Medical and Surgical Management of Hidradenitis Suppurativa: A Review of International Treatment Guidelines and Implementation in General Dermatology Practice

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Keywords

Acne inversa · Biologicals · Hidradenitis suppurativa · Surgical techniques

cedural treatments for HS. It also includes recommendations for counseling, dosing, and duration of medical therapies as well as procedure videos for the practicing dermatologist.

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Abstract

Background: Hidradenitis suppurativa (HS) is a chronic painful skin disease that severely impairs patients' quality of life. While high-quality trials of HS therapies remain limited, medical knowledge of best treatment practices is rapidly evolving, leading to the recent publication of multiple international treatment guidelines for HS. **Summary:** This review compares international HS treatment guidelines, describes evidence for effectiveness of common and emerging HS therapies, and provides guidance for integrating evidence-based HS care into practice. Although over 50 medical and procedural treatments are mentioned across international HS guidelines, only adalimumab and infliximab have grade B/weak recommendation or higher across all major guidelines. This review describes the appropriate patient selection and effectiveness of the most commonly used medical and pro-

Introduction

Hidradenitis suppurativa (HS) is a chronic disease causing painful, malodorous nodules and abscesses that scar to form sinus tracts/tunnels. HS has a devastating impact on quality of life [1, 2], contributing to chronic pain [3], poor mental health [4], substance use disorder [5], impaired intimate relationships [6, 7], and suicide rates 2.4 times that of the general population [8]. While multiple HS treatment guidelines exist [9–13], paucity of high-quality evidence limits the strength of their recommendations. This article reviews the medical and surgical management of HS, with an emphasis on comparison of international guidelines and integrating evidence-based HS care into practice.

Medical Management of HS

Topical Therapies

Key Points

- Topical clindamycin is appropriate for mild localized disease.
- Antibiotic resistance is common among bacteria cultured from HS lesions but does not seem to impact the antibiotics' effectiveness in treating HS. Topical antimicrobial use promotes antibiotic stewardship.

Topical Clindamycin

Patient Selection. Clindamycin is the only topical antibiotic with randomized controlled trials (RCTs) in HS and should be used for mild, localized disease.

Effectiveness. An RCT ($n = 27$) demonstrated decreased pustule count and improved patient assessment compared with placebo; however, abscess and nodule counts remained unchanged [14]. Another RCT ($n = 46$) showed no significant difference between topical clindamycin versus oral tetracycline [15].

Antimicrobial Washes: Benzoyl Peroxide, Chlorhexidine, and Zinc Pyrithione

Patient Selection. Addition of an antimicrobial wash may be considered with concomitant antibiotic use.

Effectiveness. In an RCT of Nd:YAG laser ($n = 22$), controls reported a 22% clinical improvement when treated with benzoyl peroxide 10% and clindamycin 1% [16]. One small study found that antimicrobial washes were associated with lower resistance to cephalosporins but not other antibiotics [17]. Because antimicrobial resistance is common among HS patients using topical or systemic antibiotics [18–20], it is worthwhile to consider the addition of a topical antimicrobial to promote antibiotic stewardship.

Resorcinol

Patient Selection. Resorcinol 15% cream may be used for acute and chronic lesions in mild-to-moderate disease.

Effectiveness. Uncontrolled studies of resorcinol 15% b.i.d. in mild-to-moderate disease have shown resolution in 66% of lesions when used as maintenance [21] and reduction in pain and abscesses duration during flares [22].

Counseling. Common side effects include desquamation, irritant contact dermatitis, and reversible hyperpigmentation [21, 22]. Resorcinol with intense pulsed light therapy may cause severe irritant reactions [23].

Systemic Antibiotics

Key Points

- Routine microbiologic cultures are not recommended in HS.
- Tetracyclines are first-line therapy for mild-to-moderate widespread HS.
- Clindamycin/rifampin is first-line therapy for moderate-to-severe disease.

Systemic antibiotics are widely used and recommended in all published HS treatment guidelines [9–13]. Yet, our understanding of antibiotics' mechanisms of action in treating HS remains limited. Despite high levels of antimicrobial resistance among bacteria cultured from HS lesions [18–20], no link between antimicrobial resistance and HS treatment response has been established. Thus, routine cultures are not recommended [10, 12].

Tetracyclines

Patient Selection. Oral tetracyclines are first line for mild-to-moderate multifocal HS.

Effectiveness. The only RCT of systemic antibiotics in HS compared tetracycline 500 mg b.i.d. against topical clindamycin 1% b.i.d. in 46 patients with Hurley stage I/II HS. Both groups had reduced abscess counts, but there were no significant differences between groups [15].

Duration. Tetracyclines have been studied for up to 4 months of consecutive therapy, but this may be extended if clinically indicated [9, 11, 13].

