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Hidradenitis Suppurativa: Surgical and Postsurgical Management

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Keywords
Hidradenitis suppurativa · Reconstructive techniques · Artificial dermis · Wound care · Post-surgical management

Abstract
Background: Hidradenitis suppurativa (HS) is a chronic inflammatory disorder. Several medical treatments, with varying degrees of efficacy, have been developed. However, in most cases of advanced HS, the definitive treatment option is often represented by surgical excisions. ***Objective:*** Surgical techniques, reconstructive approach, and local wound care should be accurately designed in order to obtain the best result. In this review we analyze the possible surgical treatments and local wound care. ***Methods:*** A MEDLINE search was performed on the various surgical treatments, reconstructive techniques, and local wound care. ***Results:*** Surgical treatment is a common therapeutic modality for HS. Different surgical reconstructive techniques and post-surgical wound care approaches are described for the management of HS patients. ***Conclusions:*** There were few high-quality evidence-based studies evaluating the surgical management of HS. Many disparate HS severity scores were used in these studies, making comparisons between them difficult. Nonetheless, research on different surgical approaches and wound care management has increased substantially in the past decade and it has given patients more surgical therapeutic strategies. The description of the best combinations and timing of surgery, wound care, and medical therapies will be a matter of future research for the definition of the optimal management of the HS patient.

Introduction

Multiple treatments have been described for the management of hidradenitis suppurativa (HS) patients [1, 2]. Surgical approaches are a quite common therapeutic modality for severe HS [3, 4]. Post-surgical management of HS patient is usually more complex with respect to other patients undergoing skin surgery because of the large areas involved by the disease and the ongoing inflammatory process in the adjacent involved skin areas.

HS Treatment

Surgical Approach

Incision and drainage are probably the easiest procedures for HS surgical treatment. It should generally be avoided because of the fast recurrence of the inflamma-

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tory reaction in the treated lesions [5]. Deroofing is a conservative surgical therapy for persisting nodules, abscesses, or sinus tracts in HS Hurley stage 1/2 and may be used either for individual lesions (local unroofing) or for all lesions in an anatomic area (extensive unroofing) [6]. During the procedure, the sinus "roof" is removed electrosurgically, side passages are explored and treated [7, 8], and wound healing is achieved by secondary intention. Pagliarello et al. [9] proposed cryoinsufflation, a modified spray cryotherapy performed by injecting liquid nitrogen (LN) through an ordinary needle directly into HS tracts. Abscesses and sinus tracts in the HS-affected areas were filled with LN using a 21-gauge needle mounted on a cryosurgical unit (CRY-AC®; Brymill Cryogenic Systems Ltd.) equipped with the CRY-AC [9]. A recent paper of Molina-Leyva et al. [10] described the effectiveness, safety, and tolerability of drainage and punch-trocar-assisted cryoinsufflation (cryopunch) in the treatment of inflammatory acute fluid collections in HS [10]. Adjunctive therapies, such as laser- and light-based therapies, have become more commonly used in the management of HS. Patients with chronic and extensive Hurley stage 3 disease, who have gone beyond the possibility of being treated with conservative measures, may be managed by local or wide excision [11]. These surgical approaches differ in the degree of invasiveness. In limited local excision, each separate lesion is excised with a certain margin of healthy tissue. In wide excision, an area embracing all lesions is removed with surgical margins designed to reach beyond the clinical borders of disease activity and with complete surgical resection of apocrine glands [12]. Local excisions and primary closure of the active lesion help to control the disease activity, but the scarceness of the excised area often leads to a high recurrence rate of HS at the same anatomical site. Despite these limitations, local excision can be used for mild (Hurley stage 1) HS defects in axillary, inguinal, and perineal regions [13]. Wide local excision is truly the method of choice for Hurley 2 and 3 disease. Not only does it definitively treat the disease process but also it relieves the problematic wound contractures that limit function, and it eliminates the risk of future conversion to a squamous cell carcinoma [14].

Wide surgical excisions must be carried out with wide lateral margins, but there is no consensus about whether partial or complete removal of the subcutaneous fat should be achieved in the deep margin [15]. The deep margin includes the skin, its appendages, and the subcutaneous tissue that should be removed only until soft, normal-appearing subcutaneous fat remains. The muscular fascia must be reached only in the most severe forms of the disease [11]. Therefore, wide excision should not always be as destructive as the "en bloc deep to the fascia" technique used in managing malignancy.

