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Hidradenitis suppurativa is a cutaneous disorder involving apocrine gland bearing skin regions. Rich in apocrine glands, the perianal region is frequently involved, as well the gluteal, inguinal, and axillary regions. Women are more frequently affected than men (3:1), and obesity and cigarette smoking are known risk factors [1]. The course of the disease is variable, but frequently progresses to a chronic condition with subcutaneous abscesses, draining sinuses and extensive skin fibrosis. Even though medical therapy, as well as simple incision and drainage, may be adequate for the management of early, limited disease and acute infection, their role in the management of chronic, extensive disease is limited [2]. Recurrence rate of 100% after simple incision and drainage is common [3].

The treatment of chronic, severe hidradenitis suppurativa is primarily surgical. For patients with extensive disease, a staged procedure may be required. On average, patients suffer 10 years of active disease before undergoing radical excision [4]. The resulting wounds can take many weeks, even months, to heal completely and can be associated with significant morbidity and disability. Quality of life is adversely affected, by the disease and its treatment, and depression and anxiety are more frequent in patients with hidradenitis suppurativa [5]. There is extensive debate in the literature regarding the extent of excision of perianal hidradenitis suppurativa and options for closure of these often massive wounds. Frequent coexistence of inflammatory bowel disease and hidradenitis suppurativa can make diagnosis and treatment challenging. Practitioners need to be aware of the risk of malignancy associated with long-standing hidradenitis suppurativa, especially in the perianal and perineal regions, and appropriate treatment of this devastating complication.

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Delayed Healing and Its Management

Surgical treatment of perianal hidradenitis suppurativa can result in wounds that may be difficult to manage. Healing by secondary intention is the most widely used method after wide local excision down to healthy tissue. These wounds require aggressive local wound care to achieve complete healing. Sitz baths or showers three to four times daily with frequent dressing changes are usually required to keep the area clean. Using this regimen, Thornton and Abcarian were able to achieve complete healing by secondary intention in 104 patients after wide local excision of perianal and perineal hidradenitis in a mean time of 3.5–7 weeks (3.5 weeks for small wounds, 7 weeks for wounds over 5 cm) [4]. Bocchini et al. presented similar results with a mean time to complete healing of 10 weeks after wide local excision and healing by secondary intention [6] while Balik et al. reported a mean time to healing of 12 weeks [7]. The time to complete healing correlates with the extent of excision. An early, aggressive surgical excision could therefore potentially shorten recovery time in these patients by reducing the surface of skin excision.

Management of extensive open wounds in the perineal or perianal area is often difficult. Multiple techniques have been described to reduce the time to complete healing of these large defects. Negative-pressure dressings have been used to help accelerate healing in chronic wounds by increasing oxygen tension and granulation tissue formation, decreasing bacterial counts, and preventing shearing forces on the wound [8]. They have also been used to bolster split-thickness skin grafts [9–11]. However, the application of such dressings in the perianal region is difficult because these devices require an air-tight seal at all times. Vacuum dressing application is mainly limited to buttock, natal cleft, or inguinal wounds with an adequate margin of normal skin from the anal verge.

Split-thickness skin grafting is commonly used for coverage of large skin defects [12]. Its use in perianal and perineal hidradenitis suppurativa is well described [2, 7, 13–17]. The use of skin grafts has been associated with a lower mean time to complete healing after wide local excision than healing by secondary intention (12.2 weeks for secondary intention versus 8 weeks for delayed skin grafting) [7]. Skin grafts are typically harvested on the thigh and morbidity from the donor site (aside from pain) is usually low. In many instances, a delayed skin graft will be performed two to three weeks after the excisional surgery. The results of split-thickness skin grafts are generally good. Partial graft loss is fairly frequent but can generally be managed with local wound care and healing by secondary intention. Bocchini et al. reported a 37.5% partial loss of skin graft in their series with 8% of patients requiring a new grafting procedure [6] while Harrison et al. reported a 45% incidence of partial skin graft loss without need for further grafting [18]. The main disadvantage of skin grafts is the need for immobilization, prolonged hospital stay, potential graft failure, and the necessity of a donor site.

