

REVIEW

Hidradenitis suppurativa: an up-to-date review of clinical features, pathogenesis and therapeutic approaches

Anthony Moussa*¹, Anneliese Willems¹ and Rodney D Sinclair^{1,2}

¹Sinclair Dermatology, East Melbourne, VIC, Australia

²University of Melbourne, Melbourne, VIC, Australia

*Corresponding author Email anthonymoussa@outlook.com

Abstract

Hidradenitis suppurativa (HS) is a chronic autoinflammatory disease characterised by recurrent painful nodules, abscesses, sinus tracts and scars at apocrine gland-bearing sites. Treatment is universally challenging and sufferers may live with chronic and recurrent draining wounds. This review provides an up-to-date, evidence-based summary of HS, including clinical features, severity assessment, disease pathogenesis and current and emerging therapeutic approaches.

Keywords chronic inflammation, follicular occlusion, hidradenitis suppurativa

For referencing Moussa A et al. Hidradenitis suppurativa: an up-to-date review of clinical features, pathogenesis and therapeutic approaches. *Wound Practice and Research* 2022; 30(1):40-49.

DOI <https://doi.org/10.33235/wpr.30.1.40-49>

Submitted 18 January 2022, Accepted 1 February 2022

Introduction

Hidradenitis suppurativa (HS), also known as acne inversa, is a chronic and debilitating autoinflammatory disease typified by painful nodules, abscesses, sinus tracts and scars in predominantly intertriginous, apocrine gland-bearing sites¹. Estimates of HS prevalence are highly variable, ranging from 0.03–4.1% globally^{2–4}. Health-related quality of life may be profoundly impacted, with HS sufferers at an increased risk of anxiety, depression and suicide^{5,6}. HS exhibits a diverse clinical phenotype and management of disease remains universally challenging^{7–9}. In this review article, we summarise clinical features of HS, explore disease pathogenesis and associations, and discuss current and emerging medical therapies.

Epidemiology

Onset of HS typically occurs after puberty in the second decade of life at a mean age of 24.6±10.5 years^{10,11}. Onset before puberty or after menopause is rarely reported¹¹. A 2018 cross-sectional study estimated a HS prevalence of 0.67% in Australia⁴. Larger European studies have reported a prevalence of 1%², while a point prevalence of 4.1% has also been described in an adult population undergoing screening for sexually transmitted infections³. Several factors

are likely to account for under-recognition of HS, including misdiagnosis, under-reporting of symptoms by patients and decentralisation of care. Females are more commonly affected than males (ratio 2.8:1)^{12,13}.

Clinical features and diagnosis

HS is diagnosed clinically using the Dessau criteria as modified and adopted at the 2nd International Conference on hidradenitis suppurativa in San Francisco 2009¹. In order to establish a diagnosis, all three criteria must be fulfilled:

- Typical lesions – deep-seated painful nodules: ‘blind boils’ in early lesions, and abscesses, draining sinus, bridged scars and ‘tombstone’ double-ended pseudo-comedones in secondary lesions.
- Typical topography – axillae, groins, perineal and perianal regions, buttocks, infra- and inter-mammary folds.
- Chronicity and recurrence¹.

Clinical presentations of HS, including the anatomical distribution, number and types of lesions, can vary widely between patients. Unfortunately, the average diagnostic delay of HS is 7.2±8.7 years¹⁴. Diagnostic delay is associated with more severe disease, a higher burden of concomitant disease and higher rates of surgical treatment^{10,14}.

Typical lesions

HS lesions include dermal and subcutaneous nodules (inflamed and non-inflamed), rounded abscesses, double-ended pseudo-comedones in secondary lesions, sinus tracts (draining or non-draining) and scarring (bridged or rope-like, hypertrophic or atrophic, and contractures)^{1,15} (Figures 1–3). Painful inflammatory nodules and abscesses generally persist for a mean of 7–15 days, after which complete spontaneous regression or partial regression into a painless inflammatory nodule occurs. Inflammatory nodules or abscesses that fail to regress may instead progress in size, with subsequent rupture and release of purulent discharge^{16,17}. Some patients may experience prodromal symptoms 12–48 hours before developing a HS lesion, including warmth, burning, pain, pruritus or hyperhidrosis^{16,17}.

