the breakdown of elastic fibers[9]. Activation of MMP-2 and MMP-9 by thrombin, plasmin or other proteinases resulted in the disruption of the capillary bed and promotion of angioproliferative activity of transforming growth factor β (TGF-β).[9]

Recently, increased microvascular density was found in hemorrhoidal tissue, suggesting that neovascularization might be another important phenomenon of hemorrhoidal disease. In 2004, Chung et al[10] reported that endoglin (CD105), which is one of the binding sites of TGF-β and is a proliferative marker for neovascularization, was expressed in more than half of hemorrhoidal tissue specimens compared to none taken from the normal anorectal mucosa. This marker was prominently found in venules larger than 100 µm. Moreover, these workers found that microvascular density increased in hemorrhoidal tissue especially when thrombosis and stromal vascular endothelial growth factors (VEGF) were present. Han et al[10] also demonstrated that there was a higher expression of angiogenesis-related protein such as VEGF in hemorrhoids.

Regarding the study of morphology and hemodynamics of the anal cushions and hemorrhoids, Aigner et al.[11] found that the terminal branches of the superior rectal artery supplying the anal cushion in patients with hemorrhoids had a significantly larger diameter, greater blood flow, higher peak velocity and acceleration velocity, compared to those of healthy volunteers. Moreover, an increase in arterial caliber and flow was well correlated with the grades of hemorrhoids. These abnormal findings still remained after surgical removal of the hemorrhoids, confirming the association between hypervascularization and the development of hemorrhoids.

Using an immunohistochemical approach, Aigner et al[12] also identified a sphincter-like structure, formed by a thickened tunica media containing 5-15 layers of smooth muscle cells, between the vascular plexus within the subepithelial space of the anal transitional zone in normal anorectal specimens. Unlike the normal specimens, hemorrhoids contained remarkably dilated, thin-walled vessels within the submucosal arteriovenous plexus, with absent or nearly-flat sphincter-like constriction on the vessels. These investigators concluded that a smooth muscle sphincter in the arteriovenous plexus helps in reducing the arterial inflow, thus facilitating an effective venous drainage. Aigner et al[13] then proposed that, if this mechanism is impaired, hyperperfusion of the arteriovenous plexus will lead to the formation of hemorrhoids.

Based on the histological findings of abnormal
venous dilatation and distortion in hemorrhoids, dysregulation of the vascular tone might play a role in hemorrhoidal development. Basically, vascular smooth muscle is regulated by the autonomic nervous system, hormones, cytokines and overlying endothelium. Imbalance between endothelium-derived relaxing factors (such as nitric oxide, prostacyclin, and endothelium-derived hyperpolarizing factor) and endothelium-derived vasoconstricting factors (such as reactive oxygen radicals and endothelin) causes several vascular disorders. In hemorrhoids, nitric oxide synthase, an enzyme which synthesizes nitric oxide from L-arginine, was reported to increase significantly.

Several physiological changes in the anal canal of patients with hemorrhoids have been observed. Sun et al revealed that resting anal pressure in patients with non-prolapsing or prolapsing hemorrhoids was much higher than in normal subjects, whereas there was no significant change in the internal sphincter thickness. Ho et al performed anorectal physiological studies in 24 patients with prolapsed hemorrhoids and compared with results in 13 sex- and age-matched normal subjects. Before operation, those with hemorrhoids had significantly higher resting anal pressures, lower rectal compliance, and more perineal descent. The abnormalities found reverted to the normal range within 3 mo after hemorrhoidectomy, suggesting that these physiological changes are more likely to be an effect, rather than the cause, of hemorrhoidal disease.

**Epidemiology and Risk Factors of Hemorrhoids**

Although hemorrhoids are recognized as a very common cause of rectal bleeding and anal discomfort, the true epidemiology of this disease is unknown because patients have a tendency to use self-medication rather than to seek proper medical attention. An epidemiologic study by Johanson et al in 1990 showed that 10 million people in the United States complained of hemorrhoids, corresponding to a prevalence rate of 4.4%. In both sexes, peak prevalence occurred between age 45-65 years and the development of hemorrhoids before the age of 20 years was unusual. Whites and higher socioeconomic status individuals were affected more frequently than blacks and those of lower socioeconomic status. However, this association may reflect differences in health-seeking behavior rather than true prevalence. In the United Kingdom, hemorrhoids were reported to affect 13%-36% of the general population. However, this estimation may be higher than actual prevalence because the community-based studies mainly relied on self-reporting and patients may attribute any anorectal symptoms to hemorrhoids.

