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Practical Guidelines for Managing Patients With Hidradenitis Suppurativa: An Update

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Abstract

Hidradenitis suppurativa (HS) is a chronic, inflammatory skin disease that is characterized by the formation of comedones, papules, nodules, abscesses and sinus tracts in the axillary, inframammary, groin, and gluteal areas. Up to 3.8% of the Canadian population has HS, though due to a lack of awareness of HS, many patients are initially misdiagnosed and do not receive adequate treatment early on in the disease course. Once a diagnosis of HS is made, developing an effective management plan can be a dilemma for many providers. There is significant variability in response to any given therapy within the HS patient population and many HS patients have other medical comorbidities which must be taken into consideration. The aim of this review is to provide a practical approach for all healthcare providers to diagnose and manage HS and its associated comorbidities. A sample electronic medical record template for HS management was developed by the Canadian Hidradenitis Suppurativa Foundation Executive Board and is intended for use in clinical settings. This will help to increase collaboration between primary healthcare providers, dermatologists, and other medical specialists and ultimately improve the quality of care that HS patients receive.

Keywords

hidradenitis suppurativa, guidelines, review

Introduction

Hidradenitis suppurativa (HS) is a chronic, inflammatory skin disease that is characterized by comedones, papules, nodules, abscesses and sinus tracts in areas of the body that have a high density of apocrine sweat glands.[1] HS typically presents in adolescents and young adults and is more common in females.[1] The prevalence of HS in Canada is estimated to be up to 3.8% of the general population.[2]

The pathogenesis of HS results from impaired functioning of the pilosebaceous-apocrine unit.[3] This leads to hyperkeratinization, occlusion, dilation and rupture of the hair follicle, which activates a local immune response and causes the formation of inflammatory lesions.[3] Genetic mutations involving γ-secretase/the notch signaling pathway, excess androgen activity, menstrual cycle hormonal fluctuations, systemic inflammation, high carbohydrate/glycemic index diets, skin friction, excessive sweating, cigarette smoking/nicotine consumption and lithium are potential triggers for HS.[1,3-9]

HS can progress in severity if left untreated, leading to chronic pain, reduced mobility and a poor overall quality of life.[10] Early recognition and effective treatment of HS is essential to reduce the burden of this disease on patients and their caregivers. However, recent studies have found that many HS patients visit multiple different healthcare providers over an average of 7 years before being diagnosed with

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Table 1. Diagnostic Criteria for Hidradenitis Suppurativa.

Criterion for diagnosis	Description
1) Lesion Morphology	Single or double open comedones, papules, nodules, abscesses, sinus tracts, fistulas and scarring.
2) Distribution of Lesions	Axillary, inframammary, groin, perineal and gluteal regions. Less common locations include the nape of the neck and lower abdomen.
3) Chronicity and Recurrence	More than two lesions during a time period of ≥ 6 months.

HS.[11] After a diagnosis of HS has been made, developing an effective management plan can be challenging. A 2020 survey found that 61% of HS patients reported dissatisfaction with current treatment options after previously trialling an average of 15 different therapies.[11] Due to the variety of aggravating factors for HS and high comorbidity burden, a combination of different treatment modalities may be necessary to achieve disease control.[3] Understanding the challenges associated with HS, common comorbidities and current evidence for treatment options can help to improve the quality of care provided to HS patients by both dermatologists and primary care physicians.

Methods

PubMed, Embase, and MEDLINE databases were searched for articles on comorbidities and management options for HS. Studies published in English prior to November 2021 were included. Systematic reviews and randomized control trials (RCTs) were preferred sources. However, given the paucity of evidence and lack of RCTs supporting many HS treatments, prospective and retrospective studies, case reports, and expert opinion statements were also included. Included studies were independently reviewed and data was extracted by the first and last authors (LJ and SP). The final manuscript was reviewed by a panel of six dermatologists (RA, MB, ID, EO, SMW, SP) and one general surgeon (RG) on the Canadian Hidradenitis Suppurativa Foundation Executive Board.

Diagnosis and Assessment of HS Severity

Three diagnostic criteria must be met in order to diagnose HS: (1) characteristic lesion morphology (2) characteristic distribution of lesions (3) chronicity and recurrence (Table 1).[12,13] If a patient meets all three diagnostic criteria, there is a 90% sensitivity and 97% specificity for a correct diagnosis of HS.[13,14]

The severity of HS is most often assessed using the Hurley staging system (Table 2).[13,15] There are three Hurley stages of HS, which indicate mild (stage I), moderate (stage II) and severe (stage III) disease. The dermatology life quality index (DLQI) and the visual analog scale (VAS) for pain are also used to assess the impact of HS on patients' daily lives.[13]

Ultrasonography is an emerging diagnostic modality for HS that may be beneficial in identifying signs of more severe disease.[16] Some features, including fistulous tracts and signs of active inflammation, can be observed using doppler ultrasound but are not always apparent on clinical examination.[16] A recent study found that ultrasonography led to restaging from Hurley stage I to stage II or III in 44.7% of patients (n = 143), ultimately leading to changes in treatment plans.[16,17]

Comorbidities Associated With HS

HS is associated with an increased prevalence of multiple medical comorbidities.[3,18-21] HS patients should be assessed for common comorbidities, in order to understand patient-specific factors that contribute to HS pathogenesis and to create treatment plans that will be effective in managing both HS and any comorbid conditions. See Appendix A/B for recommended comorbidity screening.

Inflammatory Bowel Disease (IBD)

Compared to the general population, people with HS are at a 2-fold increased risk of developing Crohn's disease and 1.5-fold increased risk of ulcerative colitis (Chen et al. 2019, n = 93,601, Crohn's disease OR 2.12, 95% CI 1.46-3.08; ulcerative colitis OR 1.51, CI 1.25-1.82).[22,23] In a cohort of 109 pediatric HS patients, 48.6% reported gastrointestinal symptoms and 11.3% of these patients had been previously diagnosed or subsequently received an IBD diagnosis.[24] Biochemical evidence supports that

Table 2. Hurley Staging System for Hidradenitis Suppurativa.

Hurley stage	Description
I	Abscess formation, single, or multiple, without sinus tracts and cicatrisation.
II	Recurrent abscesses with tract formation and cicatrisation, single or multiple, widely separated lesions.
III	Diffuse or near-diffuse involvement, or multiple interconnected tracts and abscesses across the entire area.

there are common genetic and inflammatory cytokine pathways involved in the pathogenesis of both HS and IBD, including increased production of TNF-α, IL-1, IL-6, IL-17, and IL-23.[22,23] Anti-TNF-α biologics are frequently used in the management of both conditions and IBD patients with comorbid HS are more likely to require biologic treatment to achieve disease control.[25]

Polycystic Ovarian Syndrome (PCOS)

One large cross-sectional study found that the prevalence of PCOS in female HS patients (n = 22,990) was 9.0% (OR 2.14, 95% CI 2.04-2.24) compared to 2.9% in the general population.[26,27] Hyperandrogenism is pathogenic in PCOS and can also worsen HS.[26-28]

Diabetes Mellitus (DM)

Two recent systematic reviews and meta-analyses found that there is about a 2-3-fold increased risk of DM in HS patients (Bui et al. 2018, *n* = 104,373, OR 2.78, 95% CI 1.79-4.31; Phan et al. 2019, OR 2.17, 95% CI 1.85-2.55), with most patients developing type 2 DM.[29,30] One study found that up to 75% of HS patients (*n* = 53) had biochemical evidence of insulin resistance.[31,32] Type 1 DM may also be more common in HS patients, however, this tends to precede the onset of HS.[33]

Thyroid Disease

There is an increased prevalence of both hypothyroidism and hyperthyroidism in HS patients.[21,34-36]

Inflammatory Arthritis

Rheumatoid arthritis, psoriatic arthritis, and ankylosing spondylitis are more common in HS patients.[21,37-39] A 2021 meta-analysis found that the total prevalence of inflammatory arthritis is about 1.9% in the HS patient population (95% CI 0.58-6.12).[37]

Obesity

There is an association between obesity and HS.[40-45] Obesity may worsen HS due to increased sweating, skin friction, number of skin folds, insulin resistance and systemic inflammation.[43] If patients are overweight or obese, counselling on weight loss and referral to a registered dietitian may be beneficial. In one study of HS patients who lost 15% or more of their body weight (n = 35), about 50% of patients went into clinical remission and another 20% saw improvement in their HS.[41] However, not all patients with HS are overweight or obese, and the development of HS is often multifactorial.

Metabolic Syndrome

HS is associated with features of metabolic syndrome, including hypertension, hyperlipidemia, hyperglycemia, and abdominal obesity.[46,47]

Acne

HS patients are three times more likely to report a history of acne, including acne vulgaris, acne conglobata and acne fulminans (OR 3.44, 95% CI 1.95-6.07).[48] People with HS are also more likely to develop other conditions within the 'follicular occlusion tetrad,' which includes HS, pilonidal sinus/cysts, dissecting cellulitis of the scalp, and acne conglobata.[49]

Pyoderma Gangrenosum

Pyoderma gangrenosum is associated with Crohn's disease, with a prevalence of 3.68% in patients with both HS and Crohn's disease (*n* = 48/1305, OR 12.38, 95% CI 9.15-16.74) and 0.12% (*n* = 77/66,927, OR 26.51, 95% CI 21.07-33.36) in HS patients without Crohn's disease.[50] HS is part of the rare genetic syndrome 'PASH,' which includes pyoderma gangrenosum, acne, and HS.[50]

Depression and Anxiety

A recent meta-analysis (*n* = 40,307) found that 16.9% of HS patients met diagnostic criteria for depression (95% CI 9.9%-27.2%) and 4.9% met diagnostic criteria for generalized anxiety (95% CI 1.7%-13.2%).[51] Contributing factors to psychiatric comorbidities may include health anxiety, stress from chronic disease management, pain, disability, financial concerns, negative body image, social stigmatization and sexual dysfunction.[51,52]

Anemia

HS has been associated with anemia of chronic disease and iron deficiency anemia.[21,53-57] Anemia may also occur with excessive zinc supplementation and resulting copper depletion, which HS patients may be at risk for developing due to the use of zinc supplementation as a HS treatment.[58,59]

Medical Complications of HS

Squamous Cell Carcinoma (SCC)

Patients with vulvar, perineal and/or perianal disease may have an increased risk of SCC.[60-62] SCC often arises after years of chronic inflammation and may be more advanced at presentation due to diagnostic delay.[62]

Lifestyle Modifications

Avoiding Potential Triggers

Common patient-reported triggers for HS flare-ups include stress, diet, exercise, sweating, smoking, weight gain, menstruation and skin friction.[5] Healthcare providers should inquire about specific triggers that each individual HS patient has observed and advise lifestyle changes to mitigate these factors.

Smoking Cessation

Cigarette smoking is a risk factor for HS.[63,64] Up to 70-75% of HS patients report current smoking and an additional 10-15% have a past history of smoking.[40] Smoking tobacco products is associated with a poorer response to treatment and a higher number of areas of involvement compared to HS patients who have never smoked or quit smoking.[65,66] Chemicals from tobacco smoke may increase inflammatory cytokine production, while nicotine-mediated activation of nicotinic acetylcholine receptors surrounding the pilosebaceous-apocrine unit can increase follicular occlusion.[65,67] Improvement in disease severity has been observed in patients who quit smoking.[68]

Pharmacological smoking cessation agents include nicotine replacement therapy (NRT), bupropion, and varenicline.[69] Bupropion is a norepinephrine-dopamine reuptake inhibitor and nicotinic acetylcholine receptor antagonist that is also used to treat depression.[70] Previous studies have observed an anti-inflammatory effect of bupropion, including a reduction in TNF-α levels, which may benefit HS patients.[70-73] As nicotine can worsen HS, it may be best to only use NRT for a short interval to manage acute withdrawal symptoms or use alternative agents.[68] Psychological interventions with demonstrated efficacy in smoking cessation include cognitive behavioral therapy, motivational interviewing, and support groups.[74,75]

Exercise, Clothing, Hair Removal and Menstrual Products

Pain and mobility restriction may limit exercise ability for some HS patients. Increased sweating and friction may also trigger HS flare-ups.[5] Activities which limit sweating and friction in the skin folds, such as swimming or yoga, may be preferable.[76] Patients should wear exercise clothing that is form-fitting in the skin folds, choose items composed of moisture-wicking fabrics, such as polyester, spandex or polypropylene, and use anti-friction creams and balms.[76,77] Hyperhidrosis treatments, including deodorants for sensitive skin and botulinum toxin injections, can reduce the impact of excessive sweating on disease activity.[76,78] High absorbency shorts and undergarments, which are produced by clothing manufacturers such as Knix™, can help to reduce skin-to-skin friction and prevent leakage if there are draining lesions.[79] Patients should also be counselled to avoid shaving or waxing in areas with HS lesions and use tampons or menstrual cups to reduce local skin irritation.[76]

Dietary Modification

Some patients report that dietary changes can alter disease activity. In one study, over 75% of HS patients reported eliminating at least one food from their diet, with some patients altering consumption of multiple food groups.[5,80] Limited studies have been done to investigate outcomes of specific dietary interventions in HS patients. Low glycemic index and low dairy diets have the most supporting evidence.[81,82]

Sugar and refined carbohydrate intake should be limited, as this can trigger a rapid increase in blood glucose levels and a subsequent elevation in insulin and insulin-like growth factor 1 (IGF-1).[81–84] Insulin and IGF-1 can increase androgen levels and androgen receptor sensitivity, leading to follicular occlusion.[81–83] Dairy products contain natural androgens as well as whey and casein proteins, which also increase insulin and IGF-1.[81,85] A previous study found that 83% of participants (n = 47) had improvement of their HS after following a dairy-free diet.[86] In studies on milk product consumption in acne patients, skim milk produced the highest increase in insulin response and was associated with worsening of acne, which may be due to its higher concentration of whey protein.[87-89] Whey protein shakes have also been associated with worsening acne in athletes, therefore limiting these products may benefit HS patients.[90,91]

The Mediterranean diet may also be beneficial for HS patients, as it confers a protective effect against cardiovascular and metabolic disease.[92] One study found that people with HS, especially those with more severe disease, consumed fewer Mediterranean diet foods than people without HS.[93] Other dietary modifications with support from small studies or patient surveys include wheat and brewer's yeast elimination diets, nightshade elimination, and the autoimmune protocol diet.[5,81,94,95] However, current evidence is insufficient to recommend these dietary strategies to HS patients.[81]

Supplements

Zinc, vitamin D, and myo-inositol have been investigated as potential HS treatments.[80] Serum zinc deficiency is more common in HS patients, especially in severe disease.[96] Multiple studies have found that supplementation with 90-100 mg zinc gluconate is effective in improving HS.[97-100] However, excess zinc consumption may result in copper deficiency within months of use, which may lead to

anemia, neutropenia, and if prolonged, neurological symptoms.[58,59,101,102] HS patients should consider concurrently taking copper supplements to prevent copper deficiency.[58,59,101,103] In addition, clinical studies have investigated the use of zinc supplements in HS for only up to 3-4 months, therefore, we recommend limiting this treatment to a few months' duration.