Typical topography

HS lesions are typically localised to intertriginous, apocrine gland-bearing sites including the axillae, sub-mammary, inter-mammary, inguino-genital, perineal and perianal areas. Less commonly affected areas include the trunk, neck, pre-auricular and retro-auricular areas^{1,17}. Males are more prone to gluteal and perianal disease while females are more likely to experience genitofemoral involvement¹⁷.

Chronicity and recurrence

Patients with HS may experience a variable trajectory of continuous disease, acute intermittent flares and periods of prolonged remission (weeks to months). Following resolution of lesions, HS recurrence may occur at new sites or via pre-existing non-inflammatory nodules. Long-standing active disease may result in the coalescing of nodules with sinus tract formation; these patients can experience chronic pain with daily purulent discharge^{17,18}.



Figure 1. Right axillary comedones in a patient with HS



Figure 2. Left mammary inflammatory nodules, cicatricial scarring and draining sinuses in a patient with HS



Figure 3. Severe scarring of bilateral gluteal regions secondary to HS

Complications

HS may be complicated by acute secondary infection, resulting in disease exacerbation. Long-standing HS may result in lymphatic obstruction and consequent lymphoedema^{19,20}. Scrotal elephantiasis secondary to HS associated lymphatic obstruction in the ano-genital area has also been described^{19,20}. Long-standing HS in the ano-genital areas has also, in rare instances, been associated with fistula formation into the urethra, bladder, rectum and peritoneum, and requires an exclusion of Crohn's disease¹⁹. Furthermore, chronic ano-genital involvement carries an increased risk of cutaneous squamous cell carcinoma, typically in males and less commonly in females; the prognosis is usually poor due to diagnostic delay^{19,20}. A recent, population-based cohort study of patients with HS reported an increased risk of several specific cancers, including oral cavity and pharyngeal cancer, Hodgkin lymphoma, central nervous

system cancer, non-melanoma skin cancer, prostate cancer and colorectal cancer²¹. Other potential complications of HS include anaemia, hypoproteinaemia and amyloidosis¹⁹.

Severity staging

Several severity staging tools have been developed to assess HS severity and response to treatment in clinical practice and research trials²²⁻²⁹.

Hurley staging

First described in 1989 by Dr Harry James Hurley, the Hurley staging system remains one of the most widely used HS severity assessment tools. Patients are stratified into three stages based on the extent and type of HS lesions (Table 1)²² (Figures 4–6). Hurley staging was originally developed as a tool to help select the suitability of HS-affected areas for medical management (Hurley stage I) or surgical management (Hurley stage II and III). It is commonly used because of its speed and simplicity but has several limitations. Notably, it does not take into account the specific number of lesions or sites affected, and so is limited in assessing treatment response^{20,22}.

Modified Sartorius Score

The Modified Sartorius Score is a more detailed assessment tool than Hurley staging and is principally used for research purposes. It was originally designed by Sartorius et al. (2003) but later modified to a simpler version that placed greater emphasis on inflammatory lesions^{23,24}. It is calculated by separately measuring the number and type of lesions at each HS-affected site and the longest distance between two relevant lesions. Different points are awarded per parameter to produce a score per body area and an overall score²⁴. The Modified Sartorius Score has a low interobserver variability, strongly correlates to a patient’s Dermatology Life Quality Index (DLQI) and is useful in assessing response to treatment in research studies. However, it is more time consuming than other tools as a precise lesion count is required. Furthermore, the applicability of this tool may be limited in patients with severe disease where separate lesions become confluent²⁵.

