

Hemorrhoidal Disease: A Comprehensive Review

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Hemorrhoids are one of the most common conditions to affect humans, having been mentioned many centuries ago. The first descriptions of problems associated with hemorrhoids are found in the Bible, and the occupation of proctology apparently was established then as well.¹

Anatomy and physiology

Hemorrhoids are vascular cushions within the anal canal, usually found in three main locations: left lateral, right anterior, and right posterior portions. They lie beneath the epithelial lining of the anal canal and consist of direct arteriovenous communications, mainly between the terminal branches of the superior rectal and superior hemorrhoidal arteries, and, to a lesser extent, between branches originating from the inferior and middle hemorrhoidal arteries and the surrounding connective tissue.

The vascular cushions participate in the venous drainage of the anal canal. It has been suggested that their presence is essential for continence; they contribute approximately 15% to 20% of the resting anal pressure, so they intensify the action of the anal sphincter mechanism and shield the anal canal and the anal sphincter during the act of evacuation by filling with blood and providing extra padding. The vascular cushions congest during a Valsalva maneuver or when intraabdominal pressure is increased, enabling the anal canal to remain closed; decongestion of the cushions, achieved by a rapid decrease of anal tone, allows rapid emptying of the rectal content.²⁻⁴

Epidemiology

Many individuals experience this condition without seeking medical consultation; patients are often reluctant to seek medical help because of embarrassment or the fear, discomfort, and pain associated with the treatment, so the exact incidence of this disease cannot be

estimated. Studies evaluating the epidemiology of hemorrhoids showed that 10 million people in the United States reported hemorrhoids, for a prevalence of 4.4%. In both genders, a peak in prevalence is noted between 45 and 65 years of age; development of hemorrhoids before the age of 20 is unusual, and Caucasians are affected more frequently than are African Americans.^{5,6}

Pathophysiology and etiology

The main theories about the pathophysiology of hemorrhoidal disease are that they are abnormal dilatation of veins of the internal hemorrhoidal venous plexus, abnormal distention of the arteriovenous anastomosis, and prolapse of the cushions and the surrounding connective tissue. Elevated anal sphincter pressure is also presumed as one of the etiologic factors contributing to the disease.⁷ It is not apparent whether these anorectal physiology changes are the result of the presence of hemorrhoids or the cause.⁸ The role of mucosal prolapse in hemorrhoidal disease is in debate; some surgeons regard this entity as a completely different pathology; others consider that mucosal prolapse is an integral part of the hemorrhoidal disease.⁹

During evacuation, voluntary sphincter contraction returns any residual fecal matter from the anal canal to the rectum as part of the normal physiology of evacuation. Straining to attain complete evacuation serves only to congest the vascular cushions. So straining, inadequate fiber intake, prolonged lavatory sitting, constipation, diarrhea, and conditions such as pregnancy, ascites, and pelvic space-occupying lesions that are associated with elevated intraabdominal pressure have been suspected to contribute to development of the disease. A family history of hemorrhoidal disease has also been suggested to contribute to development of the disease, although there is no evidence of a hereditary predisposition; also, diet and bowel habits are often related to customs and environment.¹⁰⁻¹²

Hemorrhoids are often regarded as internal or external varicosities.¹ This term is misleading, because the term *varicose* (*varices*) is used to describe tortuous elongation and dilatation of superficial veins (usually in the

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Table 1. Symptoms and Differential Diagnosis of Hemorrhoidal Disease

Symptoms	Differential diagnosis
Bleeding, anal swelling, prolapse, a painful anal mass, pain, discomfort, discharge, hygiene problems, soiling, pruritus ani, evacuation difficulties	Thrombosed external hemorrhoidal disease, internal hemorrhoidal disease, skin tags, condyloma acuminata (anal warts), hypertrophied anal papilla, rectal prolapse, fissure, abscess, fistula, perianal Crohn's disease, polyps, carcinoma, melanoma

lower extremities). Patients with portal hypertension may have rectal varices, a collateral circulation, in which the blood from the portal system passes into the systemic circulation through the middle and inferior hemorrhoidal veins. But hemorrhoids and rectal varices are two different entities, and many studies failed to demonstrate an increased incidence of hemorrhoidal disease in patients with portal hypertension.¹³

Classification and grading

Hemorrhoids are classified according to their origin; the dentate line (pectinate line) serves as an anatomic-histologic border. External hemorrhoids originate distal to the dentate line, arising from the inferior hemorrhoidal plexus, and are lined with modified squamous epithelium, which is richly innervated with somatic pain fibers (delta type, unmyelinated). Internal hemorrhoids originate proximal to the dentate line, arising from the superior hemorrhoidal plexus, and are covered with mucosa. Some hemorrhoids are regarded as mixed hemorrhoids (internal-external), arising from the inferior and superior hemorrhoidal plexi and their anastomotic connections, covered by mucosa in the superior part and skin in the inferior part, so they have somatic pain fibers.¹⁴

Internal hemorrhoids are further classified into four grades according to the extent of prolapse. In first-degree hemorrhoids, the hemorrhoidal tissue protrudes into the lumen of the anal canal, but does not prolapse outside the anal canal. The veins of the anal canal are increased in size and number and may bleed at the time of evacuation. Second-degree hemorrhoids may prolapse beyond the external sphincter and be visible during evacuation but spontaneously return to lie within the anal canal. Third-degree hemorrhoids protrude outside the anal canal and require manual reduction, and fourth-degree hemorrhoids are irreducible and are constantly prolapsed.¹⁴ It is important to document the grade of the hemorrhoids to determine appropriate treatment and to evaluate the efficacy of a particular treatment modality.

Clinical evaluation

Symptoms

Patients with hemorrhoidal disease may experience any of the following symptoms: bleeding, a painful mass, anal swelling, discomfort, discharge, hygiene problems, soiling, and pruritus. The most frequent complaint is painless bleeding, which usually appears early in the course of the disease.¹⁵ Johannsson and colleagues¹² found that many patients with grades III to IV hemorrhoidal disease have concomitant functional bowel symptoms, possibly associated with irritable bowel syndrome, which need to be taken into consideration when selecting treatment.

