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REVIEW ARTICLE **OPEN ACCESS**

The Physiological Conditions Related to Hemorrhoids and their Therapeutic Approaches

Manish M Musale[1], G S Chakraborthy[2*], Zalak Shah[3], Sadhana Kumbhar[4], Kunal Bahalkar[5]
[1,4,5]P G Scholar, Department of Pharmacology, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat, India, 391760
[2] Principal and Professor, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat, India, 391760
[3] Assistant Professor, Department of Pharmacology, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat, India, 391760
Corresponding Author*
G S Chakraborthy,
E-mail: g.chakraborthy19159@paruluniversity.ac.in

ABSTRACT
Hemorrhoids form when the veins are put under pressure. When the pressure remains, the vein's wall undergoes stretching, this can be caused due to low fiber diet. Furthermore, recurrent straining at the time of defecation pushes blood downward into the rectal veins, elevating pressure within the veins and leading to the development of hemorrhoids. It is located in three different sites: left lateral, right posterior, and right anterior portion, these hemorrhoidal cushions consist of blood vessels, connective tissues, elastic tissues, and smooth muscles. This systemic arrangement within the anus is referred to as an anal cushion. They facilitate to close the anus throughout bowel movements. When anal cushions become inflamed and bleed, they can be referred to as piles or hemorrhoids. A comprehensive understanding of hemorrhoid anatomy, physiology, and pathophysiology plays a vital role in selecting an appropriate treatment for hemorrhoids such as conservative management, pharmacological agents, creams, nonoperative approaches, surgical options, and novel methods for managing hemorrhoids. The objective of this review is to study the anatomy, pathophysiology, and current treatment modalities to provide insights based on the existing literature.
Keywords: Hemorrhoids, Pathophysiology, Treatment, surgical options, novel methods.

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INTRODUCTION

Hemorrhoids (HEM-o¯-Royds; hemo- blood; -rhodium flow) are superior rectal varicose veins (enlarged and inflamed). Hemorrhoids occur when the veins experience pressure and become filled with blood. As the pressure remains, the vessel wall stretches [1]. It is also described as a network of small veins within the anal region and base of the anus. Sometimes, these veins expand and become filled with an excess of blood. As a result, they give rise to one or more small, swollen areas known as hemorrhoids [2]. Such an enlarged vein bleeds; the initial indication is bleeding or itching of the development of hemorrhoids. Stretching the vein also promotes blood clots, increasing swelling and discomfort. It can be initiated by constipation resulting from a low-fiber diet. Moreover, repetitive straining during bowel movements pushes blood into the anal veins, elevating the pressure within these vessels, and potentially leading to the development of hemorrhoids or piles [1].

Hemorrhoids are currently managed through lifestyle changes, the application of anti-inflammatory and venotonic medications, dietary fibers, and various operative procedures such as hemorrhoidectomy, sclerotherapy, infra rays photocoagulation, and laser therapy. These treatments are usually costly and often have numerous side effects with no permanent relief [3,4].

This review briefly overviews the physiology and anatomy of hemorrhoids with their treatments.

Hemorrhoids?

Generally, an elongated mass of cells with veins presents in the mucosal layer. that covers the lower part of the anorectal region. When the veins undergo swelling and distended, hemorrhoids (piles) develop [5]. i.e., hemorrhoids are not varicose veins; these are clusters of blood vessels that consist of arteries, venules, and

arteriolar-venular connections. These vascular cushions can slide down, become swollen and congested, and cause bleeding [6].

Anatomy

Hemorrhoids are mainly located in three different sites: left lateral, right posterior, and right anterior portions [7]. Hemorrhoids are not varicose veins; these are clusters of vascular tissue (e.g., arterioles, veins, arteriovenous junctions), smooth muscle (e.g., Treitz muscles), and connective tissues covered by a normal epithelial layer of the anus. Hemorrhoids occur prenatally and continue until adulthood. Evidence suggests that instead of being venous, bleeding from hemorrhoids originates from arteries. It is confirmed through the light red colour of blood and its arterial pH. Based on their anatomic origin in the anal canal and the location of the pectinate line, they are categorized as internal or external depending on where they are located [8].