Reconstructive Techniques

Multiple reconstructive modalities after surgical excision have been described, including primary closure, healing by secondary intent, split-thickness skin graft (STSG), and flap closure [16]. Scuderi et al. [17] recently reviewed several surgical and reconstructive techniques for HS. Despite the many surgical and reconstructive techniques available, there is still no general consensus on the preferred surgical technique [18, 19] (Table 1).

Secondary Intention Healing

Secondary intention healing (SIH) is the most elemental form of wound closure and the most basic technique in the reconstructive ladder. SIH refers to a process in which the defect is left open and healing occurs along with the natural processes of granulation, wound shrinkage, and epithelization. This approach may be successful both in narrow wounds produced by deroofing and in larger surgical defects, resulting from wide excision [11].

SIH of large wounds has many advantages, including cosmetically acceptable scars that have considerably smaller dimensions in comparison with the initial defect, a lack of donor sites, no flap or graft loss, and an acceptable range of motion. Disadvantages include relatively long healing times, painful dressing changes, the need for meticulous wound care, and the risk of wound contracture, particularly with large excisions [16]. This approach is usually well tolerated by patients, owing to the minimal number of wounds (absence of donor sites) and the amazingly unproblematic course of healing [12].

Primary Suture

Primary suture is mostly done in the "mild" variety of the disease and it is appropriate only in the case of minor defects surrounded by lax skin [20]. It is advisable to close the wound rather loosely, which enables the outflow of exudate and limits the risk of infection. Undermining as well as suturing under high tension should be avoided because of the risk of healing disturbances [12].

Artificial Dermis and Skin Graft

Excision and STSG remains the most versatile procedure of choice to close large areas of resection, and the result of this procedure is often satisfactory. Traditionally, skin grafts are put on granulation tissue after a period of wound conditioning with an appropriate dressing.

Table 1. Reconstructive techniques

Technique	
Secondary intention healing	*Pros:* scars that have considerably smaller dimensions in comparison with the initial defect, lack of donor sites, no flap or graft loss, and an acceptable range of motion *Cons:* relatively long healing times, painful dressing changes, need for meticulous wound care, and risk of wound contracture, particularly with large excisions
Primary suture	*Pros/Cons:* simple, but appropriate only in case of minor defects surrounded by lax skin
Artificial dermis and skin graft	*Pros:* versatile procedure to close large areas of resection; ensures acceptable functional and esthetic results; dermal substitutes, using a 2-step procedure, can be used for the treatment of severe HS with good esthetic and functional results *Cons:* skin grafts may be complicated by graft healing problems and donor site morbidity and may result in contractures, noticeable differences of color and texture with the surrounding skin^, and extensive scarring
Flaps	*Pros:* best quality of skin closure and may prevent contractures and bad scarring *Cons:* harvesting procedure is difficult and invasive; they are prone to serious complications like tissue necrosis and hemorrhage; moreover, local flaps might sometimes carry the same affected skin and lead to local recurrences; therefore, local or regional flaps can only be used if a wide and adequate excision with safe margins is performed

Different authors report delayed STGS after a short period of negative pressure dressing to stimulate a sufficient bed of granulation tissue for skin grafting [21].

Owing to its good hemostatic properties, STSG can also be performed in a 1-stage procedure immediately after excision [22]. This technique saves time and decrease the risk of infection, but the residual fat exposed after a wide surgical excision provides poorly vascularized tissue to support a STSG. Moreover, immediate skin grafting often leaves a persistent depression at the site of excision.

In general skin grafts may be complicated by graft healing problems and donor site morbidity and they may result in contractures, noticeable differences in color and texture with the surrounding skin, and extensive scarring. Nevertheless, they ensure acceptable functional and esthetic results, especially in the armpits and buttocks. In these areas, skin graft contraction does not cause functional problems, and scars are covered easily [13].

When extensive resection down to the fascia becomes necessary and a primary STSG is applied directly to the fascia, often the result is a significant depression deformity and a lack of tissue flexibility. Recent data shows that the graft of dermal substitutes can be used for the treatment of severe HS. Yamashita et al. [23] described a 2-stage procedure that allows preservation of the deep fatty tissue and application of an artificial dermis graft before application of a normal skin graft. The authors report that the cosmetic results of skin grafting with the 2-stage procedure are superior compared to a single-stage procedure [23].