Constipation and prolonged straining are widely believed to cause hemorrhoids because hard stool and increased intraabdominal pressure could cause obstruction of venous return, resulting in engorgement of the hemorrhoidal plexus. Defecation of hard fecal material increases shearing force on the anal cushions. However, recent evidence questions the importance of constipation in the development of this common disorder. Many investigators have failed to demonstrate any significant association between hemorrhoids and constipation, whereas some reports suggested that diarrhea is a risk factor for the development of hemorrhoids. Increase in straining for defecation may precipitate the development of symptoms such as bleeding and prolapse in patients with a history of hemorrhoidal disease. Pregnancy can predispose to congestion of the anal cushion and symptomatic hemorrhoids, which will resolve spontaneously soon after birth. Many dietary factors including low fiber diet, spicy foods and alcohol intake have been implicated, but reported data are inconsistent.

**Classification and Grading of Hemorrhoids**

A hemorrhoid classification system is useful not only to help in choosing between treatments, but also to allow the comparison of therapeutic outcomes among them. Hemorrhoids are generally classified on the basis of their location and degree of prolapse. Internal hemorrhoids originate from the inferior hemorrhoidal venous plexus above the dentate line and are covered by mucosa, while external hemorrhoids are dilated venules of this plexus located below the dentate line and are covered with squamous epithelium. Mixed (interno-external) hemorrhoids arise both above and below the dentate line. For practical purposes, internal hemorrhoids are further graded based on their appearance and degree of prolapse, known as Goligher’s classification: (1) First-degree hemorrhoids (grade I): The anal cushions bleed but do not prolapse; (2) Second-degree hemorrhoids (grade II): The anal cushions prolapse through the anus on straining but reduce spontaneously; (3) Third-degree hemorrhoids (grade III): The anal cushions prolapse through the anus on straining or exertion and require manual replacement into the anal canal; and (4) Fourth-degree hemorrhoids (grade IV): The prolapse stays out at all times and is irreducible. Acutely thrombosed, incarcerated internal hemorrhoids and incarcerated, thrombosed hemorrhoids involving circumferential rectal mucosal prolapse are also fourth-degree hemorrhoids.

Some authors proposed classifications based on anatomical findings of hemorrhoidal position, described as primary (at the typical three sites of the anal cushions), secondary (between the anal cushions), or circumferential, and based on symptoms described as prolapsing and non-prolapsing. However, these classifications are in less widespread use.

**Clinical Evaluation of Hemorrhoids**

The most common manifestation of hemorrhoids is painless rectal bleeding associated with bowel move-
Acute thrombosis or strangulation — emergency

May 7, 2012

Table 1  Current management of internal hemorrhoids by grade

| Treatments                        | Grade I | Grade II | Grade III | Grade IV | Acute thrombosis or strangulation |
|-----------------------------------|---------|----------|-----------|----------|-----------------------------------|
| Dietary and lifestyle modification| ×       | ×        | ×         | ×        | ×                                 |
| Medical treatment                 | ×       | ×        | ×-selected| ×-selected| ×                                 |
| Non-operative treatment           | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| Sclerotherapy                     | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| Infrared coagulation              | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| Radiofrequency ablation           | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| Rubber band ligation              | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| Operative treatment               | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| Plication                         | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| DGHAL                             | ×       | ×        | ×-selected| ×-emergency| ×                                 |
| Hemorrhoidectomy                  | ×-selected| ×       | ×         | ×-emergency| ×                                 |
| Stapled hemorrhoidopexy           | ×       | ×        | ×-selected| ×-emergency| ×                                 |

DGHAL: Doppler-guided hemorrhoidal artery ligation; ×: Applicable.

Therapeutic treatment of hemorrhoids ranges from dietary and lifestyle modification to radical surgery, depending on degree and severity of symptoms[23-25]. The current management of internal hemorrhoids is illustrated in Table 1. In addition, selected meta-analyses showing various treatment options of hemorrhoidal disease are shown in Table 2[23-32].