Maeda et al. have described a reused skin graft technique with immediate grafting on the wound where the graft is harvested from the surface of the lesions before radical excision to eliminate the need for a donor site. They did not find any

clinical recurrence in the skin graft, even if histological evaluation revealed that buried epidermal cysts could cause recurrence [19]. More research is needed to validate this novel technique.

Another approach for reconstruction after wide local excision is the use of local flaps. Their utility is greatest for areas with the highest risk of contracture, especially in the groin crease [20]. Closure with local cutaneous flaps cannot be performed if the resection is too extensive and not enough skin is available for coverage. Good results have been reported with local rotation flaps or V-Y advancement flaps with shorter times to complete wound closure [6, 21, 22]. Local flap closure has also been advocated for non-healing chronic perianal wounds [23]. Minor wound dehiscence is frequent but generally can be managed with local wound care only [24]. Major dehiscence and infection is rare but can result in larger wounds even more difficult to manage than the original wide excision defect.

The use of diverting colostomy does not seem to be indicated in the vast majority of patients because the anoderm can usually be preserved, even with extensive resection. Diversion of the fecal stream may be indicated for debilitated patients or in some instances after a split-thickness skin graft for extensive perianal disease. Indwelling soft rectal tubes can be used to divert the fecal stream during the initial phase of healing [25].

Fistulas

The coexistence of perianal hidradenitis suppurativa and perianal fistulas is not uncommon, ranging from 2 to 14% according to different series [6, 15]. For this reason, an anoscopic examination should always be performed during surgical treatment of perianal hidradenitis, and some advocate colonoscopy in those with a diagnosis of perianal hidradenitis suppurativa to rule out coexisting Crohn's disease. Missed fistulas can lead to recurrent abscess and persistent chronic drainage. Hidradenitis itself can cause superficial fistula to the distal anal canal [26], while more proximal fistulas should raise the possibility of concomitant cryptoglandular disease or the diagnosis of Crohn's disease as there are no apocrine glands in the proximal anal canal [27]. Drainage of associated abscess and seton placement is the treatment of choice for associated perianal fistula to allow healing of the wound before considering definitive surgery for the fistula.

Perianal fistula associated with hidradenitis suppurativa should prompt evaluation for possible Crohn's disease. Crohn's disease is associated with hidradenitis suppurativa in 2–38% of patients and the perianal area is the most frequently involved site [15, 28–30]. In these patients, Crohn's disease is usually affecting the colon and rectum and severe rectal disease leads to a rate of proctectomy as high as 70%. Skin graft after wide local excision of perianal disease has been reported in a patient with well-controlled Crohn's disease with medical therapy [29].

Anal Stricture

Extensive excision of anoderm and perianal skin can lead to anal stricture. This is often avoidable in the treatment of perianal hidradenitis as the anoderm is usually spared but can complicate circumferential excision of severe perianal disease [6]. It has also been described following skin grafting of the perianal area. If resection near the anal verge is necessary, a staged excision may limit the risk of developing an anal stricture. Mild stricture usually responds to simple dilation but severe stricture may require anoplasty and local skin advancement flaps or circumferential full thickness skin grafting [31–33].

Recurrence of Perianal Hidradenitis Suppurativa After Surgical Treatment

Surgical treatment remains the mainstay of definitive therapy for patients with severe hidradenitis suppurativa. Surgical therapies for perianal hidradenitis include simple incision and drainage of acute abscesses, deroofting, and wide radical excision. Lack of prospective randomized controlled trials and heterogeneity of the existing retrospective data make comparison of results among different surgical treatments difficult. A 2015 meta-analysis by Mehdizadeh et al. looking specifically at recurrence of hidradenitis suppurativa after surgical management concluded that recurrence rates are lowest with wide radical excision (estimated average recurrence 13.0%), and moderate for deroofting procedures (27.0%) and limited excision (22.0%) [13]. Deroofting is a compromise between simple incision and drainage and radical excision. It consists of probe directed excision of all overlying skin with exposure of the floors of sinuses and fistulae, with curettage of granulation tissue of the fistulae, leaving islands of skin amidst the deroofted lesions so that the resulting wound is less extensive and healing more rapid [34–36]. It can be carried out with a knife, cautery, or laser.