Clindamycin/Rifampin

Patient Selection. Clindamycin/rifampin can be a first-line treatment in patients with moderate-to-severe HS or a second-line therapy for mild disease. Patients who are ≥ 50 years old or ever-smokers are less likely to tolerate this combination [24]. Rifampin induces the cytochrome P-450 system leading to numerous medication interactions, including reduced effectiveness of hormonal birth control. This regimen may select for rifampin-resistant strains of *Mycobacterium tuberculosis*, hence tuberculosis screening or avoiding this regimen may be indicated in high-risk populations [25].

Effectiveness. Among 6 case series totaling 178 patients, clinical improvement rates ranged from 63 to 85% [26–31], with remission in 11–57% [26–28]. Although one series reported a 0% relapse rate [26], two studies showed 59–61.5% relapse 4–5 months after stopping treatment [27, 30].

Duration. Although usually continued for only 10–12 weeks, longer treatment courses with clindamycin/rifampin

fampin seem to confer similar risks [32]. Starting rifampin 1 week prior to clindamycin may reduce gastrointestinal discomfort [33, 34].

Metronidazole/Moxifloxacin/Rifampin

Patient Selection. Triple antibiotic therapy may be used for second- or third-line treatment in mild-to-moderate HS.

Effectiveness. A series of 28 patients reported complete remission in 6/6 patients with Hurley I, 8/10 with Hurley II, and 2/12 with Hurley III disease [35]. A second case series of 28 patients with severe Hurley stage I disease found a clinical remission rate of 75% at week 12, with long-term benefits demonstrated by a reduced number of flares at the 1-year follow-up [36].

Duration. In these series, therapy began with metronidazole 500 mg t.i.d., moxifloxacin 400 mg daily, and rifampin 10 mg/kg/day. Metronidazole was discontinued after 6 weeks to reduce neurologic risks (e.g., aseptic meningitis, peripheral neuropathy, and vision loss). Moxifloxacin and rifampin were continued for an additional 4 weeks [35] or until 6 weeks after remission [36]. Remission was then maintained with trimethoprim-sulfamethoxazole (400 mg/80 mg daily) or doxycycline (100 mg/day).

Dapsone

Patient Selection. Due to sparse evidence and need for laboratory monitoring [37], dapsone should be reserved for third-line treatment in patients with mild-to-moderate disease.

Effectiveness/Duration. In the largest published case series, 6/24 patients (25%) experienced clinically significant improvement with rapid relapse upon cessation [38]. None of those with Hurley stage III HS ($n = 4$) improved.

Ertapenem

Patient Selection. Intravenous ertapenem is reserved for severe, treatment-refractory HS. Ertapenem may be used as a bridge to surgery or consolidation medical treatment. In the authors' clinical experiences, surgery is scheduled around week 4–6 of ertapenem therapy.

Effectiveness. In one case series, 35/36 (97.2%) patients improved [39]. However, 30/36 patients relapsed within a mean of 5.8 weeks. In another series ($n = 30$), the median Sartorius score improved significantly [40], although none of the Hurley stage III anatomic areas entered remission. Treatment with oral antibiotics after ertapenem was associated with prolonged remission and continued improvement [40].

Duration/Counseling. The target duration for ertapenem is 6 weeks. Common side effects include oral/vaginal candidiasis, gastrointestinal discomfort, and vaginitis. PICC line thrombosis/lymphangitis was seen in 5/66 patients [39, 40].

Corticosteroids

Key Points

- Intralesional triamcinolone may be used for acute HS flares.
- Systemic corticosteroids should not be used routinely due to side effects.

Intralesional Triamcinolone

Patient Selection. Intralesional triamcinolone acetate (ILT) may be used for HS nodules, abscesses, and draining sinuses.

Effectiveness. Results remain mixed. One case series ($n = 36$) of ILT 10 mg/mL for acute HS nodules and abscesses demonstrated a significant decrease in patient-reported pain within 1–2 days and improvement in physician assessment [41]. In a second uncontrolled study, injection of 0.5 mL of triamcinolone 40 mg/mL into fistulous tracts measuring <25 mm resulted in clinical resolution in 72% of cases ($n = 53$) [42]. However, a recently published RCT ($n = 55$) of 0.1 mL of ILT 10 mg/mL versus ILT 40 mg/mL versus normal saline showed no difference between treatment and placebo [43].

Systemic Corticosteroids

Patient Selection. Caution must be exercised in patients with comorbidities such as hypertension, diabetes mellitus, osteopenia/osteoporosis, and psychiatric disorders.

Effectiveness. In a case series of 13 patients with recalcitrant disease, adding low-dose prednisone (10 mg/day) to ongoing treatment with adalimumab, acitretin, doxycycline, or clindamycin/rifampin induced remission in 5 (38.5%) and partial response in 6 (46.2%) [44].

Hormonal Therapies

Antiandrogen Contraceptives

Patient Selection. Combined oral contraceptive pills are helpful in women whose primary HS treatment is unsafe in pregnancy and may reduce spironolactone's side effects. Progesterone-only contraception may worsen HS [45].

