Pilonidal Disease and Hidradenitis Suppurativa

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Key Concepts

- Pilonidal disease is an acquired chronic, infectious disease typically of the natal cleft with an unknown etiology, thought to be due to a combination of environmental and patient-specific factors.
- The treatment for pilonidal disease should not result in worsening of quality of life than the disease itself. Incision and drainage for acute infections is mandatory, but further surgical treatment should be individualized.
- Several operative strategies exist for the treatment of pilonidal disease; surgeons should be familiar with the various options available, though no single option has proven superior.
- Wound care following pilonidal excision can have a major impact on quality of life and several nonoperative treatment strategies exist.
- Hidradenitis suppurativa (HS) is a chronic, relapsing, inflammatory skin condition that typically occurs after puberty. The primary clinical presentation is painful inflamed nodules in the apocrine gland-bearing regions that progress to abscesses, sinus tracts, and scarring.
- The overall disease burden is disproportionate to the estimated prevalence, and patients with HS not seen and evaluated by dermatologists and surgeons may not get timely and appropriate treatment.
- Therapy is initially medical and consists of antibiotics both orally and topically as well as immune modulators to manage the chronic inflammation.
- Surgery is an important treatment for both acute abscess formation and painful scarring and deformity. Excision with primary closure and skin grafting can result in cure for patients with recalcitrant disease.

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Pilonidal Disease

Introduction

Pilonidal disease is a chronic, suppurative condition, typically of the sacrococcygeal natal cleft, that can present from quiescent and asymptomatic disease to an active and purulent infection. Clinical descriptions date as far back as the 1850s, yet this disease process continues to challenge clinicians today. The ideal treatment for this condition remains a dilemma, and classic techniques are still frequently utilized for treatment while newer techniques are explored. Pilonidal disease can result in significant quality of life impairment for the patient, but treatments for the disease can be equally frustrating, not infrequently resulting in chronic open wounds requiring extensive wound care with prolonged healing periods. When caring for patients with pilonidal disease, it is important to remember that the treatment of the disease should not be more debilitating than the disease itself.

The terms "pilonidal cyst," "abscess," "sinus," and "disease" are often used interchangeably. In the setting of an infection of the pilonidal sinus or cyst, the term "abscess" is most appropriate. In general, this spectrum of pilonidal conditions can be referred to as "pilonidal disease." There is a multitude of nonsurgical and surgical treatment options available for pilonidal disease that can be employed at various stages of disease severity. The plethora of literature compares procedures, with variable success and recurrence rates where no single procedure outshines the others. As such, it is important to have an understanding of the assorted options available to patients during any stage of their disease process, from the initial stage of diagnosis to recurrent disease several years after definitive surgical treatment.

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Epidemiology and Etiology

The true incidence of pilonidal disease is unknown, as it relies on patient-reported symptoms and patients may not always seek treatment, especially in the case of relatively quiescent disease. Pilonidal disease can also occur in other anatomic locations besides the natal cleft, such as the interdigital web spaces of hair dressers or dog groomers and even the umbilicus [1–7]. It is estimated that approximately 70,000 cases of natal cleft pilonidal disease occur per year [8]. Traditionally, male sex was associated with higher risk of pilonidal disease; however, data suggests that this disease affects females equally, with up to 55% of female patients in some studies [9–11]. Pilonidal disease was once termed "jeep disease" due to the high incidence during World War II in jeep drivers, with an underlying theory that prolonged sitting in vehicles was the cause in those patients [12]. Other causative risk factors include obesity, hirsutism, poor hygiene, long periods of sitting/driving, excessive sweating, deep natal cleft anatomy, and family history [9, 11, 13–15].

The underlying etiology of pilonidal disease remains unknown, though there are several working theories. While the true underlying etiology may never be elucidated, the main controversy is whether pilonidal disease is inherited or acquired. Previously, pilonidal disease was thought to be due to an inherited, congenital malunion of the dorsal midline and treatment centered around removal of all embryologic remnants [16, 17]. Now, the leading hypothesis is that it is an acquired condition occurring in the natural environment of the natal cleft, which is one of warmth, repeated friction, and moisture. The underlying theory is that this environment, combined with an inciting trauma to the skin and surrounding hair follicles, results in a granulomatous foreign body reaction, leading to the formation of inactive pilonidal sinuses or active infections.

Diagnosis

Patients presenting with pilonidal disease can have a range of symptoms. Those with asymptomatic pilonidal disease may be completely oblivious to the presence of the sinuses. Patients typically become aware of the presence of the disease upon the development of an active infection, typically reporting pain and drainage. Frequently they may mistakenly report rectal bleeding and assume a diagnosis of hemorrhoids; however, these episodes of bleeding do not relate to bowel movements and occur spontaneously. Patients may also be referred with a suspected diagnosis of anal fistula, which rarely track to the natal cleft and can be typically ruled out on physical exam. Making the diagnosis of pilonidal disease is fairly straightforward, and the true diagnosis is evident upon physical exam of the natal cleft.

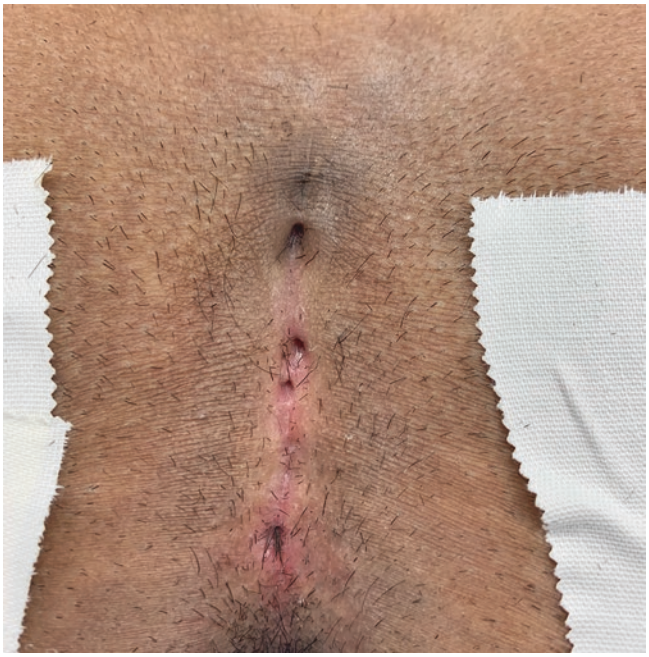

Fig. 16.1 Example of pilonidal disease. Note there are several pits present in the midline of the natal cleft

Physical exam will reveal one or several pits located in the midline of the natal cleft almost always contaminated by debris and hair (Fig. 16.1). The entire natal cleft must be examined after removing the debris and excess free hair. This may demonstrate tufts of hair coming from the pilonidal pits with associated drainage. The hair can be removed from the pits using a hemostat, which may cause some minor bleeding. In the setting of an acute abscess, there will be a raised area of erythema, fluctuance, induration, and tenderness, which is typically located just lateral to the midline. They can also be located quite some distance from the nearest pilonidal pit, but the underlying abscess cavity will communicate with a nearby pit (Fig. 16.2). The pits typically travel in the midline along the natal cleft. In some situations, the pits may be located quite inferiorly in the natal cleft close to the anal verge and may be mistaken for an external opening of an anal fistula.

Despite the prevalence of pilonidal disease and its variants, there is no formal classification system in place. There are no clear guidelines to inform procedure of choice, and typically surgeons perform procedures with which they are most comfortable. The lack of consensus results in an inability to generalize the available data, most of which are small, single-center studies. Generalizability of these single-institution studies is difficult, as procedure of choice is guided by surgeon preference as opposed to validated guidelines. Additionally, there is no true gold standard for comparison, and there is no study comparing all available treatments side by side. There is also heterogeneity in reported outcome measures, including postoperative infec-