**Dietary and lifestyle modification**

Since shearing action of passing hard stool on the anal mucosa may cause damage to the anal cushions and lead to symptomatic hemorrhoids, increasing intake of dietary fiber or providing added bulk in the diet might help eliminate straining during defecation. In clinical studies of hemorrhoids, fiber supplement reduced the risk of persisting symptoms and bleeding by approximately 50%, but did not improve the symptoms of prolapse, pain, and itching[26]. Fiber supplement is therefore regarded as an effective treatment in non-prolapsing hemorrhoids; however, it could take up to 6 wk for a significant improvement to be manifested[33]. As fiber supplements are safe and cheap, they remain an integral part of both initial treatment and of a regimen following other therapeutic modalities of hemorrhoids.

Lifestyle modification should also be advised to any patients with any degree of hemorrhoids as a part of treatment and as a preventive measure. These changes include increasing the intake of dietary fiber and oral fluids, reducing consumption of fat, having regular exercise, improving anal hygiene, abstaining from both straining and reading on the toilet, and avoiding medication that causes constipation or diarrhea.

**Medical treatment**

**Oral flavonoids:** These venotonic agents were first described in the treatment of chronic venous insufficiency and edema. They appeared to be capable of increasing vascular tone, reducing venous capacity, decreasing capillary permeability[34], and facilitating lymphatic drainage[35] as well as having anti-inflammatory effects[36]. Although their precise mechanism of action remains unclear, they are used as an oral medication for hemorrhoidal treatment, particularly in Europe and Asia. Micronized purified flavonoid fraction (MPFF), consisting of 90% dios-
SH had a significantly higher incidence of recurrences and additional operations. Flavonoids reduced the risk of bleeding, pain, persisting symptoms and recurrence. Hemorrhoidectomy was superior to RBL for the long-term treatment of grade I-III hemorrhoids, with no difference in the complication rate. Patients treated with IC or IS were more likely to require further therapy. Hemorrhoidectomy was superior to RBL for the long-term treatment of grade III, not grade II, hemorrhoids. Although hemorrhoidectomy had more pain, higher complications and more time off work, patient satisfaction and acceptance of the two treatment modalities seems to be similar.

Closed hemorrhoidectomy had faster wound healing but longer operating time. Ligasure hemorrhoidectomy resulted in significantly shorter operative time, less bleeding and complications compared to conventional hemorrhoidectomy. Fiber reduced the risk of bleeding and persistent by 50% and 47%, respectively, but it had no significant effect on pain and prolapse.

Oral calcium dobesilate decreased capillary permeability, in particular, from the internal anal sphincter, some topical treatment targets may not only improve its solubility and absorption, but also shorten the onset of action. A recent meta-analysis of flavonoids for hemorrhoidal treatment, including 14 randomized trials and 1514 patients, suggested that flavonoids decreased risk of bleeding by 67%, persistent pain by 65%, 58% and 47%, respectively, but it had no significant effect on pain and prolapse.

There was no difference in treatment efficacy, pain, complication and hospital stay between the two operations. Ligasure hemorrhoidectomy resulted in significantly shorter operative time, less early postoperative pain, earlier recovery, without any difference in recurrent bleeding or incontinence. SH had less postoperative pain, shorter operative time, shorter hospital stay, and shorter convalescence, but a higher rate of prolapse and reintervention for prolapse. SH had a significantly higher incidence of recurrences and additional operations.

With available detailed data on the patients enrolled. IC: Infrared coagulation; IS: Injection sclerotherapy; RBL: Rubber band ligation; SH: Stapled hemorrhoidectomy. TCMH: Traditional Chinese medicinal herbs.

Table 2 Selected meta-analyses showing various treatment options for hemorrhoidal disease (in order of publication year)