Effectiveness. An RCT of 24 women comparing ethinyl-estradiol/noregestrol versus ethinylestradiol/cyproterone acetate demonstrated clinical improvement in both groups, with no difference in response between regimens [46].

Finasteride

Patient Selection. Finasteride may be an adjunctive treatment in those with mild-to-moderate disease who fail first- and second-line therapies.

Effectiveness. Significant improvement was observed in 13/14 participants across 4 case series [47–50].

Metformin

Patient Selection. Consider in diabetics, pregnant patients, and females with polycystic ovarian syndrome [11].

Effectiveness. Two case series demonstrated subjective clinical improvement in 36/53 (68%) [51] and 18/25 (72%) [52] patients, respectively. One study also showed an improvement in Dermatology Life Quality Index (DLQI) among 19/25 patients, with an average DLQI score reduction of 7.6 points [52]. Insulin resistance did not predict a favorable response to metformin [51].

Dosing and Duration. Start 500 mg daily and increase by 500 mg every 1–2 weeks as tolerated to 500 mg t.i.d. [51]. Improvement usually begins by 12 weeks of therapy and may continue through 24 weeks of treatment [52].

Spironolactone

Patient Selection. Spironolactone may be used as adjunctive therapy in young, healthy women with mild-to-moderate HS.

Effectiveness. Two case series totaling 66 women with mild-to-severe HS have shown improvement in pain, lesion score and physician global assessment [53, 54].

Other Hormonal Therapies

Liraglutide, a glucagon-like peptide-1 agonist, was used successfully in 2 case reports at doses of 1.8 mg daily [55, 56].

Systemic Retinoids

Key Points

- Isotretinoin is not recommended for routine treatment of HS.
- Acitretin may be used as second- or third-line therapy in moderate disease.

Isotretinoin

Patient Selection. Healthy weight females with acne and milder HS are more likely to respond to isotretinoin [57].

Effectiveness. Although isotretinoin is commonly prescribed for HS [58], data supporting its effectiveness are inconsistent. Five large case series/retrospective cohorts

reported complete response in 26/194 (13%), partial response in 40 (21%), and no response in 128 (66%) participants [57, 59–63]. One case series suggested that isotretinoin may exacerbate HS [64]. Of 16 complete responders in one series, 11 (69%) remained in remission after a mean follow-up of 56 months [60].

Acitretin

Patient Selection. Acitretin may be used to treat moderate-to-severe HS in patients without child-bearing potential.

Effectiveness. Three case series and one trial have evaluated acitretin in treating HS [65–68], but doses and outcome measures varied.

Dosing and Duration. High-dose acitretin (0.5–0.6 mg/kg/day) appears more effective than lower doses (10–25 mg/day) [65–67]. Clinical improvement usually begins within 3 months and may continue through the first 6 months [66, 67]. Among complete responders, remission was maintained for a median of 10 months [66, 67].

Biologic Therapy

Key Points

- Adalimumab is the only FDA-approved treatment for HS. It is the first line for patients ≥ 12 years old with moderate-to-severe disease.
- Adalimumab weekly is more effective than dosing every other week.

Adalimumab

Patient Selection. Adalimumab is a fully human monoclonal tumor necrosis factor- α (TNF- α) antibody and is the first-line biologic in patients with moderate-to-severe HS.

Effectiveness. Four RCTs have investigated adalimumab in HS [69–71]. PIONEER I ($n = 307$) and PIONEER II ($n = 326$) demonstrated hidradenitis suppurativa clinical response (HiSCR) rates of 41.8% for adalimumab versus 26.0% for placebo ($p = 0.003$) and 58.9% versus 27.6% ($p < 0.001$), respectively [69]. HiSCR is a validated outcome measure defined as $\geq 50\%$ reduction in total abscess and inflammatory nodule count, with no increase in abscess count [72]. Continuation of oral tetracyclines in PIONEER II may explain its higher response rates. Adalimumab reduces patient pain scores [73] and is associated with cost savings [74]. Among those who responded to adalimumab by week 12, half maintained response at week 36. Responders at week 36 tended to maintain response through 168 weeks of treatment [69, 75]. HLA type may predict antidrug an-

tibody formation to both adalimumab and infliximab [76]. Adalimumab biosimilars have been reported in HS [77].

Dosing/Duration. Adalimumab 40 mg weekly is more effective than 40 mg every other week [71, 78] and, if tolerated, may be continued indefinitely [69, 75]. The FDA-approved dose for adolescents ≥ 12 years may differ from adult dosing (Table 1) [79]. Patients without improvement by 12 weeks are unlikely to benefit from additional treatment [78].

Infliximab

Patient Selection. Infliximab is a chimeric monoclonal TNF- α antibody. It is a second-line therapy in patients with severe HS. In the authors' experience, infliximab is often helpful for patients failing adalimumab, possibly due to greater dosing flexibility.