Gonzaga et al. [24] reported a series of 4 cases of severe axillary HS treated successfully with a bilayer dermal regeneration template (BDRT) and without recurrences in the follow-up ranging from 6 to 38 months. The use of a BDRT in the wound bed confers many advantages. As an inadequate excised area is the primary cause of disease recurrence, the surgeons can comfortably extend the excision to the limits of the unhealthy tissue and then cover the wound bed with a BDRT. The BDRT has a long shelf life, is approved for use with chronic wounds after appropriate debridement, and can be tailored to fit any wound. After 10–14 days for revascularization, a thin STSG can be placed over the top. The resulting superficial donor site heals faster, possibly with less postoperative pain [24]. Garbarino et al. [25] described a series of HS patients who underwent wide surgical anogenital excision using flexiseal fecal containment and the previously mentioned 2-step surgical procedure. The described surgical approach was characterized by a low incidence of surgical or medical adverse events and high rates of successful grafting [25].

Flaps

Reconstruction of the defects with flaps ensures the best quality of skin closure and may prevent contractures and bad scarring. Some disadvantages can be identified with respect to skin grafts, i.e., the harvesting procedure is more difficult and invasive, and flaps are more prone to serious complications like tissue necrosis and hemorrhage. Moreover, local flaps might sometimes carry the

same affected skin and lead to local recurrences. Therefore, local or regional flaps can only be used if a wide and adequate excision with safe margins is performed. These important disadvantages make flaps difficult or impossible to use in larger wounds [13]. Nevertheless, the flap surgical procedures are mandatory for coverage of important anatomic structures like exposed neurovascular bundles. Many different forms of flaps in the treatment of HS have been described by a number of authors depending on the anatomical site. Defects following wide surgical excision of axillary HS has been reconstructed by the use of transposition fasciocutaneous flaps such as the Limberg flap [26], the local fasciocutaneous V-Y advancement flap [27], and the double opposing V-Y perforator-based flap [28]. More options have described, like the use of a thoracodorsal artery perforator flap and a lateral thoracic fasciocutaneous island flap [29, 30]. Reconstruction of the inguinal region includes the rotation fasciocutaneous flaps, the transposition fasciocutaneous flaps [31], the pedicled gracilis myocutaneous flap [32] and the anterolateral thigh flap [33]. The medial thigh lift and the modified abdominoplasty have been proposed for immediate defect closure after radical excision of inguinal HS [34, 35]. For lesions located in the perianal and the perineal regions, several techniques have been carried out including a bilateral transposition flap, the gracilis musculocutaneous flap, and the anterior obturator artery perforator flap [36]. For buttocks, some options, such as the fasciocutaneous flaps and the extended split superior gluteus maximus musculocutaneous flap, have been described in the literature [37, 38].

Post-Surgical Wound Care

Local wound care is decisive to heal post-surgical skin defects in patients with HS. The management of post-surgical wound care is strictly dependent on many features, i.e., the location on the body, the patient characteristics, and the surgical reconstruction technique adopted (i.e., primary suturing, skin graft, flap, or healing by secondary intention) [11, 28].

Primary Suture and Flap

There are few published studies on the post-surgical management of primary closure for hidradenitis. One study highlighted that primary excision and closure with a gentamycin sulfate collagen sponge yielded a reduction in the number of postoperative complications compared to primary excision and closure without antibiotics [39].

Weyand [15] suggests positioning of the drainage and systemic administration of antibiotics to prevent complications in post-surgical management of flaps in HS. It is our opinion that the indications of post-surgical management do not differ from the general recommendations on the same surgical approaches in other disease contexts.

Artificial Dermis and Skin Graft

Many reports describe the use of negative pressure dressing for both STSG and artificial dermis as a method of delayed closure [25, 40]. The NPWT can be applied immediately after skin or artificial dermis grafting to secure the graft firmly to the wound bed. This procedure is especially indicated in areas of resection that are prone to shearing forces during the take of the graft, such as the groins, the axillae, the perineum, and the buttocks. Resection of HS usually means removal of the infected skin [41] and subcutaneous tissue, leaving exposed fat as the recipient site for STSG. This fat has relatively poor vascularity to support the skin grafts. In this case NPWT can be applied directly on the wound bed for a short period before skin grafting to stimulate angiogenesis [42–44].

Chen et al. [45] suggest some technical guidelines to manage skin grafts and NPWT after wide surgical resection, considering the extent of the incision and the anatomical area.

The management of inguinal, perianal, and perineal disease is somewhat more complex for several reasons: it is difficult to obtain a NPWT seal in these areas, usually the disease is bilateral, maintenance of a NPWT seal and avoidance of shearing forces on the grafts are challenging as is management of the urinary and fecal output [25] (Fig. 1).

