Current Surgical Management of Hidradenitis Suppurativa: A Systematic Review and Meta-Analysis

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BACKGROUND Hidradenitis suppurativa (HS) is a chronic dermatologic condition that often necessitates surgical treatment. Surgical approaches vary substantially with little data on efficacy and safety.

OBJECTIVE Summarize the literature on HS surgery with regards to patient characteristics, surgical approaches, and study quality. Compare postsurgical recurrence rates with a meta-analysis.

Methods PubMed, Embase, and Scopus were searched for studies on surgical HS management published after 2004. A random effects meta-analysis of recurrence rates was performed on eligible studies.

Results Of 715 identified studies, 59 were included in the review and 33 in the meta-analysis. Twenty-two studies of wide excision had the lowest pooled recurrence rate at 8% (95% confidence interval [CI] 2%–16%); local excision had the highest at 34% (95% CI 24%–44%). For studies of wide/radical excision, flap repair had the lowest pooled recurrence rate at 0% (95% CI 0%–4%); delayed primary closure had the highest at 38% (95% CI 20%–59%).

Conclusions Wide excision and flap-based reconstruction are associated with a lower postsurgical HS recurrence, although this must be balanced against potentially higher morbidity of extensive procedures. Heterogeneity and methodological limitations of the evidence limit the ability to make a strong conclusion about the relative recurrence rates associated with surgical techniques.

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Hidradenitis suppurativa (HS) is a painful, chronic dermatologic condition characterized by inflammatory nodules, abscesses, and sinus tracts with a propensity for intertriginous areas. For Hurley Stage III disease and some cases of Hurley Stage II disease, sinus tracts with fibrosis and scarring often must be definitively treated with excision. Both wide and local excisions have been used to this end, with lower rates of recurrence associated with wider surgical margins.[1] Defects are then either closed primarily, covered with flaps or grafts, or left to heal by secondary intention, depending on location and size of the wound as well as surgeon preference. Unroofing is a simple procedure in which roofs of sinus tracts are removed, leaving sinus floors intact. This procedure has relatively low morbidity, although it is associated with higher rates of recurrence than wide excision.[1] Incision and drainage is typically only used to relieve pain associated with acute, tense abscesses in HS because no diseased tissue is removed in this procedure and rates of recurrence are high. Novel procedures used in the treatment of HS include skin-tissue-sparing excision with electrosurgical peeling (STEEP) and CO_2 laser ablation.[2]

Although surgery is considered one of the most effective treatments for severe HS, there seems to be substantial variation in which patients are offered surgical treatment and which surgical approaches are used. This may be explained, in part, by limited evidence on the relative efficacy of different surgical approaches, as well as uncertainty about the benefits and harms of surgery for certain subpopulations. For example, treatment decisions are complicated by the fact that patients with HS tend to be poor surgical candidates due to high rates of obesity, comorbidities, and smoking.[3]

In light of this lack of clear consensus, this review is intended to summarize the literature available on HS surgery with regards to patient characteristics, surgical approaches, and quality of published articles. We also sought to compare the recurrence rates of different surgical approaches using a meta-analysis. We hypothesized that wider excisional methods would have lower rates of recurrence than more conservative approaches.

Methods

Information Sources and Search Strategy

This systematic review was conducted in accordance with the Meta-Analysis of Observational Studies in Epidemiology

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checklist.[4] Investigators included an MD-MPH student trained in systematic review methodology, a dermatologist with clinical expertise in the surgical management of HS, and an internal medicine physician/researcher with extensive experience conducting systematic reviews. A librarian assisted with the initial database search.

In April 2019, a comprehensive search of *PubMed, Scopus,* and *Embase* databases was performed to identify articles containing terms related to both HS and surgery. To summarize the most recent literature, only studies published after 2004 were included. Because of the primary language of the authors, articles published in languages other than English were not included. Clinicaltrials.gov was searched for relevant ongoing studies and gray literature. References of relevant review articles were hand-searched to identify additional studies. Study authors were not contacted for further information.