Differences in recurrence rates among wound closure methods are to some degree a reflection of the underlying extent of tissue excision. The high rate of recurrence reported in some series with primary closure may reflect compromise of the extent of excision in order to make primary wound closure possible. The aforementioned meta-analysis by Mehdizadeh excluded patients who had wide excision and were allowed to heal by secondary intention without a flap or graft. The definition of radical excision is also somewhat variable, with some articles reporting the excision must reach underlying fascia, and some describing a deep excision of subcutaneous tissue down to normal appearing fat, with the lateral extent of excision to include all subcutaneous tracts [13]. One method of determining extent of excision was reported by Morgan and Hughes, which consists of administering intravenous atropine to block eccrine secretion. Oxytocin is then given to stimulate sweat secretion. The skin is painted with iodine, then starch powder in castor oil is applied. This process highlights the apocrine sweat gland

distribution as black dots where sweat contacts the iodine-starch concoction, guiding wide excision of all apocrine sweat glands [37]. Another described adjunct to defining extent of excision is the injection of methylviolet (Gentian violet), or methylene blue, 3–5 ml, into the sinus tracts to color the sinus tracts and fistulae and guide excision [38]. Although these methods have been described, the frequency of their use, especially the atropine/iodine starch method, is unknown. More commonly, excision is guided by tactile and visual clues to extent of diseased tissue, i.e., induration caused by inflammation, along with granulation tissue encountered if one should divide a sinus/fistula tract during excision, as well as the use of metal probes to probe fistula tracts and sinuses. While the usual means of spread of the inflammatory process of hidradenitis suppurativa is in a lateral fashion, mandating adequate width of excision of affected tissue, the process can also extend quite deeply into the subcutaneous tissue. Involvement of underlying bone leading to osteomyelitis, and fistulization to the anus or rectum has been described, but should also lead one to rule out other diagnoses, and to consider malignant degeneration.

Method of closure is less important a factor in recurrence when compared to the extent of excision, but may influence recurrence rates to some degree. Mehdizadeh's meta-analysis found that in the patients who had wide excision, recurrence was 15% for primary closure, 8% for flap closure, and 6% for grafting. Patients who were allowed to heal solely by secondary intention were excluded from this meta-analysis [13].

Unlike the axilla and groin, where contracture of the area may occur with healing by secondary intention, contracture is rare after wide excision of perianal hidradenitis [4].

Coexistence of Crohn's disease with hidradenitis suppurativa has been reported in the literature to be as high as 38% [28]. Yadav et al. reported that patients with inflammatory bowel disease were found to be 9 times more likely than the general population to develop hidradenitis suppurativa [30]. Certainly distinguishing between the two entities can be difficult, sometimes necessitating examination under anesthesia to elucidate the correct diagnosis. On examination of the anal canal, sparing of the anal canal from the dentate line and proximally points to a diagnosis of hidradenitis suppurativa, whereas involvement of the anal canal at the dentate line may indicate Crohn's disease or cryptoglandular fistula in ano [26]. This rule of thumb arises from the histologic absence lack of apocrine sweat glands proximal to the distal two-thirds of the anal canal [27]. However, Crohn's disease and hidradenitis suppurativa frequently coexist. Convincing evidence of this is the fact that the hidradenitis suppurativa in patients with both Crohn's disease and hidradenitis suppurativa often involves typical apocrine gland bearing areas far removed from the perianal region, such as the axillae. Recurrence or persistence of perianal lesions in those patients may warrant careful examination to rule out fistula in ano associated with Crohn's disease. Even if the diagnosis seems clear, before undertaking a wide local excision of perianal hidradenitis suppurativa, performing preoperative colonoscopy to rule out concomitant inflammatory bowel disease is

prudent, as unwittingly creating a large perianal wound in a patient with Crohn's proctitis can be disastrous.

