

Surgical Management of Hidradenitis Suppurativa

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Hidradenitis suppurativa (HS) is a chronic, relapsing inflammatory disease of the skin, characterized by recurrent draining sinuses and abscesses, predominantly in skin folds carrying terminal hairs and apocrine glands. Treatment for this debilitating disease has been medical management with antibiotics and immune modulators. With the advent of better reconstructive surgical techniques, the role of surgery in the treatment of HS has expanded, from being a last resort to a modality that is deployed earlier. Larger defects can be more easily reconstructed, allowing for a more radical excision of diseased areas. Locoregional flaps, perforator flaps, and propeller flaps that use the fasciocutaneous tissue allow reconstruction of defects with similar tissue, and provide better cosmetic and functional outcomes. They are easy to execute and can be performed even in resource-poor settings with concurrent use of immune modulators and postoperative antibiotics. Hidradenitis can be successfully treated with surgery in early stages as well as severe disease, due to the advances in understanding disease behavior, multidisciplinary care, and advanced reconstructive techniques. Coupled with a multidisciplinary care team, surgery offers a durable, lasting cure for HS, significantly reducing disease morbidity. (*Plast Reconstr Surg Glob Open* 2024; 12:e5860; doi: [10.1097/GOX.0000000000005860](https://doi.org/10.1097/GOX.0000000000005860); Published online 13 June 2024.)

INTRODUCTION

Hidradenitis suppurativa (HS) is a long-ignored skin disease affecting 1% of young, underserved minorities globally: incidence is highest in African American people (1.3%), lowest in Hispanic/Latino people (0.07%), and intermediate amongst White people (0.75%),¹ accounting for approximately 4% of the US population.² Its cost impact on the patient (job losses/decreased work productivity and out-of-pocket costs) is high. Healthcare cost itself is estimated at more than \$60,000 per year.^{3,4} Despite the prevalence, HS remains an orphan disease without proper diagnostic tools or established standard of care guidelines.

Primarily affecting hair follicles, HS quickly progresses to painful, severely debilitating complications.⁵ Traditionally, medical management is the first-line therapy (Fig. 1), and surgery, the “treatment of last resort” after a 3- to 6-month trial.⁶ Treatment recommendations based on Hurley stage (Fig. 2) have a strong bias that stems from the method by which treatment modalities have been comparatively studied: medical management (especially

immunotherapy) of HS is better researched, whereas similar well-controlled studies in surgery are missing.

Surgical approaches include local destruction via cryosurgery, cryoinfusion, electrosurgery, and photodynamic therapy; incision and drainage; standard deroofing, wide deroofing, and debridement of individual sinus tracts; or complete surgical excision beyond all clinically apparent margins with reconstruction.⁷ That said, surgical treatment is based on anecdotal evidence, case studies, and case reports, with lower strength of recommendation scores^{8,9}; clinical trials comparing the two approaches head-to-head, medical versus surgical, have never been performed. Recent cooperative reports have recognized these gaps and concluded that a thoughtful combination of surgical and medical treatments could potentially yield better results than using either of them alone.^{10,11}

Here, we explore the expanding role surgery plays in the treatment of HS. Based on recent evidence, we posit that surgical extirpation and reconstruction, coupled with adjuvant antibiotic therapy, could offer a durable, long-lasting solution to a complex disease.

RATIONALE FOR SURGERY FOR HS

The reasoning for surgery to treat HS (arguably even better than medical strategies used alone) is rooted in novel characteristics of both HS as a disease and of HS patients in general.

- **Disease Biology:** The central pathogenic event in HS is the occlusion of the upper part of the hair follicle leading

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to perifollicular lympho-histiocytic inflammation.¹² The structural alterations that follow (deep, invading abscess, multiple interconnecting sinus tracts, and deep communicating dermal and impregnable cicatrization) are barriers to any medical treatment. Antibiotics and immune modulators cannot easily penetrate this hostile micro-environment (scar tissue, acidic pH, aberrant vascularity), limiting their efficacy.¹³ In sharp contrast, surgery extirpates diseased tissue, reduces disease burden, and disrupts anatomic barriers (deroofting), making it a powerful adjunct to postoperative medical management.