Bleeding associated with pain is suggestive of a thrombosed external hemorrhoid, with ulceration of the thrombus through the skin, or, more commonly, an anal fissure. Bleeding from hemorrhoids rarely causes anemia, and patients who present with anemia require further investigation of the gastrointestinal tract.^{15,16} Internal hemorrhoids usually become symptomatic only when they prolapse, become ulcerated, bleed, or thrombose. External hemorrhoids may be asymptomatic, or be associated with discomfort, acute pain, or bleeding from thrombosis or ulceration.

Differential diagnosis

During initial evaluation of the patient, other possible causes for the previously mentioned symptoms should be excluded. Colorectal and anal cancer, inflammatory bowel disease, and anorectal melanoma are all possible causes of rectal bleeding, perianal pain, painless bleeding, and a perianal mass.¹⁶⁻²⁰ Other diseases that may have similar symptoms are listed in Table 1.

Diagnostic tests

In most cases, diagnosis is easily made on physical examination, preferably accompanied by an anoscopy. In the absence of thrombosis, acute anal pain during examination is rare in patients with uncomplicated hemorrhoidal disease and might imply the presence of another disease, such as an abscess, fissure, or trauma of the examination. Acute pain may require an evaluation under anesthesia in the operating room.

Table 2. Indications for Complete Colon Evaluation in Patients with Hemorrhoidal Symptoms

Iron deficiency anemia
Positive fecal occult blood test
Age \geq 50 y, with no complete colon evaluation within 10 y
Age \geq 40 y, with positive family history for a single first-degree relative with adenoma or colorectal cancer diagnosed at age $>$ 60 and no complete examination within 10 y
Age \geq 40 y, with positive family history for two or more first-degree relatives with adenoma or colorectal cancer diagnosed at age $>$ 60 and no complete examination within 3–5 y
Any history or physical finding indicating malignancy or inflammatory bowel disease

The side-viewing anoscope, and not a retroflexed end-viewing instrument (flexible sigmoidoscope or colonoscope), is the optimal and most accurate instrument for evaluating hemorrhoids because it allows tissue to prolapse into the barrel of the instrument. When compared with flexible sigmoidoscopy, an anoscope detects a higher percentage of lesions in the anorectal region.^{21,22} Additional flexible sigmoidoscopy, barium enema, or colonoscopy may be warranted to exclude malignant diseases or inflammatory bowel disease.^{21–30} Indications for complete colon evaluation are summarized in Table 2.

Anorectal physiologic testing (such as manometry) and endorectal ultrasonography are important in evaluating patients with symptoms of soiling and incontinence. Soilage and incontinence may be from prolapsing hemorrhoids that partially obstruct defecation or injury of the sphincter mechanism.³¹ Evaluation of the anal sphincter in patients with history of incontinence who may require surgical treatment for hemorrhoids is extremely important because those patients are at greater risk of developing incontinence after surgery, and the finding will influence which surgical treatment option is preferable.³² Most patients with advanced hemorrhoidal disease do not require physiologic evaluation.

Treatment

Lifestyle modifications

Lifestyle modifications are an integral part of the treatment of hemorrhoidal disease. They should be offered to patients with all stages of hemorrhoidal disease as a part of a comprehensive treatment regimen, and as a preventive measure. These changes include improving anal hygiene, increasing the intake of dietary fiber and fluids in the diet, and avoiding constipation or diarrhea. Some of

these measures were found to have therapeutic and preventive effects; increasing the amount of fiber in the diet may relieve pain, bleeding, and prolapse,^{33–35} and sitz baths are useful for relieving anal pain and maintaining anal hygiene.^{36,37}

Oral medication

In Europe and Asia, oral vasotopic drugs are used for treating hemorrhoids. These treatments were first described in the treatment of varicose veins, venous ulcers, and edema. Purified flavonoid fraction is a botanical extract from citrus. It exerts its effects on both diseased and intact vasculature, increasing vascular tone, lymphatic drainage, and capillary resistance; it is also assumed to have antiinflammatory effects and promote wound healing. Lately, several randomized controlled studies evaluated the use of oral micronized, purified flavonoid fraction in the treatment of hemorrhoidal bleeding.^{38–40} In all of the studies, bleeding was relieved rapidly, and no complications were reported. In another recent randomized controlled trial, postoperative use of micronized, purified flavonoid fraction, in combination with short-term routine antibiotic and antiinflammatory therapy, reduced both the duration and extent of postoperative symptoms and wound bleeding after hemorrhoidectomy, compared with antibiotic and antiinflammatory treatment alone.⁴¹ Currently, the Food and Drug Administration (FDA) does not approve the use of micronized, purified flavonoid fraction in the United States.²³

Topical treatment

The use of over-the-counter medications is omnipresent in the treatment of hemorrhoids and includes pads, topical ointments, creams, gels, lotions, and suppositories. These preparations may contain various ingredients such as local anesthetics, corticosteroids, vasoconstrictors, antiseptics, keratolytics, protectants (such as mineral oils, cocoa butter), astringents (ingredients that cause coagulation, such as witch hazel), and other ingredients. Topical application of corticosteroids may ameliorate local perianal inflammation, but longterm use of high-potency corticosteroid creams should be avoided, because it can cause permanent damage and thinning of the perianal skin. Most of these products help the patient maintain personal hygiene, and may alleviate symptoms of pruritus and discomfort. There are no prospective randomized trials suggesting that they reduce bleeding or prolapse.^{14,23}

Thrombosed external hemorrhoids

Thrombosis often manifests as acute discomfort and the presence of a painful mass. In patients with recurrent episodes of thrombosis, avoidance of straining and constipation combined with increasing the amount of dietary fiber and fluid intake may serve as a prophylactic measure. Thrombosis is often encountered after heavy lifting, prolonged sitting, excessive straining at stool, or, conversely, diarrhea.

Conservative treatment includes sitz baths, mild analgesics, and stool softeners to relieve the symptoms. The thrombus will slowly be absorbed during the course of several weeks, the pain usually will subside after 2 or 3 days, and the mass will resolve within 7 to 10 days.¹⁴ In a prospective, randomized trial, Perrotti and associates⁴² demonstrated that topical application of nifedipine combined with lidocaine ointment is a safe option in the conservative treatment of thrombosed external hemorrhoids.