| Authors                  | Characteristics of comparative studies | Number of trials (total cases) | Results                                                                 |
|--------------------------|----------------------------------------|-----------------------------|-------------------------------------------------------------------------|
| Johanson et al[24]       | IC, IS and RBL                          | 5 (863)                     | RBL had greater long-term efficacy, but led to a higher incidence of post-treatment pain. IC was associated with both fewer and less severe complications. Hemorrhoidectomy was more effective than manual anal dilation and RBL, but more pain and complications. RBL had greater efficacy than IS for treating grade I-III hemorrhoids, with no difference in the complication rate. Patients treated with IC or IS were more likely to require further therapy. Hemorrhoidectomy was superior to RBL for the long-term treatment of grade III, not grade II, hemorrhoids. Although hemorrhoidectomy had more pain, higher complications and more time off work, patient satisfaction and acceptance of the two treatment modalities seems to be similar. |
| MacRae et al[24]         | IC, IS, RBL, manual anal dilation and hemorrhoidectomy | 18 (1952)                  | Fiber reduced the risk of bleeding and persisting by 50% and 47%, respectively, but it had no significant effect on pain and prolapse. Flavonoids reduced the risk of bleeding, pain, persisting symptoms and recurrence by 67%, 65%, 58% and 47%, respectively. There was no difference in treatment efficacy, pain, complication and hospital stay between the two operations. Ligasure hemorrhoidectomy resulted in significantly shorter operative time, less early postoperative pain, earlier recovery, without any difference in recurrent bleeding or incontinence. |
| Shanmugam et al[24]      | RBL vs hemorrhoidectomy                 | 3 (202)                     | SH had less postoperative pain, shorter operative time, shorter hospital stay, and shorter convalescence, but a higher rate of prolapse and reintervention for prolapse. Ligasure hemorrhoidectomy resulted in significantly shorter operative time, less early postoperative pain, earlier recovery, without any difference in recurrent bleeding or incontinence. SH had less postoperative pain, shorter operative time, shorter hospital stay, and shorter convalescence, but a higher rate of prolapse and reintervention for prolapse. SH had a significantly higher incidence of recurrences and additional operations. |
| Alonso-Coello et al[25]  | Fiber vs no therapy                     | 7 (378)                     | Fibers reduced the risk of bleeding by 67%, persistent pain by 65%, and itching by 35%, and also reduced the recurrence rate by 47%. Some investigators reported that MPFF can reduce rectal discomfort, pain and secondary hemorrhage following hemorrhoidectomy[23]. |
| Alonso-Coello et al[25]  | Oral flavonoids vs placebo or no therapy | 14 (1514)                   | Flavonoids reduced the risk of bleeding, pain, persisting symptoms and recurrence by 67%, 65%, 58% and 47%, respectively. There was no difference in treatment efficacy, pain, complication and hospital stay between the two operations. Ligasure hemorrhoidectomy resulted in significantly shorter operative time, less early postoperative pain, earlier recovery, without any difference in recurrent bleeding or incontinence. SH had less postoperative pain, shorter operative time, shorter hospital stay, and shorter convalescence, but a higher rate of prolapse and reintervention for prolapse. SH had a significantly higher incidence of recurrences and additional operations. |
| Ho et al[25]             | Closed vs open hemorrhoidectomy         | 6 (686)                     | Closed hemorrhoidectomy had faster wound healing but longer operating time. There was no difference in treatment efficacy, pain, complication and hospital stay between the two operations. Ligasure hemorrhoidectomy resulted in significantly shorter operative time, less early postoperative pain, earlier recovery, without any difference in recurrent bleeding or incontinence. SH had less postoperative pain, shorter operative time, shorter hospital stay, and shorter convalescence, but a higher rate of prolapse and reintervention for prolapse. SH had a significantly higher incidence of recurrences and additional operations. |
| Niemehuisj et al[25]     | Conventional vs ligasure hemorrhoidectomy | 12 (1142)                   | SH had less postoperative pain, shorter operative time, shorter hospital stay, and shorter convalescence, but a higher rate of prolapse and reintervention for prolapse. SH had a significantly higher incidence of recurrences and additional operations. |
| Burch et al[25]          | Hemorrhoidectomy vs SH                  | 27 (2279)                   | SH had less postoperative pain, shorter operative time, shorter hospital stay, and shorter convalescence, but a higher rate of prolapse and reintervention for prolapse. SH had a significantly higher incidence of recurrences and additional operations. |
| Giordano et al[25]       | Hemorrhoidectomy vs SH (minimum follow-up of 1 yr) | 15 (1201)                   | SH had a significantly higher incidence of recurrences and additional operations. |
| Gan et al[25]            | Various TCMH vs another TCMH or Western medicines | 9 (1822)                    | TCMHs significantly improved overall symptoms and bleeding as well as decreased the inflammation of perianal mucosa. |

*With additional data on the patients enrolled. IC: Infrared coagulation; IS: Injection sclerotherapy; RBL: Rubber band ligation; SH: Stapled hemorrhoidectomy; TCMH: Traditional Chinese medicinal herbs.