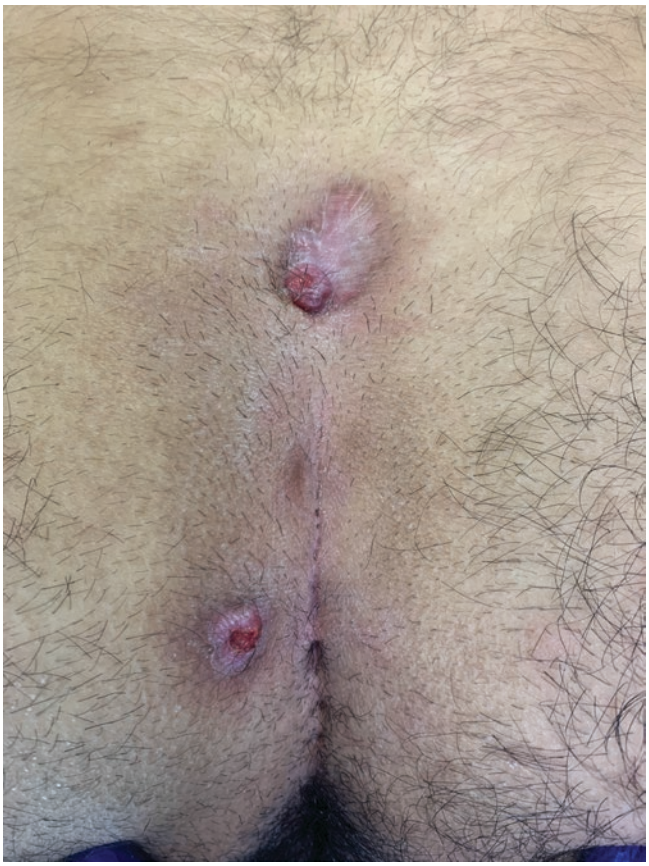

Fig. 16.2 Pilonidal disease with midline pits and two abscesses – one located lateral to the right and one located cephalad in the midline

tion, recurrence rates, postoperative pain, time off work, wound healing time, and quality of life. Despite these challenges, it is important for clinicians to understand the variety of treatments available to treat the disease.

Treatment

Managing Patient Expectations

When caring for patients with pilonidal disease, it is important to establish a baseline set of expectations for their treatment course. Upon initial presentation, a majority of patients may be managed nonoperatively, and it is important for patients to understand the potential for recurrent symptoms that may require future intervention. Additionally, postoperative complication rates are relatively high regardless of which operative strategy is chosen. It is important that the patient has a clear understanding of the potential for these postoperative complications, which largely consist of wound infections and chronic wound complications requiring dressing changes and delayed healing. Additionally, while there are a variety of operative options, the best course of treatment remains controversial.

Nonsurgical Treatment

In patients who have quiescent disease, no invasive treatment is necessary. Risk factor modification may be employed including improved hygiene, weight loss, hair removal, and avoiding prolonged sitting. Cleansing the area with a washcloth or scrub brush may help prevent hairs from becoming trapped within the pits. Hair removal can be very effective as a step towards healing. Hair removal options include shaving, waxing, depilatory creams, or laser hair removal. Patients with light-colored hair may not be candidates for laser hair removal, as it typically works best in those with light-colored skin and dark hair. The available data to support laser hair removal is limited and heterogeneous [18]. Recurrence rates of 0–28% have been reported, which were less than those seen in the non-laser hair removal groups. Additionally, depilatory creams and laser hair removal are not recommended in the setting of an active infection or ulceration. In these cases, patients should be instructed how to shave the area and may even require weekly visits to have the area shaved in the clinic. Even when operative treatment is chosen, postoperative hair removal has been shown to decrease recurrence [19].

Antibiotics

Antibiotics are typically not indicated but should be prescribed in certain circumstances. Antibiotics alone will not treat pilonidal disease but can be used as an adjunct in cases with extensive surrounding erythema/cellulitis and systemic signs of sepsis (fevers, rigors, malaise) or in certain patient populations (diabetes, immunosuppressed, artificial heart valves, or other implanted prostheses). If antibiotics are indicated, a third-generation cephalosporin and metronidazole should be prescribed [20]. If there is an acute abscess, antibiotics should not be used as the sole treatment, and incision and drainage is indicated. Typically, incision and drainage is sufficient treatment.

Phenol

A nonsurgical outpatient option to ablate pilonidal disease is phenol application. This procedure is performed under local anesthesia with overall success rates of 62–95% and low complication rates of 0–2% [21–23]. Phenol causes a caustic burn without causing pain given the anesthetic and analgesic effects of phenol solution. The phenol solution also denatures the hairs thought to cause pilonidal disease. The procedure involves debriding the tract, enlarging the cavity slightly, and then instilling 1–3 mL of crystallized phenol solution into the pilonidal cavity while protecting the surrounding skin with ointment. Typically, one to four sessions are required to achieve good results [24]. Success rates are higher when combined with laser hair removal or depilatory creams [25–27]. The procedure can also be utilized successfully in those with recurrent pilonidal disease [24].

Fibrin Glue

Similar to phenol treatment, fibrin glue (or thrombin gelatin matrix) may be utilized with recurrence rates ranging from 0% to 17%, in the absence of infection [28]. This procedure is performed by first shaving the surrounding hair and preparing the operative field in a sterile fashion. After hair and debris are removed from the sinus using a curette, fibrin glue is instilled into the sinus. The fibrin glue acts as a sealant that allows a clot to form. Efficacy for this procedure demonstrates success rates of 96% with high patient satisfaction (79%) [29, 30]. Those that reported they were dissatisfied required further treatment due to procedure failure [30]. A similar study found a 27% recurrence rate after a median of 4 months, and after second fibrin glue application, the success rates were 96.6% [31]. Fibrin glue may also be used as an adjunct with other more advanced surgical flaps, though the durability of this is unknown [32, 33]. A meta-analysis was performed that comprised four randomized control trials of fibrin glue to treat pilonidal disease which included a total of 253 patients [34]. This study revealed low-quality evidence for the use of fibrin glue as monotherapy or in conjunction with advanced flap-based procedures. Given the lack of high-quality evidence and long-term results, the true utility of fibrin glue remains unclear at this time [35].

Surgical Treatments

Incision and Drainage

Acute pilonidal disease is defined as the presence of an abscess with or without associated cellulitis [36]. Regardless of the chronicity of the disease, if a patient presents with an acute abscess, incision and drainage should be performed. The main overarching concept of performing an incision and drainage in this setting is to place the incision off of the midline over the area of maximum fluctuance. Frequently, incision and drainage with unroofing of the cavity can successfully treat the disease without the need for additional procedures. Incision and drainage is nearly always successful for resolving the immediate infection. Recurrent infections are typically due to failure to address underlying hair, debris, granulation tissue, and epithelization that are present within the cavity [37]. Abscesses that are inadequately drained may also recur if the incision site heals prematurely without true healing by secondary intent. When performing an incision and drainage, it is important to ensure that the abscess is unroofed and the skin edges are no longer opposed to avoid premature healing.

Lay Open Technique Versus Excision with Primary Closure

The lay open technique is one in which an incision is made overlying the sinus tract of the pilonidal cyst and allowed to granulate by secondary intention (Fig. 16.3). A fistula probe can be used to identify the extent of the tract. An incision can be made on top of the probe using electrocautery, unroofing the track. The overlying skin can be excised in order to create a shallow wound and prevent the wound from prematurely healing at the skin surface level. The exposed tract can then be debrided using curettes or cautery. The skin edges can also be marsupialized using absorbable polyglycolic acid or Vicryl suture in a running fashion, making the defect smaller and shallower. The wound may be too shallow for traditional

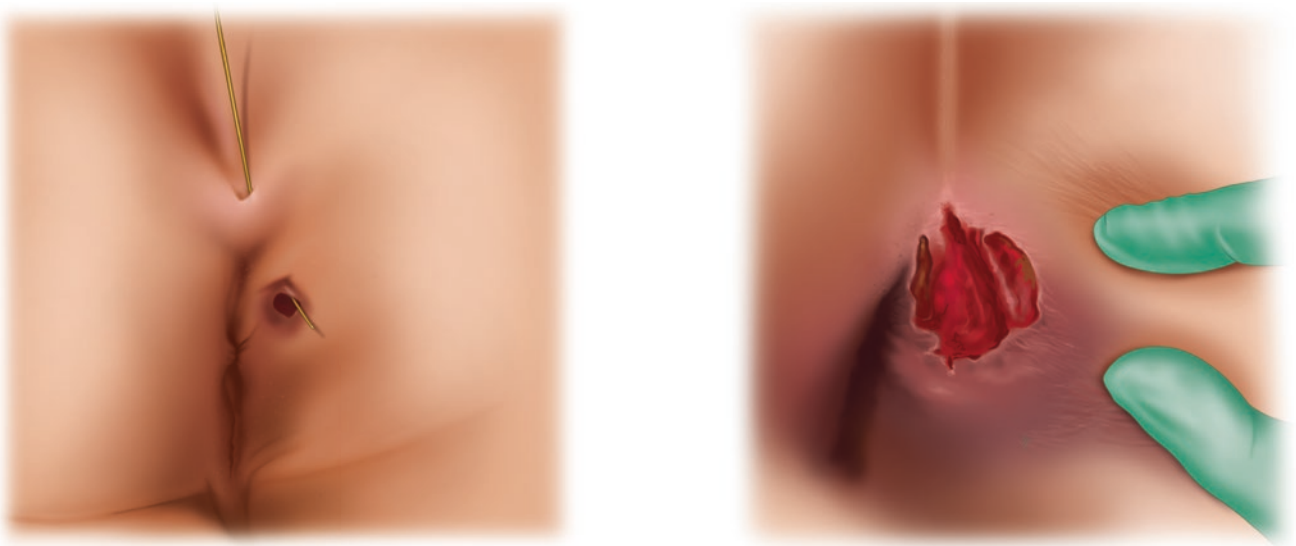

Fig. 16.3 Lay open technique: A fistula probe is used to identify the tract. An incision is made overlying the probe using electrocautery to unroof the tract. The chronic granulation tissue can be debrided and the wound edges marsupialized if desired

packing, but a dressing of gauze can be placed and changed regularly to protect the patient's clothing from drainage.