Vitamin D deficiency is more common in HS patients, especially in severe disease, and supplementation may be beneficial.[80,104] Myo-inositol and riboflavin (vitamin B2) supplements may help to reduce insulin resistance.[80,105-108] Curcumin, although not previously studied in HS patients, may be helpful in reducing levels of inflammatory cytokines and managing pain.[80,109,110]

Medical Treatments

Medical treatments should be optimized according to disease severity. Although topical therapies may be effective in managing mild disease, or as an adjunct treatment in more severe disease, systemic therapy is usually necessary in moderate to severe HS. In mild cases that are refractory to topical therapy, patients should be offered systemic agents. A recommended stage-specific approach for HS management is included in Figure 1.

Topical Skin Cleansers

Topical over-the-counter skin cleansers with anti-inflammatory and antibacterial effects have been supported as HS treatments by expert opinion or small case series but have not been been studied in clinical trials. These products include benzoyl peroxide, zinc pyrithione, chlorhexidine, and triclosan (Table 3).[99,111-119]

Topical Resorcinol

Resorcinol is a topical chemical peeling agent that has been used to treat acne and is included in over-the-counter anti-aging products.[120] One clinical study (n = 61) found that daily application of 15% resorcinol cream in an oil/water base over a 12 week period reduced the number of inflammatory nodules and abscesses by over 80% in patients with Hurley stage I and II HS.[121] Resorcinol also has shown efficacy in reducing HS-related pain and the size of sinus tracts.[121–123] Applying resorcinol within hours of onset of an acute HS flare-up can also reduce the severity and time to resolution of new nodules.[122] Patient satisfaction ratings of resorcinol are high and ongoing use is well-tolerated.[124]

Topical Antibiotics

Clindamycin is the most common topical antibiotic prescribed to treat HS.[111] Daily application of 1% topical clindamycin phosphate can reduce the number of inflammatory nodules and abscesses in mild to moderate HS and may have comparable efficacy to oral tetracycline antibiotics.[125,126] Topical clindamycin can be prescribed in combination with benzoyl peroxide.[114,115] Topical dapsone has also been supported by expert opinion and warrants further study.[111,114] A potential concern with long-term use of topical antibiotics is antibiotic resistance.[123,127]

Topical Retinoids

Topical retinoids are vitamin A derivatives that are used to treat acne vulgaris.[112,128] No studies have been done to evaluate the use of topical retinoids in HS management, though expert opinion suggests that topical adapalene or tazarotene may be beneficial in treating HS due to their anti-inflammatory and keratolytic effects.[112,116,117] Topical adapalene has efficacy in treating post-inflammatory hyperpigmentation and atrophic acne scars, which may be beneficial for reducing the appearance of HS scars.[129–131]

Oral Contraceptive Pills

Combined oral contraceptive pills (OCPs) with a high estrogen to progesterone ratio and anti-androgenic progesterones, such as drospirenone or cyproterone acetate, have been used to treat HS in female patients of child-bearing age.[132–135] The anti-androgenic activity of these OCPs is thought to be beneficial in reducing hormonal imbalances and the pro-inflammatory effects of excess androgens.[132] In Canada, three anti-androgenic OCPs are available for off-label treatment of HS: Yasmin®, Yaz® and Diane-35® (Table 4).[136–138]

One study reported that 62.4% of women with HS experienced worsening of symptoms before or during the menstruation phase of their menstrual cycles.[139] For women who report menstrual flaring, an extended birth control regimen that consists of daily OCP use for 84-126 days may help to reduce the frequency of flare-ups.[103] Progesterone-only contraceptive methods, including OCPs, hormonal IUDs, injections and implants are not recommended due to reports of worsening HS from the pro-androgenic effects of unopposed progesterone activity.[111,139] A similar effect was observed in acne patients who used progesterone-only contraception.[140–142]

Spironolactone

Spironolactone is a potassium-sparring diuretic that also acts as an androgen receptor antagonist.[132,143–146] Spironolactone is used to treat hormonal acne in female patients.[147,148] In a previous study of 20 female HS patients, 17 saw improvement in disease severity on spironolactone (100-150 mg daily) and 11 (55%) went into complete disease remission.[143] Hyperkalemia is a potential risk with spironolactone treatment, though this risk is low in individuals under the age of 45 with normal renal function, and therefore routine monitoring of electrolytes is not required in these patients.[147,148]

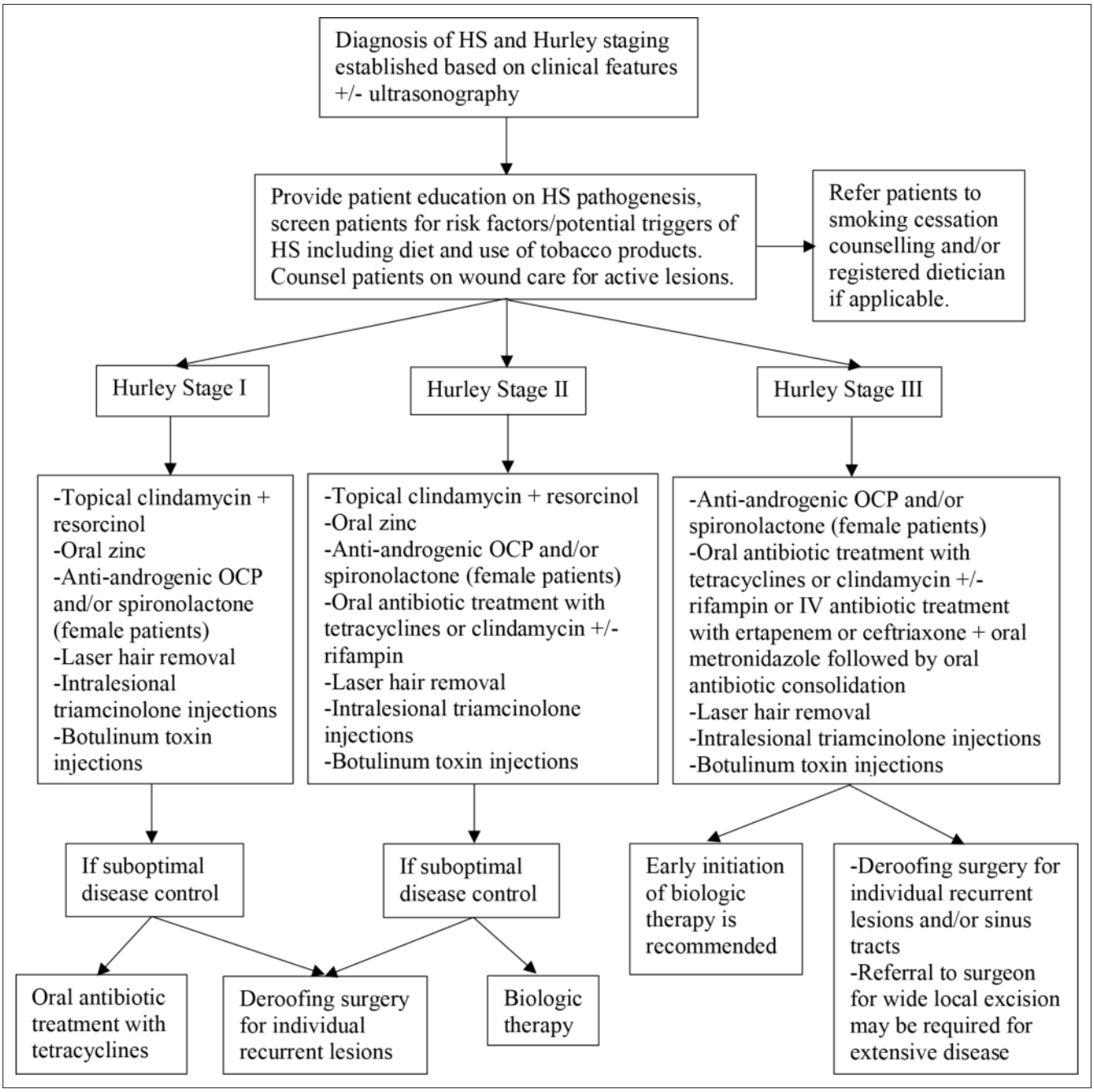

Figure 1. A Stage-Specific Approach to HS Management.

Spironolactone may lead to menstrual irregularities, which can resolve with concurrent OCP use.[147] Spironolactone is not typically used in male patients.[146]

Finasteride

Finasteride is an anti-androgen that blocks conversion of testosterone to dihydrotestosterone by 5α-reductase and is used to treat androgenic alopecia, hirsutism and prostate enlargement.[132] Finasteride has been successfully used in both female and male HS patients and has shown promise in pediatric HS patients.[149–154] Caution should be used in adolescent males, as the long-term effects of finasteride on fertility are unknown in this age group.[149,151,152] Finasteride is contraindicated in pregnancy but has not been shown to have any long-term effects on fertility in women of child-bearing age.[149,154]

Table 3. Topical Treatments for HS.

Medication	Mechanism	Drug delivery route	Side effects and contraindications	References
Benzoyl peroxide	Antibacterial, keratolytic	Topical 5% to 10% wash	Skin irritation, stinging, erythema, xerosis, desquamation.	111–115
Zinc pyrithione	Anti-androgenic anti-inflammatory, antibacterial	Topical 1% shampoo	Skin irritation, stinging, xerosis, desquamation.	116–118
Chlorhexidine	Antibacterial	Topical 4% wash	Skin irritation, stinging, xerosis, desquamation, erythema.	111,117,119
Triclosan	Antibacterial	Topical 2% wash	Skin irritation, stinging, xerosis, desquamation, erythema.	99,117
Resorcinol	Keratolytic, anti-inflammatory, antibacterial	Topical 15% cream	Skin irritation, reversible brown discoloration, xerosis, desquamation. Unknown safety in pregnancy.	117,121–124,184
Clindamycin phosphate	Antibacterial	Topical 1% solution, gel or lotion	Skin irritation, stinging with application.	111,114,115,117,125–127
Topical retinoids	Keratolytic, anti-inflammatory	Topical 0.3% gel (adapalene)	Skin irritation, xerosis, erythema, desquamation, photosensitivity. Avoid use during pregnancy.	112,113,117,128–131

Metformin

Metformin is an oral anti-hyperglycemic agent which has demonstrated efficacy in improving HS.[31,155] A previous study found that 68% (n = 36/53) of patients had clinically significant improvement in their HS while on metformin monotherapy.[31] The hypothesized mechanism is that metformin reduces insulin resistance, which can lower androgen levels.[31]

Oral Antibiotics

Although HS lesions tend to be sterile, oral antibiotics are often used as a first-line treatment for HS due to their anti-inflammatory effects.[117] Oral antibiotics used to treat HS are summarized in Table 5.[103,111,156–159] Tetracycline antibiotics are often used in mild to moderate HS, while clindamycin/rifampicin is typically used in more severe disease.[111,113,156] However, one study comparing tetracycline antibiotics to clindamycin/rifampicin found that both options may be equally effective for advanced disease.[156] Other antibiotic options with demonstrated efficacy include triple combination therapy with moxifloxacin, metronidazole and rifampin, as well as oral dapsone.[103,111,159–162] For patients with severe, refractory HS, intravenous broad-spectrum antibiotics such as ertapenem and ceftriaxone may be used as an induction treatment prior to consolidation with oral antibiotics.[111,163–167]

It is recommended that oral antibiotic treatment be limited to a maximum period of 12 weeks.[167] With the availability of other effective systemic medications, including anti-androgens and biologics, repeated courses of antibiotics are a less favorable option. A previous study found that anti-androgen therapy had a higher success rate than oral antibiotic treatment in controlling HS, with the benefit of being safe for long-term use.[168] Disease relapse after antibiotic treatment is common, with about 59% of patients (n = 10/26) relapsing within one year (mean time of relapse = 4.2 months) after a 3-month course of clindamycin/rifampin.[169] Antibiotic resistance is another major concern and therefore antibiotics should be used primarily as a bridge to other therapies and for pre-surgical disease control.[127,159]

Oral Retinoids

Isotretinoin is a vitamin A derivative that is used to treat acne vulgaris.[170] Evidence on the efficacy of isotretinoin in treating HS is inconclusive, with North American clinical practice guidelines listing isotretinoin as a second or third-line agent, while European guidelines recommend against isotretinoin use.[111,113] Some studies have found isotretinoin to be beneficial in completely or partially inducing remission of HS.[117,170–174] In contrast, other studies found that isotretinoin was not effective for most patients and in some cases, worsening of HS was observed.[175–179] In some patients, co-existing acne improved on isotretinoin while no improvement was seen in their HS.[175]

Acitretin and alitretinoin have shown greater efficacy in treating HS compared to isotreinoin.[113,117,180–183] One prospective series found that all 12 patients experienced improvement of their HS, with 9 patients experiencing no recurrence at 6 months post-treatment.[181] Patients who previously did not respond to isotretinoin had significant improvements on acitretin.[181] However, due to the teratogenic effects of acitretin, it is not ideal for use in women of child-bearing age, as they must avoid becoming pregnant for up to 3 years following treatment cessation.[181,183] Alitretinoin is a newer oral retinoid that has shown promise in managing HS. One clinical study found that 78.5% of patients (n = 14) had significant improvement on alitretinoin.[183] Alitretinoin is preferable to acitretin in women of child-bearing age due to its shorter half-life.[183,184] Oral retinoids are contraindicated in pregnancy and should not be prescribed concurrently with tetracycline antibiotics due to risks of pseudotumor cerebri.[185,186]

Intralesional Corticosteroid Injections

Intralesional triamcinolone acetonide (Kenalog®) injections can be beneficial in reducing pain and time to

Table 4. Oral Hormonal and Anti-Hyperglycemic Medications for HS.