Study Selection and Eligibility Criteria

Covidence software was used to compile, organize, and screen results of database searches. After removal of duplicates, titles and abstracts were screened for eligibility using prespecified PICOTSS criteria. A full-text review was performed by 2 investigators for all abstracts marked as potentially eligible to determine final inclusion in the review; a third investigator acted as a tiebreaker.

To be eligible for inclusion, studies had to enroll populations with a confirmed diagnosis of HS. Surgical interventions of interest were radical, wide, and local excisions, deroofing, STEEP, and CO_2 laser-based excision, as well as corresponding reconstructive methods. Articles including only information on whether surgery was performed, without details of the actual approach, were excluded. This is a descriptive review aimed at characterizing the body of literature on current surgical management of HS; as such, studies were not required to have a comparator. To provide a comprehensive review of the current surgical management of HS, we included a broad range of study designs including randomized controlled trials (RCTs), prospective and retrospective cohort studies, case series of 10 or more patients, and systematic reviews; case reports, conference papers, patient surveys, and analyses of claims data were excluded.

Data Abstraction

A standardized data collection form was used to compile information from individual studies. Variables of interest, selected for relevance to the study objectives, included study author and year, study design, country, population studied, sample size and demographics, type(s) of surgery performed, method of reconstruction, location of HS lesions, Hurley Stages, average follow-up period, adverse events, measures of patient satisfaction, and recurrence rates after surgery. There was substantial variation in terminology for the surgeries performed; as a result, standardized definitions were used to classify surgical techniques. The following categories were used in our data abstraction: local excision (one or more lesions excised individually), wide excision (a single excision encompassing all targeted lesions), radical excision (excision of entire body region where spread would be presumed, often described as excision of all regional hair-bearing or apocrine gland-bearing skin), and deroofing (excising roofs of sinus tracts).

Data for all included studies were summarized quantitatively by calculating weighted averages for parameters of interest, weighting either by sample size or total number of procedures as appropriate. Studies not reporting a given parameter were not included in quantitative analysis for that specific variable but were included in analyses of parameters they did report.

Meta-analysis

To determine whether a meta-analysis was appropriate, we assessed the number and heterogeneity of eligible studies reporting postsurgical HS recurrence rates. Pooled estimates of recurrence rates were calculated if 3 or more similar studies were available for a surgical approach using a random effects meta-analysis of proportions conducted in Stata version 15 (College Station, TX, StataCorp, 2017). Studies were included in the meta-analysis if they were nonrandomized and had an average follow-up period of greater than or equal to 1 year. Because some studies had recurrence rates of 0, Stata's metaprop command was used in combination with the Freeman–Tukey variance stabilizing transformation to normalize the distribution of recurrence rates before pooling them. Recurrence rates were stratified by surgical approach and graphed using a forest plot. A random effects model was chosen to partially account for heterogeneity created by characteristics of individual studies. Heterogeneity was also explored using meta-regression on the covariates study year, follow-up length, average patient age, and proportion of Hurley Stage III and female patients. These steps were then repeated for studies of wide and radical excision, stratifying by the method of reconstruction.

The degree of heterogeneity across studies was assessed using the inverse variance index (I^2). An I^2 value of 25% was considered low heterogeneity, 50% moderate heterogeneity, and 75% high heterogeneity.

Risk of Bias

Studies were assessed for the risk of bias using study quality assessment tools for uncontrolled studies created by the National Heart Lung and Blood Institute (NHLBI).[5] To assess for publication bias across included studies, a funnel plot of recurrence rates plotted against standard errors was generated. The Egger test was used to quantitatively assess asymmetry of the funnel plot.

Results

Of the 715 unique studies identified by database searches, 159 full-text studies were assessed for eligibility. Fifty-nine studies were ultimately included in the review. The most common reason for exclusion was a wrong study design.