Success rates for initial operation are reported to be as high as 97% [38]. Patients who undergo the lay open technique have recurrence rates varying between 8.8% if the abscess is incised and left open to 20.8% if they are excised and left open [39]. Postoperative infection rates are similar between lay open and primary closure techniques, but recurrence is significantly less likely with the lay open technique [40]. The lay open technique requires more intense wound care, such as dressing changes done twice daily, often requiring assistance from a family member. Sometimes, wounds can heal with hypertrophic granulation tissue, which can result in drainage and require further cauterization in the office setting to achieve complete healing.

Another option is excision with primary closure. Typically, the entire pilonidal cavity is excised down to the sacral fascia. The wound is then irrigated and closed in layers. The deep tissues are closed using absorbable polyglycolic acid suture. The final skin layer can be closed using a nylon or polypropylene suture in a vertical mattress fashion. The final dressing applied may include buttressing sutures to create a pressure dressing that remains in place for several days postoperatively to prevent the development of a seroma. Primary closure has been shown to result in faster healing and decreased time off from work [41–44]. Avoiding inconvenient and prolonged wound care is one of the attractive benefits of primary closure, but patients should be counselled as to the potential risk of postoperative infection requiring opening of the incision. A Cochrane review comparing 26 trials with 2530 patients identified faster healing times with primary closure but no difference in surgical site infection rates [45]. When comparing midline versus off-midline closure, there were decreased surgical site infection rates with faster healing times with off-midline closure [45]. There are no obvious benefits for open versus closed excision; but if the decisions is made to perform primary closure, then the preferred technique is to keep the closure off of the midline.

Complex Surgical Treatment

There are no formalized guidelines as to when complex surgical treatment is indicated following acute incision and drainage of an abscess. The goal of flap-based surgical treatment is to excise the diseased tissue, cover the defect with healthy tissue, and raise the natal cleft anatomy. In general, surgical excision should be considered for patients with chronic sinuses that harbor extensive, chronic, epithelialized granulation tissue, which will not heal with hygiene and hair removal alone. Surgical excision should also be considered for patients who have undergone multiple abscess drainage procedures. Timing of surgery can be typically arranged in an elective fashion. There are several types of flaps, described below.

Karydakis Flap

A Karydakis flap involves excising the effected tissue in an elliptical fashion, with the inferior and superior corners of the ellipse about 2 cm from the midline (Fig. 16.4). The skin and soft tissue, including all the pilonidal pits, are excised

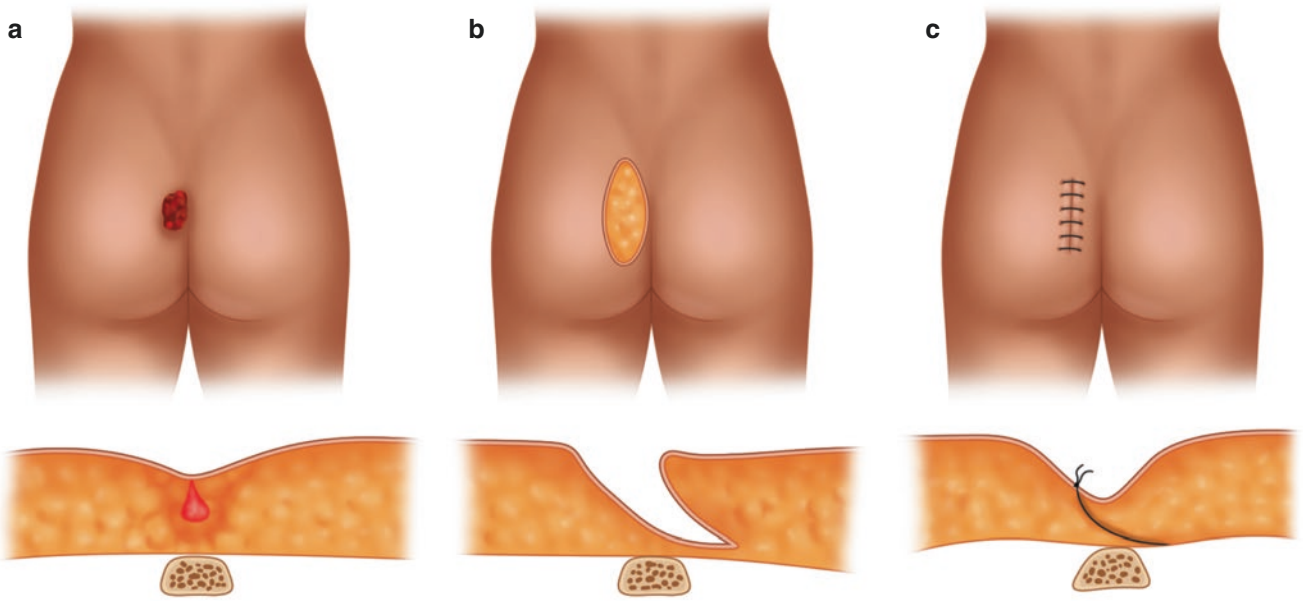

Fig. 16.4 Karydakis flap: (**a**) The affected tissue is excised down to the sacral fascia in an elliptical fashion off of the midline. (**b**) A flap of skin and subcutaneous tissue is raised and advanced over the excision defect. (**c**) This is secured in place by suturing in layers

down to the sacral fascia. After this tissue is excised, a flap of the skin and subcutaneous tissue is raised on the opposite side of the midline. This is then advanced over the resection bed. The wound is closed in layers with the deepest layer of absorbable polyglycolic sutures including the sacral fascia. Additional layers of absorbable polyglycolic sutures are placed to approximate the flap. The skin is finally closed with nonabsorbable suture (either polypropylene or nylon) in a vertical mattress fashion. A pressure dressing is applied and can be secured in place with tie-over sutures [46]. These sutures are typically left in place for 10–12 days [47].

The Karydakis flap generally has good results. Kardyakis reported his results in 6545 subsequent cases with a wound complication rate of 8% and recurrence rate of under 2% [48]. In more recent trials, the Karydakis flap has morbidity rates as high as 21% [49]. A trial comparing Kardyakis flap to excision with healing by secondary intent showed recurrence rates of 1.2% and an 18.7% rate of wound complications [50]. Another study demonstrated a 1-year recurrence rate of 3% and a 10% wound dehiscence rate when performed for recurrent disease [50]. Another trial demonstrated a wound complication rate of 8.1% and recurrence rate of 2.7% [51].

Rhomboid Flap (aka Limberg Flap)

A rhomboid flap, also known as a Limberg flap, is a rotational flap (Fig. 16.5). This involves first mapping the site of excision. This is done by identifying the extent of the pits and marking the shape of a diamond with the superior and inferior apices of the diamond just to the left of the midline. This results in a wound that does not come to a point just above the anus, which is the site with the highest risk of wound failure. The purposed excision site should include any former incision and drainage scars. This excision site will be in the shape of a diamond. The marking of the flap starts from the lateral apex of the diamond, typically on the right side. A horizontal line is drawn from the lateral apex that is approximately 5–6 cm in length. This horizontal mark represents the contralateral lower edge of the flap after rotation, and so it is important to ensure the lengths are congruent. Another line is marked from the lateral end of the horizontal line inferiomedially at an acute angle. Incisions are first made to resect the diamond-shaped tissue down to the sacral fascia. Next, the lipocutaneous flap is raised. Care should be taken to ensure that the flap is undermined appropriately to allow for a tension-free closure without creating ischemia. The flap can be secured into place with absorbable sutures. The final layer of the skin can be closed with vertical mattress sutures, and some may choose to also apply surgical glue. The use of a drain is per surgeon preference.