Effectiveness. A single-center RCT of infliximab 5 mg/kg every 8 weeks demonstrated $\geq 25\%$ improvement in HS severity index in 12/15 (87%) patients on infliximab versus 2/18 (11%) on placebo as well as improvement in DLQI [80]. A systematic review of 71 reported cases found $\geq 50\%$ improvement in HS score in approximately 78% of patients [81]. A retrospective cohort study ($n = 52$) concluded that the starting dosing schedule of 10 mg/kg every 6–8 weeks is more effective than lower starting doses [82]. Elevated interleukin (IL)-6 and high-sensitivity C-reactive protein may predict a better response to infliximab [83].

Duration. With infliximab monotherapy, relapse occurs in approximately 50% of patients after a median of 37 weeks [81]. Antidrug antibody formation occurs in approximately 17% of patients after a mean of 13 months [84], and loss of clinical effectiveness associated with these antibodies often can be rescued with the addition of methotrexate 7.5–10 mg weekly [223]. In those who maintain a satisfactory clinical response, infliximab may be continued for long-term maintenance [85].

Apremilast

Patient Selection. The phosphodiesterase-4 inhibitor apremilast may be used as second-line therapy for patients with mild-to-moderate disease.

Effectiveness. One RCT ($n = 20$) demonstrated HiSCR in 8/15 (53%) patients receiving apremilast compared to 0/5 receiving placebo [86]. Similar results were reported in a prospective open-label phase 2 study of apremilast (HiSCR in 11/20, 55%) [87].

Duration. In published studies, apremilast was continued for 16–24 weeks.

Anakinra

Patient Selection. Anakinra, an IL-1 receptor inhibitor, may be used to treat moderate-to-severe HS.

Effectiveness. In one RCT, HiSCR was achieved at 12 weeks in 7/9 (79%) patients receiving anakinra versus 3/10 (30%) on placebo ($p = 0.02$) [88].

Duration. Twelve weeks after anakinra cessation, there was no significant difference in the anakinra versus placebo arms, suggesting that HS relapses upon cessation of therapy [88]. In a case series, in 2 patients with initial response to anakinra, response was lost after 3–7 years [89].

Secukinumab

Patient Selection. The IL-17 inhibitor secukinumab may be used to treat moderate-to-severe HS.

Effectiveness. In an open-label trial of patients with Hurley stage II and III HS, HiSCR was achieved at 24 weeks in 14/20 (70%) of patients [224]. Several case reports and a smaller open-label trial also demonstrated disease improvement with secukinumab use [101–105, 224].

Ustekinumab

Patient Selection. Those with moderate disease (versus severe) and lower expression of leukotriene A4 hydrolase may respond more favorably [90].

Effectiveness. In an open-label study of ustekinumab given to 17 patients with moderate-to-severe HS for 28 weeks, HiSCR-50 was achieved in 47% of participants 12 weeks after cessation of therapy [90]. The proportion of patients in whom HS had a very large or extremely large effect on daily life decreased from 71% at the beginning of the study to 59% [90]. A retrospective review ($n = 14$) of ustekinumab infused intravenously followed by subcutaneous maintenance dosing found that 71% of patients experienced $\geq 30\%$ improvement in DLQI and visual analog pain score [91]. A systematic review of ustekinumab use in HS found that 34/45 patients (76%) had improvement in physician-reported clinical outcomes and that 38/45 patients (84%) reported symptomatic improvement [225].

Etanercept

The ALLIANCE group recommends against etanercept use in HS [10]. The only double-blinded RCT of etanercept 50 mg twice weekly demonstrated no significant improvement in patient- or physician-reported outcomes [92]. Open-label trials of etanercept have shown mixed results using doses of 50–100 mg weekly [93–97].

Table 1. Summary of guideline recommendations for medical treatments in hidradenitis suppurativa