Hemorrhoids are categorized as Internal, External, and Mixed Hemorrhoids.

Internal hemorrhoids start over the pectinate line, usually bleed or prolapse, but do not originate pain.(fig.1)

Depending on the level of prolapse, it is divided into four categories.

Grade 1: The anal canal extends outward but is not fully prolapsed.

Grade 2: It prolapses, but undergoes spontaneous reduction.

Grade 3: Prolapsed and necessitates manual repositioning.

Grade 4: Irreversible prolapse.

External hemorrhoid- starts beneath the pectinate line, leading to discomfort and itching.

Mixed hemorrhoid- are lesions that develop along the pectinate line or may represent the presence of both internal and external hemorrhoids [9].

Pathophysiology

Hemorrhoids develop because of downside anal cushions movement [11], generally within swollen blood veins in the anal, up to the lowest part of the anus. The rectum is lined with an epithelial layer of the anal canal [12]. The anal canal comprises three cushions that lie on the left lateral, right posterior, and anterior sides. These hemorrhoidal cushions consist of blood vessels, connective tissues, elastic tissues, and smooth muscles [13]. This systemic arrangement within the anus is referred to as an anal cushion. They facilitate to close the anus throughout bowel movements [14]. When anal cushions become inflamed and bleed, they can be referred to as piles or hemorrhoids [15]. Even though the specific pathophysiology of hemorrhoids is not known, hemorrhoids are thought to be caused by abnormally tightly packed and descending anal cushions. Hemorrhoids were thought to be a type of anorectal varicosities. However, significant evidence that hemorrhoids and anorectal varicosities are different. Patients who have varicosities and portal hypertension do not have more cases of hemorrhoids than the rest of the population [16]. based on that, hemorrhoid formation categorizes into different types (Fig.2) i.e.; sliding anal cushions, vascular abnormality, rectal redundancy, and increase pressure on the anorectal vascular plexus [17].

Causes [18]

Stress at the time of bowel movement

Sitting a longer time on the toilet

Due to chronic constipation

Due to low-fiber diets

Due to reducing the strength of supporting tissues of the anus that happen with aging

Due to Pregnancy

Due to lifting heavy objects

Symptoms

For external hemorrhoids,

Itching in the anal area

Hard lumps around the anus

Anal pain while sitting

Excessive cleaning, stretching, or rubbing of the anal region can exacerbate symptoms. In numerous cases, the symptoms associated with external hemorrhoids usually disappear in some days.

For internal hemorrhoids,

Bleeding from the rectum, indicated by the presence of red blood in the stool, on toilet tissue, or in the toilet bowl following a bowel movement, may occur. hemorrhoid that has descended through the anus, a condition known as prolapse [18].

Treatment

Treatment for symptomatic hemorrhoids varies from conservative treatment that includes dietary fibers and lifestyle adjustments to the uses of different pharmacological medications and topical creams, nonsurgical approaches, and surgical options [19].

Conservative management [20]

For grade I and non-thrombosed hemorrhoids.
By using warm baths to relax the rectal sphincters
Improving toilet habits by avoiding long-duration sitting.
Increases dietary fibers along with fluid consumption.
Stool softeners like polyethylene glycol, docusate, etc.
Topical corticosteroids, analgesics like lidocaine cream

Oral Medication:

In Asian countries, oral vasotopic drugs commonly employed for the treatment of hemorrhoids, such as micronized, pure flavonoid fractions are used to treat hemorrhoidal bleeding [21,22]. As compared to antibacterial and anti-inflammatory medication alone, micronized, pure flavonoid fraction combined with shorter duration regular antibacterial and anti-inflammatory medications, decreases the postoperative symptom and wound bleeding after hemorrhoidectomy [23]. In the United Nations, the FDA currently bans the use of micronized, pure flavonoid fractions [24].