- **Staging:** Clinical staging of HS (Hurley staging system; Fig. 2) demonstrates how early single lesions (stage I) are amenable to surgical excision and eradication of disease in one step, as opposed to long-term antibiotic care and flare-ups.¹⁴
- **Recent surgical advances:** Newer reconstructive techniques, elegant perforator flaps, biologics, sophisticated microsurgery, and the vacuum-assisted closure expand reconstructive choices and provide superior cosmetic and functional outcomes.
- **Multidisciplinary care:** Principally dermatology is the “home” for HS patients, and plastic surgeons, internists, infectious disease specialists, and immunologists provide “multidisciplinary care,” an ideal HS service-line model¹⁵ (Fig. 3).
- **Demand:** HS has a devastating effect on patients (most of whom are young, minorities, and underserved): poor quality of life,¹⁶ chronic pain,¹⁷ poor mental health,¹⁸ substance abuse,¹⁹ impaired intimate relationships,²⁰ with two to four times higher suicide rates than the general population.²¹ Understandably, these patients deserve a lasting, resolute, durable, and definitive treatment, instead of multiple lifelong treatments that cycle between remissions and flare-ups.

DESCRIPTION OF MOST EFFECTIVE PROCEDURES

Broadly, selection of the surgical operation depends upon two criteria:

- **Disease acuity:**
 - Acute abscesses, with/without sepsis, require drainage, postprocedural antibiotics^{7,22,23} based on intraoperative cultures but recurrent lesions are inevitable.

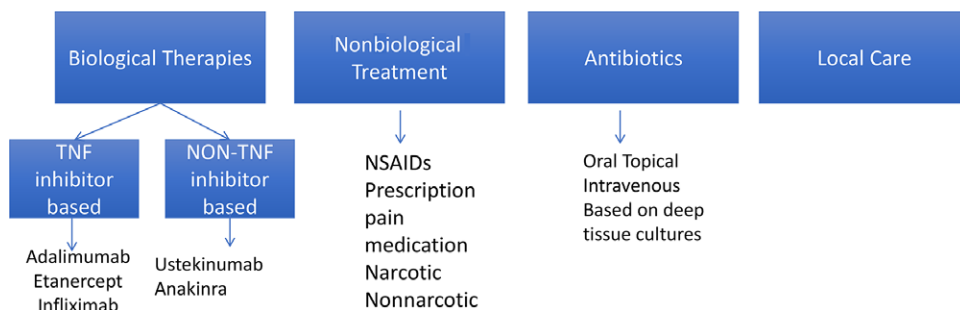


Fig. 1. First-line nonsurgical management of HS. NSAIDs, non-steroidal anti-inflammatory drugs; TNF, tumor necrosis factor.

Takeaways

Question: What emerging role does surgery play in management of hidradenitis suppurativa (HS)?

Findings: Advanced, reliable reconstructive surgical techniques, including locoregional, perforator, propeller, and free flaps allow for reconstruction of defects with similar tissue, providing better cosmetic and functional outcomes. This has expanded the role of surgery in the treatment of HS from being a last resort to a modality that is deployed earlier to achieve conclusive eradication. They are easy to execute and can be performed even in resource-poor settings with concurrent use of immune modulators and postoperative antibiotics.

Meaning: Coupled with a multidisciplinary care team, surgery offers a durable, lasting cure for HS, significantly reducing disease morbidity.

- **Hurley stage:**
 - **Limited disease:** Solitary lesions can be treated with local excision, deroofting, and skin-tissue-sparing excision with electrosurgical peeling (STEEP).²⁴ STEEP involves successive tangential excisions of lesional and fibrous tissue until the epithelialized bottom of the sinus tracts is reached, and left open to heal secondarily. This tissue-sparing technique has low recurrence rates and high patient satisfaction with relatively short healing times and favorable cosmetic outcomes.
 - **Severe widespread disease:** it needs an extensive resection (wide or radical excision, described in detail below), including resection of chronic inactive lesions that are harbinger of recurrence.²⁵

LASER: NEODYMIUMDOPED YTTRIUM ALUMINUM GARNET (ND:YAG)

The treatment of HS with CO₂ laser along with hair follicle removal with long pulse Nd:YAG laser is an effective minimally invasive tissue-saving surgical intervention for the treatment of refractory HS.²⁶ Long-pulsed Nd:YAG (1064nm) causes selective photothermolysis of the follicular unit. A 65% reduction in disease severity after 3 monthly treatments is noted, with better results in patients with Hurley stage II disease especially in inguinal