Treatment	North American [13] ^a	British [11] ^b	Alliance [10] ^c	EADV/ EDF [9] ^d	Dosing for adult patients	Ref.
<i>Topical treatments</i>						
Benzoyl peroxide	C, III	ND	ND	θ	Apply daily or b.i.d.	16
Chlorhexidine 4%	C, Expert	↑	ND	θ	Use as body wash once daily	–
Zinc pyrithione 1%	C, III	ND	ND	θ	Use as body wash once daily	123
Clindamycin 1%	C, II/III	↑	B, II	↑↑	Apply b.i.d.	14–16
Dapsone	C, Expert	ND	ND	θ	5% b.i.d. or 7.5% daily	124
Resorcinol 15% cream	C, III	ND	ND	↑	For flares: apply b.i.d.; maintenance: apply daily or b.i.d.	21, 22
Sodium fusidate 2%	ND	ND	ND	ND	t.i.d.; wash with antibacterial soap for 10 min, then apply ointment	125
<i>Systemic antibiotics</i>						
Dapsone	C, III	↑	C, IV	↑, 3rd line	100–200 mg q.d.	38, 126
Ertapenem	C, III	θ	C, IV	ND	1 g i.v. q.d. for 6 weeks	39, 40
Rifampin + clindamycin	B, II	↑↑	C, IV	↑↑	Clindamycin 300 mg b.i.d. Rifampin 600 mg q.d., 300 mg b.i.d., or 10 mg/kg q.d. Duration: 10–12 weeks	26–30
Rifampin + moxifloxacin + metronidazole	C, II	ND	C, IV	↑	Metronidazole 500 mg t.i.d. for 6 weeks Moxifloxacin 400 mg q.d. until 6 weeks after remission and ≥12 weeks + rifampin 10 mg/kg q.d. until 6 weeks after remission and ≥12 weeks	35, 36
Tetracyclines	C, II/III	↑↑	B, II	↑↑	Tetracycline 500 mg b.i.d. Doxycycline 50–100 mg b.i.d. Minocycline 100 mg b.i.d. + colchicine 0.5 mg b.i.d.	15, 112
<i>Steroids</i>						
Triamcinolone (intralesional)	C, III	↑	C, IV	↑	10 mg/mL, injected locally for acute nodules and abscesses 40 mg/mL 0.5 cc injected into sinus tracts Other concentrations unstudied, but likely effective.	41, 42, 127
Systemic corticosteroids	C, III	θ	C, IV	↑	As <i>adjunct</i> : Prednisone 10 mg qD tapered to minimum effective dose As <i>rescue/bridge</i> : Prednisone 0.5–1 mg/kg/D for several weeks Rescue in hospitalized patient: methylprednisolone 1 g IV qD ×3 days	44
<i>Hormonal therapies</i>						
Antiandrogen contraceptives	C, II	θ	ND	↑	No studies to direct dosing/selection of currently available options	45, 46
Finasteride	C, III	θ	ND	ND	Children: 1–5 mg/day; max. dose reported 10 mg/day Adults: 5 mg/day	47–50
Metformin	C, III	↑	ND	ND	500 mg daily, increased by 500 mg each week to max. dose of 500 mg t.i.d.	51, 52, 56
Liraglutide	ND	ND	ND	ND	0.6 mg s.c. daily increased by 0.6 mg weekly to max. dose 1.8 mg daily	55, 56
Spirolactone	C, III	θ	ND	ND	25–150 mg daily; most common dose: 75–100 mg daily	53, 54
<i>Systemic retinoids</i>						
Acitretin	B, II	↑	3rd line: C, IV	↑↑	0.5–0.6 mg/kg/day for 9–12 months	65–68
Isotretinoin	B, II	↓↓	ND	↓↓	0.5–1 mg/kg/day for 4–8 months British guidelines state only use if concomitant moderate/severe acne	57, 59–64

Table 1 (continued)

Treatment	North American [13] ^a	British [11] ^b	Alliance [10] ^c	EADV/EDF [9] ^d	Dosing for adult patients	Ref.
<i>Biologics</i>						
Adalimumab	A, I	↑↑	1st line: B, II	↑↑	Adults and adolescents ≥12 years old weighing >60 kg: 160 mg D1, 80 mg D15, then 40 mg weekly starting D29 Adolescents ≥12 years old weighing 30–60 kg: 80 mg D1, 40 mg D8, and 40 mg every other week starting D22 5–10 mg/kg at W0, W2, W6 and every 4–8 weeks thereafter 10 mg/kg every 6–8 weeks appears more effective than lower starting doses	69–71, 79
Infliximab	B, II	↑	2nd line: B, II	↑↑		81, 82, 128
Apremilast	ND	Θ	ND ^g	ND	10 mg on D1, increased by 10 mg/day until reaching the goal dose of 30 mg b.i.d.	86, 129
Anakinra	B, II	Θ	3rd line: B, II	ND	100 mg daily	88
Secukinumab	ND	Θ	ND	ND	300 mg weekly for 5 weeks, then every 2–4 weeks thereafter	101–105, 224
Ustekinumab	B, II	Θ	3rd/4th line: C, IV	Θ	45 mg (if ≤100 kg) or 90 mg (if >100 kg) on W0, W4, and every 12 weeks thereafter Intravenous infusion W0 (≤55 kg 260 mg; 56–85 kg 390 mg; >85 kg 520 mg); then, 90 mg s.c. every 8 weeks starting 8 weeks after induction	90, 91, 130, 225
Golimumab	C, III	ND	ND	ND	200 mg on D0, then 100 mg every 4 weeks thereafter	98, 99
Guselkumab	ND	ND	ND	ND	100 mg at W0, 4, and every 8 weeks thereafter	106, 131, 226
Etanercept	Not recommended: C, II	↓↓	Not recommended: B, II	↓↓	Not recommended	92–97
<i>Other medications</i>						
Azathioprine	Not recommended, III	Θ	ND	ND	Not recommended	132
Botulinum toxin	ND	ND	ND	Θ	Experimental	133, 134
Colchicine	C, III – only with minocycline	Θ	“Further investigation warranted”	↓↓	Minocycline 100 mg b.i.d. + colchicine 0.5 mg b.i.d.	112, 113
Cyclosporine	C, III	Θ	ND	↑: as 4 th -line therapy	2.0–3.5 mg/kg/day	114, 135
Methotrexate	Not recommended, III	Θ	ND	ND	Not recommended as monotherapy	136, 227
Zinc gluconate	ND	Θ	C, IV: with triclosan	↑	90 mg daily +/- topical triclosan 2% b.i.d.	108, 109