HS Physician Global Assessment (HS-PGA)

The HS Physician Global Assessment (HS-PGA) is a tool which classifies disease severity as one of six categories

Table 1. Description of Hurley stages in the assessment of HS²²

Hurley stage	Description
Stage I	Single or multiple abscess formation without sinus tracts and cicatrisation/scarring.
Stage II	Recurrent abscesses with sinus tract formation and cicatrisation. Single or multiple widely separated lesions.
Stage III	Diffuse or near-diffuse involvement. Multiple interconnected sinus tracts and abscesses across the entire area.



Figure 4. Hurley stage I HS of the left axilla



Figure 5. Hurley stage II HS of the left axilla



Figure 6. Hurley stage III HS of the inter-mammary and bilateral sub-mammary regions

Table 2. HS-PGA scale^{20,26}

Score	Stage	Description
0	Clear	No inflammatory or non-inflammatory nodules.
1	Minimal	Only the presence of non-inflammatory nodules
2	Mild	1–4 inflammatory nodules OR 1 abscess or draining fistula and no inflammatory nodules
3	Moderate	1–4 inflammatory nodules OR 1 abscess or draining fistula and ≥ 1 inflammatory nodules OR 2–5 abscesses or draining fistulas and < 10 inflammatory nodules
4	Severe	2–5 abscesses or draining fistulas and ≥ 10 inflammatory nodules
5	Very severe	> 5 abscesses or draining fistulas

based on the number of HS lesions (Table 2)²⁶. It is simple and quick to perform and has been widely used to date in clinical trials²⁰. However, while the HS-PGA enables monitoring of HS severity and response to treatment, it considers the global severity of HS, and not individually affected areas. Furthermore, it does not account for marked heterogeneity which may exist in patients with severe disease, and so improvements of disease in this group may not be reflected in the HS-PGA score.

Hidradenitis Suppurativa Severity Index (HSSI)

The Hidradenitis Suppurativa Severity Index (HSSI) is a scoring tool that incorporates categorical objective parameters with categorical subjective parameters^{20,27}. Features considered include the number of HS lesions, the sites involved, lesion drainage and pain assessment via a visual analogue scale. The HSSI score ranges from 0–19. A score of ≥ 13 denotes severe disease, a score of 8–12 indicates moderate disease and a score of 0–7 indicates mild disease²⁷.

Hidradenitis Suppurativa Severity Score System (IHS4)

The Hidradenitis Suppurativa Severity Score System (IHS4) is a validated tool used in clinical practice and research settings to assess disease severity and monitor response to treatment²⁸. It is calculated by adding the number of inflammatory nodules (multiplied by 1), the number of abscesses (multiplied by 2) and the number of draining tunnels (multiplied by 4). A score of ≥ 11 denotes severe HS, a score of 4–10 denotes moderate HS and a score of ≤ 3 denotes mild HS²⁸.

Hidradenitis Suppurativa Area and Severity Index (HASI)

The Hidradenitis Suppurativa Area and Severity Index (HASI)

is a severity assessment tool used in clinical trials. It combines signs of HS-related inflammation with the affected body surface area (BSA)²⁹. To calculate the regional HASI score, each sign of HS-related inflammation (erythema, thickness, drainage, tenderness) is scored on a Likert scale from 0–3 for each affected region. The sum of the four variable scores is multiplied by the area score of each involved region and then by the proportion of the BSA of that region. Regional HASI scores are added together to give a cumulative HASI score, ranging from 0–72²⁹.

Pathogenesis

HS has a complex multifactorial pathogenesis that is not yet fully understood. Traditionally, hair follicle occlusion has been regarded as the main driver of disease activity in HS. In this pathogenic model, follicular hyperkeratinisation is followed by occlusion, dilatation, rupture and resultant lympho-histiocytic inflammation^{20,30,31}. Recently, this model has been challenged. Current observational, experimental and therapeutic evidence supports the concept of inflammation being the primary driver of disease activity in HS³¹. Despite its use, the term hidradenitis suppurativa is a historical misnomer as the central pathogenic event is not a suppurative inflammation of the apocrine glands³⁰.