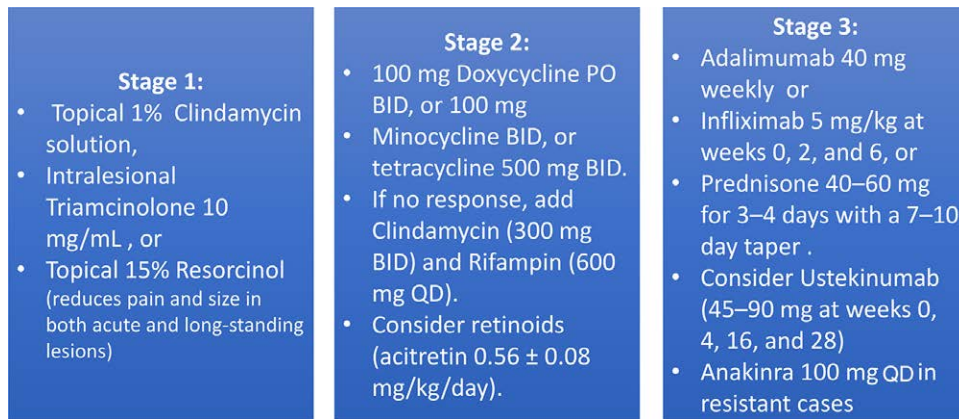


Fig. 2. Stage-specific first-line therapy for HS. PO, per oral; BID, twice daily; QD, once daily.

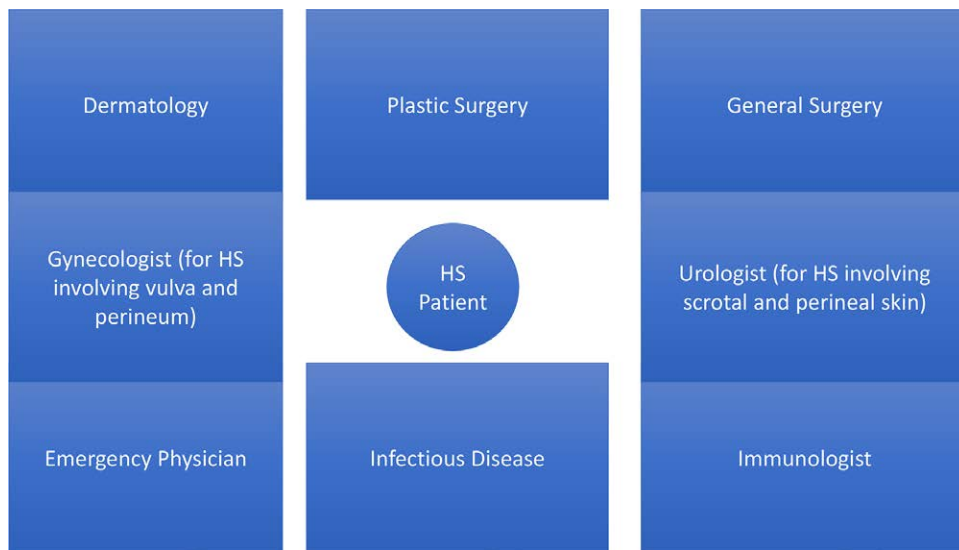


Fig. 3. Multidisciplinary care model for hidradenitis patients.

and axillary sites.²⁷ Recommended starting settings are based on Fitzpatrick skin type (types I–III: fluence 40–50 J/cm², pulse duration 20ms, spot size 10mm; types IV–VI: fluence 35–50 J/cm², pulse duration 35ms, spot size 10mm). Nodules should be treated with double pulsing, whereas background lesional skin is treated with a single pulse.²⁸

Deroofing

Deroofing procedures are effective for mild to moderate HS (Hurley stage: I/II) and aim at surgically excising the “roof” or overlying skin of the HS tract and allowing secondary healing. It is a tissue-saving technique whereby the “roof” of an abscess, cyst, or sinus tract is surgically removed with electrocautery or knife (STEEP). A blunt probe is inserted in sinus openings where purulent exudate is noted. The lesion is then explored with the probe in all directions to find and explore all communicating tracts, taking care to not create false passages. Injection of methylene or lymphazurin blue dye can assist in identifying all possible tracts

of the region affected. Low local recurrence and high satisfaction rates are reported.^{7,29}