Study Characteristics

Of the 59 included studies, 56 were case series, 2 were RCTs,[5,6] and one was a retrospective cohort study.[7] As none of the controlled studies compared different surgical approaches, all were treated as uncontrolled studies. Thirty-one studies examined surgeries performed by plastic surgeons, 16 examined surgeries performed by dermatologists, and 11 examined surgeries performed by general surgeons; one study included procedures performed by dermatologists, plastic surgeons, and general surgeons. One RCT compared wide HS excision in conjunction with acitretin to treatment with acitretin alone; data from only the wide excision arm were included.[6] Another RCT compared outcomes from HS excision with and without enclosure of a gentamicin-collagen sponge at the surgical site; there was no significant difference in recurrence rates between treatment arms, and data from both arms were analyzed together.[5] The one included retrospective cohort study compared outcomes of radical HS excision with and without biologic therapy; the biologic arm experienced a comparatively lower rate of HS recurrence, and so only data from the control arm were analyzed.[7]

All 33 studies included in the meta-analysis were uncontrolled. Twenty-one countries were represented; most studies were set in the United States ($N = 13$) and Turkey ($N = 9$). Study characteristics and outcomes are listed in **Supplemental Digital Content 4** (see Table 1, http://links.lww.com/DSS/A675).

Patient Characteristics

The mean number of patients for the 59 included studies was 54.2 (range 10–590). Data from 3,197 patients were included in this review. Fifty studies reported the percentage of women participants for an overall percentage of 60.9% female patients. For 41 studies reporting the number of procedures, the average number of procedures per patient was 1.8 (SD 0.63). For 25 studies reporting HS duration, the average duration of disease before surgery was 8.5 years (SD 3.4 years). Fifty studies reporting patient age at the time of surgery had an average patient age of 37.3 years (SD 4.9 years). Smoking rates were reported inconsistently with variable definitions of what constituted smoking (i.e., active vs ever-smokers); therefore, the percentage of smoking patients was not averaged across studies. Rates of comorbid conditions such as hypertension and diabetes were frequently not reported and thus were not summarized as part of this analysis. Of 23 studies reporting the Hurley Stages for their sample, overall percentages were as follows: 5.3% Hurley Stage 1, 21.4% Hurley Stage 2, and 73.3% Hurley Stage 3.

Characteristics of Surgical Interventions

For 38 studies reporting the number of procedures per anatomic region, 58.8% of lesions were axillary, 20.1% inguinal, 4.7% perineal/perianal, 11.1% gluteal, 1.2% vulvar/scrotal, 2.4% inframammary, and 3.7% "other." Of the 59 included studies, 3 included only patients undergoing local excisional procedures,[9–11] 36 included patients undergoing wide excisions, and 5 included patients undergoing radical excisions. For 3 included studies, it was unclear if local, wide, or radical excisions were performed. Four studies performed deroofing or STEEP.[12–15] Because of few available studies and the fact that both techniques are performed with the intention of maximally preserving healthy tissue, the decision was made to lump STEEP and deroofing together into one category. Two reported results of CO_2 laser-based evaporation,[16,17] and 5 reported the use of multiple surgical techniques. One study reported the use of a modified seton procedure for complex anal fistulas caused by HS.[18]

Eleven studies reported wide surgical margins ranging from 1 to 3 cm. Sixteen reported deep margins ranging from the level of the subcutaneous fat to muscle fascia. Regarding marginal involvement, most studies simply reported excision of all diseased tissue, with variable reporting of marginal depth/width as noted above; it was presumed that visual inspection was used to determine clear margins. One study reported ultrasound of the axilla to identify involved areas before excision. Two studies used indigo carmine solution to mark fistulating areas. Four studies reported injection of methylene blue to guide excision.

Reporting of adverse events was highly variable and not amenable to quantitative synthesis. Although a formal analysis was not conducted, it was noted that studies describing results of secondary intention healing more frequently reported hypergranulation as an adverse event, and studies of primary closure reported dehiscence more frequently than other methods of closure. As would be expected, studies of flap closure reported occurrences of flap tip necrosis and studies of grafting reported graft failure.