Complex fistula in ano may also be confused with perianal hidradenitis suppurativa, especially if neglected, with development of multiple branches, and in horseshoe fistulas, with bilateral involvement of the ischiorectal spaces. Again, examination of the anal canal with identification of the primary fistula opening and its relationship to the dentate line, may clarify the diagnosis.

Squamous Cell Carcinoma Arising in Hidradenitis Suppurativa

At this point, squamous cell carcinoma arising in the setting of long-standing hidradenitis suppurativa is a well-known entity, in many ways analogous to Marjolin's ulcer arising in chronic burn wounds. Jackman found an incidence of squamous cell carcinoma arising in hidradenitis suppurativa of 3.2% [39] and one large series of 217 hidradenitis suppurativa patients reported an incidence of 4.6% [40]. Location of disease in the perineum appears to be a separate risk factor for development, as squamous cell carcinoma arising in axillary hidradenitis suppurativa has not been described in the literature [41]. All of the described cases occurred in the perianal, perineal, gluteal, thigh, groin, or vulvar regions. Although hidradenitis suppurativa is more common in women, extra-axillary hidradenitis suppurativa is more common in men, as is malignant degeneration to squamous cell carcinoma, with a 4:1 ratio. Typically, the duration of symptomatic hidradenitis is lengthy, with a mean duration of 25 years (range 3–50 years) [41]. It has been suggested that human papilloma virus infection may have a role in causation [42, 43], which would help to explain the lack of cases of squamous cell carcinoma in axillary or inframammary hidradenitis suppurativa. Prognosis is variable, but the diagnosis is often delayed, with a poor outcome. Two year mortality in Maclean's series from 2007 was 48% [41], and in Pena's review of 21 patients reported in the literature, the mortality rate was at least 43%, although time from diagnosis was lacking in many of those patients [44]. Of those whose time from diagnosis was noted, one died just 2 days after diagnosis, another, one month after diagnosis. Presence of regional lymph nodes virtually assures that cure is not achievable [41]. Wide radical excision is the treatment of choice in those patients without lymph node or distant metastases. Palliative radiation and chemotherapy as appropriate for anal squamous cell carcinoma should be considered for those patients whose disease is metastatic. Radical "palliative" surgery should be discouraged, especially if there is little hope of R0 resection. MacLean and Coleman present the case of a 50 year old man who 32 years after gluteal suppurative hidradenitis, was diagnosed with a squamous cell carcinoma within the hidradenitis. He was given chemotherapy and radiation, without surgery, with some relief of symptoms. The patient developed a second area of squamous cell cancer on the contralateral buttock 8 months later, and ultimately underwent radical excision of his disease from

both buttocks and perineum, abdominoperineal resection with pedicled rectus abdominis musculocutaneous flap and split-thickness skin grafts to close the resulting tissue defect, bilateral groin dissections, and right hip disarticulation. After hip disarticulation he developed a local recurrence on the buttock after 4 months and thereafter rapidly died, 26 months after his initial cancer diagnosis [41]. This case demonstrates the aggressiveness of this entity and serves as a warning to temper enthusiasm for attempts at surgical eradication in the face of relentless local disease. Altunay et al's series describes a 54 year old man with bilateral nodal metastases, 7 cm × 4 cm on one side, with contralateral lymphadenopathy. "The amputation of the lower half of the trunk from the upper level of the pelvis and the sacral region was planned, but the patient refused. He died 3 months later" [45]. Figures 7.1, 7.2 and 7.3 are from a 54 year old woman who suffered from



Fig. 7.1 Preoperative severe perianal, gluteal, and thigh hidradenitis suppurativa, of 27-year duration. She was found to have multifocal squamous cell carcinoma