Medication	Mechanism	Daily dose	Side effects	Contraindications	References
Drospirenone OCPs (Yasmin®, Yaz®)	Androgen receptor antagonist, menstrual cycle regulation	Yasmin®: 30 mcg ethinyl estradiol plus 3 mg drospirenone Yaz®: 20 mcg ethinyl estradiol plus 3 mg drospirenone	Breast sensitivity, nausea, headache, menstrual irregularities, hyperkalemia (rare)	Smoking and > 35 years old (high VTE risk), pregnancy, breast cancer, history of cerebrovascular or cardiovascular or thromboembolic disease, renal impairment, liver disease, migraines with aura	114,132,135–137,269,270
Cyproterone acetate OCPs (Diane-35®)	Androgen receptor antagonist, menstrual cycle regulation	35 µg ethinyl estradiol plus 2 mg cyproterone acetate	Same as drospirenone OCPs	Same as drospirenone OCPs	103,132–134,138,270
Spironolactone	Androgen receptor antagonist	50-200 mg (50100 mg with concurrent use of drospirenone OCP)	Breast sensitivity and enlargement, nausea, diarrhea, hypotension, fatigue, dizziness, increased urination, menstrual cycle irregularities, hyperkalemia (rare)	Pregnancy (potential feminization of a male fetus), male patients, severe renal disease (hyperkalemia)	103,132,143–148
Finasteride	5α-reductase inhibitor	5-10 mg	Breast enlargement and sensitivity, dizziness, headache, nausea, menstrual irregularities	Pregnancy (potential feminization of a male fetus)	132,149–154
Metformin	Antihyperglycemic agent	500-1500 mg (Maximum dose: 1500-3000 mg)	Nausea, GI upset, diarrhea, lactic acidosis (rare)	Severe renal, cardiac or liver disease, metabolic acidosis	31,155

Abbreviations: GI, gastrointestinal; OCP, oral contraceptive pill; VTE, venous thromboembolism.

resolution of HS nodules.[187–195] Typically, a concentration of 10 mg/ml is used, with a maximum total dose of 40 mg per treatment session.[111,113,187,194,196] Allowing HS patients to book urgent fit-in appointments to receive intralesional corticosteroid injections can help to manage acute flare-ups and may reduce the need for patients to present to emergency care settings.[195]

Botulinum Toxin Injections

Botulinum toxin (BTX) is a FDA-approved treatment for axillary hyperhidrosis.[78] One study found that 55% of HS patients reported focal hyperhidrosis in areas where they had HS lesions and patient surveys often report excessive sweating as a trigger for flare-ups.[5,78] Results from six previous case reports, one prospective analysis and one pilot RCT indicate that BTX injections may be a beneficial treatment for HS.[78,197–203] Notable reductions in the number of HS lesions and patient-reported pain, healing of sinus tracts and improvements in DLQI have been reported.[78,197–203] Treatment sites included the axillary, inframammary, groin and gluteal areas and treatments were repeated every 3-10 months, with no loss of efficacy.[78,197–203] No complications with BTX treatment were reported in any of the studies.

Laser Hair Removal

Laser hair removal (LHR) uses specific wavelengths of light to selectively target and destroy hair follicles.[204,205] Multiple RCTs have found that monthly long-pulse Nd:YAG LHR treatments are effective in progressively improving HS, with no post-procedure recovery time required and high post-treatment patient satisfaction ratings.[115,204–209] Cost is a significant barrier to accessing LHR, as a single treatment session may cost hundreds of dollars and LHR is often not covered by medical insurance plans.[210]

Photodynamic Therapy

Intralesional photodynamic therapy (PDT) can be performed by injecting 5-aminolevulinic acid (5-ALA) or methylene blue (MB) into individual lesions, followed by fiber optic laser illumination. Intralesional PDT has demonstrated some improvement of HS lesions in small clinical studies.[113,211–215] Further study is needed to assess the efficacy of PDT in treating HS.

Biologics

Adalimumab (Humira®) and its biosimilar versions) is an injectable TNF-α inhibitor which is currently the only FDA-approved biologic for HS.[167,216–220] It is indicated for the treatment of moderate to severe HS in patients ≥ 12 years of

Table 5. Oral and Intravenous Antibiotics Used to Treat HS.

Medication	Daily dose and duration	Common side effects	Contraindications	References
Doxycycline	100-200 mg PO QD x 12 weeks	GI upset, diarrhea, photosensitivity, vaginal candidiasis, pseudotumor cerebri	Allergy, children ≤ 9 years old, pregnancy	103,111,156,157,159,271
Minocycline	100 mg PO QHS x 12 weeks	GI upset, diarrhea, photosensitivity, tinnitus, headache, hepatitis, vaginal candidiasis, pseudotumor cerebri, lupus-like syndrome	Allergy, children ≤ 9 years old, pregnancy	103,111,156,159,271
Tetracycline	500 mg PO BID x 12 weeks	GI upset, diarrhea, photosensitivity, vaginal candidiasis, pseudotumor cerebri	Allergy, children ≤ 9 years old, pregnancy	103,156,157,159,271
Clindamycin	300 mg PO BID x 12 weeks	GI upset, diarrhea, pseudomembranous colitis	Allergy, history of C. difficile or IBD, severe renal disease	103,158,159,271
Clindamycin with Rifampicin	Clindamycin 300 mg PO BID and Rifampicin 300 mg PO BID x 12 weeks	GI upset, diarrhea, orange urine discoloration, hepatitis (should monitor liver enzymes), reduced OCP efficacy, arthralgia	Allergy, history of C. difficile or IBD severe renal disease	103,111,156,158,159,271
Moxifloxacin, metronidazole and rifampicin	Moxifloxacin 400 mg PO QD metronidazole 500 mg PO TID, and rifampin 300 mg PO BID x 12 weeks	GI upset, diarrhea, orange urine discoloration, hepatitis, reduced OCP efficacy, arthralgia photosensitivity, peripheral neuropathy, vertigo, dysgeusia, tendon rupture	Allergy, severe renal disease, peripheral neuropathy, history of seizures, history of C. difficile	111,159,160
Dapsone	50-150 mg PO QD x 12 weeks	GI upset, hemolytic anemia with methemoglobinemia, agranulocytosis, hepatotoxicity, peripheral neuropathy	Allergy, G6PD deficiency, sulfonamide allergy, liver or renal disease, peripheral neuropathy	103,111,159,161,162
Ertapenem	1 g IV infusion (via PICC line) QD x 6 weeks	Oral and vaginal candidiasis, GI upset, diarrhea, headaches (mild, during infusion), elevated liver enzymes, asthenia, lymphangitis, phlebitis and/or thrombophlebitis	Allergy, severe renal disease, history of seizures, history of C. difficile	159,163–167
Ceftriaxone with metronidazole	Ceftriaxone 1 g IV infusion (via PICC line) QD and metronidazole 1.5 g PO QD x 3 weeks	GI upset, diarrhea, lymphangitis, phlebitis and/or thrombophlebitis, peripheral neuropathy, vertigo, dysgeusia	Allergy, severe renal disease, peripheral neuropathy, history of seizures, history of C. difficile	103,111,158,159,271

Abbreviations: BID, twice daily; C. difficile, clostridioides difficile; GI, gastrointestinal; G6PD, glucose-6-phosphate dehydrogenase; IBD, inflammatory bowel disease; IV, intravenous; OCP, oral contraceptive pill; PICC, peripherally inserted central catheter; PO, orally; QD, once daily; TID, three times daily.

age.[216–219] Two large RCTs (PIONEER I and II, n = 633) found that after 12 weeks of treatment, 50.6% of participants had at least a 50% reduction in inflammatory nodules and abscesses, compared to only 26.8% of the placebo group.[216,217] A pooled analysis on the safety profile of adalimumab, which analyzed data of 30,000 patients from multiple different trials, found that the incidence rate of serious infection was 2.8 per 100 person-years and the rate of malignancy was 0.5 per 100 person-years in HS patients.[221] Contraindications to biologic treatment include active tuberculosis, hepatitis B, hepatitis C or HIV infection, moderate to severe heart failure, active malignancy or malignancy within the past 5 years, and multiple sclerosis or other neurologic conditions.[222]

For patients who do not respond to adalimumab, infliximab is the second-line biologic treatment of choice for HS.[111,167,219,220,223–226] Ustekinumab and anakinra are recommended as third-line treatment options and brodalumab, secukinumab and bimekizumab have also demonstrated efficacy in clinical trials (Table 6).[111,167,219,220,227–238] Phase 2 and 3 RCTs are ongoing for the following classes of biologics: anti-TNF-α (etanercept), anti-IL-1 (lutikizumab, anakinra, bermkimab), anti-IL-12/23 (ustekinumab), anti-IL-17 (bimekizumab, secukinumab), anti-IL-23 (risankizumab, guselkumab), anti-IL-36 (spesolimab, ismidolimab), and anti-CD-40 (iscalimab).[239]

Other Immunomodulatory Agents

Prednisone is not used as a long-term HS treatment due to high relapse rates upon discontinuation and significant side effects, but short courses may be beneficial in improving responses to biologic treatment.[240] Apremilast, an oral phosphodiesterase 4 inhibitor, has shown efficacy in treating moderate HS in one RCT and is currently undergoing additional study.[239,241] Other small molecule inhibitors that are

Table 6. First, Second and Third-Line Biologic Agents Used to Treat HS.

Medication	Target	Drug delivery route	Dosing and schedule	Order preference of agent	References
Adalimumab	TNF-α	SQ	160 mg at baseline, 80 mg week 2, 40 mg weekly starting at week 4 Can increase dose to 80 mg weekly if inadequate response. Monitoring therapeutic drug levels is recommended if suboptimal response.	1st Line	111,167,216–220
Infliximab	TNF-α	IV	5 mg/kg at baseline, week 2, week 6 and then every 8 weeks Can increase to 7.5-10 mg/kg every 4-6 weeks	2nd Line	111,167,217,219,220,223,226
Ustekinumab	Il-12/23 p40 subunit	SQ	45 mg (or 90 mg if patient weight > 100 kg) at baseline, week 4 and then every 8-12 weeks	3rd Line	111,167,217,219,220,227,229
Anakinra	IL-1R	SQ	100 mg daily	3rd Line	111,167,217,219–221
Brodalumab	IL-17RA	SQ	210 mg at baseline, week 1, week 2 and then every 2 weeks	3rd Line	232–234
Secukinumab	IL-17A	SQ	300 mg at baseline and weekly from weeks 1-4, then every 4 weeks	3rd Line	235–237
Bimekizumab	IL-17A and IL-17F	SQ	640 mg at baseline, then 320 mg every 2 weeks	3rd Line	238

Abbreviations: IL, interleukin; IV, intravenous; R, receptor; SQ, subcutaneous; TNF-α, tumor necrosis factor–α.

currently under investigation in RCTs include JAK1 inhibitors (tofacitinib and upadacitinib), CXCR1 and CXCR2 signaling inhibitors, LTA4 hydrolase inhibitors, and complement C5a inhibitors (IFX-1, avacopan).[239,242]

Pain Management

HS patients report that pain is one of the most challenging complications of their disease and it has a substantial negative impact on their quality of life.[243] Despite this, pain management is an often overlooked aspect of HS treatment plans.[244] A patient survey reported that over 80% of HS patients use at home remedies in order to control their pain, which may include self-lancing of nodules, application of hot compresses, over-the-counter pain medications and cannabis products.[245] Poorly-managed pain may lead to more frequent emergency department visits, suboptimal HS management and an increased risk of opioid use disorder.[246–248] Thus, it is essential for physicians who treat HS patients to have an approach to managing different types of HS-associated pain.

HS patients may experience both acute nociceptive pain during flare-ups and chronic pain, which can have features of both nociceptive and neuropathic pain.[109,249–251] A detailed pain history can help with selecting pain management options that are most likely to be effective. First-line treatments for acute nociceptive pain during flare-ups may include topical resorcinol, topical diclofenac, acetaminophen, ibuprofen, naproxen, intralesional corticosteroid injections, incision and drainage, and tramadol.[109,121–123,195,252,253] For chronic pain (>6 weeks) with neuropathic characteristics, topical lidocaine or menthol, selective serotonin and norepinephrine reuptake inhibitors (duloxetine, venlafaxine), tricyclic antidepressants (amitriptyline, nortriptyline), and gabapentinoids (gabapentin and pregabalin) may be beneficial.[109,252,253] For all patients, optimizing medical management of their HS, treating psychiatric comorbidities, and providing education on wound care is recommended.[109] A referral to a pain management specialist should be considered if pain is refractory to multiple therapies or if long-term opioid therapy is being considered.[109]

Surgical Management

Surgical intervention is usually required to remove sinus tracts in patients with Hurley stage II or III disease and can help to prevent recurrence of individual lesions.[254,255] Surgical interventions that are utilized in HS include incision and drainage (I&D), deroofing, and wide local excision.[255,256]

Although I&D can offer immediate relief during acute flare-ups, the recurrence rate of HS lesions is nearly 100% and therefore routine use of I&D is not recommended.[256] Deroofing is the preferred surgical intervention for individual lesions and sinus tracts, due to the tissue-sparing nature and the ability to perform deroofing as an in-office procedure under local anesthesia.[256] Deroofing involves removing the top layers of skin using curettage and/or electrosurgical dissection, followed by removal of fibrous bands and gelatinous tissue from lesions and sinus tracts.[257,258] A curette probe can be used to explore sinus tracts for side passages.[257] Healing typically occurs by secondary intention due to higher recurrence rates with primary closure.[257,259] More than 80% of patients do not have local recurrence after deroofing.[260] For extensive Hurley stage III HS, wide

Table 7. Sample Electronic Medical Record Template for New HS Patients' First Clinic Visits.