Local Excision

Traditionally, HS has been treated with local excision with variable margins. This method is beneficial for small early Hurley stage I or II lesions, particularly if they are discrete and separated by large areas of healthy tissue. However, postoperative recurrences of HS can occur in up to 20%–50% of patients.^{30,31}

Wide Excision

Wide excision and flap-based reconstruction are associated with lower recurrence rates. As a caveat, disease heterogeneity and limitations of the evidence hamper the ability to predict relative recurrence rates associated with surgical techniques.^{32,33} Typically, wide excision involves removal of a lesion with a grossly clear margin. It is currently considered an effective treatment to remove affected areas and reduce recurrence and must be balanced against potentially higher morbidity of extensive procedures.³⁴

Radical Excision

General consensus is that radical wide excision of all involved skin and tissue is the only curative treatment. In severe disease states, the lesions extend into the fat, and in general, excision should be done to ensure removal of all tissue, including skin and subcutaneous fat, down to the deep underlying fascia. A margin of 1–2 cm is often essential to ensure a cure. Radical excision can be successfully performed in all HS locations from Hurley stage I to III. When surgeons are uncertain about the extent of the disease, preoperative magnetic resonance imaging or ultrasound can be used. Alternatively, intraoperative color marking of sinus tracts with dyes such as methyl violet and iodine starch can be used to define the operative area. In patients with Hurley stage III lesions, excision of the entire hair-bearing skin of the affected anatomic site is necessary for disease clearance. It has the lowest recurrence rates (range 0%–27%),^{35,36} when compared with a wide resection (42%) or drainage alone (100%).³⁷

Surgery + Immunomodulators

Patients with Hurley stage III HS need radical resection with immediate reconstruction or delayed primary closure, followed by adjuvant biologic therapy. Biologics reduce the inflammatory load in HS lesions. However, in our clinical experience, in the presence of tunnels and deep-seated nodules, local recurrence could occur if the excision is not wide enough. We therefore advise that deroofting or wide local excision of chronic lesions be undertaken first, when patients are receiving biologic therapy followed by a radical excision. Combination of biologic therapy with surgery has a higher probability of achieving a 75% reduction in active nodule count.³⁸ An ongoing phase IV randomized controlled trial (NCT02808975) assessing the safety and efficacy of adalimumab+surgery is ongoing.³⁹ In other immune-mediated diseases, such as psoriasis, psoriatic arthritis, rheumatoid arthritis, and inflammatory bowel disease, performing major surgery while on biologic treatment did not increase postoperative complications. A 100% consensus within the HS ALLIANCE working group recommends *not stopping* biologic therapy preoperatively in HS patients.⁸ The Safety and Efficacy of Adalimumab for Hidradenitis Suppurativa Peri-Surgically trial (phase 4, randomized, double-blind, placebo-controlled study of adalimumab in conjunction with surgery)⁴⁰ concluded that adalimumab was efficacious in conjunction with wide-excision surgery with no need to interrupt treatment preoperatively.

Further, the use of adjuvant biologic therapy after radical resection for recalcitrant HS results in lower rates of recurrence and disease progression, and a longer disease-free interval.⁴¹

RECONSTRUCTIVE STRATEGIES

Skin Grafts and Biologics

Secondary intention healing, negative pressure wound therapy (NPWT), skin grafting, and flap closure are options. Healing by secondary intention has decidedly suboptimal results,⁴² particularly if performed for any wide-excision other than deroofting. Defects reconstructed

with flaps or grafts when compared with primary closure or healing by secondary intention result in lower recurrence rates.⁴³ Immediately after excision, if the wound bed is not ready for reconstruction (heavily infected purulent), 2–3 weeks of NPWT are recommended, followed by secondary reconstruction to stimulate angiogenesis and prepare the wound.⁴⁴ Used as the only method of wound closure, NPWT could cause scars and contractures.

In large defects where flap coverage is difficult or not feasible, skin grafting allows a faster recovery to a “closed wound.” Biologics, including dermal regenerative templates followed by split thickness skin grafts at a secondary stage, are useful and can improve contour and diminish cicatricial contracture,⁴⁵ but could be cost-prohibitive.