Topical medication:

Topical medications that are used for hemorrhoids are categorized into anesthetics, astringents (such as witch hazel), and antiseptics, which may be significant in long-term utilization and can cause allergies. Short-term relief from pain is achieved through topical creams and suppository [25]. Nitro-glycerine and nifedipine relieve anal sphincter spasms., with taking precautions because of side effects, such as hypotension [26,27]. Preparation H is used to relieve itching and discomfort due to hemorrhoids, relieve burning, temporarily protect the inflamed anal surface, and defecation less painful due to temporarily shrinking hemorrhoids, it is available in various formulations, like ointments, cooling gel, and cream with one percent Hydrocortisone, and wipes. The main constituents such as mineral oil, white paraffin, phenylephrine hydrochloride, and shark liver oil. Topical corticosteroids can improve local perianal inflammation, but long-term usage to avoid as it may lead to irreversible damage [28].

Nonoperative approaches:

Generally, it is used when conservative therapy of grades I and II internal hemorrhoids fails [29]

Rubber band ligation

This is a general procedure for managing 1st, 2nd, or 3rd-degree hemorrhoids, conducted in an office setting without the necessity of local anesthesia. An anoscope is used to apply a band ligature on the anal mucosa proximal to 1 cm or more above the dentate line [30]. Tissue ligation induces ischemic fibrosis, ulceration, and death of cells present in anorectal wall [31]. The necrosis that results from band application sloughs off 5 to 7 days later, it is effective in approx. 75% of 1st and 2nd-grade internal hemorrhoids, and less effective in 3rd-grade hemorrhoids [29]

Coagulation, electrocautery, and electrotherapy

Coagulation therapy uses infra radiation which targets the site of hemorrhoids [32]. It is transmitted radiation that coagulates the mucosa, causes tissue damage, and induces inflammatory reactions, resulting in scarring [33]. This method necessitates many days of exposing hemorrhoid tissues to light, allowing the tissue to sluff off. This procedure is generally used for smaller hemorrhoid masses [34]. The rate of damage relies on the application's intensity and duration. The process is carried out by placing the infrared coagulator's tip close to the hemorrhoid's tip for a 1.0-1.5 second energy pulse. During one treatment session, approximately three to four hemorrhoids are made and one to three hemorrhoids are treated [35]. Bipolar electrocautery is used for lower-grade hemorrhoids; Low volt current works better for high-graded hemorrhoids. It requires ground time and provides excellent pain control. a new approach involving retroflex endoscopic monopolar coagulation for 2nd-grade and 3rd-grade internal hemorrhoids is effective and can be perfectly combined with the end of colonoscopy to evaluate hematochezia [36].

Sclerotherapy and cryotherapy

Sclerotherapy and cryotherapy are procedures commonly used to treat first- and second-grade hemorrhoids. About 5 mL of a sclerosant is injected into the submucosal layer i.e., present in the lower part of the hemorrhoid, causing vascular occlusion and sclerosis of the adjacent connective tissue [29,37] Avoid injecting the sclerosant solution directly into the hemorrhoidal vein, as it may lead immediate pain in the abdomen [38].

After the therapy, the patient might be given proper dietary suggestions, and use a stool softener, bulking agent, sitz bath, and sometimes analgesics [35].

Laser therapy and radiofrequency ablation

Radio ablation is a procedure that leads to an instant decrease of oozing material which is targeted and felicitated with the healing process to scarring [39]. Those waves remove the tissue, turning the waves into heat. An alternate current circulates to the tip of the non-insulated electrode in the target tissue, causing alterations in ion direction in the tissue fluid. This results in ion mixing by frictional heating. This process removes extracellular and intracellular water into the tissues and resulting damages it through coagulation necrosis [40]. This ablation results in fibrosis and fixation of the tissue, The ablation was done with radio waves and then the hemorrhoids were sutured [41].

Surgical Options:

Surgical Options are generally for patients when conservative therapy of grades 1st and 2nd internal hemorrhoids fails [33]

Hemorrhoidectomy

It is used for grade 3rd and grade 4th hemorrhoids. It is carried out in two ways i.e., open and closed haemorrhoidectomy [33]. In open hemorrhoidectomy, Milligan-Morgan hemorrhoidectomy (MMH), The intramucosal defect has been healed, but the skin incision has been kept open for secondary healing for four to eight weeks. Closed hemorrhoidectomy is similar to open exceptionally a continuous suture is done to close the opening procedure like in MMH [13]. Postoperative complications and pain remain a major problem. Severe pain can be managed with narcotic pain medications, anti-inflammatory medications, muscle relaxants, and topical medications like sitz baths and ice packs [19].