Surgical excision can be performed safely as an outpatient procedure under local anesthesia, with a low recurrence and complication rate.⁴³ Before surgical intervention, the extent of the hemorrhoidal disease should be assessed, and other anal pathology should be excluded, especially thrombosed internal hemorrhoids.

Excision within 48 to 72 hours of onset of symptoms often results in rapid relief from symptoms. The patient should be aware of the natural course of the disease and realize that after 72 hours, the discomfort of surgical excision often exceeds the pain of the thrombosed hemorrhoid. So, excision should be recommended, especially for patients with severe pain, or if ulceration or rupture occur within 72 hours of onset of symptoms. Incision and simple removal of the clot should be avoided; although it causes the pain to subside, it often results in recurrent hemorrhage into the subcutaneous tissue and clot reorganization. Usually, an elliptical incision is made into the skin overlying the thrombosed hemorrhoid, preferably radial to the sphincter. Bleeding often accompanies the incision and may be controlled with pressure or electrocautery. The wound can be left open or primarily closed. In patients with bulky hemorrhoidal disease, severe pain with hypersensitivity, or anxiety, the procedure can be done under general anesthesia. If a mass or an unusual tissue is encountered during the procedure, a histopathologic analysis is warranted.^{44,45}

Postoperative care should include pressure to control bleeding. This goal may be achieved with a pressure

dressing, which the patient should not remove until a few hours after the procedure. Late bleeding is occasionally seen, especially when the wound is left open and epinephrine is used in combination with the local anesthetic. Sitz baths, topical anesthetic cream, and mild analgesics are recommended for the first 7 to 10 days after the procedure.

Complications are usually minor and may include bleeding that becomes evident after the influence of the epinephrine wears off, or with the passage of a hard stool. Local infections are uncommon, probably because of the rich vascular network in the anal area; nevertheless, prophylactic antibiotics are prescribed by some physicians. Skin tags and scarring can also occur, but, if desired, can be electively addressed at a subsequent date.⁴⁴ Greenspon and associates⁴⁶ evaluated 231 patients with thrombosed external hemorrhoids. One hundred nineteen patients (51.5%) were managed conservatively and 112 (48.5%) were managed surgically. The authors reported that the time to resolution of symptoms averaged 24 days in the "conservative management" group versus 3.9 days in the "surgical treatment" group ($p < 0.0001$). Most patients who were treated conservatively eventually did experience resolution of their symptoms, but the recovery period was prolonged, with higher rates of recurrence and shorter remission intervals compared with patients who were treated by surgical excision.

Thrombosed internal hemorrhoids

Prolapse of internal hemorrhoids may cause stasis and result in thrombosis. This complication is less common than are thrombosed external hemorrhoids and is less painful, but because of the location of the internal hemorrhoids, operative intervention is more complicated and is rarely indicated. Sitz baths, analgesics, topical anesthetics, and stool softeners are recommended. If surgery is indicated, excisional hemorrhoidectomy is recommended.

Internal hemorrhoids: nonsurgical treatment

These interventions include rubber-band ligation, sclerotherapy, infrared coagulation, bipolar diathermy and direct-current electrotherapy, cryotherapy, laser therapy, and more. These procedures are usually office-based procedures done during the patient's first visit. They offer treatment for hemorrhoidal disease without the need for anesthesia or preparation of the patient. Some physicians advocate a mild bowel preparation (such as an

enema or a mild oral cathartic) before these procedures. The presence of fecal material in the rectum is not considered a contraindication to these procedures, although liquid stool might make the procedure technically more difficult. When treating mixed hemorrhoids, it is important to remember that they have a component of the anoderm (which is richly innervated with pain fibers) and that some form of anesthesia is required.

Sclerotherapy

This procedure was first described 2 centuries ago as treatment for hemorrhoidal disease. Currently, it is recommended as a treatment option for patients with symptomatic nonprolapsing grades I to II hemorrhoidal disease;²³ occasionally, a large hemorrhoid can be successfully treated with sclerotherapy.

Sclerotherapy is frequently done without anesthesia; the anoscope or proctoscope is passed through the anal canal into the rectal ampulla and then withdrawn until the mucosa “prolapses” over the opening of the scope. After the hemorrhoidal tissue is identified, the submucosa at the base of the hemorrhoid is injected with 5 mL of 5% phenol oil, vegetable oil, quinine, and urea hydrochloride or hypertonic salt solution. Injection of the sclerosant solution directly into the hemorrhoidal vein should be avoided because it can cause immediate transient precordial and upper abdominal pain.⁴⁷ The injection of an irritant sclerosant produces edema, inflammatory reaction with proliferation of fibroblasts, and intravascular thrombosis; this reaction creates submucosal fibrosis and scarring, which prevents or minimizes the extent of the mucosal prolapse and potentially reduces the hemorrhoidal tissue itself. After the procedure, the patient should receive appropriate dietary education and take stool softeners, bulking agents, sitz baths, and mild analgesics.

Although sclerotherapy can be done safely within a few minutes,⁴⁸ the physician needs to be particularly cautious when injecting in this area because of the proximity of the rectum to the periprostatic parasympathetic nerves. Accidentally injuring the periprostatic parasympathetic nerves can cause erectile dysfunction after sclerotherapy.⁴⁹ Hepatic complications after sclerotherapy for hemorrhoidal disease were also described.⁵⁰ Local infection and abscess formation are rare but may occur. Burning sensation and discomfort are often experienced by patients undergoing multiple injections.

Advanced-grade internal hemorrhoids with evidence of inflammation, infection, or ulceration should not be treated with sclerotherapy. Concomitant anal diseases such as fistulas, tumors, anal fissures, and skin tags are a contraindication to treatment with sclerotherapy. Sclerotherapy is not a treatment option for external hemorrhoidal disease, and might result in scarring and stricture if applied to external hemorrhoids.

Antibiotic prophylaxis is indicated for patients with predisposing valvular disease or immunodeficiency because of the possibility of bacteremia after sclerotherapy.⁵¹ If the patient is asymptomatic after sclerotherapy, a followup visit is not required.