Adjacent tissue transfer:

The ideal method of reconstruction of HS defects is to replace “like for like.” Locoregional flaps are similar in texture, color, and functionality; are sensate; and are easy to perform even in an outpatient setting. These include local random pattern flaps, adjacent tissue transfer, transposition, or rotational flaps, especially for smaller defects.

Perforator flaps:

Perforator flaps provide several benefits in reconstructing HS defects, and varied choices are available (Fig. 4):

- Larger areas such as the axilla, defects as large as 15 cm by 10 cm,⁴⁶ can be reconstructed in a single stage⁴⁷ using a perforator flap based on the thoracodorsal artery (Fig. 5)
- Donor site closure is usually accomplished with primary closure and skin grafting as rarely needed;
- Most importantly the flap harvest does not result in any functional deficit;
- Perforator flaps being fasciocutaneous in nature, there is no risk of cicatricial contractures, which commonly affect dynamic areas (axilla, groin) that otherwise would have needed a skin graft;
- Postoperative recovery is much faster for patients⁴⁸;
- Finally, perforator-based reconstruction avoids the need for microsurgical anastomosis and its risks.⁴⁹

As our understanding of perforator flaps and their anatomy has evolved, consistent and reliable options have emerged for HS. Our preference for axillary reconstruction is a flap based on the thoracodorsal vascular system (TDAP) or the intercostal perforators. Generally, several perforators from the descending or transverse branch of the thoracodorsal artery are easily identified using a hand-held Doppler (Fig. 5). For the gluteal region, we rely on parasacral perforators based on the superior gluteal arteries and inferior gluteal arteries (IGAP; Fig. 6). Inguinal defects can be reconstructed with flaps based on the medial circumflex femoral artery. These flaps are reliable workhorses and are most commonly used. In select patients wherein they are not available, due in part to unavailable tissue or unidentifiable perforators, other flaps such as anterolateral thigh flaps, superficial circumflex iliac artery perforator flaps, circumflex scapular flaps,

Anatomic Sites	Non microsurgical option	Microsurgical option
Axilla	TDAP, ICAP, Serratus perforator, posterior arm flap, circumflex scapular,	DIEP flap, ALT, Lateral arm
Chest	TDAP, serratus, internal mammary perforator, TRAM, latissimus muscle flaps	ALT, DIEP
Groin	Pedicled ALT, SCIP flap, superficial circumflex iliac, gracilis, pedicled DIEP, SIEA flap	Free ALT, DIEP
Buttocks	SGAP, IGAP, posterior thigh, lumbar perforator	
Perineal	Singapore Flap, pudendal artery perforator flap, IGAP	

Fig. 4. Reconstructive choices based on anatomic location of lesions. ICAP, intercostal artery perforator; TRAM, transverse rectus abdominis myocutaneous; SIEA, superficial inferior epigastric artery.