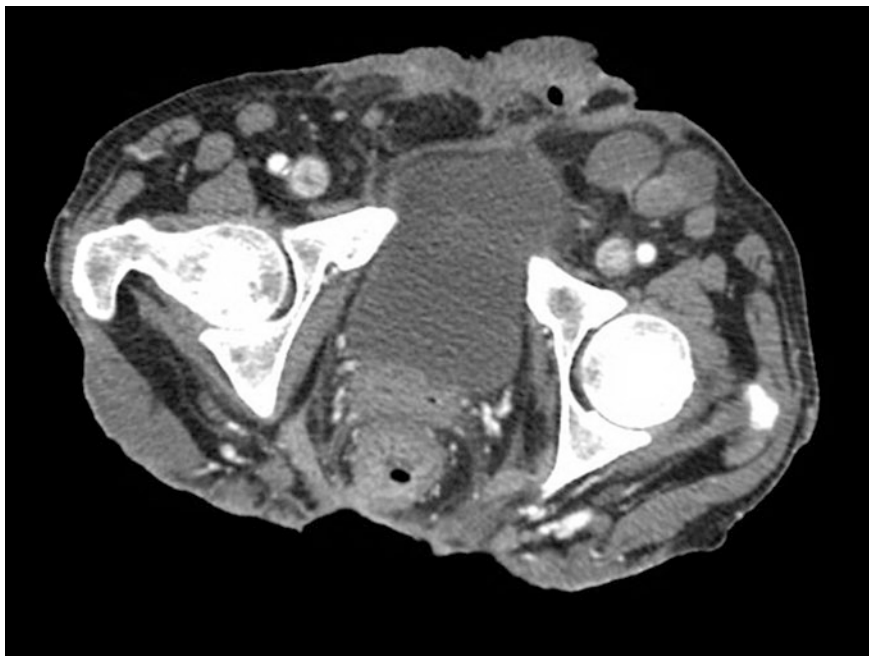


Fig. 7.2 Preoperative CT scan of the pelvis in a 54-year old woman with multifocal squamous cell carcinoma of the perineum arising in a background of hidradenitis suppurativa. Note the left groin lymphadenopathy

hidradenitis suppurativa of the axillae, pubis, groins, perineum, and thighs for over 25 years before presenting with unrelenting gluteal and perineal pain, associated with leg pain and swelling. Malignancy was not recognized preoperatively and she underwent wide resection of her hidradenitis. Multifocal squamous cell carcinoma was identified in the surgical specimen. Her last known follow up was less than 6 months postoperatively, when chemotherapy was suspended due to lack of efficacy and progression of disease, and she was referred to palliative care. At the time, she was bedridden secondary to debilitating pain and non-healing surgical wounds.

Certainly, squamous cell carcinoma arising in a background of hidradenitis suppurativa is a much more aggressive entity than squamous cell carcinoma in “normal” skin. Early diagnosis, aided by a high index of suspicion, and prompt surgical excision with adequate margins when an R0 resection can be achieved provides the only hope of cure. Multiple rounds of biopsies may be required to establish a diagnosis of squamous cell carcinoma in this setting. This malignancy has a propensity to spread along the subcutaneous tracts of the hidradenitis suppurativa so that the underlying malignancy in these tracts may be missed if biopsies are not adequately deep. Biopsies that are too superficial may reveal only atypical pseudoepitheliomatous hyperplasia. Repeat biopsy with deeper sampling is in order if clinical suspicion is high [40].



Fig. 7.3 Immediately postoperative after massive excision of severe gluteal and perineal hidradenitis suppurativa. The surgical specimen revealed multifocal squamous cell carcinoma. There are multiple areas of residual carcinoma

New case reports in the literature of this entity associated with the use of biologic treatments such as infliximab [40, 46] demonstrate the aggressiveness of squamous cell carcinoma in this setting, especially in combination with the immunosuppressive effects of monoclonal antibodies, and underscore the advantages of early surgical treatment of suppurative hidradenitis.