Numerous studies have been conducted to evaluate and compare different treatment modalities for hemorrhoidal disease; the results have been inconsistent, although sclerotherapy seems to be a less effective option.^{52,53}

Rubber-band ligation

Ligation of the hemorrhoidal tissue with a rubber band causes ischemic necrosis, ulceration, and scarring, which results in fixation of the connective tissue to the rectal wall. Some surgeons believe that all three hemorrhoid bundles can be ligated in a single office visit; others practice a more conservative treatment and offer one primary site ligation per visit at intervals of 4 weeks or until symptoms resolve; advocates of this regimen suggest that such treatment results in less pain for the patient. In a prospective randomized trial by Poon and coworkers,⁵⁴ 205 patients with grades I to II hemorrhoidal disease were randomized to receive either conventional rubber-band ligation (one site per visit), or triple rubber-band ligation; the researchers concluded that both methods were effective in treating grades I to II hemorrhoidal disease and that the incidences of complications and pain after both procedures were similar. Triple rubber-band ligation was found to be more cost effective.

The disadvantage of rubber-band ligation as an office procedure is that it usually requires two operators (operator and assistant) to perform the procedure; one needs to maintain the anoscope/proctoscope in position while the other holds the ligator and the grasping forceps. To obviate the need for an assistant, numerous devices have been developed.⁵⁵ Some operators prefer to use two rubber bands rather than one to achieve better strangulation of the mucosa and to avoid break or slippage of the

rubber band. When the rubber band is applied close to the dentate line, the patient might feel discomfort, so it is important to place the rubber band on the base of the internal hemorrhoid, which usually lies 1.5 to 2 cm proximally to the dentate line. If the patient experiences severe pain, the rubber band can be removed. Severe pain during or immediately after the procedure is rare, and can result from strangulation of the anoderm (mixed hemorrhoids, rubber band placed close or distal to the dentate line), inflammation, and edema of the area; other causes must be excluded macroscopically by closely inspecting the area. If the patient has severe pain and anxiety, the need for sedation or general anesthesia should be considered; this will allow a more thorough examination of the area. After the rubber band is removed, if no gross evidence of infection or other cause of pain was found, the operator can retry ligation and grasp the mucosa at a more proximal site, away from the dentate line. Again, appropriate dietary modification, stool softeners, bulking agents, sitz baths, and mild analgesics are indicated.

Common complications may include moderate discomfort for several days after the procedure, which usually is relieved by sitz baths, mild analgesics, and avoidance of hard stools. Other complications may include severe pain, late hemorrhage (1 to 2 weeks after the procedure), thrombosed external hemorrhoid, ulceration, slippage of the rubber band, pelvic sepsis, and, albeit extremely rare, even Fournier's gangrene.^{56,57}

Contraindication for rubber band ligation includes patients who are taking anticoagulants, because of the increased risk of delayed hemorrhage. These patients can be offered treatment by other modalities such as sclerotherapy and infrared coagulation.

Rubber-band ligation is considered an excellent alternative for patients with hemorrhoidal disease. MacRae and McLeod⁵² conducted a metaanalysis comparing treatment options for grades I to III hemorrhoids. Eighteen trials were included in that metaanalysis. The authors found that patients who underwent hemorrhoidectomy had a better response to treatment than did patients who were treated with rubber-band ligation ($p = 0.001$), although complications and pain were greater in the hemorrhoidectomy group. Rubber-band ligation resulted in a better response to treatment as compared with sclerotherapy, and the complication rates were similar with both treatment modalities. Patients treated with sclerotherapy or infrared coagulation were

expected to require more therapy than those individuals treated with rubber-band ligation ($p = 0.031$ and $p = 0.0014$, respectively).

Recently, a systematic review of randomized trials comparing rubber-band ligation with excisional hemorrhoidectomy was published.⁵⁸ The technique of excising the hemorrhoidal tissue (open, semiclosed, closed) and the type of instrument used for excision (scissors, diathermy, laser, stapler) were not criteria for exclusion. The article included only three trials, with a total of 216 patients with different degrees of hemorrhoidal disease. The systematic review revealed significant heterogeneity among the studies regarding definition of postoperative pain, although the authors indicated that significantly more patients undergoing hemorrhoidectomy experienced this complication. Hemorrhoidectomy was associated with overall greater individual complication rates, although there was no statistically significant difference in the incidence of urinary retention, hemorrhage, and anal stenosis. The patient satisfaction was overall similar in both groups. The authors concluded that hemorrhoidectomy has a better longterm efficacy for grade III hemorrhoidal disease compared with rubber-band ligation, but at the expense of more postoperative pain, complications, and more time off work.

Chew and colleagues⁵⁹ conducted a retrospective study to assess the longterm results of combined sclerotherapy and rubber-band ligation. The procedure was performed in an office setting. Each hemorrhoid or prolapsed mucosal segment was first injected with 5% phenol in almond oil, and then two bands were applied. The recurrence rate was 16%; the overall complication rate was 3.1%, minor bleeding being the most frequent complication, and major bleeding that required hospitalization was seen in 0.6% of the patients. Another complication was severe anal pain. Hemorrhoidectomy was required in 7.7% of the responders. The authors concluded that combined sclerotherapy and rubber-band ligation is an effective treatment for early hemorrhoids and incomplete mucosal prolapse, with low rates of recurrence, complications, and hemorrhoidectomy, and it could easily be repeated.

Infrared coagulation

Infrared light penetrates the tissue and converts to heat. Manipulating the instrument can regulate the amount of destruction of the tissue. This procedure creates coagulation, occlusion, and sclerosis of the hemorrhoidal tis-

sue; eventually fibrosis develops at the site. The procedure is fast, with relatively minor complications. If an external component is to be treated with infrared coagulation, anesthesia is needed.

A metaanalysis of 5 prospective trials evaluated 862 patients with grades I to II hemorrhoidal disease who received treatment with infrared coagulation, rubber-band ligation, or sclerotherapy. Although rubber-band ligation demonstrated a greater longterm efficacy than sclerotherapy or infrared coagulation, it was associated with significantly higher incidence of postprocedure pain. The authors concluded that infrared coagulation is the most favorable nonsurgical treatment for hemorrhoids.⁵³

Other techniques

Bipolar diathermy and direct-current electrotherapy cause coagulation and fibrosis after local application of heat. Some studies suggest that the success rates of these methods are similar to those of infrared coagulation, with relatively low complication rates.^{60,61}

Cryosurgery is based on damage to the tissue from very low temperature; this damage creates water crystals within the cells, destroying the cell membrane and eventually destroying the tissue. It was suggested that this method will cause less pain from destruction of the sensory nerve endings by freezing, creating immediate anesthetic effect, but clinical trials have proved otherwise.⁶² The procedure itself is time consuming and associated with a profuse discharge, prolonged recovery, and loss of working days. This treatment does not offer the patient any advantages over other treatment modalities.^{14,23} Recent publications assessing cryosurgery as a treatment option for hemorrhoidal disease are absent.