Results of the Limberg flap are conflicting. Wound infection rates are reported to range from 1.5% to 4% [52, 53]. Recurrence rates have been reported between 0% and 4.9% [51, 52, 54]. Conversely, complications have been reported to be as high as 49%, including a wound dehiscence rate of 45%, infection rate of 4%, and recurrence rate of 13% [53].

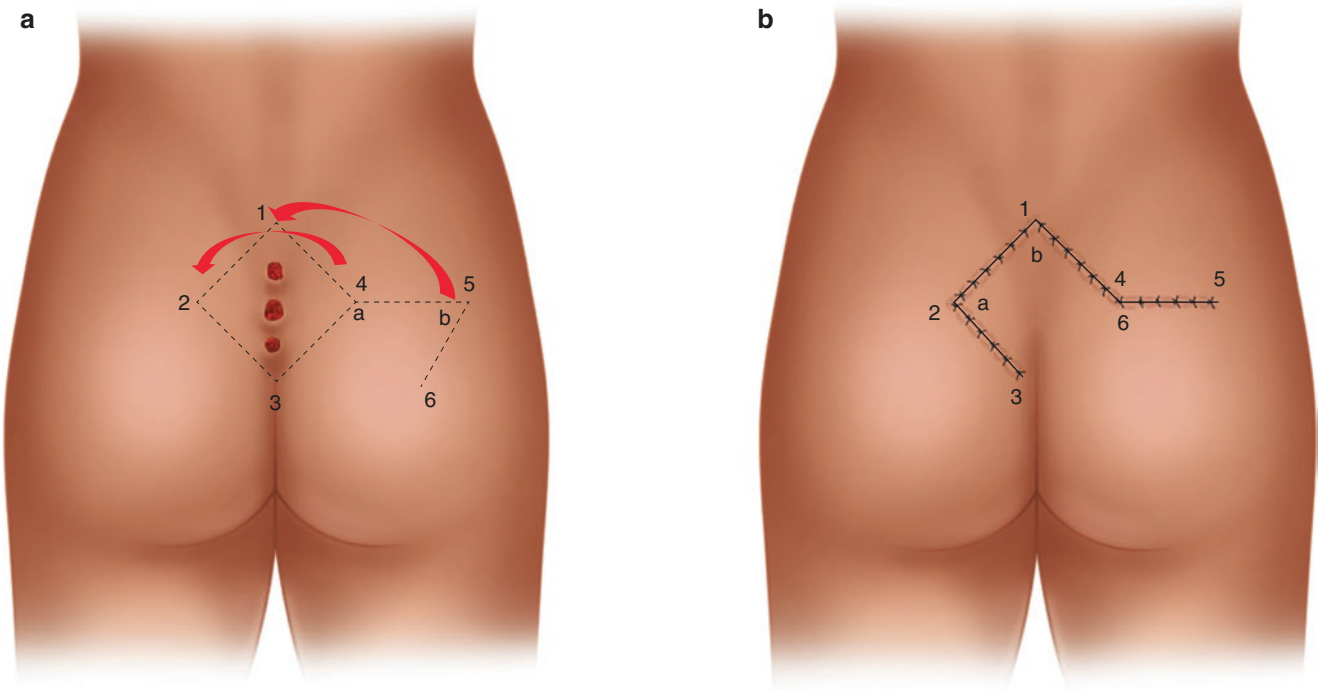

Fig. 16.5 Limberg flap (rhomboid flap). (**a**) The excision site is marked in a rhomboid shape, and the edges of the flap are drawn out. The rhomboid affected area is excised in a rhomboid shape down to the sacral fascia. (**b**) The flaps are raised as marked and then rotated as indicated by the arrows. The flap is secured in place with several layers of absorbable suture over a drain

Another study demonstrated an overall morbidity rate of 19.7% and recurrence rate of 1.6% [55]. One downside of the Limberg flap is the postoperative scarring, as it is not as cosmetically appealing as other flaps.

Cleft Lift Flap (Bascom Procedure)

The cleft lift flap, also known as the Bascom procedure, is designed to "lift" the concavity of the natal cleft and create an incision that is closed off midline (Fig. 16.6). This procedure is performed by first marking the "safety zone" of the gluteal cleft. The patient is placed in a prone position, and the safety zone is defined by the tissues that are able to touch when the gluteal cleft is pulled together – this is marked and represents the most lateral extent of the dissection. The tissue to be excised is also marked out. The area of excision comes across the central pits in the midline and extends in a scimitar shape at the inferior aspect of the excision site. This procedure, unlike the other flaps, does not require excising the entirety of the diseased tissue. After the excision area is marked, create an incision vertically across the midline through the central pits and ensure that the inferior aspect follows the scimitar-shaped marking. Creation of the flap occurs before excision of the diseased tissues. The flap is raised towards the opposite side from the tissue to be excised, which can be performed sharply or with electrocautery. The thickness of the flap should be similar to that of a mastectomy, and care should be taken to preserve subcutaneous tissues towards the anal side. Next, the excision of the skin overlying the area of disease is performed, with a majority of the subcutaneous tissue left in place. Any central scarring

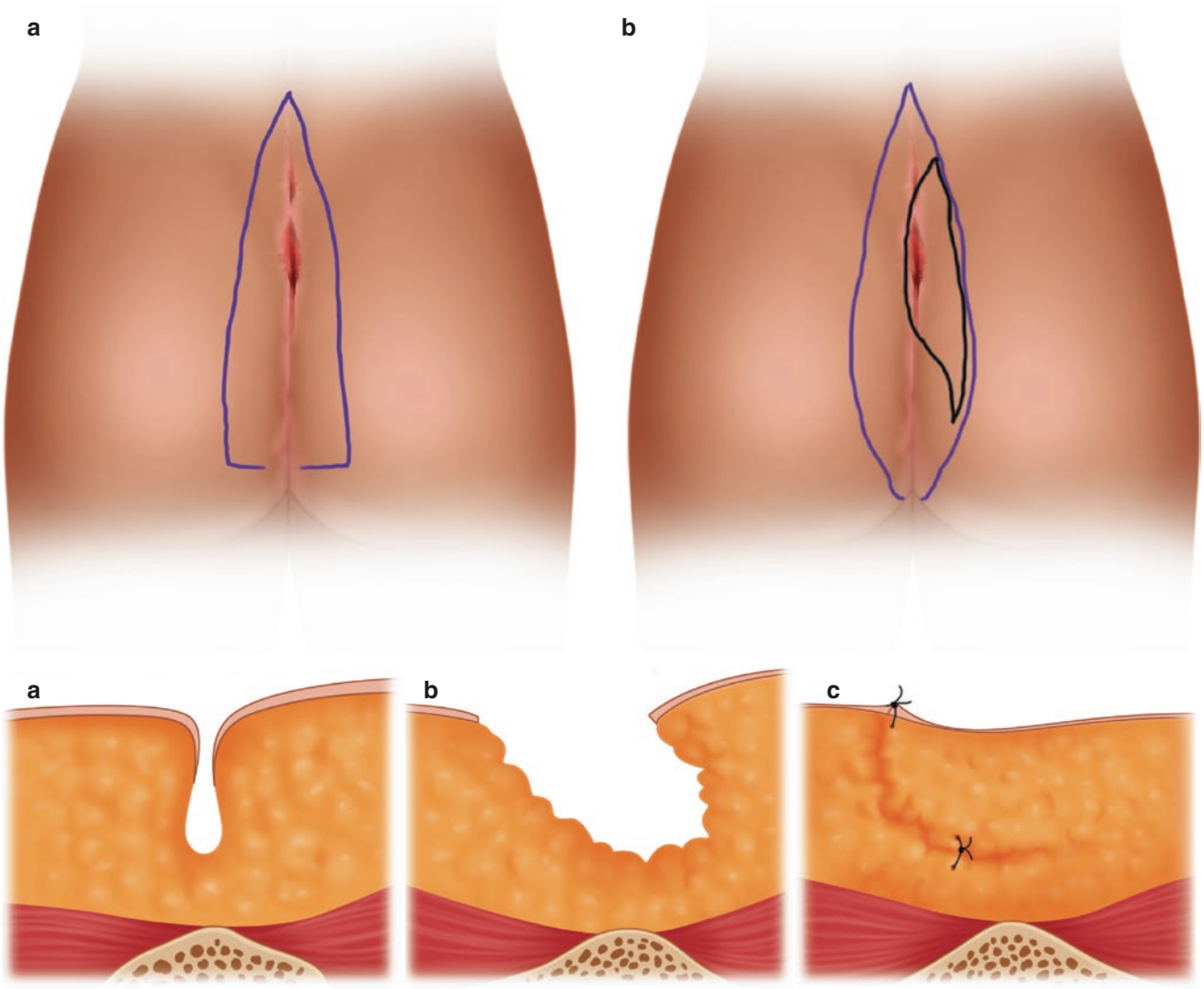

Fig. 16.6 Bascom flap (cleft lift). (**a**) First, a safety zone and a scimitar shaped incision are marked. (**b**) An incision is carried in the vertical midline and a flap is raised towards the opposite side from the tissue to be excised. After the buttock tapes are removed, the flap is checked to see the extent of reach contralaterally. Then the diseased tissue is excised, ensuring the flap will cover this tissue. (**c**) The flap is then secured in layers over a drain

can be lanced to free the contracture. The excision site is then closed with absorbable polyglycolic acid suture to close the deep space. A 7 mm closed suction drain is placed. The skin is then closed over a drain in a subcuticular running fashion using absorbable monofilament suture. This raises the natal cleft and keeps the incision off the midline.