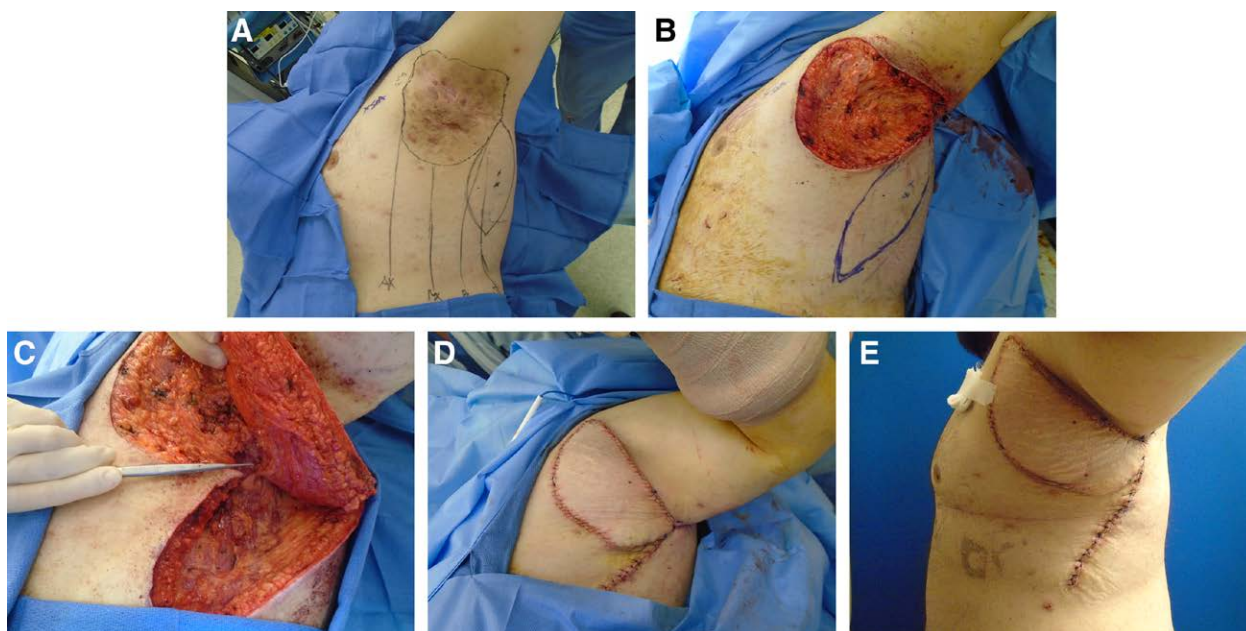


Fig. 5. Case 1. A 23-year-old man (body mass index = 40) with a 10-year history of bilateral axillary hidradenitis (Hurley stage III) unresponsive to topical and oral antibiotics and Humira. A–B, preoperative and after wide resection (20 × 15 cm) with immediate TDAP fasciocutaneous flap (22 × 10 cm) reconstruction [based on two perforators (shown in C)] was performed. Surrounding tissue was widely undermined and (D) flap inset was undertaken loosely (body mass index considerations). Patient was admitted postoperatively, taken back on POD 2 for final inset, and discharged on POD 4. The patient did well postoperatively, and will be undergoing right HS wide local excision and reconstruction. E, One month postoperative appearance.

posterior arm perforator flaps,⁵⁰ and even deep inferior epigastric flaps can be used.

Postoperative Care and Antibiotics

In general, patients with HS have an increased risk of cutaneous and extracutaneous infection, possibly due to skin barrier disruption and immune dysregulation. These patients have more comorbidities, increasing the risk of postoperative infections,⁵¹ and must receive appropriate

perioperative antibiotics. Postsurgical treatment using antibiotics is challenging because most patients develop resistance to the several antibiotics they have received before surgery. The choice is guided by the perioperative culture and sensitivity reports. These samples are specifically obtained intraoperatively, from the deeper surface of the excised specimen (rather than from the skin lesions themselves). These deeper cultures provide much more accurate data than culturing skin flora alone. Empirically



Fig. 6. Case 2. A 21-year-old woman with a 5-year history of perineal/gluteal hidradenitis (Hurley stage III). Topical treatments were ineffective, and she refused systemic medical therapies. After wide local excision (A), a superior gluteal artery perforator fasciocutaneous flap based on two parasacral artery perforators [with a 90-degree pivot; perforators marked with x (B)] was used for reconstruction (C). Postoperatively, the patient was kept on prone bed rest for 1 day and then out of bed as tolerated with sitting and supine laying restrictions for 6 weeks. On the inferior aspect of the flap, the patient developed a small dehiscence, primarily closed in the office.

using clindamycin postoperatively until the cultures are back is a reasonable measure.⁵² Typically, antibiotics used are intravenous in most cases; however, the final choice and course of antibiotics is decided in conjunction with the infectious-disease service (integral part of the multidisciplinary team).

Postoperative care also in axillary HS involves restriction of arm movements for 2 weeks. In perineal HS, the patient is recommended a low air loss mattress for 3 weeks, pressure offloading on the surgical site, and restricting activities except simple self-care activities.