Stapled hemorrhoid surgery

Generally, it is an invasive hemorrhoid procedure where the circumference of the mucous membrane is stapled 3-4 centimeters above the pectinate line with a round stapler. The open stapler is introduced via string suture and subsequently tightened and closed to remove the ring of hemorrhoid tissue. This leads to mucosectomy reduces prolapse of the anal mucosa and interrupts the hemorrhoid vessels. This stapling of the hemorrhoidal tissue disrupts the upper hemorrhoid plexus and permits the hemorrhoid tissue to return to its original anatomical position [42,43].

Doppler Guided Hemorrhoid Artery Ligation (DGHAL)

This procedure involves the insertion of the probe in the upper hemorrhoidal artery for binding. Further, this demarcates the location of hemorrhoid arteries, which may subsequently be sutured and knotted. The distilled part of the upper arteries is stitched to decrease the oozing material from the tissues which may lead to fibrosis. It holds an advantage over hemorrhoid removal because the method reduces enlarged hemorrhoids [44].

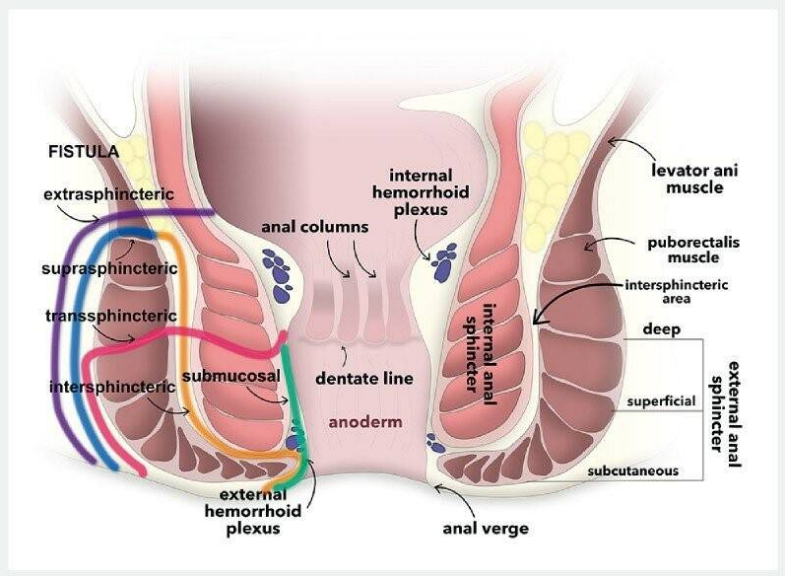

Fig. 1 Anatomy of the Rectum [10]