Patient History

Clinical Presentation

- History and current presentation of HS (locations, lesion types)
- Timeline of lesion onset
- Symptoms (wound drainage, pain, itch)
- Symptom severity rating scales (DLQI and VAS for pain)

Potential Triggers for HS

- Premenstrual/perimenstrual flaring
- Smoking
- Sweating (focal hyperhidrosis)
- Diet
- Clothing, hair removal (shaving/waxing)
- Medications that can make HS worse: lithium, progesterone-only contraceptives

Previous Treatments and Considerations for Future Treatments

- Dietary changes, supplements, wound care
- Previous medications and/or procedural interventions for HS
- Pain management
- Current contraceptive use and plans for future pregnancy

Physical Examination

Diagnostic Criteria for HS

(90% sensitivity and 97% specificity for a correct diagnosis of HS if all 3 criteria are met.[13,14])

1. Lesion Morphology
   - Single or double open comedones
   - Papules, nodules, abscesses
   - Sinus tracts and fistulas
   - Scarring
2. Distribution of Lesions
   - Axilla
   - Inframammary region
   - Groin
   - Vulvar/Perineal/Perianal areas
   - Gluteal folds
   - Nape of the neck
   - Abdomen
3. Chronicity and Recurrence
   - More than two lesions during a time period of ≥ 6 months

Hurley Staging

- Stage I
- Stage II
- Stage III

Comorbidity Screening

Essential

- IBD
- Inflammatory arthritis

Optional

- PCOS, diabetes mellitus, thyroid disease, anemia, obesity, hypertension, dyslipidemia, acne, pyoderma gangrenosum, dissecting cellulitis of the scalp, pilonidal sinus, SCC, depression, anxiety

Patient Counselling and Management Options

Lifestyle Changes

- Avoidance of patient-reported triggers (ie, avoid shaving affected areas, choose clothing that limits skin-to-skin friction)
- Smoking cessation
- Weight loss
- Dietary modification (low glycemic index diet, Mediterranean diet, limit skim milk and products that contain whey protein)

(Continued)

Table 7. Continued

Medical Treatments	• Topical therapies: clindamycin phosphate 1% solution, resorcinol 15% cream • Zinc gluconate 45-90 mg (taken with food) and copper 2-4 mg (supplements should be taken separately, at different times) • OCP with drospirenone (Yasmin®, Yaz®) or cyproterone acetate (Diane-35®) • Spironolactone (50-200 mg) or Finasteride (5-10 mg) • Metformin 500 mg BID • Doxycycline 100 mg PO BID x 12 weeks, Clindamycin 300 mg PO BID +/- Rifampin 300 mg PO BID x 12 weeks • Biologics (1st line: adalimumab, 2nd line: infliximab, 3rd line: ustekinumab and anakinra)
Laser, Procedural and Surgical Interventions	• Intralesional triamcinolone acetonide injections • Botulinum toxin injections • Laser hair removal • De-roofing, local excision, wide excision
Pain Management	• Acute flare-ups: resorcinol 15% cream, diclofenac 10% gel, acetaminophen 500 mg q4-6h, ibuprofen 400 mg q4-6h, naproxen 250-500 mg q12h, fit-in appointments for ILK injections. • Chronic pain: topical lidocaine or menthol, SSNRIs, TCAs, gabapentinoids.
Referrals	• Smoking cessation counselling • Dietitian • Plastic surgery (for wide excision) • Rheumatology (if symptoms of inflammatory joint disease present and/or positive rheumatologic work-up) • Gastroenterology (if symptoms of IBD are present) • Chronic pain specialist (if pain refractory to ≥ 2 agents or if considering long-term opioid therapy)

Abbreviations: h, hours; HS, hidradenitis suppurativa; IBD, inflammatory bowel disease; ILK, intralesional Kenalog®; OCP, oral contraceptive pill; PCOS, polycystic ovarian syndrome; q, every; SCC, squamous cell carcinoma.

local surgical or carbon dioxide laser excision may be necessary to achieve disease control.[259,261–263]

Wound Care

Ideal dressings for HS are inexpensive, absorbent, non-irritating, and have antibacterial properties to prevent secondary infection.[264–266] Patients can be prescribed silver-impregnated foam, hydrofiber with silver, or calcium alginate with silver dressings.[264] However, cost may limit accessibility of these dressings.[264] Alternatively, abdominal or feminine hygiene pads may be used.[264] Antimicrobial skin cleansers, topical antibiotics, Manuka honey, and platelet-rich plasma gel can be applied underneath dressings to improve wound healing.[265–268]

Summary

It is important for primary care physicians and dermatologists to be aware of comorbidities that commonly occur with HS to help guide treatment decisions. Collaboration with other medical disciplines, including gastroenterology, endocrinology, rheumatology, plastic surgery, and psychiatry, is essential to provide high quality care to HS patients. Smoking cessation, dietary changes, wound care and pain management should be addressed with every patient. Patients should be advised that multiple lifestyle, medical and surgical interventions may be necessary to achieve disease control and treatment plans should be individualized. A recommended electronic medical record template, which includes an approach to history-taking, initial assessment and management of HS, is summarized in Table 7.

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Supplemental Material

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References

1. Alikhan A, Lynch PJ, Eisen DB. Hidradenitis suppurativa: a comprehensive review. *J Am Acad Dermatol*. 2009;60(4):539-561. doi:10.1016/j.jaad.2008.11.911
2. Lachaine J, Miron A, Shear N, Alhusayen R. The prevalence and incidence of hidradenitis suppurativa in Canada: results from a population-based survey. *Value in Health*. 2016;19(3):A123. doi:10.1016/j.jval.2016.03.495
3. Hoffman LK, Ghias MH, Lowes MA. Pathophysiology of hidradenitis suppurativa. *Semin Cutan Med Surg*. 2017;36(2):47-54. doi:10.12788/j.sder.2017.017
4. Melnik BC, Plewig G. Impaired Notch-MKP-1 signalling in hidradenitis suppurativa: an approach to pathogenesis by evidence from translational biology. *Exp Dermatol*. 2013;22(3):172-177. doi:10.1111/exd.12098
5. Thompson AM, Fernandez JM, Rick J, et al. Identifying triggers for hidradenitis suppurativa flare: a patient survey. *Br J Dermatol*. 2021;185(1):225-226. doi:10.1111/bjd.19926
6. von der Werth JM, Williams HC. The natural history of hidradenitis suppurativa. *J Eur Acad Dermatol Venerol*. 2000;14(5):389-392. doi:10.1046/j.1468-3083.2000.00087.x
7. Acharya P, Mathur M. Hidradenitis suppurativa and smoking: a systematic review and meta-analysis. *J Am Acad Dermatol*. 2020;82(4):1006-1011. doi:10.1016/j.jaad.2019.10.044
8. Hana A, Booken D, Henrich C, et al. Functional significance of non-neuronal acetylcholine in skin epithelia. *Life Sci*. 2007;80(24-25):2214-2220. doi:10.1016/j.lfs.2007.02.007
9. Dessinioti C, Zisimou C, Tzanetakou V, Ntritsos G, Kontochristopoulos G, Antoniou C. A retrospective institutional study of the association of smoking with the severity of hidradenitis suppurativa. *J Dermatol Sci*. 2017;87(2):206-207. doi:10.1016/j.jdermsci.2017.04.006
10. Kirby JS. Qualitative study shows disease damage matters to patients with hidradenitis suppurativa. *J Am Acad Dermatol*. 2016;74(6):1269-1270. doi:10.1016/j.jaad.2016.01.001
11. Scarred for Life: 2020 Update – A National Report of Patients' Experiences Living with Hidradenitis Suppurativa. Canadian Skin Patient Alliance. Updated May 2020. Accessed November 12, 2021. https://www.canadianskin.ca/advocacy/hs-report
12. Daxhelet M, Suppa M, White J, et al. Proposed definitions of typical lesions in hidradenitis suppurativa. *Dermatology*. 2020;236(5):431-438. doi:10.1159/000507348
13. Revuz JE, Jemec GBE. Diagnosing hidradenitis suppurativa. *Dermatol Clin*. 2016;34(1):1-5. doi:10.1016/j.det.2015.08.009
14. Esmann S, Dufour DN, Jemec GBE. Questionnaire-based diagnosis of hidradenitis suppurativa: specificity, sensitivity and positive predictive value of specific diagnostic questions. *Br J Dermatol*. 2010;163(1):102-106. doi:10.1111/j.1365-2133.2010.09773.x
15. Hurley H. Axillary hyperhidrosis, apocrine bromhidrosis, hidradenitis suppurativa, and familial benign pemphigus: surgical approach. In: Roenigh RRH, ed. *Dermatologic Surgery*. Marcel Dekker; 1989:729-739.
16. Almuhanna N, Wortsman X, Wohlmuth-Wieser I, Kinoshita-Ise M, Alhusayen R. Overview of ultrasound imaging applications in dermatology [Formula: see text]. *J Cutan Med Surg*. 2021;25(5):521-529. doi:10.1177/12034754 21999326
17. Martorell A, Alfageme Roldán F, Vilarrasa Rull E, et al. Ultrasound as a diagnostic and management tool in hidradenitis suppurativa patients: a multicentre study. *J Eur Acad Dermatol Venereol*. 2019;33(11):2137-2142. doi:10.1111/jdv.15710
18. Tzellos T, Zouboulis CC. Comorbidities of hidradenitis suppurativa: implications for daily clinical practice [published correction appears in *Dermatol Ther* (Heidelb). 2020;10(3):523. *Dermatol Ther*. 2020;10(3):63-71. doi:10.1007/s13555-020-00354-2
19. Garg A, Malviya N, Strunk A, et al. Comorbidity screening in hidradenitis suppurativa: evidence-based recommendations from the US and Canadian hidradenitis suppurativa foundations [published online ahead of print January 23, 2021]. *J Am Acad Dermatol*. 2021;S0190-9622(21):00213-9. doi:10.1016/j.jaad.2021.01.059
20. Fimmel S, Zouboulis CC. Comorbidities of hidradenitis suppurativa (acne inversa). *Dermatoendocrinol*. 2010;2(1):9-16. doi:10.4161/derm.2.1.12490

21. Kimball AB, Sundaram M, Gauthier G, et al. The comorbidity burden of hidradenitis suppurativa in the United States: a claims data analysis. *Dermatol Ther*. 2018;8(4):557-569. doi: 10.1007/s13555-018-0264-z
22. Chen W-T, Chi C-C. Association of hidradenitis suppurativa with inflammatory bowel disease: a systematic review and meta-analysis. *JAMA Dermatol*. 2019;155(9):1022-1027. doi: 10.1001/jamadermatol.2019.0891
23. Phan K, Tatian A, Woods J, Cains G, Frew JW. Prevalence of inflammatory bowel disease (IBD) in hidradenitis suppurativa (HS): systematic review and adjusted meta-analysis. *Int J Dermatol*. 2020;59(2):221-228. doi:10.1111/ijd.14697
24. Lloyd-McLennan AM, Ali S, Kittler NW. Prevalence of inflammatory bowel disease among pediatric patients with hidradenitis suppurativa and the potential role of screening with fecal calprotectin. *Pediatr Dermatol*. 2021;38(1):98-102. doi:10.1111/pde.14417
25. Vilarrasa Rull E, González Lama Y. Clinical features of hidradenitis suppurativa and crohn disease: what do these two entities have in common?. Aspectos clínicos de la hidradenitis supurativa y de la enfermedad de Crohn: ¿qué hay en común? *Actas Dermosifiliogr*. 2016;107(Suppl 2):21-26. doi:10.1016/S0001-7310(17)30005-4
26. Garg A, Neuren E, Strunk A. Hidradenitis suppurativa is associated with polycystic ovary syndrome: a population-based analysis in the United States. *J Invest Dermatol*. 2018;138(6):1288-1292. doi:10.1016/j.jid.2018.01.009
27. Phan K, Charlton O, Smith SD. Hidradenitis suppurativa and polycystic ovarian syndrome: systematic review and meta-analysis. *Australas J Dermatol*. 2020;61(1):e28-e33. doi:10.1111/ajd.13110
28. Rosenfield RL, Ehrmann DA. The pathogenesis of polycystic ovary syndrome (PCOS): the hypothesis of PCOS as functional ovarian hyperandrogenism revisited. *Endocr Rev*. 2016;37(5):467-520. doi:10.1210/er.2015-1104
29. Bui T-L, Silva-Hirschberg C, Torres J, Armstrong AW. Hidradenitis suppurativa and diabetes mellitus: a systematic review and meta-analysis. *J Am Acad Dermatol*. 2018;78(2):395-402. doi:10.1016/j.jaad.2017.08.042
30. Phan K, Charlton O, Smith SD. Hidradenitis suppurativa and diabetes mellitus: updated systematic review and adjusted meta-analysis. *Clin Exp Dermatol*. 2019;44(4):e126-e132. doi:10.1111/ced.13922
31. Jennings L, Hambly R, Hughes R, Moriarty B, Kirby B. Metformin use in hidradenitis suppurativa. *J Dermatolog Treat*. 2020;31(3):261-263. doi:10.1080/09546634.2019.1592100
32. Napolitano M, Megna M, Monfrecola G. Insulin resistance and skin diseases. *Scientific World Journal*. 2015;2015:479354.-. doi:10.1155/2015/479354
33. Kjærsgaard Andersen R, Jørgensen IF, Reguant R, Jemec GBE, Brunak S. Disease trajectories for hidradenitis suppurativa in the Danish population. *JAMA Dermatol*. 2020;156(7):780-786. doi:10.1001/jamadermatol.2020.1281
34. Phan K, Huo YR, Charlton O, Smith SD, Suppurativa H. Hidradenitis suppurativa and thyroid disease: systematic review and meta-analysis. *J Cutan Med Surg*. 2020;24(1):23-27. doi: 10.1177/1203475419874411
35. Acharya P, Mathur M. Thyroid disorders in patients with hidradenitis suppurativa: a systematic review and meta-analysis. *J Am Acad Dermatol*. 2020;82(2):491-493. doi:10.1016/j.jaad.2019.07.025
36. Miller IM, Vinding G, Sørensen HA, et al. Thyroid function in hidradenitis suppurativa: a population-based cross-sectional study from Denmark. *Clin Exp Dermatol*. 2018;43(8):899-905. doi:10.1111/ced.13606
37. Hanna N, Silverberg OM, Reaume M, et al. Incidence, prevalence, and predictors of inflammatory arthritis in patients with hidradenitis suppurativa: a systematic review and meta-analysis [published online ahead of print August 25, 2021]. *Int J Dermatol*. 2021;nm10. doi:10.1111/ijd.15860
38. Schneeweiss MC, Kim SC, Schneeweiss S, Rosmarin D, Merola JF. Risk of inflammatory arthritis after a new diagnosis of hidradenitis suppurativa. *JAMA Dermatol*. 2020;156(3):342-345. doi:10.1001/jamadermatol.2019.4590
39. Rondags A, Arends S, Wink FR, Horváth B, Spoorenberg A. High prevalence of hidradenitis suppurativa symptoms in axial spondyloarthritis patients: a possible new extra-articular manifestation. *Semin Arthritis Rheum*. 2019;48(4):611-617. doi:10.1016/j.semarthrit.2018.03.010
40. Alikhan A, Sayed C, Alavi A, et al. North American clinical management guidelines for hidradenitis suppurativa: a publication from the United States and Canadian hidradenitis suppurativa foundations: part I: diagnosis, evaluation, and the use of complementary and procedural management. *J Am Acad Dermatol*. 2019;81(1):76-90. doi:10.1016/j.jaad.2019.02.067
41. Kromann CB, Ibler KS, Kristiansen VB, Jemec GBE. The influence of body weight on the prevalence and severity of hidradenitis suppurativa. *Acta Derm Venereol*. 2014;94(5):553-557. doi:10.2340/00015555-1800
42. Shalom G, Freud T, Harman-Boehm I, Polishchuk I, Cohen AD. Hidradenitis suppurativa and metabolic syndrome: a comparative cross-sectional study of 3207 patients. *Br J Dermatol*. 2015;173(2):464-470. doi:10.1111/bjd.13777
43. Sivanand A, Gulliver WP, Josan CK, Alhusayen R, Fleming PJ. Weight loss and dietary interventions for hidradenitis suppurativa: a systematic review. *J Cutan Med Surg*. 2020;24(1):64-72. doi:10.1177/1203475419874412
44. Vazquez BG, Alikhan A, Weaver AL, Wetter DA, Davis MD. Incidence of hidradenitis suppurativa and associated factors: a population-based study of Olmsted County, Minnesota. *J Invest Dermatol*. 2013;133(1):97-103. doi:10.1038/jid.2012.255
45. Tzellos T, Zouboulis CC, Gulliver W, Cohen AD, Wolkenstein P, Jemec GBE. Cardiovascular disease risk factors in patients with hidradenitis suppurativa: a systematic