Inflammation

Immune dysregulation with overexpression of pro-inflammatory cytokines has been demonstrated in HS pathogenesis. Elevated levels of interleukin (IL)-1 β , IL-12, IL-17, IL-23 and tissue necrosis factor alpha (TNF)- α are seen in HS-affected tissue^{32,33}. IL-23 is involved in the induction of a distinct IL-17 producing T helper (Th) cell subset, called Th17. Th17 cells have been found to infiltrate the dermis in chronic HS lesions. Several inflammatory cytokines that are upregulated in HS are produced by Type 1 Th (Th1) cells^{20,34}.

Genetics

Approximately 30–40% of HS patients report a family history of disease in a first-degree relative, suggesting a hereditary component with a mostly autosomal dominant transmission pattern^{20,35}. Mutations in the gamma (γ)-secretase Notch signalling pathway have been implicated in a subset of patients with severe HS phenotypes. γ -secretase is an intramembranous endoprotease complex of four hydrophobic proteins. It is involved in the cleavage of multiple type 1 transmembrane proteins including Notch receptors. Disruption of γ -secretase or Notch signalling in mice results in skin changes that are histopathologically similar to HS^{20,35}.

Causative microorganisms

The role of bacteria in HS pathogenesis remains cryptogenic. While a polymorphic flora may be observed at HS-affected sites, superficial and deep bacterial cultures from early unruptured lesions are often sterile. Cultures of older lesions that have ruptured may demonstrate a wide range of bacteria, often contaminants of the normal skin flora²⁰. In rare cases, a positive bacterial culture may represent secondary

infection of an initially sterile process. It has been theorised that bacteria are implicated in HS pathogenesis by promoting an inflammatory response. Furthermore, biofilm formation is associated with chronic HS lesion, which likely aggregates as a secondary event and contributes to the persistence of inflammation seen in HS³⁶.

Comorbidities and associations

Obesity

Obesity is observed in over 75% of patients with HS²⁰. Furthermore, severity of HS appears to positively correlate with an increase in one's body mass index. Several factors may account for this, including increased epidermal barrier stress and increased physical occlusion at affected intertriginous sites³⁷. Increased visceral fat may also contribute to a chronic, low-grade inflammation and increased release of pro-inflammatory cytokines (IL-1 β , IL-6 and TNF- α) that are implicated in disease pathogenesis³². Weight loss, as later described, can lead to significant HS improvement in overweight and obese patients^{18,37}.

Smoking

Several studies have established an association between smoking and HS. Up to 88.9% of patients with HS are active smokers. Despite this, studies assessing the effects of smoking on HS severity have produced conflicting results, ranging from slight associations to no associations^{20,38}. Nevertheless, improvement of HS severity has been reported following smoking cessation³⁸. There is evidence that smoking may also negatively affect treatment response in HS patients¹⁸. The mechanisms underlying the interplay between smoking and HS are likely multifactorial. Nicotine promotes follicular plugging by inducing infundibular epithelial hyperplasia *in vitro*³⁹. It may exert these actions via the nicotinic acetylcholine receptors (nAChR) found on HS lesion immune cells. Other immunological effects of smoking include altered function of regulatory T cells, an increase in the number and responsiveness of dendritic cells and Th17 pathway activation³².

Mechanical stress

Mechanical stress refers to the direct pressure or friction at an affected HS site and may be seen in situations of obesity or when tight clothes are applied. Reports of HS lesions induced by mechanical stress and improved by avoidance of tight-fitting clothing are described in the literature; however, a direct causal relationship has yet to be proven. Mechanical stress-induced epidermal hyperplasia may be implicated^{20,40}.