Internal hemorrhoidal disease: surgical treatment

As stated in the revised practice parameters for the management of hemorrhoids,²⁵ surgical treatment should be offered to patients in whom office procedures were unsuccessful, patients who are not capable of tolerating office procedures, patients with large external hemorrhoidal disease, and patients with grades III to IV mixed (internal-external) hemorrhoidal disease.

Preoperative preparation usually includes one or two disposable phosphate enemas (CB Fleet Co, Inc) on the morning of the operation. Prophylactic antibiotics are necessary for patients who are at high risk, in accordance with the recommendation of the American Heart Association.⁶³

There are numerous surgical methods of hemorrhoidectomy aiming to decrease postoperative pain and hemorrhage.⁶⁴⁻⁷² The conventional procedure includes excision of the external and internal components of the hemorrhoidal tissue, using various techniques, with or without closure of the anorectal mucosa or the anoderm. Different instruments are available to perform excision of the hemorrhoidal tissue, including electrocautery, scissors, scalpel, laser, bipolar scissors, linear staplers, LigaSure (Valleylab, Tyco Health Care Group), or Harmonic Scalpel (Ethicon Endo-Surgery, Inc).⁶⁶⁻⁷² These instruments can be combined with a variety of surgical procedures.

In 1995, Dr Antonio Longo presented another surgical procedure that clearly and demonstrably reduced postoperative pain. This novel operative technique for hemorrhoidal disease is actually performed in the distal rectal mucosa and submucosa away from the modified squamous epithelium of the distal anal canal, which is richly innervated with somatic pain fibers. In Longo's procedure, neither the anal mucosa nor the hemorrhoidal tissue is removed, so the procedure is not a hemorrhoidectomy. The procedure was termed procedure for prolapse and hemorrhoids (PPH), hemorrhoidopexy, or stapled anopexy. A modified circular stapler is used to remove a ring of distal rectal mucosa and submucosa, with simultaneous fixation of the redundant tissue to the rectal wall. Because of the distance from the somatic fibers in the distal anal canal, it is presumed that this procedure is associated with less postoperative pain.⁷³⁻⁷⁵

All of these techniques require special training, because the complications can be devastating and can result in hemorrhage, incontinence, anal stenosis, fistula, and fatal septic complications including Fournier's gangrene (Table 3).⁷⁶⁻⁸¹ Each technique will be individually addressed.

Ferguson's (closed) hemorrhoidectomy

This procedure was developed in 1952, in the United States, by Ferguson. Currently, like any other surgical treatment for hemorrhoids, it is usually done in an outpatient setting (23 hours or less hospital stay). According to surgeon, anesthesiologist, and patient preference, anesthesia can be general, caudal, or spinal. Local anesthesia, in which the anal submucosa is infiltrated with a local anesthetic combined with low-dose epinephrine, is usually also applied. This technique minimizes bleeding,

Table 3. Common Complications of Hemorrhoid Treatment

Pain
Urinary retention
Hemorrhage
Constipation
Fissure
Abscess
Skin tag
Pseudopolyp
Anal stricture
Fistula, rectovaginal fistula
Sepsis
Rectal perforation
Incontinence

but does not affect the patient's blood pressure or heart rate, and allows creation of a plane between the hemorrhoidal tissue and the underlying internal sphincter, making the surgical excision easier and safer to perform.¹⁴

The conventional Ferguson's hemorrhoidectomy is performed with a scalpel, scissors, or electrocautery, although excision of the hemorrhoidal tissue can be achieved with any (electronic or other) cutting instrument. There are numerous publications about these techniques, and the results are inconsistent about which method causes fewer complications and less pain. After the hemorrhoidal pedicle has been mobilized, an absorbable suture is usually placed at the pedicle site. After the hemorrhoidal bundle is excised, with any internal or external components of the disease, the mucosal wound and skin are completely closed with a continuous suture. Wounds are cleaned and checked for appropriate hemostasis, and antiseptic ointment and a small dressing are often applied; no packing is necessary. Postoperative care includes prolonged sitz baths (approximately 20 minutes or more) several times a day. Topical creams or lotions may be applied, although the use of ointments should be avoided. Mild nonnarcotic analgesics are usually recommended to avoid constipation. Diet modifications rich with fiber and high fluid intake, bulking agents, or stool softeners are strongly recommended. Preferably, the patient will void after the procedure or before discharge. The patient should be instructed to report any complaints of urinary retention. The patient should also be notified that often after the first bowel movement, the sutures loosen. The followup visit is usually scheduled 3 or 4 weeks after the procedure if no complications develop in the interim.

Chen and colleagues⁸⁰ assessed the risk factors for developing secondary hemorrhage after closed hemorrhoidectomy, with special emphasis on the surgeon's seniority and specialization. Forty-five of 4,880 patients who were included in the study (0.9%) developed secondary hemorrhage. The tendency of male patients to develop secondary hemorrhage was significantly higher ($p = 0.003$). Interestingly, the rates of secondary hemorrhage were independently related to the individual surgeon. The authors related the results to the technical ability of the surgeon, with a potential possibility to avoid secondary bleeding if the operation is performed by a highly skilled surgeon.

Milligan-Morgan (open) hemorrhoidectomy

The first descriptions of open hemorrhoidectomy are from 2 centuries ago; the technique was made popular in the United Kingdom by Milligan and Morgan, in 1937, and is still widely used in Europe. In this procedure, hemorrhoidal tissue and vessels involved are excised in the same manner as in Ferguson's procedure, including the placement of a suture at the hemorrhoid pedicle, but the incisions are left open. Often, because of location, technical difficulties, or extensive disease with gangrenous hemorrhoidal tissue, an open approach is required; this technique also may be more useful for avoiding subsequent anal stenosis. To achieve hemostasis, electrocautery is often used. Even when using the open technique, it is important to maintain adequate bridges of normal anoderm because primary wound healing can also result in stricture and anal stenosis. Postoperative management is recommended for closed hemorrhoidectomy. Often, the procedure will be a combination of open and closed hemorrhoidectomy, and some of the sites will be left open and others will be primarily closed.