Secondary Intention Healing

The current treatment paradigm for wound care in HS involves management of exudate, bacterial colonization, odor, and pain [46]. The goal of postoperative care in large wounds left for SIH is to maintain a moist and clean wound, achieved with wound dressing changes, hydrotherapy, and physical therapy. This approach to wound healing is used after both deroofing and wide excision. In particular, in order to prevent bridging, wound care may require meticulous attention to preserving specific planes of healing [11].

After deroofing, wound healing is achieved by secondary intention. Danby et al. [11] suggest using only simple petrolatum gauze applied directly to the wound and dressed in cotton gauze. The resulting non-adherent dressings laid on or bound to the wound must cover the whole wound surface to avoid dry gauze attaching to the wound edges and removing fresh epithelium. Daily (or

Color version available online

Fig. 1. a HS involvement of the axillae. **b** Intraoperative image with an artificial dermis graft. **c** Thirty days later: mesh dermo-epidermal graft. **d** Two months later: final result.

more frequent) dressing changes involve gentle rinsing of the wound in clear running water, free of soap or cleansers, followed by reapplication of petrolatum [11].

Blok et al. [8] successfully used alginates in combination with silicone dressings in defects left open for SIH after STEEP procedure in patients with HS.

Janse et al. [12] suggest covering the large wounds left for SIH after wide excision with a thick absorbing dressing made of gauze soaked in a mixture of petroleum jelly and liquid paraffin [11]. Oral antibiotics should be not administered routinely while in the first postoperative week it is usually necessary to administer oral pain medications [12]. The bacterial colonization and biofilms present in HS may benefit from the use of gentian violet and methylene blue, polyhexamethylene biguanide [46].

Silastic foam is a polymer of synthetic silicone used to enhance healing in open wounds. It takes about 3 min to create a 3-dimensional template, like a sponge in the wound bed that precisely tracks the wound edges. Morgan et al. [47] compared the healing time of post-surgical axillary wounds with that of skin grafts and SIH in 20 patients [47]. Patients preferred the silastic dressing and found it to be more comfortable and easy to use, with greater limb freedom and a lack of painful donor sites; they also had good esthetic results and a low recurrence rate [47]. NPWT has been frequently used for wounds left for SIH and of significant depth, primarily in the axillary, buttock, and groin regions [48]. Ricci et al. reported 4 cases of severe vulvar HS. Closure was achieved in 3 of the cases using NPWT solely as an adjunct for secondary closure for 3 months [49].

One study by Nicoli et al. [50] described the use of platelet-rich plasma to stimulate tissue growth and fibroblastic proliferation in a wound left open for SIH after a wide and deep nuchal skin excision.

Future Perspectives

Surgical therapies in HS should be analyzed in larger cohort studies with standardized grading and severity assessment. For the best outcome of wide surgical treatments, patients should undergo excision during HS remission (e.g., not during an HS flare-up). Medical thera-

py and adequate dressing should be adequately performed in the 4 weeks preceding surgery in order to inhibit HS flares. In our experience antibiotic therapy (rifampin and clindamycin, cephalosporins, or other wide-spectrum antibiotics) and local care of HS lesions should be performed on a daily basis in the period that precede surgery. Advanced silver impregnated dressings can be used in selected patients according to Kazemi et al. [51] in order to prevent superinfections and manage HS lesion exudate. The use of targeted therapy with immunomodulatory drugs before and during surgery should be considered in order to prevent HS flare-ups, but this medical approach needs to be further analyzed by future studies.

Conclusions

Our review describes the current knowledge on the surgical and post-surgical management of HS patients, which are strictly dependent on many features, i.e., the location on the body, the patient characteristics, and the surgical reconstruction technique adopted. At present, the studies regarding surgical therapies in HS are still few cohort studies and case series with low-grade evidence because of the small population and the differing methodologies and outcome definitions.

For the best HS surgical management, the surgical technique and the reconstructive approach should be accurately designed in order to obtain the maximum clinical benefit, improving patients' quality of life and minimizing the possible surgical risks or the main post-surgical complications. In addition to surgical and reconstructive techniques, HS surgical treatment should encompass post-surgical wound care and medical treatment of the patient before and after surgery in order to decrease the length of hospital stay and achieve the best functional and esthetic results.

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Author Contributions

M. Manfredini and F. Garbarino designed this study and wrote this paper. L. Bigi contributed to the design and implementation of this research. G. Pellacani encouraged the investigation and supervised the findings of this work. C. Magnoni designed and performed surgery, analyzed data, and cowrote this paper. All of the authors discussed the results and contributed to the final version of this paper.

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