Sex hormones

Although the mechanisms underlying the association between HS and sex hormones are not completely understood, several observations provide evidence of a link. Notably, HS has a female predilection, rarely occurs prior to puberty and after menopause, is seen at a higher incidence in patients with polycystic ovarian syndrome, may flare during perimenstrual periods, typically improves with pregnancy, and may be

responsive to anti-androgen therapy^{18,20}. However, in most patients, testosterone, dehydroepiandrosterone sulfate, oestrogens and progesterone are not significantly elevated compared to controls, suggesting that end-organ sensitivity to normal levels and/or *in situ* production may be a factor in HS⁴¹.

Metabolic syndrome

Metabolic syndrome – obesity, dyslipidaemia, hypertension, hyperglycaemia and insulin resistance – is more prevalent among individuals with HS. Adipose tissue dysfunction and insulin resistance are the key mechanism underlying metabolic syndrome. The chronic inflammatory nature of HS is a likely driver of the increased risk of metabolic syndrome; however, the precise mechanisms remain under investigation⁴². Importantly, there is evidence that HS increases an individual's risk of cardiovascular disease-associated death, myocardial infarction and ischaemic stroke independent of confounders^{18,20,42}.

Medications

Drug-associated HS is rare, but has been reported following lithium, sirolimus, leflunomide, cyclosporin and certain formulations of the oral contraceptive pill^{43,44}. However, a systematic review by Frew et al. (2018) noted the presence of alternative explanations in many cases of purported drug-associated HS⁴³.

Autoinflammatory disease

A well-known association exists between HS and certain autoinflammatory conditions including Crohn's disease, pyoderma gangrenosum, spondyloarthritis and Familial Mediterranean Fever^{18,45}.

Genodermatoses

Genodermatoses associated with HS include Dowling Degos disease (DDD), Keratitis-Ichthyosis-Deafness syndrome (KIDS), steatocystoma multiplex and pachyonychia congenita⁴⁵.

Follicular occlusion syndrome

The follicular occlusion syndrome or tetrad describes a group of co-existing diseases characterised by blockage of the hair follicle with keratin and subsequent rupture. Acne conglobata, dissecting cellulitis of the scalp, HS and pilonidal sinus comprise the follicular occlusion tetrad^{18,20,45}.

Other syndromic associations

Several syndromic associations of HS have been described, including:

- PASH: Pyoderma gangrenosum, Acne and Suppurative Hidradenitis.
- PASS: Pyoderma gangrenosum, Acne conglobata, Suppurative hidradenitis, axial Spondyloarthritis.
- PAPASH: Pyogenic Arthritis, Pyoderma gangrenosum, Acne, Suppurative Hidradenitis.

- PsAPASH: Psoriatic Arthritis, Pyoderma gangrenosum, Acne, Suppurative Hidradenitis.
- SAPHO: Synovitis, Acne, Pustulosis, Hyperostosis, Osteitis^{42,45}.

Management

The multi-layered and variable clinical course of HS can make treatment challenging. A holistic, patient-centred approach is pivotal⁹. Several global treatment guidelines have been published by various expert groups, including the European Academy of Dermatology and Venerology, the Swiss consensus group, the Canadian Dermatology Association (CDA), the British Association of Dermatologists (BAD), the Brazilian Society of Dermatology (SBD) and the US and Canadian HS Foundations^{9,20,46}.

Lifestyle measures

General, non-pharmacological adjuvant measures should be taken for management of HS in the relevant circumstances. Overweight or obese individuals should be encouraged and counselled on weight loss, and smokers should be encouraged to take steps towards cessation^{8,9,20}. Weight loss can lead to significant HS improvement, likely due to decreased epidermal barrier stress, reduced physical occlusion at affected sites and a reduction in generalised, chronic low-grade inflammation^{18,37}. Furthermore, smoking cessation improves the long-term HS prognosis^{9,18}.

Psychosocial support

The deleterious psychosocial impacts of HS are well documented. Health-related quality of life can be significantly compromised with patients at an increased risk of social isolation, anxiety, depression and suicide^{5,6}. Sexual dysfunction is also described as a feature of disease, more commonly among females^{13,20}. Furthermore, patients with HS are also more likely to be absent from work and experience slower income growth¹⁰. As part of the multidisciplinary management of patients with HS, referral for mental health care may be indicated.