review and meta-analysis of observational studies. *Br J Dermatol*. 2015;173(5):1142-1155. doi:10.1111/bjd.14024
46. Phan K, Charlton O, Smith SD. Hidradenitis suppurativa and metabolic syndrome - systematic review and adjusted meta-analysis. *Int J Dermatol*. 2019;58(10):1112-1117. doi:10.1111/ijd.14500
47. Shalom G, Freud T, Harman-Boehm I, Polishchuk I, Cohen AD. Hidradenitis suppurativa and metabolic syndrome: a comparative cross-sectional study of 3207 patients. *Br J Dermatol*. 2015;173(2):464-470. doi:10.1111/bjd.13777
48. Phan K, Charlton O, Smith SD. Hidradenitis suppurativa and acne vulgaris and conglobata—systematic review and meta-analysis. *Biomed Dermatol*. 2019;3(1):12. doi:10.1186/s41702-019-0045-z
49. Vasanth V, Chandrashekar BS. Follicular occlusion tetrad. *Indian Dermatol Online J*. 2014;5(4):491-493. doi:10.4103/2229-5178.142517
50. Tannenbaum R, Strunk A, Garg A. Overall and subgroup prevalence of pyoderma gangrenosum among patients with hidradenitis suppurativa: a population-based analysis in the United States. *J Am Acad Dermatol*. 2019;80(6):1533-1537. doi:10.1016/j.jaad.2019.02.004
51. Machado MO, Stergiopoulos V, Maes M, et al. Depression and anxiety in adults with hidradenitis suppurativa: a systematic review and meta-analysis. *JAMA Dermatol*. 2019;155(8):939-945. doi:10.1001/jamadermatol.2019.0759
52. Akoglu G, Yildiz I, Karaismailoğlu E, Esme P. Disease severity and poor mental health are the main predictors of stigmatization in patients with hidradenitis suppurativa. *Dermatol Ther*. 2021;34(3):e14910. doi:10.1111/dth.14910
53. Resnik SR, Geisler EL, Reyes N, Lozano J, Ramirez-Caussade RA, Resnik B. Prevalence and risk factors for anemia in a population with hidradenitis suppurativa. *Cureus*. 2020;12(12):e12015. doi:10.7759/cureus.12015
54. Soliman YS, Chaitowitz M, Hoffman LK, Lin J, Lowes MA, Cohen SR. Identifying anaemia in a cohort of patients with hidradenitis suppurativa. *J Eur Acad Dermatol Venereol*. 2020;34(1):e5-e8. doi:10.1111/jdv.15837
55. Huang CM, Lowes MA, Cserti C, Alavi A, Levels H. Hemoglobin levels and serum C-reactive protein in patients with moderate to severe hidradenitis suppurativa. *J Cutan Med Surg*. 2019;23(5):501-506. doi:10.1177/1203475419858963
56. Ghias MH, Johnston AD, Babbush KM, et al. epcidin levels can distinguish anemia of chronic disease from iron deficiency anemia in a cross-sectional study of patients with hidradenitis suppurativa [published online ahead of print April 2, 2021]. *J Am Acad Dermatol*. 2021;S0190-9622(21):00655-1. doi:10.1016/j.jaad.2021.03.090
57. Ponikowska M, Matusiak L, Kasztura M, Jankowska EA, Szepietowski JC. Deranged iron status evidenced by iron deficiency characterizes patients with hidradenitis suppurativa. *Dermatology*. 2020;236(1):52-58. doi:10.1159/000505184
58. Duncan A, Yacoubian C, Watson N, Morrison I. The risk of copper deficiency in patients prescribed zinc supplements. *J Clin Pathol*. 2015;68(9):723-725. doi:10.1136/jclinpath-2014-202837
59. Stashower J, Pollack K, Flowers RH. Severe anemia and copper deficiency in a patient treated with supplemental zinc for hidradenitis suppurativa [published online ahead of print May 5, 2021]. *Int J Dermatol*. 2021. doi:10.1111/ijd.15652
60. Makris G-M, Poulakaki N, Papanota A-M, Kotsifa E, Sergentanis TN, Psaltopoulou T. Vulvar, perianal and perineal cancer after hidradenitis suppurativa: a systematic review and pooled analysis. *Dermatol Surg*. 2017;43(1):107-115. doi:10.1097/DSS.0000000000000944
61. Jourabchi N, Fischer AH, Cimino-Mathews A, Waters KM, Okoye GA. Squamous cell carcinoma complicating a chronic lesion of hidradenitis suppurativa: a case report and review of the literature. *Int Wound J*. 2017;14(2):435-438. doi:10.1111/iwj.12671
62. Sachdeva M, Mufti A, Zaaroura H, et al. Squamous cell carcinoma arising within hidradenitis suppurativa: a literature review [published online ahead of print June 2, 2021]. *Int J Dermatol*. 2021. doi:10.1111/ijd.15677
63. Acharya P, Mathur M. Hidradenitis suppurativa and smoking: a systematic review and meta-analysis. *J Am Acad Dermatol*. 2020;82(4):1006-1011. doi:10.1016/j.jaad.2019.10.044
64. König A, Lehmann C, Rompel R, Happle R. Cigarette smoking as a triggering factor of hidradenitis suppurativa. *Dermatology*. 1999;198(3):261-264. doi:10.1159/000018126
65. Bukvić Mokos Z, Miše J, Balić A, Marinović B. Understanding the relationship between smoking and hidradenitis suppurativa. *Acta Dermatovenerol Croat*. 2020;28(1):9-13.
66. Denny G, Anadkat MJ. The effect of smoking and age on the response to first-line therapy of hidradenitis suppurativa: an institutional retrospective cohort study. *J Am Acad Dermatol*. 2017;76(1):54-59. doi:10.1016/j.jaad.2016.07.041
67. Hana A, Booken D, Henrich C, et al. Functional significance of non-neuronal acetylcholine in skin epithelia. *Life Sci*. 2007;80(24-25):2214-2220. doi:10.1016/j.lfs.2007.02.007
68. Macklis PC, Tyler K, Kaffenberger J, Kwatra S, Kaffenberger BH. Lifestyle modifications associated with symptom improvement in hidradenitis suppurativa patients [published online ahead of print April 23, 2021]. *Arch Dermatol Res*. 2021. doi:10.1007/s00403-021-02233-y
69. Nagano T, Katsurada M, Yasuda Y, Kobayashi K, Nishimura Y. Current pharmacologic treatments for smoking cessation and new agents undergoing clinical trials. *Ther Adv Respir Dis*. 2019;13:1753466619875925. doi:10.1177/1753466619875925
70. Foley KF, DeSanty KP, Kast RE. Bupropion: pharmacology and therapeutic applications. *Expert Rev Neurother*. 2006;6(9):1249-1265. doi:10.1586/14737175.6.9.1249
71. Kast RE. Anti- and pro-inflammatory considerations in antidepressant use during medical illness: bupropion lowers and mirtazapine increases circulating tumor necrosis factor-alpha levels. *Gen Hosp Psychiatry*. 2003;25(6):495-496. doi:10.1016/S0163-8343(03)00093-8

72. Kast RE, Altschuler EL. Remission of Crohn's disease on bupropion. *Gastroenterology*. 2001;121(5):1260-1261. doi:10.1053/gast.2001.29467
73. Kast RE, Altschuler EL. Anti-apoptosis function of TNF-alpha in chronic lymphocytic leukemia: lessons from Crohn's disease and the therapeutic potential of bupropion to lower TNF-alpha. *Arch Immunol Ther Exp*. 2005;53(2):143-147.
74. Lightfoot K, Panagiotaki G, Nobes G. Effectiveness of psychological interventions for smoking cessation in adults with mental health problems: a systematic review. *Br J Health Psychol*. 2020;25(3):615-638. doi:10.1111/bjhp.12431
75. Barth J, Jacob T, Daha I, Critchley JA. Psychosocial interventions for smoking cessation in patients with coronary heart disease. *Cochrane Database Syst Rev*. 2015;7:CD006886. doi:10.1002/14651858.CD006886.pub2
76. Collier E, Shi VY, Parvataneni RK, Lowes MA, Hsiao JL. Special considerations for women with hidradenitis suppurativa. *Int J Womens Dermatol*. 2020;6(2):85-88. doi:10.1016/j.ijwd.2020.02.005
77. Loh TY, Hendricks AJ, Hsiao JL, Shi VY. Undergarment and fabric selection in the management of hidradenitis suppurativa. *Dermatology*. 2021;237(1):119-124. doi:10.1159/000501611
78. Grimstad Ø, Kvammen BØ, Swartling C. Botulinum toxin type B for hidradenitis suppurativa: a randomised, double-blind, placebo-controlled pilot study. *Am J Clin Dermatol*. 2020;21(5):741-748. doi:10.1007/s40257-020-00537-9
79. Knix™. Knix Wear Inc. Knix™ website. Accessed November 12, 2021. https://knix.ca/
80. Dempsey A, Butt M, Kirby JS. Prevalence and impact of dietary avoidance among individuals with hidradenitis suppurativa. *Dermatology*. 2020;236(4):289-295. doi:10.1159/000503063
81. Silfvast-Kaiser A, Youssef R, Paek SY. Diet in hidradenitis suppurativa: a review of published and lay literature. *Int J Dermatol*. 2019;58(11):1225-1230. doi:10.1111/ijd.14465
82. Burris J, Shikany JM, Rietkerk W, Woolf K. A low glycemic index and glycemic load diet decreases insulin-like growth factor-1 among adults with moderate and severe acne: a short-duration, 2-week randomized controlled trial. *J Acad Nutr Diet*. 2018;118(10):1874-1885. doi:10.1016/j.jand.2018.02.009
83. Kurzen H, Kurzen M. Secondary prevention of hidradenitis suppurativa. *Dermatol Reports*. 2019;11(2):8243. doi:10.4081/dr.2019.8243
84. Mavropoulos JC, Yancy WS, Hepburn J, Westman EC. The effects of a low-carbohydrate, ketogenic diet on the polycystic ovary syndrome: a pilot study. *Nutr Metab*. 2005;2:35. doi:10.1186/1743-7075-2-35
85. Melnik BC, Schmitz G. Role of insulin, insulin-like growth factor-1, hyperglycaemic food and milk consumption in the pathogenesis of acne vulgaris. *Exp Dermatol*. 2009;18(10):833-841. doi:10.1111/j.1600-0625.2009.00924.x
86. Danby FW. Diet in the prevention of hidradenitis suppurativa (acne inversa). *J Am Acad Dermatol*. 2015;73(5 Suppl 1):S52-S54. doi:10.1016/j.jaad.2015.07.042
87. Danby FWB. Acne: diet and acnegenesis. *Indian Dermatol Online J*. 2011;2(1):2-5. doi:10.4103/2229-5178.79851
88. Adebamowo CA, Spiegelman D, Danby FW, Frazier AL, Willett WC, Holmes MD. High school dietary dairy intake and teenage acne. *J Am Acad Dermatol*. 2005;52(2):207-214. doi:10.1016/j.jaad.2004.08.007
89. Juhl C, Bergholdt H, Miller I, Jemec G, Kanters J, Ellervik C. Dairy intake and acne vulgaris: a systematic review and meta-analysis of 78,529 children, adolescents, and young adults. *Nutrients*. 2018;10(8):1049. doi:10.3390/nu10081049
90. Simonart T. Acne and whey protein supplementation among bodybuilders. *Dermatology*. 2012;225(3):256-258. doi:10.1159/000345102
91. Pontes TdeC, Fernandes Filho GMC, Trindade AdeSP, Sobral Filho JF. Incidence of acne vulgaris in young adult users of protein-calorie supplements in the city of João Pessoa—PB. *An Bras Dermatol*. 2013;88(6):907-912. doi:10.1590/abd1806-4841.20132024
92. Martini D. Health benefits of mediterranean diet. *Nutrients*. 2019;11(8):1802. doi:10.3390/nu11081802
93. Barrea L, Fabbrocini G, Annunziata G, et al. Role of nutrition and adherence to the mediterranean diet in the multidisciplinary approach of hidradenitis suppurativa: evaluation of nutritional status and its association with severity of disease. *Nutrients*. 2018;11(1):57. doi:10.3390/nu11010057
94. Cannistrà C, Finocchi V, Trivisonno A, Tambasco D. New perspectives in the treatment of hidradenitis suppurativa: surgery and brewer's yeast-exclusion diet. *Surgery*. 2013;154(5):1126-1130. doi:10.1016/j.surg.2013.04.018
95. Konijeti GG, Kim N, Lewis JD, et al. Efficacy of the autoimmune protocol diet for inflammatory bowel disease. *Inflamm Bowel Dis*. 2017;23(11):2054-2060. doi:10.1097/MIB.0000000000001221
96. Poveda I, Vilarrasa E, Martorell A, et al. Serum zinc levels in hidradenitis suppurativa: a case-control study. *Am J Clin Dermatol*. 2018;19(5):771-777. doi:10.1007/s40257-018-0374-5
97. Brocard A, Knol A-C, Khammari A, Dréno B. Hidradenitis suppurativa and zinc: a new therapeutic approach. A pilot study. *Dermatology*. 2007;214(4):325-327. doi:10.1159/000100883
98. Dréno B, Khammari A, Brocard A, et al. Hidradenitis suppurativa: the role of deficient cutaneous innate immunity. *Arch Dermatol*. 2012;148(2):182-186. doi:10.1001/archdermatol.2011.315
99. Hessam S, Sand M, Meier NM, Gambichler T, Scholl L, Bechara FG. Combination of oral zinc gluconate and topical triclosan: an anti-inflammatory treatment modality for initial hidradenitis suppurativa. *J Dermatol Sci*. 2016;84(2):197-202. doi:10.1016/j.jdermsci.2016.08.010