Initially described by Bascom and Bascom, this procedure had initial success rates of 90% with a 100% success rates after the remainder of the patients underwent additional procedures [56]. A follow-up study by the same authors demonstrated healing rates of 96% [57]. Further studies have replicated these good results with healing rates as high as 97% [20, 58]. Patient satisfaction is high with cleft lift procedure, given a decrease in postoperative pain and low recurrence rate, though postoperative morbidity is as high as 20% [55].

Minimally Invasive Treatments

Minimally invasive treatments for pilonidal disease are desirable given the major morbidity that can occur with other operative options. These include endoscopic/video-assisted ablation, laser ablation, and trephination.

Endoscopic/Video-Assisted Ablation of Pilonidal Sinus (VAAPS)

In this procedure, a 4 mm hysteroscope is inserted into the opening of the pilonidal cavity after the opening is saucerized with electrocautery. The sinus and its lateral tracks are identified with the scope, under a continuous infusion of saline, and a mechanical adhesiolysis is performed. Any hair that is visualized is removed with grasping forceps. The cavity is ablated using a 5F bipolar electrode in one centimeter increments. The main sinus tract and any accessory tracts are identified. Finally, the residual cavity is debrided, and an iodine solution is injected into the cavity [59]. This procedure has demonstrated high healing rates and patient satisfaction scores. A prospective study with a median follow-up of 52 weeks demonstrated a success rate of 67% with a delayed healing rate of 77% [60]. Recurrence rates have been reported to be lower than standard excisional operations [61]. Modifications include the injection of phenol in the tract [62, 63]. When compared to the traditional Limberg flap, endoscopic treatment of pilonidal disease may have higher recurrence rates but is associated with fewer postoperative complications [64].

Laser Ablation of Pilonidal Sinus

The diode laser has been used in several other disease processes such as anal fistula and can be applied to pilonidal disease as well. This outpatient procedure depends upon ablation of the epithelium of the pilonidal sinus and promotion of new granulation tissue. The area is injected with local anesthetic, and the subcutaneous tract is located. The tract is debrided to remove hair and debris and then curetted to remove the tissues lining the tract. The tract is irrigated with saline, and a diode laser is introduced into the tract. Laser energy is delivered to the tract to create a homogenous ablation and destruction of the tissues in the tract. Every pit must be treated with the laser. Results of this operation have been promising [65]. Patients are able to return to daily activities and return to work immediately in as many as 92.8% of patients. Patients with less severe disease have better outcomes. Success rates are around 85–90%, and recurrence rates of as low as 2.9% have been reported [66, 67]. Complications include pain, hematoma, abscess, and drainage.

Trephination

Trephination is a procedure that involves the use of skin trephines to excise pilonidal pits and debride the underlying tracts and cavities (Fig. 16.7) [68]. Each pit is individually probed to evaluate the anatomy including the depth of the pit and presence of any associated tracts. Skin trephines sized 2.0–9.0 mm in diameter are used to core out the pits. When a subcutaneous tract is identified, excision is carried down to the cavity with 4.0–5.0 mm trephines. Any acutely infected areas are excised using 6.0–9.50 mm trephines and left open to heal by secondary intent. This technique has been reported to have a healing rate of 89.7% at 4 weeks with a recurrence rate of 16.2%. Postoperative complications occur in <5% of patients with wound infection rate <1% [69]. Postoperative wound care is minimal and includes light packing to allow the wounds to heal by secondary intent. Performing trephination does not exclude future excisional flap procedures in the case of recurrence.

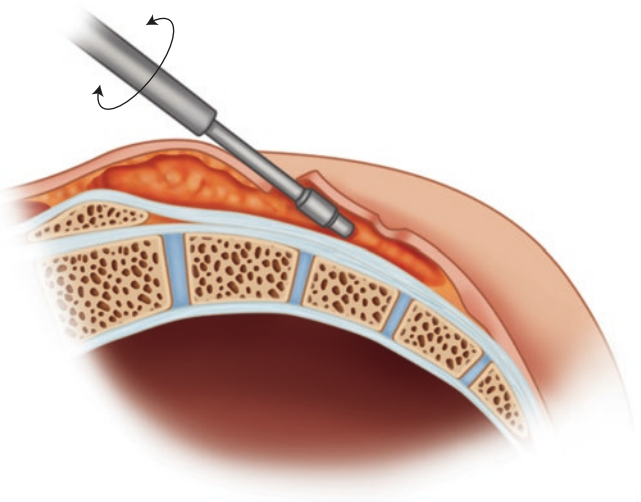

Fig. 16.7 Trephination. A skin biopsy punch is used to core out each symptomatic pit, which are left open to heal by secondary intent

Management of Recurrent Disease

Despite the variety of surgical options available to treat pilonidal disease, recurrent disease remains prevalent with rates as high as 34% after 1 year and 66% after 5 years [70]. There are no formal guidelines for the management of recurrent pilonidal disease with limited data to drive practice guidelines [36]. As described, no single procedure is without recurrence risk, so it is important to recognize the need to manage recurrent disease as well as primary disease. In the setting of an acute abscess, eliminating the immediate infection is necessary with incision and drainage. After resolution of the immediate infectious situation, the wound must be evaluated to assess the extent of the recurrence. Recurrence tends to be higher following treatment with antibiotics and need for incision and drainage, and up to 45% of patients with recurrence are obese [71]. When recurrence occurs, local excision, flap-based procedures, or minimally invasive procedures may be considered.

Wound Healing Adjuncts

Regardless of which type of surgical treatment is chosen, small or large wounds may form and require chronic management. This is most likely the result of the repeated friction that occurs in the natal cleft area with movement. After ruling out recurrent sepsis and prior to embarking on extensive surgical re-excision, local wound care efforts should be utilized to promote healing. Silver nitrate can be applied to any hypertrophic granulation tissue. Warm water soaks and soap cleansing can also encourage the wound to heal by secondary intention. In the case that this does not result in complete wound healing, several products are available that may encourage definitive wound healing. These include silver-impregnated gauze strips, hydrophilic wound dressing cream, and creams with methylene blue and gentian violet. Application of these twice a day, covered with a regular gauze dressing to protect the clothing, can result in successful healing without the need for further surgical intervention (Fig. 16.8).

Hidradenitis Suppurativa

Introduction

Hidradenitis suppurativa (HS) or acne inversa is a chronic, recurrent, inflammatory skin disease, initially presenting as