Oral calcium dobesilate: This is another venotonic drug commonly used in diabetic retinopathy and chronic venous insufficiency as well as in the treatment of acute symptoms of hemorrhoids[38]. It was demonstrated that calcium dobesilate decreased capillary permeability, inhibited platelet aggregation and improved blood viscosity; thus resulting in reduction of tissue edema[39]. A clinical trial of hemorrhoid treatment showed that calcium dobesilate, in conjunction with fiber supplement, provided an effective symptomatic relief from acute bleeding, and it was associated with a significant improvement in the inflammation of hemorrhoids[39].

Topical treatment: The primary objective of most topical treatment aims to control the symptoms rather than to cure the disease. Thus, other therapeutic treatments could be subsequently required. A number of topical preparations are available including creams and suppositories, and most of them can be bought without a prescription. Strong evidence supporting the true efficacy of these drugs is lacking. These topical medications can contain various ingredients such as local anesthesia, corticosteroids, antibiotics and anti-inflammatory drugs[40].

Topical treatment may be effective in selected groups of hemorrhoidal patients. For instance, Tjandra et al[40] showed a good result with topical glyceryl trinitrate 0.2% ointment for relieving hemorrhoidal symptoms in patients with low-grade hemorrhoids and high resting anal canal pressures. However, 43% of the patients experienced headache during the treatment. Perrotti et al[41] reported the good efficacy of local application of nifedipine ointment in treatment of acute thrombosed external hemorrhoids. It is worth noting that the effect of topical application of nitrite and calcium channel blocker on the symptomatic relief of hemorrhoids may be a consequence of their relaxation effect on the internal anal sphincter, rather than on the hemorrhoid tissue per se where one might anticipate a predominantly vasodilator effect.