100. Molinelli E, Brisigotti V, Campanati A, et al. Efficacy of oral zinc and nicotinamide as maintenance therapy for mild/moderate hidradenitis suppurativa: a controlled retrospective clinical study. *J Am Acad Dermatol*. 2020;83(2):665-667. doi:10.1016/j.jaad.2020.04.092
101. Agnew UM, Slesinger TL, Toxicity Z. Zinc Toxicity. In: *StatPearls*. StatPearls Publishing; 2021.
102. Salzman MB, Smith EM, Koo C. Excessive oral zinc supplementation. *J Pediatr Hematol Oncol*. 2002;24(7):582-584. doi:10.1097/00043426-200210000-00020
103. Hidradenitis Suppurativa. University of Michigan Medicine. Accessed November 12, 2021. https://medicine.umich.edu/sites/default/files/content/downloads/Hidradenitis%20suppurativa%20handout_0.pdf
104. Guillet A, Brocard A, Bach Ngohou K, et al. Verneuil's disease, innate immunity and vitamin D: a pilot study. *J Eur Acad Dermatol Venereol*. 2015;29(7):1347-1353. doi:10.1111/jdv.12857
105. Donnarumma M, Marasca C, Palma M, Vastarella M, Annunziata MC, Fabbrocini G. An oral supplementation based on myo-inositol, folic acid and liposomal magnesium may act synergistically with antibiotic therapy and can improve metabolic profile in patients affected by hidradenitis suppurativa: our experience. *G Ital Dermatol Venereol*. 2020;155(6):749-753. doi:10.23736/S0392-0488.18.06012-1
106. Unfer V, Facchinetti F, Orrù B, Giordani B, Nestler J. Myo-inositol effects in women with PCOS: a meta-analysis of randomized controlled trials. *Endocr Connect*. 2017;6(8):647-658. doi:10.1530/EC-17-0243
107. Mackenna RM, Lehmann H. The glucose tolerance curve in hidradenitis suppurativa. *Br J Dermatol*. 1960;72:142-144. doi:10.1111/j.1365-2133.1960.tb13862.x
108. Mazur-Bialy AI, Pocheć E. Riboflavin reduces pro-inflammatory activation of adipocyte-macrophage co-culture. Potential application of vitamin B2 enrichment for attenuation of insulin resistance and metabolic syndrome development. *Molecules*. 2016;21(12):1724. doi:10.3390/molecules21121724
109. Savage KT, Singh V, Patel ZS, et al. Pain management in hidradenitis suppurativa and a proposed treatment algorithm. *J Am Acad Dermatol*. 2021;85(1):187-199. doi:10.1016/j.jaad.2020.09.039
110. Aggarwal BB, Gupta SC, Sung B. Curcumin: an orally bioavailable blocker of TNF and other pro-inflammatory biomarkers. *Br J Pharmacol*. 2013;169(8):1672-1692. doi:10.1111/bph.12131
111. Alikhan A, Sayed C, Alavi A, et al. North American clinical management guidelines for hidradenitis suppurativa: a publication from the United States and Canadian hidradenitis suppurativa foundations: part II: topical, intralesional, and systemic medical management. *J Am Acad Dermatol*. 2019;81(1):91-101. doi:10.1016/j.jaad.2019.02.068
112. Patil S, Apurwa A, Nadkarni N, Agarwal S, Chaudhari P, Gautam M. Hidradenitis suppurativa: inside and out. *Indian J Dermatol*. 2018;63(2):91-98. doi:10.4103/ijd.IJD_412_16
113. Zouboulis CC, Desai N, Emtestam L, et al. European S1 guideline for the treatment of hidradenitis suppurativa/acne inversa. *J Eur Acad Dermatol Venereol*. 2015;29(4):619-644. doi:10.1111/jdv.12966
114. Scheinfeld N. Hidradenitis suppurativa: a practical review of possible medical treatments based on over 350 hidradenitis patients. *Dermatol Online J*. 2013;19(4):1. doi:10.5070/D35VW402NF
115. Mahmoud BH, Tierney E, Hexsel CL, Pui J, Ozog DM, Hamzavi IH. Prospective controlled clinical and histopathologic study of hidradenitis suppurativa treated with the long-pulsed neodymium: yttrium-aluminium-garnet laser. *J Am Acad Dermatol*. 2010;62(4):637-645. doi:10.1016/j.jaad.2009.07.048
116. Danesh MJ, Kimball AB. Pyrithione zinc as a general management strategy for hidradenitis suppurativa. *J Am Acad Dermatol*. 2015;73(5):e175. doi:10.1016/j.jaad.2015.07.026
117. Frew JW, Hawkes JE, Krueger JG. Topical, systemic and biologic therapies in hidradenitis suppurativa: pathogenic insights by examining therapeutic mechanisms. *Ther Adv Chronic Dis*. 2019;10:2040622319830646. doi:10.1177/2040622319830646
118. Gupta M, Mahajan VK, Mehta KS, Chauhan PS. Zinc therapy in dermatology: a review. *Dermatol Res Pract*. 2014;2014:709152.-. doi:10.1155/2014/709152
119. Leiphart P, Kitts S, Sciacca Kirby J. Adherence to over-the-counter antimicrobial washes in hidradenitis suppurativa patients. *Dermatology*. 2019;235(5):440-441. doi:10.1159/000500827
120. Dayal S, Amrani A, Sahu P, Jain VK. Jessner's solution vs. 30% salicylic acid peels: a comparative study of the efficacy and safety in mild-to-moderate acne vulgaris. *J Cosmet Dermatol*. 2017;16(1):43-51. doi:10.1111/jocd.12266
121. Molinelli E, Brisigotti V, Simonetti O, et al. Efficacy and safety of topical resorcinol 15% as long-term treatment of mild-to-moderate hidradenitis suppurativa: a valid alternative to clindamycin in the panorama of antibiotic resistance. *Br J Dermatol*. 2020;183(6):1117-1119. doi:10.1111/bjd.19337
122. Pascual JC, Encabo B, Ruiz de Apodaca RF, Romero D, Selva J, Jemec GB. Topical 15% resorcinol for hidradenitis suppurativa: an uncontrolled prospective trial with clinical and ultrasonographic follow-up. *J Am Acad Dermatol*. 2017;77(6):1175-1178. doi:10.1016/j.jaad.2017.07.008
123. Boer J, Jemec GBE. Resorcinol peels as a possible self-treatment of painful nodules in hidradenitis suppurativa. *Clin Exp Dermatol*. 2010;35(1):36-40. doi:10.1111/j.1365-2230.2009.03377.x
124. Docampo-Simón A, Beltrá-Picó I, Sánchez-Pujol MJ, et al. Topical 15% resorcinol is associated with high treatment satisfaction in patients with mild to moderate hidradenitis

suppurativa [published online ahead of print April 22, 2021]. *Dermatology*. 2021:1-4. doi:10.1159/000515450

125. Clemmensen OJ. Topical treatment of hidradenitis suppurativa with clindamycin. *Int J Dermatol*. 1983;22(5):325-328. doi:10.1111/j.1365-4362.1983.tb02150.x
126. Jemec GB, Wendelboe P. Topical clindamycin versus systemic tetracycline in the treatment of hidradenitis suppurativa. *J Am Acad Dermatol*. 1998;39(6):971-974. doi:10.1016/S0190-9622(98)70272-5
127. Fischer AH, Haskin A, Okoye GA. Patterns of antimicrobial resistance in lesions of hidradenitis suppurativa. *J Am Acad Dermatol*. 2017;76(2):309-313. doi:10.1016/j.jaad.2016.08.001
128. Kolli SS, Pecone D, Pona A, Cline A, Feldman SR. Topical retinoids in acne vulgaris: a systematic review. *Am J Clin Dermatol*. 2019;20(3):345-365. doi:10.1007/s40257-019-00423-z
129. Shenoy A, Madan R. Post-inflammatory hyperpigmentation: a review of treatment strategies. *J Drugs Dermatol*. 2020;19(8):763-768. doi:10.36849/JDD.2020.4887
130. Loss MJ, Leung S, Chien A, Kerrouche N, Fischer AH, Kang S. Adapalene 0.3% gel shows efficacy for the treatment of atrophic acne scars. *Dermatol Ther*. 2018;8(2):245-257. doi:10.1007/s13555-018-0231-8
131. Dréno B, Bissonnette R, Gagné-Henley A, et al. Prevention and reduction of atrophic acne scars with adapalene 0.3%/benzoyl peroxide 2.5% gel in subjects with moderate or severe facial acne: results of a 6-month randomized, vehicle-controlled trial using intra-individual comparison. *Am J Clin Dermatol*. 2018;19(2):275-286. doi:10.1007/s40257-018-0352-y
132. Clark AK, Quinonez RL, Saric S, Sivamani RK. Hormonal therapies for hidradenitis suppurativa: review. *Dermatol Online J*. 2017;23(10):13030/qt6383k0n4. doi:10.5070/D32310036990
133. Mortimer PS, Dawber RP, Gales MA, Moore RA. A double-blind controlled cross-over trial of cyproterone acetate in females with hidradenitis suppurativa. *Br J Dermatol*. 1986;115(3):263-268. doi:10.1111/j.1365-2133.1986.tb05740.x
134. Sawers RS, Randall VA, Ebling FJ. Control of hidradenitis suppurativa in women using combined antiandrogen (cyproterone acetate) and oestrogen therapy. *Br J Dermatol*. 1986;115(3):269-274. doi:10.1111/j.1365-2133.1986.tb05741.x
135. Montero-Vilchez T, Valenzuela-Amigo A, Cuenca-Barrales C, Arias-Santiago S, Leyva-García A, Molina-Leyva A. The role of oral contraceptive pills in hidradenitis suppurativa: a cohort study. *Life*. 2021;11(7):697. doi:10.3390/life11070697
136. YASMIN® Product Monograph. Mississauga, ON: Bayer Inc.; 2021. Updated April 8, 2021. Accessed November 5, 2021. https://www.bayer.com/sites/default/files/2020-11/yasmin-pm-en.pdf
137. YAZ® Product Monograph. Mississauga, ON: Bayer Inc.; 2017. Updated March 2, 2017. Accessed November 5, 2021. https://www.bayer.com/sites/default/files/2020-11/yaz-pm-en.pdf
138. Diane-35® Product Monograph. Mississauga, ON: Bayer Inc.; 2017. Updated March 16, 2017. Accessed November 5, 2021. https://www.bayer.com/sites/default/files/diane-35-pm-en.pdf
139. Collier EK, Price KN, Grogan TR, Naik HB, Shi VY, Hsiao JL. Characterizing perimenstrual flares of hidradenitis suppurativa. *Int J Womens Dermatol*. 2020;6(5):372-376. doi:10.1016/j.ijwd.2020.09.002
140. Williams NM, Randolph M, Rajabi-Estarabadi A, Keri J, Tosti A. Hormonal contraceptives and dermatology. *Am J Clin Dermatol*. 2021;22(1):69-80. doi:10.1007/s40257-020-00557-5
141. Bosanac SS, Trivedi M, Clark AK, Sivamani RK, Larsen LN. Progestins and acne vulgaris: a review. *Dermatol Online J*. 2018;24(5):13030/qt6wm945xf. doi:10.5070/D3245040035
142. Lortscher D, Admani S, Satur N, Eichenfield LF. Hormonal contraceptives and acne: a retrospective analysis of 2147 patients. *J Drugs Dermatol*. 2016;15(6):670-674.
143. Lee A, Fischer G. A case series of 20 women with hidradenitis suppurativa treated with spironolactone. *Australas J Dermatol*. 2015;56(3):192-196. doi:10.1111/ajd.12362
144. Quinlan C, Kirby B, Hughes R. Spironolactone therapy for hidradenitis suppurativa. *Clin Exp Dermatol*. 2020;45(4):464-465. doi:10.1111/ced.14119
145. Golbari NM, Porter ML, Kimball AB. Antiandrogen therapy with spironolactone for the treatment of hidradenitis suppurativa. *J Am Acad Dermatol*. 2019;80(1):114-119. doi:10.1016/j.jaad.2018.06.063
146. Salavastru CM, Fritz K, Tiplica GS. Spironolacton in dermatologischen behandlungen. "on-label-" und off-label-indikationen [Spironolactone in dermatological treatment. On and off label indications. *Hautarzt*. 2013;64(10):762-767. doi:10.1007/s00105-013-2597-y
147. Searle TN, Al-Niaimi F, Ali FR. Spironolactone in dermatology: uses in acne and beyond. *Clin Exp Dermatol*. 2020;45(8):986-993. doi:10.1111/ced.14340
148. Layton AM, Eady EA, Whitehouse H, Del Rosso JQ, Fedorowicz Z, van Zuuren EJ. Oral spironolactone for acne vulgaris in adult females: a hybrid systematic review. *Am J Clin Dermatol*. 2017;18(2):169-191. doi:10.1007/s40257-016-0245-x
149. Khandalavala BN, Do MV. Finasteride in hidradenitis suppurativa: a "male" therapy for a predominantly "female" disease. *J Clin Aesthet Dermatol*. 2016;9(6):44-50.
150. Babbush KM, Andriano TM, Cohen SR. Anti-androgen therapy in hidradenitis suppurativa: finasteride for females [published online ahead of print July 14, 2021]. *Clin Exp Dermatol*. 2021. doi:10.1111/ced.14847
151. Randhawa HK, Hamilton J, Pope E. Finasteride for the treatment of hidradenitis suppurativa in children and

adolescents. *JAMA Dermatol*. 2013;149(6):732-735. doi:10.1001/jamadermatol.2013.2874