Three of the included studies examined results of biologic therapy in addition to surgical intervention. There were no significant differences in rates of adverse events in patients taking a biologic versus those not on a biologic.

Forty-four studies reported follow-up periods, with an average of 3.01 years (SD 1.8 years). Follow-up periods for individual patients within studies varied substantially. Forty-one studies reported recurrence rates, although what constituted recurrence was frequently not defined clearly, and in 3 cases it could not be ascertained whether the authors were referring to local recurrence versus disease progression at any anatomical site. Of 38 studies reporting local recurrence rates, 34 had average follow-up periods of greater than 1 year.

Fifteen studies formally assessed patient satisfaction with operative outcomes; of these, 7 used validated surveys/scales. This included 3 studies using the Dermatology Life Quality Index, 3 using the Visual Analog Pain Scale, one using Patient Global Assessment, one using Physician Global Assessment, one using the Disabilities of the Arm, Shoulder, and Hand questionnaire, one using the Hidradenitis Suppurativa Lesion, Area, and Severity Index, and one using the Constant-Murley shoulder outcome score. All reported that most patients were satisfied with results of surgery. Three studies reporting results of significance testing for measures of patient satisfaction reported statistically significant improvements as a result of surgery.[19–21]

Meta-analysis

Supplemental Digital Content 1 (see Figure S1, http://links.lww.com/DSS/A672) depicts the forest plot for recurrence rates of these studies, stratified by surgical approach. The pooled recurrence rate for 22 studies of wide excision was 8% (95% confidence interval [CI] 2%–16%).[20,22–42] Two studies of radical excision reported recurrence rates of 0% and 38%.[8,19] One study of local excision reported a recurrence rate of 34% (95% CI 24%–44%).[11] One study of STEEP and one of unroofing reported recurrence rates of 29% and 17%, respectively, with no significant difference in recurrence between the 2 studies.[2,15] Three studies of mixed surgical approaches reported recurrence rates of 0%, 6%, and 24%.[43–45] One study reporting excisions of an unspecified type had a 10% recurrence rate (95% CI 7%–15%).[46] Two studies reporting CO_2 laser-based evaporation had recurrence rates of 1% and 29% (95% CI 18%–43%).[16,17] We were only able to pool recurrence rates from studies of wide excision due to heterogeneity across studies and relatively few studies reporting on other surgical interventions.

Heterogeneity

The I^2 statistic across all studies of wide excision was 0.886, indicating that approximately 88.6% of variation in recurrence rates was attributable to between-study heterogeneity. Meta-regression of recurrence rates on the variables follow-up period, year of publication, proportion of patients with Hurley III disease, proportion of female patients, and average patient age revealed no significant associations. **Supplemental Digital Content 2** (see Figure S2, http://links.lww.com/DSS/A673) shows the funnel plot of recurrence rates for studies included in the meta-analysis. This plot is visibly asymmetrical, and the Egger test for small study effects was significant ($p < .05$), suggesting a bias toward the publication of studies with lower recurrence rates. Two studies in the wide excision group were outliers but did not differ substantially from other included studies with regards to study population or design.[23,25] When these were removed for exploratory purposes, the pooled estimate for recurrence was slightly lower (5%; 95% CI 1%–10%) and there was less statistical heterogeneity (I^2 decreased to 0.755).

Reconstructive Methods

Fifty-eight studies reported the proportion of patients undergoing different methods of reconstruction. Percentages of patients in each category were as follows: 36.9% secondary intention healing; 34.7% primary closure; 15.4% grafts; 10.1% flaps; and 3.5% others (representing patients undergoing a modified seton procedure or delayed primary closure).