Wound care and dressings

Proper wound care is an integral component of HS management. HS sufferers may live with chronic and recurrent draining wounds (Figure 7). No standard wound care protocol exists for managing HS lesions and indeed several factors must be considered when determining an appropriate dressings regimen, including the location of the lesions, the morphology of the lesions (i.e., draining tunnels, abscesses), the degree of exudate, wound odour and the cost and availability of dressings^{20,47}. Wound care aims to improve patient quality of life by helping to manage pain and to mitigate staining of clothes and odour. Desirable dressing qualities include high absorption, comfort, easy accessibility and cost effectiveness. Furthermore, dressing shape is an important consideration given the dynamic contours of intertriginous areas. Selecting the right shape is necessary



Figure 7. Chronic wounds secondary to HS of the (a) axilla; (b) mammary and sub-mammary regions; (c) genitofemoral regions

to ensure the dressing remains in place and avoids friction. Similarly, atraumatic adhesives are preferred as they reduce the risk of trauma and minimise pain during dressing changes⁴⁷. Superficial HS lesions may be managed with plain absorptive dressings. The degree of exudation will guide the choice of dressing. HS lesions with cavities and tunnelling are best managed with dressings that can be packed to fill these spaces and adequately absorb fluid^{20,47}.

The importance of a proper dressings plan cannot be overemphasised. A study by Schneider et al. (2021) demonstrated improvement in quality of life of HS patients who had access to a variety of dressings⁴⁸. The European S1, SBD and Canadian consensus guidelines all highlight the need for further studies evaluating wound care and dressings in HS^{20,46}.

Analgesia

The pain associated with HS may be significant and debilitating. Non-pharmacological measures to manage pain include minimising pressure and friction in areas of disease such as with loose fitting undergarments. However, analgesia is often required and prescription should follow the principles of the World Health Organization Analgesic Ladder^{9,20}. Anti-inflammatory therapy, such as intralesional or oral steroids, may also be used to provide acute symptomatic relief^{9,20}. These are later described in detail.

Topical antiseptic and antibacterial agents

Topical antiseptic and antibacterial agents, such as chlorhexidine 4%, benzoyl peroxide, sodium hypochlorite, triclosan and zinc pyrithione, have been used in the management of HS to reduce bacterial colonisation. Despite being recommended by experts, robust evidence to support their use in HS is lacking^{8,9,20}. Topical antiseptics are supported by expert opinion in the North American and Swiss consensus group guidelines^{9,46}.

Topical retinoids

Topical retinoids, such as adapalene and tazarotene, have been described for use in HS for their anti-inflammatory properties. However, evidence to support their use is lacking^{8,9}.

Topical resorcinol

Topical resorcinol 15% has been used in the treatment of HS. It is a 1,3-isomer of benzenediol that promotes removal of follicular plugging and early abscess rupture via its keratolytic properties. It also has antipruritic and antiseptic effects^{8,9,20}. Topical resorcinol is recommended as a first and second-line agent in several international HS treatment guidelines^{9,20,46}.

Topical antibiotics

Topical clindamycin 1%, applied twice daily for 3 months, is used for the treatment of localised Hurley stage I or mild stage II disease, and is widely recommended. It is

considered to be most beneficial in patients with superficial lesions (i.e., folliculitis, pustules, papules) or solitary lesions, and less beneficial for deeper lesions^{8,20,46}.

Systemic antibiotics

Tetracycline monotherapy (i.e., tetracycline, minocycline, doxycycline) has been used to effectively treat more widely spread Hurley stage I or mild Hurley stage II HS. Regimens include oral tetracycline 500mg twice daily, doxycycline 100mg daily or minocycline 50mg twice daily. Treatment is often continued for 3 months. Despite their antibacterial properties (inhibition of the 30S ribosomal unit), the beneficial effects of tetracyclines in HS are likely achieved via their anti-inflammatory effects^{8,20,46}.