Functional Outcomes

Outcomes measures for HS treatments include recurrence rate, range of motion, and satisfaction. The Hidradenitis Suppurativa Quality of Life questionnaire is a validated scoring system that enables comparison and standardization of treatment outcomes.⁵³ Most patients report high or very high satisfaction with their surgical results.⁵⁴ Other available measures include the Dermatology Life Quality Index and Arizona Sexual Experiences Scale.⁵⁵

Avoiding Complications

- Preoperative anticipation of the defect size, anatomic variations, and effects on donor site helps prevent last-minute reconstructive planning;
- Timing of reconstruction: heavily infected draining lesions that are best reconstructed at a second stage;
- Postoperatively, patients should be strictly monitored, frequent flap checks performed every 2–4 hours for the first 24 hours. Staff-education and preparedness are vital;
- Axillary resections need a postoperative arm splint, to not compress the flap. Extensive perineal/gluteal reconstructions need appropriate pressure offloading;
- Nonnarcotic pain management is preferred over opioids, especially because patients with HS are at higher addiction risk, having being given narcotics chronically;
- Case managers/social workers help with postdischarge planning and reduce re-admissions.

Pearls and Pitfalls

- Preplanning emphasizes preoperative counseling on tobacco cessation, weight loss, treatment of superinfections, and postoperative wound management (Fig. 7).
- Consistently document Hurley stage followed by validated postoperative evaluation of treatment response, Hidradenitis Suppurativa Clinical Response score⁵⁶;
- Consider adjuvant nonsurgical therapy and pain management, including preoperative adalimumab;
- When radical or extensive wide local excision is selected, consider performing diversion procedures (temporary colostomy or suprapubic cystostomy).
- Specific procedural pearls:
 - At the start of the perforator-based reconstruction, use a hand-held Doppler probe to identify candidate perforators close to the margin of the defect.
 - Perforators closer to the margin are better *as long as they are not in the inflamed tissue zone*; otherwise, a delayed flap loss might ensue.
 - If the perforator is far, use subfascial dissection to increase perforator-pedicule length.
 - Magnification with 2.5/3.5×-loupes facilitates clear, direct perforator visualization.
 - Needle-tip Bovie (cutting mode) along with bipolar cautery facilitates supra and subfascial dissection.
 - Once a large perforator is identified, isolate, but do not skeletonize it, especially suprafascially, until all other audible and visualized perforators are isolated.
 - In case two perforators are identified, and one has to be chosen to propellerize the flap, use an atraumatic vascular clamp on each perforator and check flap vascularity to select the better one.⁵⁷
 - Intraoperatively, use a hand-held Doppler (in a sterile plastic wrap) to frequently assess the perforator (prior and after inset).
 - A peninsular flap, rather than an island (Fig. 5) improves venous drainage and overall vascular supply. The resultant contour deformity can be easily revised later;

- Assemble a multidisciplinary care model for HS patients;
- Plan a treatment algorithm based on each patient's disease stage, acuity, and previous response to treatment;
- Accurate staging pre treatment is a must;
- Assess treatment-response using a standardized tool;
- Stage the surgical treatment and reconstruction if needed
- Consider all reconstructive options carefully including non microsurgical, surgical, and least-invasive procedures keeping functional outcomes in sharp focus.

Fig. 7. What providers of care for HS patients need to know.

- Seek out providers that offer a team approach to care, including medical and surgical options;
- Understand that the treatment is multi pronged and may involve multiple modalities;
- Limited disease can be treated surgically as well as medically;
- Severe HS in multiple sites may need preoperative reduction of disease by using immune therapies, risk-reduction, and antibiotics
- Reconstructive surgery for advanced disease can provide good functional outcomes and durable results.

Fig. 8. What HS patients need to know.

- Loosely inset the perforator flap without tension to optimize flap survival significantly. Speculatively, this offsets, in part, the anticipated postexcision swelling of a previously inflamed zone;
- Delay the flap if the vascularity of the flap is compromised on inset;
- Last, supercharge the vein if congestion is acute and severe;
- Cultures taken intraoperatively are of value only if they show nonskin flora. Taking cultures from the deeper aspect of the lesion after resection is much more valuable; they help select systemic antibiotics for the short/long term.
- If an enlarged more than 1-cm lymph node is identified or seems infected, resect and obtain both histopathological and microbial analysis.

WHAT PATIENTS SHOULD KNOW BEFORE HAVING THIS PROCEDURE

Adequate access to information on HS is critical for patients. It facilitates the best shared decision model, clearer understanding of treatment goals, timeline of recovery, postoperative rehabilitation, and surveillance (Fig. 8).⁵⁸

CONCLUSIONS

Hidradenitis is successfully treated with surgery in early and late stages through better understanding of disease

behavior and advanced reconstructive techniques to achieve better functional outcomes with durable, lasting results.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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