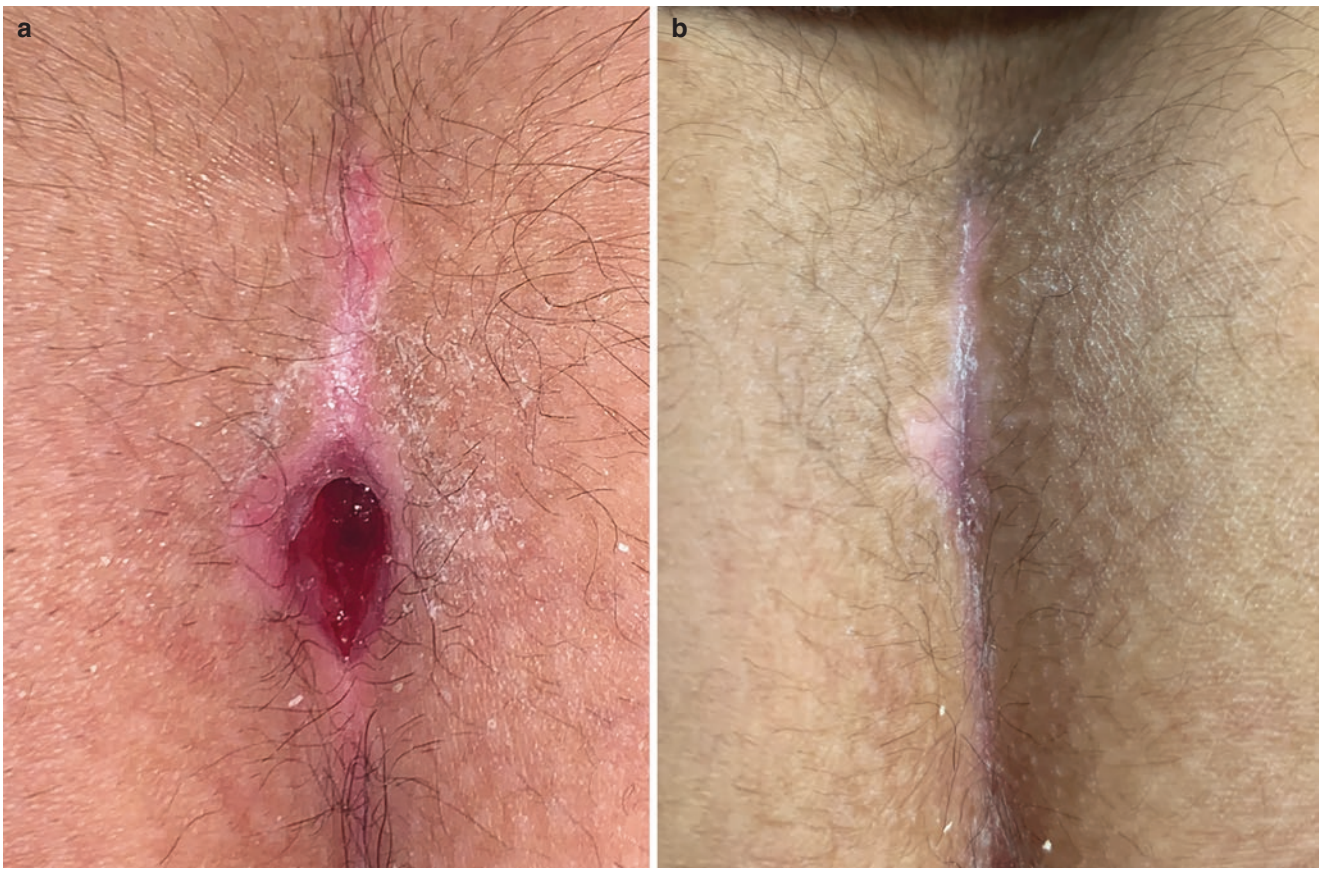

Fig. 16.8 (**a**) This is a nonhealing pilonidal wound after excision with primary closure. Several attempts at sitz baths, dressing changes, and silver nitrate had failed. (**b**) This is the same wound after 2 weeks of twice daily use of hydrophilic wound dressing cream

painful subcutaneous nodules as the characteristic suppurating lesion. These nodules can spontaneously rupture and coalesce which create deep dermal, exquisitely painful abscesses. The inflammatory abscesses can ultimately heal, producing fibrosis, dermal contractures, and induration of the skin as well as chronic sinuses. The severity of the disease is variable as is the clinical presentation with periods of quiescence and active flares. The disease occurs in the apocrine gland-bearing skin folds, typically the perineum, inguinal, inframammary, and axillary regions. The most commonly affected region is the axilla (70%) followed by the perineum and groin [72]. Patients may experience symptoms in more than one location. HS is associated with a marked reduction in quality of life and high incidence of comorbid mental illness [73]. Once believed to be the result of apocrine gland infection, it is now considered a disease of follicular occlusion. Factors implicated in the development of HS include (1) host defenses, (2) genetics, (3) endocrine abnormalities, (4) obesity, (5) smoking, and (6) environmental.

Incidence and Etiology

The exact incidence of HS is not known due to sparse epidemiologic data. In a recent cohort analysis, the overall prevalence in the US population was estimated at 0.1%, or 98 per 100,000 persons [74]. Woman were more than twice as likely to be affected compared to men with the prevalence highest among patients aged 30–39 years compared with all other age groups. HS prevalence among African American patients was more than threefold greater than white patients. Only 2% of cases occur before the age of 11 years [75]. In a retrospective study of 855 patients, 7.7% reported an onset of HS before the age of 13 years [76]. Early onset HS was associated with stronger genetic susceptibility and more widespread disease.

Modifiable risk factors have been identified as smoking and obesity. In a recent cohort analysis of smokers in the United States, the overall adjusted odds of developing HS was 1.9 (95% confidence interval 1.84–1.96) among tobacco smokers, compared with nonsmokers [77]. Tobacco smokers diagnosed with HS were most commonly aged 18–39 years, women, and white and had a body mass index (BMI) ≥30. Although the precise pathophysiologic role of smoking in HS remains uncertain, nicotine has been found to promote colonization of *Staphylococcus aureus* in intertriginous areas, chemotaxis of inflammatory mediators, and hyperplasia of the infundibular epidermis which can lead to the disease process [78]. In a recent meta-analysis of 25 studies (101,977 HS patients and 17,194,921 non-HS controls), a significant association between current smoking status and HS was identified (OR = 4.26 [95% confidence interval 3.68–4.94]) [79]. Both the prevalence and severity of HS are increased in obese patients with one study demonstrating an increased odds ratio of 1.12 for every one unit increase in body mass index [80, 81]. Obesity may aggravate HS via increased skin-skin and skin-clothing friction. Mechanical stress is associated with worsening of HS by increasing follicular occlusion and rupture [72].

Increasingly HS is viewed as an auto-inflammatory skin disorder associated with alterations in the innate immune system although large gaps remain in the understanding of the pathogenesis of HS [82]. There is increasing evidence supporting the role of Th17 cells and enhanced expression of IL-17 and IL-1β, which represent potential targets for therapy. Bacteria and biofilms are likely contributory but secondary drivers of inflammation [83]. This is aggravated by obesity, metabolic syndrome, and smoking [84, 85]. The primary defect in HS pathophysiology rests with the hair follicle. Follicular occlusion, followed by follicular rupture, with discharge of contents including keratin and bacteria into the surrounding dermis resulting in a foreign body-type immune response are necessary conditions for the development of clinical HS [86].

Clinical Presentation and Diagnosis

Diagnostic delay in hidradenitis suppurativa is a significant problem. In one study the average patient delay in seeing a physician (time from onset of symptoms to the first visit with any physician) was 2.3 ± 5.0 years, and the diagnostic delay was 7.2 ± 8.7 years [87]. Patients present with a range of signs and symptoms from a single open comedone (clogged hair follicle) to multiple painful, swollen nodules, generally with little purulent discharge. The inflammatory process may resolve without treatment but often waxes and wanes over many weeks to years. Chronic skin changes and discharge may develop that is both painful and socially limiting including sinus tract formation, contractures, and fibrosis (Fig. 16.1). In a study of 100 patients, 21% reported missing work, and 60% reported loss of work productivity during the preceding week as a result of HS. Seventy-two percent of these patients reported daily activity impairment with moderate to strong correlations between reduction in quality of life and presenteeism, overall work impairment, and activity impairment. Activity impairment was higher among patients with Hurley stage III [88].

The diagnosis of HS is made by lesion morphology (nodules, abscesses, tunnels, and scars), location (axillae, inframammary folds, groin, perigenital, or perineal), and lesion progression (two recurrences within 6 months or chronic or persistent lesions for ≥3 months). The differential diagnosis in the perineal or genital area is primarily between HS and other subcutaneous tunneling diseases, and if uncertain, a biopsy should be considered. The absence of midline pits

over the sacrum helps distinguish HS from pilonidal disease; the absence of involvement of the anal canal helps distinguish HS from Crohn's disease and benign anal fistula.