Oral rifampicin (600mg daily or 300mg twice daily) and clindamycin (300mg twice daily) combination therapy may be used in patients who fail to respond to tetracycline monotherapy, or as first-line therapy in patients with any severity of active inflammatory HS. Treatment duration is typically 10–12 weeks^{8,20,46}.

Other oral antibiotics, such as erythromycin, moxifloxacin and metronidazole, have been described in the literature for use in HS. Patients who respond to systemic antibiotics should only be selectively kept on long-term maintenance doses to reduce the risk of adverse events. Indeed, patients who achieve satisfactory control of their HS with systemic antibiotics may cease treatment and continue topical maintenance therapy^{8,9,20,46}.

Anti-inflammatory therapy

Intralesional corticosteroids: intralesional triamcinolone acetonide (5–10mg/ml), either as monotherapy or in combination with systemic therapy, may be used directly on an inflammatory nodule for the rapid reduction of inflammation. Clinical improvement of pain and inflammation may occur within 48–72 hours. Intralesional triamcinolone acetonide should not be used if bacterial infection is suspected due to the rare risk of superinfection. Complications may include atrophy and dyspigmentation at the site of injection^{9,20}.

Oral corticosteroids: oral corticosteroids (i.e., prednisolone 0.5–0.7mg/kg) may be used as short-term rescue therapy to effectively treat acute flares. Withdrawal of short-term or long-term oral corticosteroids can result in a rebound flare of HS, and so tapering to stop is important. Corticosteroids should be used with care as they may increase the risk of HS-related comorbidities such as weight gain, insulin resistance and dyslipidaemia^{8,9,20}.

Cyclosporine

Cyclosporine is a calcineurin inhibitor that has been used to treat cases of recalcitrant HS through its potent immunosuppressive activity. It has been used at doses of 2–6mg/kg for variable durations, ranging from 6 weeks to 7 months. Major adverse events may include nephrotoxicity, hypertension and an increased risk of malignancy, especially

lymphoma and skin cancer^{8,9,20}. In the CDA, SBD, European S1 and Swiss consensus treatment guidelines, cyclosporine is reserved as a third-line agent in refractory HS^{20,46}.

Dapsone

Dapsone is a sulphone drug that has been used to treat Hurley stage I and II HS. Its effects are likely achieved via its anti-inflammatory and antibacterial properties. For the treatment of HS, dapsone has been used at doses of 25–200mg daily. It is contraindicated in patients with G6PD deficiency, severe anaemia, acute porphyria and sulphonamide allergy^{8,9,20}.

Oral retinoids

Isotretinoin has been used to treat HS off-label with mixed results. Its benefits, if any, appear to be restricted to patients with mild HS^{9,20}. The European S1 guidelines do not currently recommend the use of isotretinoin in the treatment of HS²⁰. Other international guidelines describe its use as a third-line agent in patients with concomitant acne⁴⁶.

Acitretin, a metabolite of etretinate, has been used to treat HS with conflicting results of efficacy. It appears to have a high response rate in a reasonable proportion of patients. It is indicated for usage in early Hurley stage I and II HS as second-line agent. The optimal dosing for acitretin for treatment of HS has yet to be established, with doses ranging from 0.25–0.88mg/kg in the literature^{8,9,20,46}.

Biologics

Biologics have revolutionised the treatment of several chronic inflammatory disorders. Advances in the understanding of HS pathogenesis has led to the recognition of several potential therapeutic targets^{9,20,33}. The TNF- α inhibitors adalimumab and infliximab have demonstrated efficacy in the management of moderate to severe HS. In Australia, adalimumab is the only approved and PBS-subsidised biologic for severe HS. Potential therapeutic targets in HS, including biologics undergoing investigation, are presented in Table 3.