You and colleagues⁸² conducted a prospective randomized trial comparing the outcomes of surgical hemorrhoidectomy by open and closed techniques. Patients with grades III to IV hemorrhoids were included in the study; there were 40 patients in each group. A linear analogue scale was used to assess postoperative pain. Patients were followed up at 1, 2, and 3 weeks after operation. The authors concluded that the closed technique was superior to the open technique with respect to postoperative pain ($p < 0.05$) and speed of wound healing ($p < 0.001$). In another prospective study, open hemorrhoidectomy led to faster wound healing ($p < 0.05$)

compared with the closed technique, although it was not associated with less pain or fewer complications.⁸³

Possible complications of both open and closed hemorrhoidectomy include postoperative pain, urinary retention, secondary hemorrhage, anal fissure, abscess, fistula, formation of skin tags, anal stenosis, pseudopolyps, and fecal incontinence. Postoperative pain is a major concern after hemorrhoidectomy with neither technique offering the patient a pain-free postoperative course. Pain may be a result of manipulation of the skin distally to the dentate line or spasm of the anal sphincter after the procedure. Urinary retention can be attributed to pain, narcotics and anticholinergic drugs, fluid overload, high ligation of the hemorrhoidal pedicle, and operative trauma. To decrease the risk of urinary retention after operation, minimal intravenous fluids (ideally 100 mL or less) should be administered before operation, and when anesthesia is applied, the patient should be encouraged to void after the procedure.¹⁴ If urinary retention occurs, most patients will require temporary urinary catheterization. Secondary hemorrhage after hemorrhoidectomy usually occurs 7 to 10 days after operation and can easily be diagnosed by rectal examination.⁸⁰ Secondary hemorrhage is a relatively common complication, and bleeding may arise from the vascular pedicle or from the edges of the wounds. If the patient is hemodynamically unstable or pain prevents an adequate rectal examination, an examination under anesthesia may be warranted. Skin tags can be painful initially; usually their presence interferes with maintaining adequate hygiene and may cause pruritus ani. Surgical removal can be offered to the patient at a later date. Fecal incontinence is one of the most dreaded complications of hemorrhoidectomy. Anal leakage is common in the early postoperative course, but the patient usually regains normal control within a few weeks after the procedure. Frank incontinence should be an alerting sign for the physician. Preoperative physiologic studies and anal ultrasonography are advised for patients with history of imperfect continence.³² Anal stenosis results from anal narrowing because of fibrosis. This complication can be minimized if adequate mucosal bridges are retained after closed or open hemorrhoidectomy. The surgeon should realize that anal stenosis may indicate extensive underlying damage to the anal sphincter mechanism; in these cases, physiologic studies and anorectal ultrasonography are warranted before surgical correction.

Harmonic and LigaSure hemorrhoidectomy

Excision of the hemorrhoidal tissue can be achieved with numerous techniques. The Harmonic Scalpel (Ethicon Endo-Surgery) uses ultrasonic waves that allow cutting and coagulation of hemorrhoidal tissue at lower temperatures in a specific point, with reduced lateral thermal effect. The Harmonic Scalpel generates less smoke compared with lasers and other electro-surgical instruments. When using electrocautery, coagulation is achieved at temperatures higher than 150°C, resulting in formation of eschar that covers and seals the bleeding area. In one prospective study that compared Harmonic Scalpel hemorrhoidectomy with traditional closed hemorrhoidectomy, Harmonic Scalpel hemorrhoidectomy did not show any advantage in postoperative pain, fecal incontinence, operative time, quality of life, or other complications compared with traditional closed hemorrhoidectomy.⁶⁷

The LigaSure vessel sealing system (Valleylab, Tyco Health Care Group) for sutureless hemorrhoidectomy is a relatively new technique that uses a bipolar electrothermal device. The procedure offers surgical treatment with shorter operative time and less postoperative pain.⁸¹

By using the Harmonic Scalpel or LigaSure, the surgeon is theoretically minimizing the damage to adjacent tissues, causing less discomfort and faster healing. As with other traditional excisional procedures, hemorrhoidectomies performed with these instruments can be done in an outpatient setting, and hospital stay is generally not required. These methods can be used either with open or closed hemorrhoidectomy.

Chung and associates⁶⁹ conducted a prospective, double blinded study, comparing different excision techniques: Harmonic Scalpel hemorrhoidectomy, bipolar scissors hemorrhoidectomy, and regular scissors. The study population included 89 patients with grade 4 hemorrhoidal disease. The study showed that the Harmonic Scalpel was as efficient as were bipolar scissors in terms of reducing postoperative hemorrhage. Harmonic Scalpel was superior to the other methods in terms of postoperative pain and, consequently, patient satisfaction. Recovery time was similar with all the techniques. The added cost when performing the procedure with the Harmonic Scalpel is approximately \$350 for the disposable hand piece,^{66,68} and \$125 for the disposable LigaSure hand piece.⁸¹

Other surgical procedures

Park's (submucosal) hemorrhoidectomy⁸⁴ includes removal of the hemorrhoidal tissue through an incision in the anal and rectal mucosa and anoderm. The rationale of this surgical method is to minimize injury to the anoderm and mucosa, causing less damage to somatic nerve fibers. This technique is not frequently used, because it does not offer a solution to the external component of the hemorrhoidal bundle or to the excess of mucosa that is often a part of the disease.

Whitehead's hemorrhoidectomy was described by Whitehead in 1882 and is rarely performed today because of high complication rates, including stricture, loss of anal sensation, and development of mucosal ectropion.¹⁴

Lateral internal sphincterotomy during conventional hemorrhoidectomy was assumed to reduce the postoperative pain, even when there is no preoperative evidence of an anal fissure. Currently, there is no conclusive evidence that patients with no concomitant anal fissure will benefit from this procedure. On the contrary, studies suggest that this procedure does not reduce pain and may have a deleterious effect on continence.⁸⁵

The procedure for prolapse and hemorrhoids—PPH (Longo's procedure)

This procedure has numerous terms: mechanical hemorrhoidectomy with a circular stapler,⁷³ stapler hemorrhoidectomy,⁸⁶ circular stapler hemorrhoidopexy, stapled circumferential mucosectomy,⁸⁷ procedure for prolapsing hemorrhoids (PPH), stapled anopexy, among others. The terms *PPH* and *hemorrhoidopexy* most accurately describe this technique.