152. Mota F, Machado S, Selores M. Hidradenitis suppurativa in children treated with Finasteride-A case series. *Pediatr Dermatol*. 2017;34(5):578-583. doi:10.1111/pde.13216
153. Joseph MA, Jayaseelan E, Ganapathi B, Stephen J. Hidradenitis suppurativa treated with finasteride. *J Dermatolog Treat*. 2005;16(2):75-78. doi:10.1080/09546630510031403
154. Berek JS. Endocrine Disorders. In: Berek D, ed. *Berek and Novak's Gynecology*. 15th ed. Lippincott Williams & Wilkins; 2011:1066.
155. Verdolini R, Clayton N, Smith A, Alwash N, Mannello B. Metformin for the treatment of hidradenitis suppurativa: a little help along the way. *J Eur Acad Dermatol Venereol*. 2013;27(9):1101-1108. doi:10.1111/j.1468-3083.2012.04668.x
156. van Straalen KR, Tzellos T, Guillem P, et al. The efficacy and tolerability of tetracyclines and clindamycin plus rifampicin for the treatment of hidradenitis suppurativa: results of a prospective European cohort study. *J Am Acad Dermatol*. 2021;85(2):369-378. doi:10.1016/j.jaad.2020.12.089
157. Jørgensen A-HR, Yao Y, Thomsen SF, Ring HC. Treatment of hidradenitis suppurativa with tetracycline, doxycycline, or lymecycline: a prospective study. *Int J Dermatol*. 2021;60(7):785-791. doi:10.1111/ijd.15459
158. Caposiena Caro RD, Cannizzaro MV, Botti E, et al. Clindamycin versus clindamycin plus rifampicin in hidradenitis suppurativa treatment: clinical and ultrasound observations. *J Am Acad Dermatol*. 2019;80(5):1314-1321. doi:10.1016/j.jaad.2018.11.035
159. Bettoli V, Join-Lambert O, Nassif A. Antibiotic treatment of hidradenitis suppurativa. *Dermatol Clin*. 2016;34(1):81-89. doi:10.1016/j.det.2015.08.013
160. Join-Lambert O, Coignard H, Jais J-P, et al. Efficacy of rifampin-moxifloxacin-metronidazole combination therapy in hidradenitis suppurativa. *Dermatology*. 2011;222(1):49-58. doi:10.1159/000321716
161. Yazdanyar S, Boer J, Ingvarsson G, Szepietowski JC, Jemec GBE. Dapsone therapy for hidradenitis suppurativa: a series of 24 patients. *Dermatology*. 2011;222(4):342-346. doi:10.1159/000329023
162. Kaur MR, Lewis HM. Hidradenitis suppurativa treated with dapsone: a case series of five patients. *J Dermatolog Treat*. 2006;17(4):211-213. doi:10.1080/09546630600830588
163. Join-Lambert O, Coignard-Biehler H, Jais J-P, et al. Efficacy of ertapenem in severe hidradenitis suppurativa: a pilot study in a cohort of 30 consecutive patients. *J Antimicrob Chemother*. 2016;71(2):513-520. doi:10.1093/jac/dkv361
164. Curran M, Simpson D, Perry C. Ertapenem: a review of its use in the management of bacterial infections. *Drugs*. 2003;63(17):1855-1878. doi:10.2165/00003495-200363170-00006
165. Braunberger TL, Nartker NT, Nicholson CL, et al. Ertapenem - a potent treatment for clinical and quality of life improvement in patients with hidradenitis suppurativa. *Int J Dermatol*. 2018;57(9):1088-1093. doi:10.1111/ijd.14036
166. Chahine AA, Nahhas AF, Braunberger TL, Rambhatla PV, Hamzavi IH. Ertapenem rescue therapy in hidradenitis suppurativa. *JAAD Case Rep*. 2018;4(5):482-483. doi:10.1016/j.jdcr.2017.12.010
167. Zouboulis CC, Bechara FG, Dickinson-Blok JL, et al. Hidradenitis suppurativa/acne inversa: a practical framework for treatment optimization - systematic review and recommendations from the HS ALLIANCE working group. *J Eur Acad Dermatol Venereol*. 2019;33(1):19-31. doi:10.1111/jdv.15233
168. Kraft JN, Searles GE. Hidradenitis suppurativa in 64 female patients: retrospective study comparing oral antibiotics and antiandrogen therapy. *J Cutan Med Surg*. 2007;11(4):125-131. doi:10.2310/7750.2007.00019
169. Dessinioti C, Zisimou C, Tzanetakou V, Stratigos A, Antoniou C. Oral clindamycin and rifampicin combination therapy for hidradenitis suppurativa: a prospective study and 1-year follow-up. *Clin Exp Dermatol*. 2016;41(8):852-857. doi:10.1111/ced.12933
170. Chu S, Michelle L, Ekelem C, Sung CT, Rojek N, Mesinkovska NA. Oral isotretinoin for the treatment of dermatologic conditions other than acne: a systematic review and discussion of future directions. *Arch Dermatol Res*. 2021;313(6):391-430. doi:10.1007/s00403-020-02152-4
171. Huang CM, Kirchhof MG. A new perspective on isotretinoin treatment of hidradenitis suppurativa: a retrospective chart review of patient outcomes. *Dermatology*. 2017;233(2-3):120-125. doi:10.1159/000477207
172. Patel N, McKenzie SA, Harview CL, et al. Isotretinoin in the treatment of hidradenitis suppurativa: a retrospective study. *J Dermatolog Treat*. 2021;32(4):473-475. doi:10.1080/09546634.2019.1670779
173. Boer J. Are there indications for isotretinoin treatment of hidradenitis suppurativa? *Dermatology*. 2017;233(2-3):111-112. doi:10.1159/000477615
174. Boer J, van Gemert MJ. Long-term results of isotretinoin in the treatment of 68 patients with hidradenitis suppurativa. *J Am Acad Dermatol*. 1999;40(1):73-76. doi:10.1016/S0190-9622(99)70530-X
175. Soria A, Canoui-Poitrine F, Wolkenstein P, et al. Absence of efficacy of oral isotretinoin in hidradenitis suppurativa: a retrospective study based on patients' outcome assessment. *Dermatology*. 2009;218(2):134-135. doi:10.1159/000182261
176. Jørgensen A-HR, Thomsen SF, Ring HC. Isotretinoin and hidradenitis suppurativa. *Clin Exp Dermatol*. 2019;44(4):e155-e156. doi:10.1111/ced.13953
177. Caposiena Caro RD, Bianchi L. Can retinoids flare hidradenitis suppurativa? A further case series. *Clin Exp Dermatol*. 2019;44(4):e153-e154. doi:10.1111/ced.13956
178. Gallagher CG, Kirthi SK, Cotter CC, Revuz JR, Tobin AMT. Could isotretinoin flare hidradenitis suppurativa? A case

series. *Clin Exp Dermatol*. 2019;44(7):777-780. doi:10.1111/ced.13944

179. Kamp S, Fiehn AM, Stenderup K, et al. Hidradenitis suppurativa: a disease of the absent sebaceous gland? Sebaceous gland number and volume are significantly reduced in uninvolved hair follicles from patients with hidradenitis suppurativa. *Br J Dermatol*. 2011;164(5):1017-1022. doi:10.1111/j.1365-2133.2011.10224.x
180. Hogan DJ, Light MJ. Successful treatment of hidradenitis suppurativa with acitretin. *J Am Acad Dermatol*. 1988;19(2 Pt 1):355-356. doi:10.1016/S0190-9622(88)80251-2
181. Boer J, Nazary M. Long-term results of acitretin therapy for hidradenitis suppurativa. Is acne inversa also a misnomer? *Br J Dermatol*. 2011;164(1):170-175. doi:10.1111/j.1365-2133.2010.10071.x
182. Matusiak L, Bieniek A, Szepietowski JC. Acitretin treatment for hidradenitis suppurativa: a prospective series of 17 patients. *Br J Dermatol*. 2014;171(1):170-174. doi:10.1111/bjd.12884
183. Verdolini R, Simonacci F, Menon S, Pavlou P, Mannello B. Alitretinoin: a useful agent in the treatment of hidradenitis suppurativa, especially in women of child-bearing age. *G Ital Dermatol Venereol*. 2015;150(2):155-162.
184. Deckers IE, Prens EP. An update on medical treatment options for hidradenitis suppurativa. *Drugs*. 2016;76(2):215-229. doi:10.1007/s40265-015-0516-5
185. Reserva J, Adams W, Perlman D, et al. Coprescription of isotretinoin and tetracyclines for acne is rare: an analysis of the national ambulatory medical care survey. *J Clin Aesthet Dermatol*. 2019;12(10):45-48.
186. Bagatin E, Costa CS. The use of isotretinoin for acne - an update on optimal dosing, surveillance, and adverse effects. *Expert Rev Clin Pharmacol*. 2020;13(8):885-897. doi:10.1080/17512433.2020.1796637
187. Riis PT, Boer J, Prens EP, et al. Intralesional triamcinolone for flares of hidradenitis suppurativa (HS): a case series. *J Am Acad Dermatol*. 2016;75(6):1151-1155. doi:10.1016/j.jaad.2016.06.049
188. Garelik J, Babbush K, Ghias M, Cohen SR. Efficacy of high-dose intralesional triamcinolone for hidradenitis suppurativa. *Int J Dermatol*. 2021;60(2):217-221. doi:10.1111/ijd.15124
189. Álvarez P, García-Martínez FJ, Poveda I, Pascual JC. Intralesional triamcinolone for fistulous tracts in hidradenitis suppurativa: an uncontrolled prospective trial with clinical and ultrasonographic follow-up. *Dermatology*. 2020;236(1):46-51. doi:10.1159/000499934
190. García-Martínez FJ, Vilarrasa Rull E, Salgado-Boquete L, et al. Intralesional corticosteroid injection for the treatment of hidradenitis suppurativa: a multicenter retrospective clinical study. *J Dermatolog Treat*. 2021;32(3):286-290. doi:10.1080/09546634.2019.1655524
191. Salvador-Rodríguez L, Arias-Santiago S, Molina-Leyva A. Ultrasound-assisted intralesional corticosteroid infiltrations for patients with hidradenitis suppurativa [published correction appears in *Sci Rep*. October 13, 2020;10(1):17551]. *Sci Rep*. 2020;10(1):13363. doi:10.1038/s41598-020-70176-x
192. Saunte DML, Jemec GBE. Intralesional triamcinolone for hidradenitis suppurativa-how much is needed? *Dermatol Surg*. 2021;47(7):1013-1014. doi:10.1097/DSS.0000000000002753
193. Fajgenbaum K, Crouse L, Dong L, Zeng D, Sayed C. Intralesional triamcinolone may not be beneficial for treating acute hidradenitis suppurativa lesions: a double-blind, randomized, placebo-controlled trial. *Dermatol Surg*. 2020;46(5):685-689. doi:10.1097/DSS.0000000000002112
194. Deshmukh NS, Belgaumkar VA, Mhaske CB, Doshi BR. Intralesional drug therapy in dermatology. *Indian J Dermatol Venereol Leprol*. 2017;83(1):127-132. doi:10.4103/0378-6323.190870
195. Tracey EH. Don't forget these 5 things when treating hidradenitis suppurativa. *Cutis*. 2019;104(5):E27-E28.
196. Morelli Coppola M, Salzillo R, Segreto F, Persichetti P. Triamcinolone acetonide intralesional injection for the treatment of keloid scars: patient selection and perspectives. *Clin Cosmet Investig Dermatol*. 2018;11:387-396. doi:10.2147/CCID.S133672
197. Feito-Rodríguez M, Sendagorta-Cudós E, Herranz-Pinto P, de Lucas-Laguna R. Prepubertal hidradenitis suppurativa successfully treated with botulinum toxin A. *Dermatol Surg*. 2009;35(8):1300-1302. doi:10.1111/j.1524-4725.2009.01231.x
198. Campanati A, Martina E, Giuliodori K, Bobyr I, Consales V, Offidani A. Two cases of hidradenitis suppurativa and botulinum toxin type a therapy: a novel approach for a pathology that is still difficult to manage. *Dermatol Ther*. 2019;32(3):e12841. doi:10.1111/dth.12841
199. Khoo ABS, Burova EP. Hidradenitis suppurativa treated with clostridium botulinum toxin A. *Clin Exp Dermatol*. 2014;39(6):749-750. doi:10.1111/ced.12380
200. O'Reilly DJ, Pleat JM, Richards AM. Treatment of hidradenitis suppurativa with botulinum toxin A. *Plast Reconstr Surg*. 2005;116(5):1575-1576. doi:10.1097/01.prs.0000184354.32111.dc
201. Shi W, Schultz S, Strouse A, Gater DR. Successful treatment of stage III hidradenitis suppurativa with botulinum toxin A. *BMJ Case Rep*. 2019;12(1):e226064. doi:10.1136/bcr-2018-226064
202. Reilly DJ, Munasinghe CP, Nizzero DE, Morsi AW. Botulinum toxin A for the management of hidradenitis suppurativa. *Plastic Surgery Case Studies*. 2015;1(1):3-4. doi:10.1177/2513826X1500100101
203. Hua VJ, Kuo KY, Cho HG, Sarin KY. Hyperhidrosis affects quality of life in hidradenitis suppurativa: a prospective analysis. *J Am Acad Dermatol*. 2020;82(3):753-754. doi:10.1016/j.jaad.2019.08.046
204. Naouri M, Maruani A, Lagrange S, et al. Treatment of hidradenitis suppurativa using a long-pulsed hair removal neodymium: yttrium-aluminium-garnet laser: A multicenter,

prospective, randomized, intraindividual, comparative trial. *J Am Acad Dermatol*. 2021;84(1):203-205. doi:10.1016/j.jaad.2020.04.117

205. Vossen ARJV, van der Zee HH, Terian M, van Doorn MBA, Prens EP. Laser hair removal alters the disease course in mild hidradenitis suppurativa. *J Dtsch Dermatol Ges*. 2018;16(7):901-903. doi:10.1111/ddg.13563
206. Tierney E, Mahmoud BH, Hexsel C, Ozog D, Hamzavi I. Randomized control trial for the treatment of hidradenitis suppurativa with a neodymium-doped yttrium aluminium garnet laser. *Dermatol Surg*. 2009;35(8):1188-1198. doi:10.1111/j.1524-4725.2009.01214.x
207. Jfri A, Saxena A, Rouette J, et al. The efficacy and effectiveness of non-ablative light-based devices in hidradenitis suppurativa: a systematic review and meta-analysis. *Front Med*. 2020;7:591580. doi:10.3389/fmed.2020.591580
208. John H, Manoloudakis N, Stephen Sinclair J. A systematic review of the use of lasers for the treatment of hidradenitis suppurativa. *J Plast Reconstr Aesthet Surg*. 2016;69(10):1374-1381. doi:10.1016/j.bjps.2016.05.029
209. Xu LY, Wright DR, Mahmoud BH, Ozog DM, Mehregan DA, Hamzavi IH. Histopathologic study of hidradenitis suppurativa following long-pulsed 1064-nm Nd:YAG laser treatment. *Arch Dermatol*. 2011;147(1):21-28. doi:10.1001/archdermatol.2010.245
210. Carrington AE, Vatanchi M, Sivamani R. Laser hair reduction for hidradenitis suppurativa warrants insurance coverage. *Dermatol Online J*. 2020;26(4):13030/qt55q2q6h8. doi:10.5070/D3264048366
211. Mordon S. Treating hidradenitis suppurativa with photodynamic therapy. *J Cosmet Laser Ther*. 2018;20(4):223-228. doi:10.1080/14764172.2017.1400169
212. Schweiger ES, Riddle CC, Aires DJ. Treatment of hidradenitis suppurativa by photodynamic therapy with aminolevulinic acid: preliminary results. *J Drugs Dermatol*. 2011;10(4):381-386.
213. Rose RF, Stables GI. Topical photodynamic therapy in the treatment of hidradenitis suppurativa. *Photodiagnosis Photodyn Ther*. 2008;5(3):171-175. doi:10.1016/j.pdpdt.2008.07.002
214. Fadel MA, Tawfik AA. New topical photodynamic therapy for treatment of hidradenitis suppurativa using methylene blue niosomal gel: a single-blind, randomized, comparative study. *Clin Exp Dermatol*. 2015;40(2):116-122. doi:10.1111/ced.12459
215. Suárez Valladares MJ, Eiris Salvado N, Rodríguez Prieto MA. Treatment of hidradenitis suppurativa with intralesional photodynamic therapy with 5-aminolevulinic acid and 630nm laser beam. *J Dermatol Sci*. 2017;85(3):241-246. doi:10.1016/j.jdermsci.2016.12.014
216. Kimball AB, Okun MM, Williams DA, et al. Two phase 3 trials of adalimumab for hidradenitis suppurativa. *N Engl J Med Overseas Ed*. 2016;375(5):422-434. doi:10.1056/NEJMoa1504370
217. Goldburg SR, Strober BE, Payette MJ. Hidradenitis suppurativa: current and emerging treatments. *J Am Acad Dermatol*. 2020;82(5):1061-1082. doi:10.1016/j.jaad.2019.08.089
218. Zouboulis CC, Hansen H, Caposiena Caro RD, et al. Adalimumab dose intensification in recalcitrant hidradenitis suppurativa/acne inversa. *Dermatology*. 2020;236(1):25-30. doi:10.1159/000503606
219. Rosales Santillan M, Morss PC, Porter ML, Kimball AB. Biologic therapies for the treatment of hidradenitis suppurativa. *Expert Opin Biol Ther*. 2020;20(6):621-633. doi:10.1080/14712598.2020.1732918
220. Hendricks AJ, Hsiao JL, Lowes MA, Shi VY. A comparison of international management guidelines for hidradenitis suppurativa. *Dermatology*. 2021;237(1):81-96. doi:10.1159/000503605
221. Burmester GR, Gordon KB, Rosenbaum JT, et al. Long-term safety of adalimumab in 29,967 adult patients from global clinical trials across multiple indications: an updated analysis. *Adv Ther*. 2020;37(1):364-380. doi:10.1007/s12325-019-01145-8
222. Poelman SM, Keeling CP, Metelitsa AI. Practical guidelines for managing patients with psoriasis on biologics: an update. *J Cutan Med Surg*. 2019;23(1_suppl):3S-12. doi:10.1177/1203475418811347
223. Ghias MH, Johnston AD, Kutner AJ, Micheletti RG, Hosgood HD, Cohen SR. High-dose, high-frequency infliximab: a novel treatment paradigm for hidradenitis suppurativa. *J Am Acad Dermatol*. 2020;82(5):1094-1101. doi:10.1016/j.jaad.2019.09.071
224. Oskardmay AN, Miles JA, Sayed CJ. Determining the optimal dose of infliximab for treatment of hidradenitis suppurativa. *J Am Acad Dermatol*. 2019;81(3):702-708. doi:10.1016/j.jaad.2019.05.022
225. Sullivan TP, Welsh E, Kerdel FA, Burdick AE, Kirsner RS. Infliximab for hidradenitis suppurativa. *Br J Dermatol*. 2003;149(5):1046-1049. doi:10.1111/j.1365-2133.2003.05663.x
226. Grant A, Gonzalez T, Montgomery MO, Cardenas V, Kerdel FA. Infliximab therapy for patients with moderate to severe hidradenitis suppurativa: a randomized, double-blind, placebo-controlled crossover trial. *J Am Acad Dermatol*. 2010;62(2):205-217. doi:10.1016/j.jaad.2009.06.050
227. Takeda K, Kikuchi K, Kanazawa Y, Yamasaki K, Aiba S. Ustekinumab treatment for hidradenitis suppurativa. *J Dermatol*. 2019;46(12):1215-1218. doi:10.1111/1346-8138.15122
228. Gulliver WP, Jemec GBE, Baker KA. Experience with ustekinumab for the treatment of moderate to severe hidradenitis suppurativa. *J Eur Acad Dermatol Venereol*. 2012;26(7):911-914. doi:10.1111/j.1468-3083.2011.04123.x
229. Blok JL, Li K, Brodmerkel C, Horvátovich P, Jonkman MF, Horváth B. Ustekinumab in hidradenitis suppurativa: clinical