b.i.d., twice daily; EADV/EDF, European Academy of Dermatology and Venereology/European Dermatology Forum; ND, not discussed; D1, day 1; D15, day 15, etc.; W0, week 0; W2, week 2, etc.; ↑↑, strong recommendation for the use of an intervention or inclusion in primary treatment algorithm; ↑, weak recommendation for the use of an intervention; Θ, no recommendation – insufficient evidence to support any recommendation; ↓↓, strong recommendation against the intervention. ^a Recommendation level and evidence grade according to Strength of Recommendation Taxonomy (SORT) [137]. ^b Recommendations according to British Association of Dermatologists adoption of GRADE methodology [138]. ^c Levels of evidence and grades of recommendation according to Oxford Centre for Evidence-Based Medicine [139]. ^d Recommendation category defined by the authors’ review of narrative text and confirmed with the senior author of the EADV/EDF guidelines (GBEJ).

Table 2. Guidelines for lifestyle modifications in hidradenitis suppurativa

Lifestyle modifications	North American [13] ^a	British [11] ^b	Alliance [10] ^c	EADV/EDF [9] ^d
Smoking cessation	C, III	↑	A, I	↑
Weight loss	C, II	↑	C, IV	↑
Dairy avoidance	[C, III] ^e	Ø	ND	ND
Brewer's yeast avoidance	[C, II] ^e	Ø	ND	ND
Mechanical irritation/tight clothing avoidance	[C, III] ^e	↑	ND	Ø
Shaving/depilation avoidance	[C, II] ^e	ND	ND	ND

EADV/EDF, European Academy of Dermatology and Venereology/European Dermatology Forum; ND, not discussed; ↑, weak recommendation for the use of an intervention; Ø, no recommendation – insufficient evidence to support any recommendation. ^a Recommendation level and evidence grade according to Strength of Recommendation Taxonomy (SORT) [137]. ^b Recommendations according to British Association of Dermatologists adoption of GRADE methodology [138]. ^c Levels of evidence and grades of recommendation according to Oxford Centre for Evidence-Based Medicine [139]. ^d Recommendation category defined by the authors' review of narrative text and confirmed with the senior author of the EADV/EDF guidelines (GBE). ^e Text from North American Guidelines states that “insufficient evidence exists to recommend avoidance of dairy or brewer's yeast, vitamin D supplementation, avoidance of friction, deodorant, and depilation/shaving.”

Other Biologics – Golimumab and Guselkumab

Two case reports using the TNF- α inhibitor golimumab have been published. The report suggesting benefit used higher doses (200 mg i.v. followed by 100 mg i.v. every 4 weeks) than were used in the negative case report [98, 99].

Inflammatory pathways involving IL-23- and IL-17-producing T helper cells have been implicated in the pathogenesis of HS [100]. Guselkumab is a monoclonal antibody that targets subunit p19 of IL-23 and has been reported to ameliorate refractory moderate-to-severe HS [131, 226] but sometimes requires ≥ 4 months before improvement begins [106].

Other Medical Treatments

Zinc Gluconate

HS patients often have low zinc levels [107]. Two case series totaling 88 patients have demonstrated modest clinical and DLQI improvement among Hurley stage I/II patients treated with zinc gluconate 90 mg/day with or without topical triclosan 2% b.i.d. [108, 109]. Zinc's most common side effect is gastrointestinal discomfort. However, excessive zinc supplementation may cause copper deficiency, iron deficiency anemia, leukopenia, and neutropenia [110, 111].

Colchicine

A prospective case series of 20 patients demonstrated improvement in DLQI and patient global assessment using a regimen of minocycline 100 mg daily and colchicine

0.5 mg b.i.d. $\times$ 6 months, followed by colchicine 0.5 mg b.i.d. $\times$ 3 months [112]. The only prospective series of colchicine monotherapy 0.5 mg b.i.d. for up to 4 months demonstrated no clinically relevant improvement [113].

Cyclosporine

A retrospective case series of 18 patients treated with cyclosporine 2.0–3.5 mg/kg showed some benefit in half of the patients [114].

For a summary of guideline-based recommendations for medical management and lifestyle modifications in HS, see Tables 1 and 2. Studies of many promising agents in patients with HS are ongoing, including medications which target IL-1 α , IL-17, IL-23, complement, and Janus kinase-1. For an updated list of trials being conducted in the USA, visit www.clinicaltrials.gov.