The meta-analysis was repeated for studies of wide excision (pooled recurrence rate 8%, 95% CI 2%–16%) and radical excision (2 studies, recurrence rates 0% and 38%), stratifying by reconstructive method; the forest plot is depicted in **Supplemental Digital Content 3** (see Figure S3, http://links.lww.com/DSS/A674).[8,19,20,22–42] Two studies of secondary intention healing had recurrence rates of 12% and 19%.[20,40] Twelve studies of mixed reconstructive methods had a pooled recurrence rate of 12% (95% CI 3%–26%).[22–26,29,32,34,36,38,39,42] Six studies of flap repair had a pooled recurrence rate of 0% (95% CI 0%–4%).[19,27,28,31,33,37] Three studies of graft repair had recurrence rates of 0%, 0%, and 6%.[30,35,41] One study of delayed primary closure had a recurrence rate of 38% (95% CI 20%–59%).[8]

The mixed and flap groups had I^2 values of 0.916 and 0, respectively, indicating high heterogeneity in the mixed group and essentially no heterogeneity in the flap group.

Study quality assessment of all 59 reviewed studies was performed using a checklist for uncontrolled studies adapted from the NHLBI. We assessed 38 studies to be of poor quality, 19 of fair quality, and 2 of good quality.

Discussion

Populations of the included studies reflect those of other published reviews with a predominantly female patient population, high rates of smoking, and high Hurley scores. The axilla was the most commonly operated on region. Wide excision was the most commonly performed surgery, likely because it is a relatively straightforward approach and a common practice trend among surgeons. In addition, many studies focused on novel reconstructive methods after HS surgery, which is more relevant for wide or radical excisions than for smaller procedures. Most surgical wounds were left to heal by secondary intention. Reconstruction with grafts and flaps was associated with lower rates of recurrence compared with studies with mixed closure methods, secondary intention healing, and delayed primary closure.

A systematic review and meta-analysis from 2015 found that between wide excision, local excision, and unroofing, wide excision had the lowest rate of recurrence at 13.0%, local excision the next lowest at 22.0%, and unroofing the highest at 27.0%; the overall rate of recurrence was 15%.[1] The authors found recurrence rates of 15%, 8%, and 6% for primary closure, flaps, and grafts, respectively. As this previous study reported an association between higher recurrence rates and longer follow-up periods, we restricted our analysis to studies with follow-up periods of greater than 1 year. Even with this constraint, our meta-analysis demonstrates comparatively lower recurrence rates for wide and radical excision as well as for flap and graft reconstruction. This apparent improvement in postsurgical HS recurrence could be the result of advances in HS surgery, as our study included articles published between 2004 and 2019, whereas the previous review analyzed articles published between 1990 and 2015. It is also possible that other developments in HS treatment, such as biologic therapies, have contributed to lower recurrence rates. This is supported by a retrospective cohort study that found significantly lower recurrence rates in patients with HS undergoing surgery while on a biologic.[8]

Limitations of this review include the high risk of bias for most included studies, most which were case series. In addition, there was high heterogeneity across studies, indicating that these results should be interpreted cautiously. Furthermore, asymmetry of the funnel plot and a significant Egger test indicate potential publication bias. Although disease severity has important implications for treatment efficacy, fewer than half of the included studies reported Hurley stages. Very few studies had been published on conservative surgical approaches, with substantial methodologic heterogeneity; as a result, pooled estimates of recurrence rates were not calculated for these studies.

The aforementioned limitations of existing studies should be used to inform future research on optimal surgical management of HS. In particular, more high-quality RCTs or cohort studies should be conducted to compare different methods of excision and repair. It is generally agreed upon that wider surgical margins are typically more effective in preventing recurrence. However, it is unclear whether differences in reported post-surgical outcomes reflect effectiveness of the surgical approaches themselves or if variables such as patient characteristics, follow-up times, definitions of outcomes, and habits of individual surgeons are confounding the observed associations. Furthermore, potentially higher morbidity from larger excisions should be assessed and weighed against potentially lower rates of HS occurrence for optimal surgical decision making. Multiple planned and ongoing RCTs were identified through a search of Clinicaltrials.gov.[47–50] Results from these studies should be incorporated into future reviews.

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