results and a search for potential biomarkers in serum. *Br J Dermatol*. 2016;174(4):839-846. doi:10.1111/bjd.14338

230. Tzanetakou V, Kanni T, Giatrakou S, et al. Safety and efficacy of anakinra in severe hidradenitis suppurativa: a randomized clinical trial [published correction appears in *JAMA Dermatol*. September 1, 2017;153(9):950]. *JAMA Dermatol*. 2016;152(1):52-59. doi:10.1001/jamadermatol.2015.3903
231. Leslie KS, Tripathi SV, Nguyen TV, Pauli M, Rosenblum MD. An open-label study of anakinra for the treatment of moderate to severe hidradenitis suppurativa. *J Am Acad Dermatol*. 2014;70(2):243-251. doi:10.1016/j.jaad.2013.09.044
232. Frew JW, Navrazhina K, Grand D, et al. The effect of subcutaneous brodalumab on clinical disease activity in hidradenitis suppurativa: an open-label cohort study. *J Am Acad Dermatol*. 2020;83(5):1341-1348. doi:10.1016/j.jaad.2020.05.007
233. Arenbergerova M, Arenberger P, Marques E, Gkalpakiotis S. Successful treatment of recalcitrant gluteal hidradenitis suppurativa with brodalumab after anti-TNF failure. *Int J Dermatol*. 2020;59(6):733-735. doi:10.1111/ijd.14792
234. Yoshida Y, Oyama N, Iino S, Shimizu C, Hasegawa M. Long-standing refractory hidradenitis suppurativa responded to a brodalumab monotherapy in a patient with psoriasis: a possible involvement of Th17 across the spectrum of both diseases. *J Dermatol*. 2021;48(6):916-920. doi:10.1111/1346-8138.15807
235. Casseres RG, Prussick L, Zancanaro P, et al. Secukinumab in the treatment of moderate to severe hidradenitis suppurativa: results of an open-label trial. *J Am Acad Dermatol*. 2020;82(6):1524-1526. doi:10.1016/j.jaad.2020.02.005
236. Prussick L, Rothstein B, Joshipura D, et al. Open-label, investigator-initiated, single-site exploratory trial evaluating secukinumab, an anti-interleukin-17A monoclonal antibody, for patients with moderate-to-severe hidradenitis suppurativa. *Br J Dermatol*. 2019;181(3):609-611. doi:10.1111/bjd.17822
237. Reguiaï Z, Fougerousse AC, Maccari F, Bécherel PA. Effectiveness of secukinumab in hidradenitis suppurativa: an open study (20 cases. *J Eur Acad Dermatol Venereol*. 2020;34(11):e750-e751. doi:10.1111/jdv.16605
238. Glatt S, Jemec GBE, Forman S, et al. Efficacy and Safety of Bimekizumab in Moderate to Severe Hidradenitis Suppurativa: A Phase 2, Double-blind, Placebo-Controlled Randomized Clinical Trial [published online ahead of print August 18, 2021]. *JAMA Dermatol*. 2021;e212905. doi:10.1001/jamadermatol.2015.3903
239. Amat-Samaranch V, Agut-Busquet E, Vilarrasa E, Puig L. New perspectives on the treatment of hidradenitis suppurativa. *Ther Adv Chronic Dis*. 2021;12:20406223211055920. doi:10.1177/20406223211055920
240. Wong D, Walsh S, Alhusayen R. Low-dose systemic corticosteroid treatment for recalcitrant hidradenitis suppurativa. *J Am Acad Dermatol*. 2016;75(5):1059-1062. doi:10.1016/j.jaad.2016.06.001
241. Vossen ARJV, van Doorn MBA, van der Zee HH, Prens EP. Apremilast for moderate hidradenitis suppurativa: results of a randomized controlled trial. *J Am Acad Dermatol*. 2019;80(1):80-88. doi:10.1016/j.jaad.2018.06.046
242. Folkes AS, Hawatmeh FZ, Wong A, Kerdel FA. Emerging drugs for the treatment of hidradenitis suppurativa. *Expert Opin Emerg Drugs*. 2020;25(3):201-211. doi:10.1080/14728214.2020.1787984
243. Matusiak Łukasz, Szczęch J, Kaaz K, Lelonek E, Szepietowski JC. Clinical characteristics of pruritus and pain in patients with hidradenitis suppurativa. *Acta Derm Venereol*. 2018;98(2):191-194. doi:10.2340/00015555-2815
244. Garg A, Neuren E, Cha D, et al. Evaluating patients' unmet needs in hidradenitis suppurativa: results from the global survey of impact and healthcare needs (voice) project. *J Am Acad Dermatol*. 2020;82(2):366-376. doi:10.1016/j.jaad.2019.06.1301
245. Ravn Jørgensen AH, Yao Y, Thomsen SF, Christian Ring H. Self-reported pain alleviating methods in patients with hidradenitis suppurativa. Métodos referidos POR Los pacientes para aliviar El dolor asociado a la hidradenitis supurativa. *Actas Dermosifiliogr*. 2021;112(2):153-158. doi:10.1016/j.ad.2020.08.011
246. Kirby JS, Miller JJ, Adams DR, Leslie D. Health care utilization patterns and costs for patients with hidradenitis suppurativa. *JAMA Dermatol*. 2014;150(9):937-944. doi:10.1001/jamadermatol.2014.691
247. Taylor MT, Orenstein LAV, Barbieri JS. Pain severity and management of hidradenitis suppurativa at US emergency department visits. *JAMA Dermatol*. 2021;157(1):115-117. doi:10.1001/jamadermatol.2020.4494
248. Reddy S, Orenstein LAV, Strunk A, Garg A. Incidence of long-term opioid use among opioid-naive patients with hidradenitis suppurativa in the United States. *JAMA Dermatol*. 2019;155(11):1284-1290. doi:10.1001/jamadermatol.2019.2610
249. Nielsen RM, Lindsø Andersen P, Sigsgaard V, Theut Riis P, Jemec GB. Pain perception in patients with hidradenitis suppurativa. *Br J Dermatol*. 2020;182(1):166-174. doi:10.1111/bjd.18656
250. Huilaja L, Hirvonen MJ, Lipitsä T, et al. Patients with hidradenitis suppurativa may suffer from neuropathic pain: a Finnish multicenter study. *J Am Acad Dermatol*. 2020;82(5):1232-1234. doi:10.1016/j.jaad.2019.11.016
251. van Straalen KR. Chronic pain in hidradenitis suppurativa explained through the process of central sensitization. *JAMA Dermatol*. 2020;156(6):615-616. doi:10.1001/jamadermatol.2020.0225
252. Scheinfeld N. Treatment of hidradenitis supprurativa associated pain with nonsteroidal anti-inflammatory drugs, acetaminophen, celecoxib, gabapentin, pegabalin, duloxetine, and venlafaxine. *Dermatol Online J*. 2013;19(11):20616. doi:10.5070/D31911020616

253. Fernandez JM, Thompson AM, Borgstrom M, Orenstein LAV, Hsiao JL, Shi VY. Pain management modalities for hidradenitis suppurativa: a patient survey [published online ahead of print September 20, 2020. *J Dermatolog Treat*. 2020:1-4. doi:10.1080/09546634.2020.1822501
254. Melendez Gonzalez MDM, Sayed CJ. Surgery is an essential aspect of managing patients with hidradenitis suppurativa. *J Am Acad Dermatol*. 2020;83(3):979-980. doi:10.1016/j.jaad.2020.03.008
255. Janse I, Bieniek A, Horváth B, Matusiak Ł. Surgical procedures in hidradenitis suppurativa. *Dermatol Clin*. 2016;34(1):97-109. doi:10.1016/j.det.2015.08.007
256. Danby FW, Hazen PG, Boer J. New and traditional surgical approaches to hidradenitis suppurativa. *J Am Acad Dermatol*. 2015;73(5 Suppl 1):S62-S65. doi:10.1016/j.jaad.2015.07.043
257. van Hattem S, Spoo JR, Horváth B, Jonkman MF, Leeman FWJ. Surgical treatment of sinuses by deroofing in hidradenitis suppurativa. *Dermatol Surg*. 2012;38(3):494-497. doi:10.1111/j.1524-4725.2011.02255.x
258. van der Zee HH, Prens EP, Boer J. Deroofing: a tissue-saving surgical technique for the treatment of mild to moderate hidradenitis suppurativa lesions. *J Am Acad Dermatol*. 2010;63(3):475-480. doi:10.1016/j.jaad.2009.12.018
259. Posch C, Monshi B, Quint T, Vujic I, Lilgenau N, Rappersberger K. The role of wide local excision for the treatment of severe hidradenitis suppurativa (Hurley grade III): retrospective analysis of 74 patients. *J Am Acad Dermatol*. 2017;77(1):123-129. doi:10.1016/j.jaad.2017.01.055
260. Bouazzi D, Chafranska L, Saunte DML, Jemec GBE. Systematic review of complications and recurrences after surgical interventions in hidradenitis suppurativa. *Dermatol Surg*. 2020;46(7):914-921. doi:10.1097/DSS.0000000000002323
261. Hazen PG, Hazen BP. Hidradenitis suppurativa: successful treatment using carbon dioxide laser excision and marsupialization. *Dermatol Surg*. 2010;36(2):208-213. doi:10.1111/j.1524-4725.2009.01427.x
262. Madan V, Hindle E, Hussain W, August PJ. Outcomes of treatment of nine cases of recalcitrant severe hidradenitis suppurativa with carbon dioxide laser. *Br J Dermatol*. 2008;159(6):1309-1314. doi:10.1111/j.1365-2133.2008.08932.x
263. Nicholson CL, Hamzavi I, Ozog DM. Rapid healing of chronic ulcerations and improvement in range of motion after fractional carbon dioxide (CO2) treatment after CO2 excision of hidradenitis suppurativa axillary lesions: a case report. *JAAD Case Rep*. 2016;2(1):4-6. doi:10.1016/j.jdcr.2015.11.001
264. Kazemi A, Carnaggio K, Clark M, Shephard C, Okoye GA. Optimal wound care management in hidradenitis suppurativa. *J Dermatolog Treat*. 2018;29(2):165-167. doi:10.1080/09546634.2017.1342759
265. Alavi A, Kirsner RS. Local wound care and topical management of hidradenitis suppurativa. *J Am Acad Dermatol*. 2015;73(5 Suppl 1):S55-S61. doi:10.1016/j.jaad.2015.07.048
266. Alavi A, Sibbald RG, Kirsner RS. Optimal hidradenitis suppurativa topical treatment and wound care management: a revised algorithm. *J Dermatolog Treat*. 2018;29(4):383-384. doi:10.1080/09546634.2017.1385719
267. Cooper RA, Molan PC, Krishnamoorthy L, Harding KG. Manuka honey used to heal a recalcitrant surgical wound. *Eur J Clin Microbiol Infect Dis*. 2001;20(10):758-759. doi:10.1007/s100960100590
268. Nicoli F, Balzani A, Lazzeri D, et al. Severe hidradenitis suppurativa treatment using platelet-rich plasma gel and Hyalomatrix. *Int Wound J*. 2015;12(3):338-343. doi:10.1111/iwj.12117
269. Wu CQ, Grandi SM, Filion KB, Abenhaim HA, Joseph L, Eisenberg MJ. Drospirenone-containing oral contraceptive pills and the risk of venous and arterial thrombosis: a systematic review. *BJOG*. 2013;120(7):801-810. doi:10.1111/1471-0528.12210
270. Gialeraki A, Valsami S, Pittaras T, Panayiotakopoulos G, Politou M. Oral contraceptives and HRT risk of thrombosis. *Clin Appl Thromb Hemost*. 2018;24(2):217-225. doi:10.1177/1076029616683802
271. Bienenfeld A, Nagler AR, Orlow SJ. Oral antibacterial therapy for acne vulgaris: an evidence-based review. *Am J Clin Dermatol*. 2017;18(4):469-490. doi:10.1007/s40257-017-0267-z