Shortly after Longo introduced the technique in 1995,⁷³ numerous reports, mainly from Asia and Europe, were published documenting less operative time, less postoperative pain, faster recovery, and earlier return to daily activities. In 2001, an international task force convened to assess the efficacy and safety of this procedure and to create general guidelines for surgeons who plan to practice this technique.⁸⁸ The procedure was named stapled hemorrhoidopexy. The committee stated that to perform this procedure, it is fundamental that the surgeon be familiar with anorectal anatomy and experienced in anorectal surgery, has adequate experience with circular stapling devices, and was formally trained by attending an official course.

The device for PPH is manufactured by Ethicon Endo-Surgery, Inc. The procedure can be done with mild sedation, local, regional, or general anesthesia.⁸⁹ In the United States, the procedure is done in an outpatient setting. During the procedure, a circumferential purse-string suture is placed approximately 2 cm proximal to the dentate line. The stapler is introduced transanally, and the suture is tied around the shaft. On closing and firing the stapler, a circumferential band of excessive rectal mucosa and submucosa proximal to the hemorrhoidal tissue is excised, and the defect in the mucosa is simultaneously closed by the stapler while fixing the mucosa to the underlying rectal wall. This procedure also interrupts the blood supply of the superior hemorrhoidal artery proximal to the hemorrhoidal tissue. So it treats the mucosal prolapse, with concurrent disruption of the blood supply to the hemorrhoidal tissue.

In 2002 Zmora and coworkers,⁹⁰ using a porcine model, performed a study to assess whether PPH can be safely performed twice. The investigators performed two PPH procedures in one session, leaving a ring of approximately 1 cm of mucosa between the two staple lines. The anal canal was examined 1 month later. The investigators documented that there was no evidence of anal stenosis, no significant difference in degree of fibrosis, and the mean mucosal blood flow between the two staple lines did not differ significantly from the flow measured proximally and distally. Their findings suggested that a synchronous or a subsequent PPH is feasible. A controlled experience involving human subjects is required to further validate these findings.

Indications for PPH include grade III hemorrhoidal disease and uncomplicated grade IV hemorrhoidal disease that are reducible at operation or after manipulation in the operating room (because the hemorrhoidal tissue is not excised during the procedure), and patients in whom other treatments failed.⁸⁸ But while performing conventional hemorrhoidectomy, a simultaneous treatment of other perianal conditions, such as anal fissure, skin tags, hypertrophied anal papillae, and acute thrombosis can easily be accomplished. PPH does not involve incisions in the anoderm, so does not treat any external components of the disease or other perianal conditions. The surgeon must inform the patient that these conditions will not be treated by PPH, unless additional incisions are made to deliberately treat them.

Contraindications for PPH include anal abscess or gangrene, because the operation does not remove the

source of sepsis. Anal stenosis is also considered a contraindication, because the procedure requires insertion of a circular anal dilator. Full-thickness rectal prolapse is also considered a contraindication, because it is not adequately treated with PPH. Use of the circular anal dilator during the procedure and the inadvertent removal of smooth muscle while removing excessive mucosa was speculated to lead to impairment of bowel control, although studies suggest that PPH does not significantly affect the continence score, quality of life, or mean anal resting pressure;^{91,92} patients with preexisting sphincter injury and those with anal incontinence should be offered other treatment modalities.

Although one of the advantages of PPH is the reduction of postoperative pain, pain may result from thrombosis of the residual hemorrhoidal tissue. Other possible explanations for postoperative pain include a staple line that is too close to the anal verge, which may result in partial excision of sensitive anoderm, or inappropriate placement of the purse-string suture that may result in incorporation of rectal muscle and nerves. Bleeding after the procedure may occur at the staple line. This complication can take place during the procedure, and hemostasis can easily be achieved by oversewing the bleeding point. Postoperative bleeding can be managed by submucosal injection of epinephrine during proctoscopy. If injection fails, if the bleeding source is undetected, or if the proctoscopy causes discomfort to the patient, examination under anesthesia is indicated. Acute urinary retention may also occur as a complication of PPH, and should be managed as described for conventional hemorrhoidectomy. Other rare postoperative serious complications after PPH that have been reported include rectal perforation, anastomotic dehiscence, retroperitoneal sepsis, retroperitoneum, rectal stricture, rectal obstruction, rectovaginal fistula, and even mortality.^{76,77,93-97} The risk for rectovaginal fistula can be minimized by assessing the thickness of the rectovaginal septum before applying the purse-string; care should be taken not to place the suture too deep, and the vagina must be examined before firing the stapler. Incorrect placement of the purse-string suture may also result in complete rectal obstruction.

One of the first large prospective multicenter studies in the United States comparing PPH with closed hemorrhoidectomy concluded that PPH offers the benefits of less postoperative pain, less need for analgesics, and less pain at the first bowel movement. Only patients

with grade III hemorrhoidal disease were enrolled in that study. Seventy-seven patients were in the PPH group compared with 79 patients in the closed hemorrhoidectomy group. There was no significant difference in the complications between the two groups, but postoperative pain, pain at first bowel movement, and need for postoperative analgesics were significantly less in the group of patients who had PPH.⁹⁸

A metaanalysis by Lan and coauthors⁹⁹ included 10 randomized controlled studies that evaluated the safety and efficacy of PPH compared with open hemorrhoidectomy. Two of the trials included in this metaanalysis were conducted as multicenter studies. Seven hundred ninety-nine patients with grades III to IV hemorrhoidal disease were included (one study included also grade II hemorrhoids), and followup varied from 1 to 48 months. A metaanalysis of the safety data comparing the two procedures did not show any significant differences. Postoperative bleeding and blood loss were significantly lower in the PPH group. Data for postoperative urinary retention were inconclusive between the two groups in the six studies that were comparable; only one study showed that the number of patients with urinary retention was higher in the PPH group. The mean operative time and the length of stay were significantly shorter in the PPH group ($p < 0.05$ and $p < 0.001$, respectively). Resumption of normal activity, as shown by pooled data from 2 studies (a total of 300 patients), although not significantly different, was earlier in the PPH group. Other studies that were not integrally analyzed showed that resumption of normal activities was significantly earlier in the PPH group. The incidence, duration, and severity of pain were lower in the PPH group, and less postoperative analgesia was required. Pooled data from three trials (a total of 275 patients) suggested that anal discharge was more common after open procedures. The incidence of incontinence was rare in both groups, and pooled data of 456 patients suggested that there was no significant heterogeneity between the two procedures. Postoperative anal tags were more prevalent in the PPH group. Data from three studies reported that there were no significant differences in the anal sphincter function. Information collected from four studies suggested that patients in the PPH group perceived a higher rate of operative success.