The Microbiology of Hidradenitis Suppurativa

One of the mainstays of therapy for mild hidradenitis suppurativa is antibiotic therapy. The etiology of hidradenitis suppurativa has long been debated. The most widely accepted theory posits that keratin plugging of the hair follicle leads to follicular dilation, rupture, and surrounding inflammation. What part bacteria play in the process is still under debate. Does bacterial invasion trigger inflammatory pathways? Or is bacterial invasion secondary? The fact that clindamycin, rifampicin, and tetracycline, which are three of the most effective antibiotics used in hidradenitis suppurativa, have known anti-inflammatory properties also clouds the issue. Ring et al. published a review of 9 studies from between 1988 and 2014 on

the bacteriology of hidradenitis suppurativa. Most of these bacteriologic studies did not confine themselves to one area, i.e., they contained patients suffering from axillary hidradenitis, inguinal lesions, vulvar and scrotal lesions, as well as perianal disease, or a combination of these. They also did not break down the microbiologic findings by site of collection [47]. A 1988 study by Highet et al., confined itself to microbiology of perineal hidradenitis suppurativa. This included perianal, upper thigh, inguinal, buttock, and genital lesions. The authors implicated *Streptococcus milleri* most significantly in causing disease exacerbation in their patients, and antibiotics clearing that bacterium were often successful in improving suppuration. *Staphylococcus aureus* was implicated as well, but to a lesser degree. Interestingly, coagulase negative staphylococcus (CoNS) was frequently cultured from patients, but was essentially disregarded as being a ubiquitous commensal and considered nonpathogenic [48]. Subsequent studies have lent CoNS much more of a role in propagation of the disease process because of its production of a biofilm (“slime”), a matrix of extracellular polymeric substance comprised of proteins, polysaccharides, and extracellular DNA. The bacteria which produce this biofilm are embedded in the slime, which gives them some protection from antibiotics as well as natural host defenses. Both *Staphylococcus epidermidis* and *Staphylococcus lugdunensis* are coagulase negative staph species that produce biofilm. Both have been implicated in hidradenitis suppurativa lesions [49–51].

Anaerobic actinomycetes (*Actinomyces turicensis*, *Actinomyces radingae*, *Actinomyces neuii*, and *Actinobaculum schaalii*) have been recovered from a majority of hidradenitis suppurativa lesions in later studies. These species are slow growing and difficult to identify, which may account for them not being cultured in earlier studies. They typically are difficult to eradicate and require prolonged antibiotics. They usually coexist with strict anaerobes [50, 52].

Finally, there exists a case report of a patient with gluteal hidradenitis suppurativa who underwent ileostomy and local incisions and drainages, fistulectomies, and unroofings, only to have his sepsis recur on ileostomy reversal. A large resection of one buttock was performed, with a finding of a 9 mm larva of *Ancylostoma braziliense* (hookworm) in one of the abscess cavities. This larva is responsible for cutaneous larva migrans when it migrates through the skin causing serpiginous raised tunnels. In this case, it was felt that the larva may have incited further inflammation. It was not implicated as causing the hidradenitis suppurativa [53].

In summary, many bacterial species have been implicated in pathogenesis or superinfection of hidradenitis lesions, including skin commensals, such as coagulase negative staph species *S. epidermidis* and *lugdunensis*, *Streptococcus milleri*, pathogens, such as *Staph. aureus* and actinomycetes, as well as rarer bacteria such as *Bilophila wadsworthia* that colonize the GI tract, but have been implicated in other disease processes such as appendicitis [54]. Antibiotic regimens active against these may result in improvement in suppurative lesions, but recurrence after their cessation is the norm. In addition, many of the more common antibiotic regimens used in hidradenitis suppurativa employ clindamycin, tetracycline, and rifampin, that

have anti-inflammatory properties which may account for some of their beneficial effects in hidradenitis.

Summary

Perianal and gluteal hidradenitis suppurativa is a chronic, relapsing disease capable of causing patients great disability and decreased quality of life. There is still often a significant delay in diagnosis. While a myriad of medical treatments can afford temporary relief, surgical excision is the most effective means of cure. Prolonged disease can be associated with the development of squamous cell carcinoma. These neoplasms tend to be more aggressive than denovo squamous cell carcinoma. Early diagnosis and appropriate R0 resection, if possible, is the only means of cure. Patients with long-standing hidradenitis in the perianal and gluteal areas need to be adequately informed of the risk of development of cancer.

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