Apart from topical medication influencing tone of the internal anal sphincter, some topical treatment targets vasoconstriction of the vascular channels within hemorrhoids such as Preparation-H® (Pfizer, United States), which contains 0.25% phenylephrine, petrola-
mass. A probe is applied to the base of the hemorrhoid
infrared radiation which coagulates tissue and evaporizes
Infrared coagulation:
and two weeks after RBL.
should stop taking anticoagulants for one week before
hemorrhoids, and extremely rarely, pelvic sepsis. The patients
ceration, urinary retention, thrombosed external hemor
complications include minor bleeding from mucosal ul
by taking mild laxatives or bulk-forming agents. Other
sitz baths, mild analgesics and avoidance of hard stool
make the procedure a one-person effort.
suction to draw the redundant tissue in to the applicator
ligator rectoscope
mercially available instruments, including hemorrhoid
one place in a single session
ence of somatic nerve afferents and requires immediate
placement of rubber band too close to
the dentate line may cause severe pain due to the pres
of mucosal ulceration or necrosis, and rare septic complications such as prostatic abscess and retroperi
tissue with a rubber band causes ischemic necrosis and
third-degree hemorrhoids. Ligation of the hemorrhoidal
second-degree hemorrhoids and selected patients with
simple, quick, and effective means of treating first- and
Rubber band ligation:
Rubber band ligation (RBL) is a
simple, quick, and effective means of treating first- and
second-degree hemorrhoids and selected patients with
third-degree hemorrhoids. Ligation of the hemorrhoidal
with a rubber band causes ischemic necrosis and
scarring, leading to fixation of the connective tissue to the rectal wall. Placement of rubber band too close to
the dentate line may cause severe pain due to the pres
ence of somatic nerve afferents and requires immediate
RBL is safely performed in one or more than
one place in a single session with one of several commer
cially available instruments, including hemorrhoid
ligator rectoscope and endoscopic ligator which use
suction to draw the redundant tissue in to the applicator
to make the procedure a one-person effort.
The most common complication of RBL is pain
or rectal discomfort, which is usually relieved by warm
sitz baths, mild analgesics and avoidance of hard stool
by taking mild laxatives or bulk-forming agents. Other
complications include minor bleeding from mucosal ul
ceration, urinary retention, thrombosed external hemorrhoids, and extremely rarely, pelvic sepsis. The patients
should stop taking anticoagulants for one week before
and two weeks after RBL.
Infrared coagulation:
The infrared coagulator produces
infrared radiation which coagulates tissue and evaporizes
water in the cell, causing shrinkage of the hemorrhoid
mass. A probe is applied to the base of the hemorrhoid
through the anoscope and the recommended contact
time is between 1.0-1.5 s, depending on the intensity
and wavelength of the coagulator. The necrotic tissue
is seen as a white spot after the procedure and eventu
ally heals with fibrosis. Compared with sclerotherapy,
infrared coagulation (IRC) is less technique-dependent
and avoids the potential complications of misplaced
sclerosing injection. Although IRC is a safe and rapid
procedure, it may not be suitable for large, prolapsing hemorrhoids.
Radiofrequency ablation: Radiofrequency ablation (RFA)
is a relatively new modality of hemorrhoidal treatment. A
ball electrode connected to a radiofrequency generator is placed on the hemorrhoidal tissue and causes the contact-
ting tissue to be coagulated and vaporized. By this method,
vascular components of hemorrhoids are reduced and
hemorrhoidal mass will be fixed to the underlying tissue
by subsequent fibrosis. RFA can be performed on an out
patient basis via an anoscope similar to sclerotherapy.
Its complications include acute urinary retention, wound
infection, and peripheral thrombosis. Although RFA is avirtually painless procedure, it is associated with a higher rate of recurrent bleeding and prolapse.
Cryotherapy: Cryotherapy ablates the hemorrhoidal
in a freezing cryoprobe. It has been claimed to
cause less pain because sensory nerve endings are de
stroyed at very low temperature. However, several clinic
trials revealed that it was associated with prolonged
pain, foul-smelling discharge and a high rate of persist
ent hemorrhoidal mass. It is therefore rarely used.
There are two meta-analyses comparing outcomes
among the three common non-operative treatments of
hemorrhoids (sclerotherapy, RBL and IRC). These
two studies demonstrated that RBL resulted in the fewest
recurrent symptoms of hemorrhoids and the lowest rate of
retreatment, but that it led to a significantly higher inci
dence of pain following the procedure. Hence, RBL could
be recommended as the initial non-operative modality for
treatment of grade I - III hemorrhoids. In a British survey
of almost 900 general and colorectal surgeons, RBL
was the most common procedure performed, following
by sclerotherapy and hemorrhoidectomy.
Operative treatment
An operation is indicated when non-operative approach
es have failed or complications have occurred. Different
philosophies regarding the pathogenesis of hemorrhoid
al disease creates different surgical approaches (Table 3).
Hemorrhoidectomy: Excisional hemorrhoidectomy is the
most effective treatment for hemorrhoids with the low
est rate of recurrence compared to other modalities. It
can be performed using scissors, diathermy, or vascular
tool such as Ligasure (Covidien, United States) and Harmonic scalpel (Ethicon Endosurgery, United States). Ef
sional hemorrhoidectomy can be performed safely under perianal anesthetic infiltration as an ambulatory surgery. Indications for hemorrhoid
ectomy include failure of non-operative management,
Hemorrhoids develop when the supporting tissues of the anal cushions disintegrate or deteriorate. May 7, 2012

Hemorrhoidal prolapse is associated with an internal rectal prolapse. Surgical approach

Surgical outcomes of DGHAL are still required for symptomatic hemorrhoids, further studies on the long-term outcomes of DGHAL are still required. DGHAL returned to work quicker, and had fewer complications. Meanwhile, non-operative treatments are needed to prompt the development of novel and innovative surgical approaches.

Table 3 Summary of different philosophies regarding the pathogenesis of hemorrhoids and related surgical approaches

| Theory                          | Short description                                                                 | Surgical approach                     |
|---------------------------------|------------------------------------------------------------------------------------|---------------------------------------|
| Sliding anal cushions           | Hemorrhoids develop when the supporting tissues of the anal cushions disintegrate  | Hemorrhoidectomy, plication           |
| Rectal redundancy               | Hemorrhoidal prolapse is associated with an internal rectal prolapse               | Stapled hemorrhoidopexy               |
| Vascular abnormality            | Hyperperfusion of arteriovenous plexus within anal cushion results in the formation| Doppler-guided hemorrhoidal artery ligation |
|                                 | of hemorrhoids                                                                     |                                       |

Acute complicated hemorrhoids such as strangulation or thrombosis, patient preference, and concomitant anorectal conditions such as anal fissure or fistula-in-ano which require surgery. In clinical practice, the third-degree or fourth-degree internal hemorrhoids are the main indication for hemorrhoidectomy.