Other controlled randomized trials of PPH compared with conventional hemorrhoidectomy are listed in Table 4.

Table 4. Controlled Randomized Trials of Procedure for Prolapse and Hemorrhoids Compared with Conventional Hemorrhoidectomy

First author, year of publication	PPH, n	Technique, n	Reduced pain	Reduced hospital stay	Reduced recovery time	Reduced total complication rate
Ho, ⁸⁶ 2000	57	Open diathermy, 62	Yes	Similar	Yes	Similar
Mehigan, ¹⁰⁰ 2000	20	Open diathermy, 20	Yes	Similar	Yes	Similar
Rowell, ¹⁰¹ 2000	11	Closed diathermy, 11	Yes	Yes	Yes	—
Shalaby, ¹⁰² 2001	100	Open, 100	Yes	Yes	Yes	Similar
Ganio, ¹⁰³ 2001	50	Open diathermy, 50	Yes	Yes	No	Similar
Boccasanta, ⁸⁷ 2001	40	HLB,* 40	Yes	Yes	Yes	Similar
Ortiz, ¹⁰⁴ 2002	27	Diathermy, 28	Yes	—	No	Similar [†]
Pavlidis, ¹⁰⁵ 2002	40	Open, 40	Yes	Yes	—	Similar
Hetzer, ¹⁰⁶ 2002	20	Closed, 20	Yes	Yes	Yes	Similar
Correa-Rovelo, ¹⁰⁷ 2002	42	Closed, 42	Yes	Yes	Yes	Similar
Cheetham, ¹⁰⁸ 2003	15	Diathermy, 16	Yes	No	Yes	Similar [‡]
Palimento, ¹⁰⁹ 2003	37	Open diathermy, 37	Yes	No	Yes	Similar
Racalbuto, ¹¹⁰ 2004	50	Modified open, 50	Yes	—	Yes	Similar
Kairaluoma, ¹¹¹ 2003	30	Open diathermy, 30	Yes	No	No	No
Senagore, ⁹⁸ 2004	77	Closed, 79	Yes	Similar	Yes	Similar [§]
Kraemer, ¹¹² 2005	25	Ligasure, 25	Similar	Similar	Similar	Similar
Ortiz, ¹¹³ 2005	15	Open diathermy, 16	Yes	—	Similar	No
Chung, ¹¹⁴ 2005	43	Harmonic Scalpel, 45	Yes	Yes	Yes	Similar
Gravie, ¹¹⁵ 2005	63	Open, 63	Yes	Yes	Yes	Similar

*HLB- Circular hemorrhoidectomy according to the Hospital Leopold Bellan.⁸⁷

[†]Seven patients in the PPH group re-presented with prolapse compared with none in the conventional hemorrhoidectomy group ($p = 0.004$).

[‡]At longterm followup, 3 patients in the PPH group complained of fecal urgency and anal pain, and 3 patients required further surgery to remove symptomatic external hemorrhoids.

[§]Reoperation because of complication was required in 6 of the patients who underwent conservative hemorrhoidectomy and in none of the patients in the PPH group.

PPH, procedure for prolapse and hemorrhoids.

Recently, the largest trial describing experience with 3,711 stapled hemorrhoidopexies was published.¹¹⁶ The study was conducted as a retrospective review of all patients who underwent PPH during a 5-year period. Parameters studied were indications for operation, length of operation, postoperative complications, and recurrences, among others. The main indications for PPH were bleeding (80.7%), hemorrhoidal prolapse (59.6%), and thrombosis (3.9%). The median duration of operation was 15 minutes (range 5 to 45 minutes). Minor complications occurred in 12.3% of the patients and included acute urinary retention (4.9%), bleeding (4.3%), postoperative pain requiring admission (1.6%), anorectal stricture (1.4%), perianal hematoma (0.05%), and significant residual skin tags (0.05%). Anastomotic dehiscence occurred in three patients (0.08%). Twelve (0.3%) patients had a recurrence at a median of 16 months (range 5 to 45 months). The authors concluded that PPH is a safe and effective procedure for hemorrhoidal disease.

The cost of PPH to the health-care system is lower than that of standard hemorrhoidectomy: \$328 compared with \$390 (data from Medicare reimbursement tables, 2006), although other authors reported that the total costs incurred 3 months after PPH were higher than those with standard hemorrhoidectomy.⁸⁶

In summary, hemorrhoidal disease is one of the most common anorectal conditions. Preventive medicine plays an important role when addressing this issue. Non-operative measures can be offered to patients with mild symptoms or minimally symptomatic hemorrhoids. When dietary modifications and nonsurgical treatments fail to improve symptoms, surgical therapy should be considered. Surgical treatment should be individually tailored to each patient according to the degree of symptoms, coexisting anorectal diseases, and the degree of external anorectal component of the disease. The physician should remember that the most common presenting symptom of hemorrhoidal disease—rectal bleeding—should not be automatically attributed to the

hemorrhoids, and a thorough evaluation of the gastrointestinal tract is mandatory when there is suspicion of malignancy or other gastrointestinal disease. Currently, there is a variety of surgical treatments that are available to treat this disease, and most have similar success rates. The procedure for prolapsing hemorrhoids is a relatively new surgical technique that offers the patients surgical treatment with less postoperative pain, shorter hospital stay and recovery time, and a complication rate similar to that with conventional hemorrhoidectomy. Albeit rare, devastating complications have been described with this procedure, so only experienced surgeons should perform PPH at this time.

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