Given the wide-ranging severity of both disease burden and symptoms, there have been a number of classification systems proposed in an effort to quantify and categorize patients with HS [81, 89–92]. The majority of these scoring systems has not been validated or may be better suited for research purposes than clinical care of patients impacted by the disease. Disease severity can be classified according to the Hurley classification, which defines stage I as transient nonscarring inflammatory lesions; stage II as separate lesions consisting of recurrent abscesses with tunnel formation and scarring and single or multiple lesions separated by normal looking skin; and stage III as coalescent lesions with tunnel formation, scarring, and inflammation [93]. This system has been criticized as its intent was to classify the disease severity in a single anatomic region, and many patients with HS have disease that is multifocal, and a revised system has been proposed. This new classification subdivides Hurley stage I and II into three substages, mild (A), moderate (B), and severe (C) based on the overall extent of the disease and degree of inflammation. Hurley stage III is not subcategorized and is always severe. The refined Hurley classification strongly correlates with HS severity assessed by both patients and clinicians using quality of life scoring tools [20]. Other critics have pointed out that the Hurley score is a static score and not sufficiently responsive to change, particularly relating to the inflammatory component of HS [94]. The Sartorius score is another classification system that is commonly used whereby involved anatomical predetermined regions are counted, classified, and weighted according to type. Additional points are given for the longest distance between two lesions within each affected anatomical region and for any regions containing Hurley III. The points are added for an overall severity score [81]. Another approach for physician assessment is the Hidradenitis Suppurativa Clinical Response (HiSCR) score developed and validated for use as the primary endpoint in randomized control trials studying the use of adalimumab [92]. The primary component of HiSCR evaluation is the objective and uncomplicated counting of HS lesions. The HiSCR is a valid and meaningful endpoint for assessing HS treatment effectiveness in the inflammatory component of HS and is also significantly correlated with improvements in all physician-related measures (Hurley stage, modified Sartorius scores, and HS Physicians Global Assessment) and patient-reported outcomes (visual analogue pain scale, dermatology life quality index, and work productivity and activity impairment questionnaire).

Several comorbid conditions have well-known association with HS given the systemic nature of the disease. The link between hidradenitis suppurativa and systemic associations may be attributed to common genetic or environmental factors or shared inflammatory pathways.

Metabolic disorders including obesity and metabolic syndrome are the most common associated conditions observed in patients with hidradenitis suppurativa [95]. Autoimmune diseases, like inflammatory bowel diseases, autoinflammatory diseases, spondyloarthritis, some genetic keratin disorders, and also the risk of skin tumor, seem to occur more frequently in these patients [82]. There is a well-established link between acne and HS as well as pilonidal disease. In one study evaluating the disease severity of HS, the presence of severe acne was associated with an increased Sartorius score, as was male sex, increasing BMI, atypical locations of HS lesions, and absence of a family history of HS [96]. In a review of 826 patients with HS, overall 45% of the patients had Hurley I, 41% had Hurley II, and 13% had Hurley III. Severity was associated with male sex (OR 2.11; $p < .001$), disease duration (OR 1.03; $p < .001$), body mass index (OR 1.03; $p = .01$), smoking pack-years (OR 1.02; $p = .001$), and axillary (OR 2.24; $p < .001$), perianal (OR 1.92; $p < .001$), and mammary lesions (OR 1.48; $p = .03$). Women had earlier onset, more inguinal and mammary lesions, and more frequent family history for hidradenitis suppurativa. Men more commonly had gluteal, perianal, and atypical lesions and a history of severe acne. Patients with a family history had earlier onset, longer disease duration, a history of severe acne, and more extensive disease and were more often smokers [97].

Treatment

Treatment of HS is multidisciplinary as there are a host of medical and surgical therapies from incision and drainage to infusions with biologic agents. The practicing colorectal surgeon may be the first medical provider to identify these patients especially when their disease is located in the perineal region. Surgery of HS lesions is typically reserved for intractability and acute abscess formation but is one of the most successful treatments available. The persistent and recurring nature of the disease requires an individualized treatment plan. It is imperative to educate the patient about the chronic relapsing nature of the disease and to elicit the goals of therapy prior to making any decisions about treatment options.

Medical Therapy

Topical Therapy

Clindamycin lotion (1%) is the only antibiotic that has been studied as a topical agent. In a placebo-controlled, double-blind, randomized trial in 30 patients with HS, the overall effect of clindamycin treatment based on patients'

assessments, number of abscesses, inflammatory nodules, and pustules was significantly better than placebo at each monthly evaluation over the 3-month study period [98]. It is primarily used in patients with Hurley stage I or mild stage II. The proposed dosing regimen is twice daily, for 3 months. If clinical response is not achieved after that treatment period, other treatment options must be considered.

Other topical agents include resorcinol, a phenol derivate with keratolytic and anti-inflammatory properties. It was evaluated in 32 HS patients, and by days 7 and 30, there was a significant reduction in the clinical size of the lesions and the mean pain score [99].

Systemic Antibiotics

Antibiotics are commonly used to treat HS flares because of secondary bacterial infections, and some, such as tetracycline and rifampicin, also may have immunomodulatory properties. For example, tetracycline suppresses neutrophil migration and chemotaxis and inhibits matrix metalloproteinase [100].

Tetracycline 500 mg b.i.d. has been evaluated and compared with topical clindamycin in a double-blind, randomized, controlled trial of 46 patients with Hurley stage I and II disease [101]. No significant difference was identified between the two treatment arms. Tetracycline can be used as a first-line treatment in patients with more widespread Hurley I and mild Hurley II stage, when topical therapy would not be practical, for up to 4 months. Clindamycin 300 mg b.i.d. in combination with rifampicin 600 mg once daily or 300 mg b.i.d. has been evaluated in several case series [102]. In a study of 116 patients with severe HS, combination therapy decreased the Sartorius scores, while quality of life scores improved significantly. In another prospective study, 26 patients were given combination therapy for 12 weeks with 1-year follow-up with a reported initial clinical response in 19 of 26 patients (73%) immediately following the treatment and then decreasing to 7 of 17 patients (41%) at 1 year. The remaining relapsed a mean of 4.2 months following treatment cessation [103]. This treatment combination can be used as a first-line treatment option in patients with moderate and severe HS for up to 10 weeks.

Biologics

Adalimumab, given subcutaneously at a dose of 40 mg weekly, has been studied in a prospective, randomized, double-blind, placebo controlled trial [104]. One hundred and fifty four patients with moderate to severe HS who had failed antibiotic therapy were treated. There was a significant reduction in the HiSCR, as well as pain scores, while quality of life and work productivity increased. These results have been reproduced in three additional randomized trials [105, 106]. Adalimumab is recommended as a first-line treatment option in patients with moderate to severe HS who were unresponsive or intolerant to oral antibiotics. Infliximab (IFX) 5 mg/kg has been evaluated in a randomized, placebo-controlled, crossover trial. No significant difference was noted in the HiSCR score although more patients receiving IFX achieved a 50% reduction in HS lesions compared to placebo. There was a significant improvement in patients' quality of life scores and VAS pain scores. Infliximab is recommended in patients with moderate to severe HS as a second-line treatment option, only after failure of adalimumab. If clinical response is not achieved after 12 weeks of treatment, other treatment modalities must be considered. Both anakinra (recombinant IL-1 receptor antagonist) and ustekinumab (human IgG1κ monoclonal antibody) have been recently studied in the treatment of moderate to severe HS and have shown to be efficacious as an alternate therapy [107, 108].

There is some evidence to support the use of biologics as an adjunct to surgery as a means to decrease recurrence when compared with surgery alone [109]. In one study, 68 patients with moderate to severe HS were treated with biologics. The mean disease duration was 10 years, and Hurley stage III was seen in 63% of patients. Patients who received biologics had a larger drop in their Sartorius scores and active nodule count than those who never received biologics. The effect of biologics was greater in patients who also underwent surgery. Timing of biologics relative to surgery did not impact efficacy. Patients who received HS surgery with biologic therapy were most likely to achieve a 75% reduction in active nodule count [110]. In another study, 11 patients underwent combined surgical and biologic therapy, whereas radical resection alone was performed in 10 patients. Biologic agents including infliximab ($n = 8$) and ustekinumab ($n = 3$) were initiated 2–3 weeks after closure and were continued for an average of 10.5 months. Recurrence was noted in 19% and 38% of previously treated sites for combined and surgery-only patients, respectively ($p < 0.01$). For the combined cohort, the disease-free interval was approximately 1 year longer on average ($p < 0.001$). New disease developed in 18% and 50% of combined and surgery-only patients, respectively ($p < 001$). No adverse events were noted among patients who received biologic therapy [111].

Other Medical Therapies

Androgens influence HS, as evidenced by the effects of pregnancy and menstrual cycles for many patients, but the recommendations on hormonal therapies are based on limited evidence. The only RCT of hormonal therapy compared ethinyl estradiol/noregestrol with ethinyl estradiol and cyproterone acetate; it was a double-blind, controlled, crossover trial of 24 women. Both therapies resulted in similar improvement, with 12 patients improving or clearing completely [112].