Procedural Management of HS

Few high-quality studies of procedural interventions in HS exist. Hence, guidelines for procedural management are somewhat disparate (Table 3). This section discusses 3 procedures: neodymium-doped yttrium aluminum garnet laser (Nd:YAG), deroofting, and excision. Online supplementary videos (for all online suppl. material, see www.karger.com/doi/10.1159/000507323) demonstrating HS deroofting and excision are available in the online supplement.

Table 3. Summary of guideline recommendations for procedural management of hidradenitis suppurativa (HS)

Treatment	North American [12] ^a	British [11] ^b	Alliance [10] ^c	European [9] ^d	Patient selection/notes	Ref.
<i>Laser/Light therapy</i>						
Alexandrite (755 nm)	C, III	Ø	ND	ND	Hurley stage I/II; Fitzpatrick skin types I–III	140–142
Fractional ablative CO ₂ (10,600 nm), for scars	C, III	Ø	ND	ND	Treats chronic ulceration and improves range of motion after HS excision	143, 144
Diode (1,450 nm)	C, III	Ø	ND	ND	Fitzpatrick skin types I–VI	145
Intense pulsed light	C, III	Ø	ND	Ø	Hurley stage I/II; Fitzpatrick skin types I–III	23, 146, 147
Nd:YAG (1,064 nm)	B, II	Ø	ND	↑↑	Hurley stage I/II; Fitzpatrick skin types I–VI	16, 115, 116
Nd:YAG (1,064 nm) + fractional CO ₂	ND	ND	ND	ND	Hurley stage I/II	148
Photodynamic therapy	C, IV/III	Ø	ND	Ø	Wide variety in reported techniques and effectiveness	149, 150–161
Radiation, external beam	C, III	Ø	ND	ND	–	162–165
Radiofrequency	C, III	Ø	ND	ND	–	166
Fistula tract laser closure	ND	ND	ND	ND	Report of use in 2 cases of complex urethrovaginal fistula closures	167
Microwave ablation	ND	↓↓	ND	ND	Not recommended	168, 169
<i>Surgical procedures</i>						
Incision and drainage	C, II	ND	C, IV	ND	May relieve pain from acute abscess, but lesion almost always recurs	170, 171
Deroofing	B, II	ND	C, IV	↑↑	Relieves pain in acute abscess	170, 172–175
Skin-sparing excision with electrosurgical peeling (STEEP)	C, II	ND	C, IV	↑	Opening of sinus tracts in dermis	119, 176, 177
Electrosurgery	C, III	Ø	ND	ND	Removal of sinus tracts in dermis/fat	178
Surgical excision	B, II	↑	C, IV	↑↑	Removal of sinus tracts in dermis/fat	170, 171, 179–192
CO ₂ laser excision (10,600 nm)	C, II	Ø	C, IV	↑↑	Removal of sinus tracts in dermis/fat	193–197
Cryoaspiration	C, III	↓↓	ND	ND	Insufficient evidence to recommend	198–201
<i>Closure technique after excision</i>						
Secondary intention	C, II	↑	ND	↑	Patient/surgeon preference	202–206
Primary closure	C, II	ND	ND	↑	Patient/surgeon preference	207, 208
Flap	C, II	ND	ND	↑	Safest choice when arteries/major motor nerves exposed	209–215
Skin graft	C, II	↑	ND	↑	Patient/surgeon preference	215–219
Skin substitutes	C, II	ND	ND	ND	Patient/surgeon preference	220, 221
<i>Combination Therapy</i>						
Continue biologics pre- and post-operatively	ND	ND	C, IV	ND	Recommended for all patients on biologics prior to surgery	222

EADV/EDF, European Academy of Dermatology and Venereology/European Dermatology Forum; ND, not discussed; ↑↑, strong recommendation for the use of an intervention or inclusion in primary treatment algorithm; ↑, weak recommendation for the use of an intervention; Ø, no recommendation – insufficient evidence to support any recommendation; ↓↓, strong recommendation against the intervention. ^aRecommendation level and evidence grade according to Strength of Recommendation Taxonomy (SORT) [137]. ^bRecommendations according to British Association of Dermatologists adoption of GRADE methodology [138]. ^cLevels of evidence and grades of recommendation according to Oxford Centre for Evidence-Based Medicine [139]. ^dRecommendation category defined by the authors' review of narrative text and confirmed with the senior author of the EADV/EDF guidelines (GBE).

Fig. 1. Treatment of inguinal HS using Nd:YAG laser (1,064 nm). **a** Right medial thigh prior to treatment. **b** Right medial thigh following 3 treatments.

Fig. 2. Deroofing technique. **a** Following local anesthesia, a double-ended fistula probe is used to delineate the extent of a well-demarcated cutaneous sinus. **b** Iris scissor used over the top of the probe to open the sinus. **c** Removal of tissue overlying the sinus to create a beveled edge. **d** The dermal base of the sinus tract is left

intact after probing reveals no lateral extension. To ensure that the floor of the sinus tract remains intact, the contents of the sinus tract should be removed using gentle debridement or gauze grattage. **e** Wound after hemostasis using aluminum chloride solution and electrocautery. **f** Healed wound 5 weeks after deroofing.