Other treatments

In published cases or small case series, other treatments that have been reported to be effective in treating HS include botulinum toxin, intramuscular immunoglobulin, zinc gluconate, liraglutide, metformin, anti-androgen therapy and cryo-insufflation^{8,9,20,46}.

Surgery

Surgical therapy remains a pillar of HS management. Lesion-directed therapies include incision and drainage, deroofing, local excision of individual lesions, and extensive, wide excision of affected areas^{9,20}. Incision and drainage is useful for the management of abscesses; however, recurrence rates are high. Inflammatory nodules without fluctuance should not be incised²⁰. Deroofing is used as a tissue-sparing technique to surgically remove the roof of an abscess or sinus tract, often with a blunt probe (via conventional or electrosurgery). Excision of single lesions results in lower

Table 3. Potential therapeutic targets in HS and biologics (including those under investigation)^{8,33}

Therapeutic target	Biologic	
TNF- α	TNF- α	Adalimumab
	TNF- α	Entanercept
	TNF- α	Infliximab
IL-1	IL-1A and IL1B	Anakinra
	IL-1A	Bermekimab
IL-12/23	IL-12/23p19	Ustekinumab
IL-17	IL-17A	Secukinumab
	IL-17A/F	CJM112
	IL-17A	Ixekizumab
	IL-17RA	Brodalumab
	IL-17A/F	Bimekizumab
IL-23	IL-23A	Guselkumab
	IL-23A	Risankizumab
IL-36	IL-36	Spesolimab
Syk	Syk	Fostamatinib
JAK	JAK1	Upadacitinib
C5a	C5a	IFX-1
	C5aR	Avacopan

recurrence compared to incision and drainage, and may be suitable for patients with few, non-inflamed nodules or sinus tracts^{9,20}. Wide local excision may be indicated in extensive HS where multiple interconnecting sinus tracts are seen. As the resulting wounds are rarely amenable to primary closure, further reconstruction with grafting (immediate or delayed) or a flap may be necessary depending on the anatomic site. Post-operatively, sites managed with wide local excision may be prone to strictures. Indeed, such radical surgery may be disfiguring and require a prolonged recovery²⁰. Ultrasound imaging may be used to pre-operatively map HS lesions, delineate lesional areas and aid in characterising different fistula tracts. Furthermore, the inflammatory activity of HS lesions may be assessed using colour doppler. Overall, ultrasound has been shown to enhance surgical management⁴⁹.

Ablative laser therapy

Scanner-assisted carbon dioxide (CO₂) laser may be used to remove all affected HS tissue. Treatment aims to achieve focal radical vaporisation of all HS lesions (i.e., nodules, abscesses, fistulas) while preserving healthy tissue between lesions^{9,20}. Ablative CO₂ lasers have demonstrated efficacy in the treatment of HS in RCTs²⁰. Wounds produced from ablative CO₂ laser are often left to heal by secondary intention; however, this can take many weeks^{9,20}. Overall, CO₂ laser treatment appears to be an effective treatment modality for recurrent HS lesions and is associated with high levels of self-reported patient satisfaction⁵⁰.

Non-ablative laser therapy

Neodymium-doped yttrium aluminium garnet (Nd:YAG) laser and intense pulsed light (IPL) have been used for the treatment of HS, based on the premise that occlusion of the upper part of the hair follicle is the central pathogenic event. Nd:YAG appears to be an effective treatment modality for HS and, while evidence for IPL is less established, results are also promising^{9,20}.

Conclusions

HS is a chronic and often debilitating condition. Management is frequently challenging and sufferers may live with chronic and recurrent draining wounds. Further research is required to identify and optimise management in those with severe disease.

Author contribution

We declare that all listed authors have made substantial contributions to the conception of this work, drafting of this work and final approval of the version to be published. Furthermore, all authors attest to the validity and integrity of this work.

Acknowledgements

None.

Conflict of interest

The authors declare no conflicts of interest.

Ethics statement

An ethics statement is not applicable.

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

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