Metformin is a biguanide involved in several processes: it reduces gluconeogenesis of the liver, and it improves the insulin-mediated glucose uptake by skeletal muscles. It also reduces the androgens produced by ovaries and has been shown to have anti-inflammatory properties [113, 114]. Patients with mild to moderate HS have seen improvement in both the clinical course of their disease and quality of life scores when taking metformin over a 24-week period. Most of the patients in the trial were females with features of polycystic ovarian syndrome.

Historically, retinoids were frequently used for HS, because the pathogenesis was considered more similar to that of acne vulgaris. However, results have been disappointing consistent with the current understanding of HS as a follicular disorder. In all, 4 retrospective and 3 prospective uncontrolled cohort studies have been reported for isotretinoin monotherapy, for a total of 207 patients. Therapy ranged from 4 to 10 months, and outcome measures varied markedly, but a total of 85 of 207 (41%) improved, with better responses in milder disease. Isotretinoin should be considered most strongly in patients with concomitant nodulocystic acne [115].

Laser Therapies

Laser and light-based therapies have been used in the management of HS and work to reduce the occurrence of HS flare-ups by decreasing the number of hair follicles, sebaceous glands, and bacteria in affected areas. The best results are seen when treatment is individualized, taking disease severity into consideration when selecting specific energy-based approaches [116]. In a study by Tierney et al., Nd:YAG laser was shown to be an effective treatment for patients with stage II or III HS. The authors completed a prospective randomized controlled study of 22 patients in which 3 monthly laser sessions were performed on half of the body and results were compared with the other control half. Using a modified Sartorius scoring system, percentage decreases in HS severity after 3 months of treatment were 65% for all anatomic sites, 73% for inguinal sites, 62% for axillary sites, and 53% for inframammary sites. This reflected a statistically significant change in HS severity from baseline to month 3 in the treated areas but not at the control sites [117]. Carbon dioxide laser excision may help patients with more extensive involvement and has high patient satisfaction; however, it has been studied only in patients with Hurley stage II disease and has higher recurrence rates compared with wide excision [118]. In a study evaluating the carbon dioxide laser in 24 patients with a mean follow-up of 27 months, 22 patients reported resolution with no recurrence of their HS. Postsurgical results were reported to be cosmetically satisfactory [119]. Vaporization was usually able to reach the deep subcutaneous fat or fascia, and healing occurred over a median of 4 weeks.

Surgery

Patients who fail medical therapy and who are experiencing debility and pain from their HS lesions may opt for surgery which can lead to some excellent outcomes. While the evidence for surgical therapies in HS is limited and mostly based on cohort studies and case series with differing definitions and outcome measures, the main goal is always to excise the pilosebaceous or hair-bearing region of the involved area (axilla, inframammary fold, groins, and perineum). The extent of the excision will depend on the extent of the disease and the goals of the patient, with a range of options from simple incision and drainage to wide local excision and skin grafting. Excision should involve the entire skin down to the subcutaneous fat and even fascia as appropriate to ensure elimination of the pilosebaceous unit. For tense and painful abscesses, no medical therapy should be offered, and surgical drainage is required with the understanding that this is a temporizing measure and recurrence of disease is inevitable [120].

In an effort to avoid the morbidity of a large wound, studies have explored the efficacy of a deroofing technique in which the roof of a lesion is surgically removed and the floor of the lesion is left exposed. Forty-four patients with recurrent Hurley stage I or II HS lesions underwent 73 deroofing techniques with 83% showing no recurrence during a median follow-up period of 34 months. The other 17% of patients showed recurrence after a median follow-up period of 4.6 months. Ninety percent of patients responded that they would recommend the procedure to other individuals with HS [121]. A variation using an electrosurgical loop to excise the overlying skin has been developed and coined the STEEP procedure (skin tissue sparing excision with electrosurgical peeling), with a 4% recurrence rate [122]. The goal is to reduce the collateral injury to surrounding normal tissue and maintaining as much of the subcutaneous fat as possible. This is achieved by performing successive tangential excisions of the affected tissue until the epithelialized bottom of the sinus tracts has been reached. From here, healing occurs by secondary intention. Fibrotic tissue can also be completely removed as this can serve as a source of recurrence. This tissue-sparing technique results in low recurrence rates, high patient satisfaction with relatively short healing times, and favorable cosmetic outcomes without contractures [123]. No controlled, prospective studies exist, but deroofing appears to be effective for acute and chronic lesions, with utility in a variety of outpatient settings [124, 125].

For patients with more extensive disease, wide local excision has been the mainstay of traditional surgery and can result in a disease-free state where the excision is performed. Once the area has been excised, the resulting wound may be approached in different ways. If the wound is small, it can be closed primarily without tension. For larger wounds, the defect may be left open to close by secondary intention.

Perineal and perianal wounds so treated rarely require a colostomy. Large wounds may also be treated by immediate or delayed split-thickness skin graft.

Because surgery alone does not alter disease biology, understanding the trade-offs between extent of excision, surgical morbidity, and reducing the risk of future lesions is an important consideration. In a series of 590 patients treated with excision, deroofing, or drainage, drainage was associated with the highest recurrence, whereas deroofing and wide excision were about equal in effectiveness. Most patients in this series were white (91%), men (57%), and smokers (58%) with Hurley stage III disease (81%). Postoperative complications occurred in 15 patients (2.5%), and 24% suffered postoperative recurrence, which necessitated reoperation in 12% of those patients. Recurrence risk was increased by younger age (hazard ratio [HR], 0.8), multiple surgical sites (HR, 1.6), and drainage-type procedures (HR, 3.5). Operative location, disease severity, gender, and operative extent did not influence the recurrence rate [120]. In a retrospective review of 79 patients who had 220 operative sites evaluated over a 4-year period, a 25% recurrence rate was identified. The median disease-free interval between surgery and recurrence was 8 months. Almost two thirds of recurrences necessitated repeated excisional surgery ($n = 35$, 63%). Patients who achieved remission had a significantly lower number of affected regions than those who experienced a recurrence (2.3 vs 3.6, $p = .0023$). Additionally, recurrence rate differed significantly between body locations ($p = .0440$). Operative sites in the axilla had the lowest rate of recurrence, while operative sites at the groin held the highest recurrence rate. There was no significant difference between the rates of wound complication for each location. Smoking, BMI, Hurley grade, closure method, and excision size did not influence local cure rate. There was no difference in the recurrence or complication rates between operative sites closed with direct sutures, skin grafts, or rotation advancement flaps [126]. In a meta-analysis of 22 articles on surgical treatment of HS, the estimated average recurrences were wide excision, 13.0%; local incision, 22.0%; and deroofing, 27.0%. In the wide excision group, recurrence rates were as follows: 15% for primary closure, 8% for flaps, and 6.0% for grafting. The secondary intention healing option was most commonly chosen after local excision and deroofing [127].

Overall, patients report good outcomes following surgery with one study evaluating patient-reported outcomes included movement, pain, satisfaction with treatment, willingness to undergo surgery again, and appearance. Patients graded each outcome on a 4-point scale. The median score regarding function, aesthetics, and satisfaction after all interventions was 17 out of 20, but the score was lower after fasciocutaneous flaps than primary closure, healing by secondary intent, and split-thickness skin grafting [128]. In a survey of 111 patients with Hurley stage III disease following excision or unroofing, patients were satisfied or very satisfied with their surgical results (85%), were glad they underwent surgery (96%), and would recommend surgery to a friend or relative (83%). Most patients were satisfied or very satisfied with the appearance of their healed wound (62%). Retrospective mean quality of life increased significantly from 5 preoperatively to 8.4 postoperatively ($p < .001$) [125]. Negative pressure wound therapy has been shown to shorten the duration between excision and delayed closure or grafting. It has been suggested that this system improves wound healing by increasing blood flow and granulation tissue formation, reducing bacterial load, and thereby reducing the size and complexity of the wound. Comparisons of various approaches using negative-pressure wound therapy alone versus silver dressings or dermal regeneration templates (Integra, Integra LifeSciences, Plainsboro, NJ) are limited [129–131].

Conclusions

HS is a chronic disease that can result in significant debility and suffering. Most patients present in their prime working years and report a loss of productivity secondary to the waxing and waning nature of the disease. Treatment should be multidisciplinary with a focus on managing the patient's goals and expectations. For smaller areas of mild disease, topical or oral antibiotic therapy can be effective. For more widespread or severe disease, biologic agents have shown to be efficacious with newer treatment options emerging with evolving understanding of the inflammatory targets. Surgery remains an important treatment option and includes controlling infection with incision and drainage to wide local excision of the affected area to remove the hair-bearing skin followed by split-thickness skin grafting or healing by secondary intention.

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