A major drawback of hemorrhoidectomy is postoperative pain. There has been evidence that Ligasure hemorrhoidectomy results in less postoperative pain, shorter hospitalization, faster wound healing and convalescence compared to scissors or diathermy hemorrhoidectomy. Other postoperative complications include acute urinary retention (2%-36%), postoperative bleeding (0.03%-6%), bacteremia and septic complications (0.5%-5.5%), wound breakdown, unhealed wound, loss of anal sensation, mucosa prolapse, anal stricture (0%-6%), and even fecal incontinence (2%-12%). Recent evidence has suggested that hemorrhoidal specimens can be exempt from pathological examination if no malignancy is suspected.

Plication: Plication is capable of restoring anal cushions to their normal position without excision. This procedure involves oversewing of hemorrhoidal mass and tying a knot at the uppermost vascular pedicle. However, there are still a number of potential complications following this procedure such as bleeding and pelvic pain.

Doppler-guided hemorrhoidal artery ligation: A new technique based on doppler-guided ligation of the terminal branches of the superior hemorrhoidal artery was introduced in 1995 as an alternative to hemorrhoidectomy. Doppler-guided hemorrhoidal artery ligation (DGHAL) has become increasingly popular in Europe. The rationale of this treatment was later supported by the findings from vascular studies, which demonstrated that patients with hemorrhoids had increased caliber and arterial blood flow of the terminal branch of the superior rectal arteries. Therefore, ligating the arterial supply to hemorrhoidal tissue by suture ligation may improve hemorrhoidal symptoms. DGHAL is most effective for second- or third-degree hemorrhoids. Notably, DGHAL may not improve prolapsing symptoms in advanced hemorrhoids. Short-term outcomes and 1-year recurrence rates of DGHAL did not differ from those of conventional hemorrhoidectomy. Given the fact that there is the possibility of revascularization and recurrence of symptomatic hemorrhoids, further studies on the long-term outcomes of DGHAL are still required.

Stapled hemorrhoidopexy: Stapled hemorrhoidopexy (SH) has been introduced since 1998. A circular stapling device is used to excise a ring of redundant rectal mucosa proximal to hemorrhoids and resuspend the hemorrhoids back within the anal canal. Apart from lifting the prolapsing hemorrhoids, blood supply to hemorrhoidal tissue is also interrupted. A recent meta-analysis comparing surgical outcomes between SH and hemorrhoidectomy, which included 27 randomized, controlled trials with 2279 procedures, showed that SH was associated with less pain, earlier return of bowel function, shorter hospital stay, earlier return to normal activities, and better wound healing, as well as higher degree of patient satisfaction. However, in the longer term, SH was associated with a higher rate of prolapse. Considering the recurrence rate, cost of stapling device and potential serious complications including rectovaginal fistula and rectal stricture, SH is generally reserved for patients with circumferential prolapsing hemorrhoids and having ≥3 lesions of advanced internal hemorrhoids.

These two recent surgical options, DGHAL and SH, aim to correct the pathophysiology of hemorrhoids by reducing blood flow to the anal canal (dearterialization) and eliminating anorectal mucosal prolapse (reposition), respectively. A recent retrospective study of 18-mo outcomes of DGHAL (n = 51) and SH (n = 63) for grade III hemorrhoids revealed that both procedures were safe and effective. DGHAL had less pain, shorter hospital stay, and faster functional recovery; however, it was associated with higher recurrence rate and lower patient satisfaction rating. Lately, a smaller prospective trial comparing DGHAL to SH for grade II-III hemorrhoids showed similar short-term and long-term outcomes of the two procedures. Nevertheless, patients undergoing DGHAL returned to work quicker, and had fewer complication rates than those receiving SH.

CONCLUSION

Therapeutic treatment of hemorrhoids ranges from dietary and lifestyle modification to radical surgery, depending on degree and severity of symptoms. Although surgery is an effective treatment of hemorrhoids, it is reserved for advanced disease and it can be associated with appreciable complications. Meanwhile, non-operative treatments are not fully effective, in particular those of topical or pharmacological approach. Hence, improvements in our understanding of the pathophysiology of hemorrhoids are needed to prompt the development of novel and innova-
tive methods for the treatment of hemorrhoids.

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