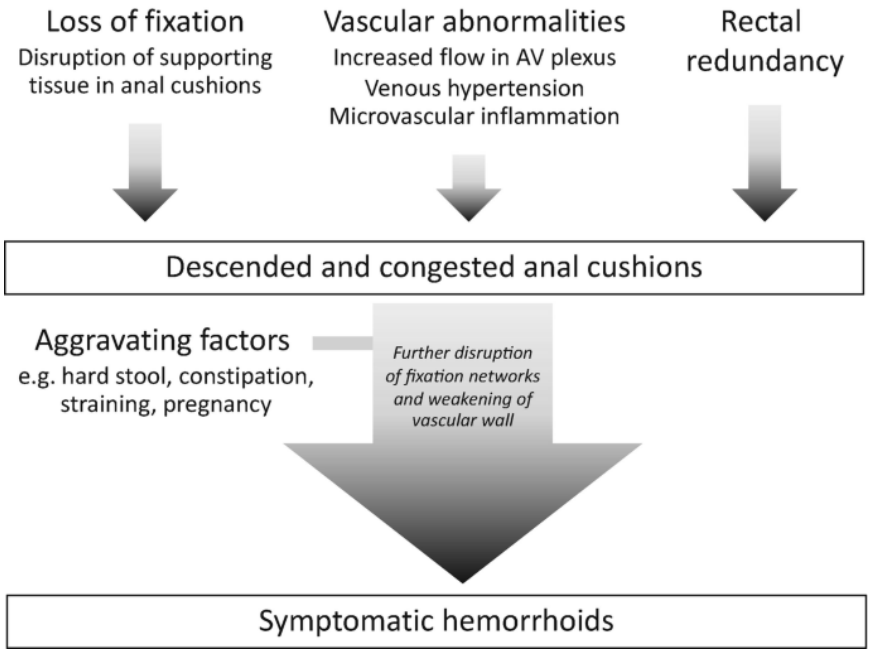

Fig 2. Schematic Diagram of Hemorrhoid Formation [16]

Table No. 1: Summary of disease conditions with different concepts of the pathophysiology of hemorrhoids, related treatment methods, site of action, route of administration, and its complications.

Disease Condition	Short description	Therapeutic approach	Route Of Administration or Position	Site Of Action	Complications
Grade 1	Increased pressure on the anorectal vasculature, Hemorrhoids bleed but no prolapse.	Dietary Supplement/ Fluid intake	Oral	Stools softer	Electrolyte imbalance, nausea, diarrhea, or weakness
		Lifestyle modification	Improve toilet habits with no prolonged sitting	Avoid swelling in the veins or around the anus	No serious complications, It only helps to control disease, not for a complete cure.
Grade 2	Structural changes in the anorectal vasculature due to high arterial blood flow and venous high blood pressure lead to hemorrhoids. They prolapse but spontaneously reduce.	Phlebotonics	Oral/ Topical	Improve venous tone, stabilize capillary permeability	It gives temporary relief with no side effects.
		Diosmin	Oral	Improves venous tone, reduces the inflammatory response, improves micro-circulation	Stomach ache, diarrhea, dizziness, headache, skin redness, muscle pain, and blood problems,
		Sclerotherapy	The submucosa of the back passage	Hemorrhoid gradually shrinks or shrivels up	Hepatitis, abdominal bloating, and discomfort
		Laser treatment	Using Radiowaves over hemorrhoid tissue	Fibrosis and fixation of the ablated tissues	Bleeding and re-intervention

Grade 3	The tissues a broken down which results in loss of the fixation network. that also prolapse but have to be manually reduced.	Rubber band ligation	A mass is attached with a rubber band	Stopping blood flow to the hemorrhoidal mass causes the tissue to shrink and die.	Bleeding, thrombosed hemorrhoids, intense pain, urinary retention and death
		Hemorrhoid-ectomy	Prone jackknife position for surgery	Small cut around the anus leads to the removal of hemorrhoidal tissue	Severe pain, bleeding, faecal impaction, wound breakdown, and anal stricture.
Grade 4	It is depicted with internal arrangement which cannot be minimized.	Stapled hemorrhoido-pexy	Stapling the last section of the large bowel	Stapling reduces the supply of blood to the hemorrhoids and causes them to shrink	Recurrence of hemorrhoids, severe pain, stenosis, fissure, skin tag, thrombosis, faecal urency, staples problems, gas flatus
		Doppler Guided Hemorrhoidal Artery Ligation	Transducer inserted into the anal canal for ligation	Ligation of arteries can reduce blood flow to tissue and lead to the formation of fibrosis	Thrombosis, bleeding, dyschezia, pain, secondary hemorrhage, urinary retention, fecal incontinence

CONCLUSION

In this review, we discuss the anatomy, physiology, and pathophysiology of rectal regions and hemorrhoids, but the specific causes and pathophysiology of hemorrhoids remain unknown, it gives a brief description of hemorrhoids, their treatment such as conservative therapy, non-operative therapies, surgical approaches, operative measures are curable but that causes various complications. This article also gives brief details to make well-informed decisions for patients to improve their quality of life, and seek relief from the discomfort caused by hemorrhoids.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable

CONFLICTS OF INTEREST

The authors reveal no conflicts of interest concerning the work reported in this article.

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