Fig. 3. Comparison of sinus tract removal by excision versus deroofing technique. **a** Cross-sectional view of sinus tract prior to intervention. This sinus tract extends through the reticular dermis and closely approaches the subcutaneous fat. The base/floor of the sinus tract is outlined in purple, and the epithelium on the roof/top of the sinus tract is red. **b** Excision – the borders of the entire sinus tract are outlined clinically, and excision is extended to the subcutaneous fat. An intraoperative fistula probe is used to detect any additional interconnecting tracts, and the margins are extended laterally if appropriate. **c** Excision – surgical defect after exci-

sion. Note, the base of the sinus tract is completely removed in HS sinus tract excision. **d** Deroofing – scissors are used to remove the epithelium overlying the sinus tract. **e** Deroofing – after the entire roof of the sinus tract is removed and probing reveals no further extension, gelatinous material is removed from the sinus tract using gentle gauze grattage. Rough debridement may result in defects in the floor of the sinus tract, which prolongs healing time. **f** Deroofing – surgical defect after deroofing. The epithelium at the base of the sinus tract, marked in purple, remains intact.

Nd:YAG Laser

Long-pulsed Nd:YAG (1,064 nm) causes selective photothermolysis of the follicular unit (Fig. 1). One RCT demonstrated a 65% reduction in disease severity after 3 monthly treatments, with better results in Hurley stage II disease and in inguinal and axillary sites [16, 115, 116]. Recommended starting settings are based on Fitzpatrick skin type (types I–III: fluence 40–50 J/cm², pulse duration 20 ms, spot size 10 mm; types IV–VI: fluence 35–50 J/cm², pulse duration 35 ms, spot size 10 mm) [117]. Nodules should be treated with double pulsing, while background lesional skin is treated with a single pulse.

Deroofing

Deroofing is a tissue-sparing technique used to treat recurrent HS lesions. See Figure 2 for description and

photographs of the procedure and online supplementary video 1 for video demonstration. A meta-analysis estimated the recurrence rate after deroofing at 27.0% [118].

Skin-Sparing Excision with Electrosurgical Peeling

Skin-sparing excision with electrosurgical peeling is a tissue-sparing technique in which an electrosurgical wire loop is successively passed over the sinus tract in tangential sections until the epithelialized floor of the sinus tract is exposed [119]. Similar to deroofing, the aim of skin-sparing excision with electrosurgical peeling is to remove all lesional tissue and scar, while leaving the epithelialized floor of the sinus tract and the subcutaneous fat intact.

Excision

Unlike deroofing, excision removes tissue to the depth of subcutaneous fat to completely eliminate the sinus

Fig. 4. Wound healing following surgical excision of HS sinus tract. **a** Prior to excision. **b** Postoperative day 4. **c** Postoperative week 6. **d** Postoperative month 4.

tract (Fig. 3, and 4, online suppl. video 2). Anesthesia with local infiltration or tumescent technique reduces the risk of bleeding and toxicity in larger surgical cases. Excision is performed using a scalpel, electrosurgery, or ablative CO₂ laser (10,600 nm). Debulking using the CO₂ laser may offer improved hemostasis and visualization of the operative field (Fig. 5). CO₂ laser settings for vaporization or excision of sinus tracts are fluence 55 W, continuous wave pulse duration. A meta-analysis estimated HS recurrences at 22.0% following local excision and 13.0% following wide excision [118]. Although not commonly available, ultrasound characterization of a fistula may inform its likelihood of responding to medical therapy and may aid in identifying surgical candidates [120].

Closure Techniques

There is no consensus regarding the optimal closure technique following HS excision. Closure techniques frequently employed include secondary intent healing, primary linear closure, graft, and flap. The closure technique may be selected based on patient preference and provider assessment of perioperative risks including bleeding, infection, dehiscence, graft necrosis, and preservation of function/range of motion.

Fig. 5. Wound healing following CO₂ excision of right axilla. **a** Prior to excision. **b** Immediately after surgery. **c** Postoperative day 3. **d** Postoperative week 2. **e** Postoperative week 3. **f** Postoperative week 30.

Conclusion

HS is a chronic inflammatory disease with substantial impact on quality of life. Evidence-based guidelines provide insight into best management practices, yet remain limited by low-quality evidence and lack of standardized outcome measures. The dermatologic community's understanding of HS pathophysiology and therapeutic targets is rapidly evolving, providing a rationale for the many promising therapies in ongoing clinical trials [121, 122].

Key Messages

Few hidradenitis suppurativa treatments outside of adalimumab are currently supported by high-quality randomized clinical trials, contributing to divergence in international treatment guidelines. This article reviews evidence for implementing best practices in HS treatment in the general dermatology clinic.

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Author Contributions

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