Annals of Case Reports & Reviews

Case Report

doi: 10.39127/2574-5747/ACRR:1000367
Garcia L, et al. Annal Cas Rep Rev: ACRR-367

Fluorescence Image Guided Use of an Antibiofilm Agent in the Treatment of Recalcitrant Pilonidal Ulcers: A Case Review

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Citation: Garcia LT, Georgiades A, Serena LM, Serena T (2023) Fluorescence Image Guided Use of an Antibiofilm Agent in the Treatment of Recalcitrant Pilonidal Ulcers: A Case Review. Annal Cas Rep Rev: ACRR-367.

Received Date: 27 November, 2023; **Accepted Date:** 02 December, 2023; **Published Date:** 08 December, 2023

Abstract

Pilonidal sinus disease afflicts more than 70,000 Americans each year. Despite advances in surgical and nonsurgical techniques, some patients develop recalcitrant sacrococcygeal ulcers following treatment. These wounds can persist for weeks to months and interfere with the patient's daily activities and ability to work. Nonhealing pilonidal wounds arise following attempts at primary closure, complicated by surgical site infection, and when a pilonidal left open to heal by secondary intention fails to close in a timely fashion. A recent study evaluating the effectiveness of fluorescence imaging in detecting bacteria suggests that more than 80% of surgical wounds, including nonhealing pilonidal ulcers, contain levels of bacteria that inhibit wound healing. The study concluded that fluorescence imaging improved the detection of high bacterial load 11-fold. Using fluorescence imaging to guide antiseptic treatment in nonhealing pilonidal ulcers holds promise in closing these difficult-to-heal wounds. In addition, bacteria in nonhealing wounds favor a biofilm phenotype. The use of an agent designed to deconstruct the biofilm and kill bacteria may facilitate closure of nonhealing pilonidal ulcers. Two patients with nonhealing pilonidal ulcers are presented in whom fluorescence imaging guided the application of an antibiofilm agent. The nonhealing ulcers had been present for several months in all cases. The results suggest that further investigation on fluorescence guided antibiofilm therapy may be a viable option for troublesome pilonidal wounds.

Keywords: *Pilonidal sinus, surgical site infection, fluorescence imaging, biofilm, antiseptics.*

Introduction

Pilonidal sinus disease afflicts more than 70,000 individuals in the United States annually [1]. It is more than twice as common in males and most patients present in their early twenties [2]. The prevailing theories on etiology attribute the cause of pilonidal disease to the presence of hair sequestered beneath the skin [3,4]. The hair acting as a foreign body leads to the formation of abscesses and sinus tracts[5]. The American Society of Colon and Rectal Surgeons recommends several operative and nonoperative approaches to pilonidal disease in its guidelines published in 2019; however, despite advances in surgical and nonsurgical techniques, some patients develop recalcitrant sacrococcygeal ulcers following treatment [1,5].

The recommended treatment for patients that present acutely with a pilonidal abscess is incision and drainage(I&D) [6]. The recurrence rate following I&D is estimated to be as high as 69% [7]. It is believed that retained hair, unrecognized sinus tracts and inflammation account for most recurrences. This is supported by a meta-analysis that found that curettage in association with I&D reduced recurrence rates to 4.5% [8]. The role of bacteria levels that impede wound healing and the role of biofilms in nonhealing pilonidal ulcers has not been extensively studied.

Recently introduced, point-of-care fluorescence imaging detects bacteria at levels greater than 10^4 CFU/g [9]. The device detects bacteria in planktonic and biofilm phenotypes [10]. This level of bacteria, termed the chronic inhibitory bacterial load (CIBL), is known to impede wound healing and is likely a precursor to invasive infection [11]. A study evaluating bacterial loads in open surgical wounds found that 82% of the wounds had bacterial levels greater than the CIBL [12]. In addition, the ability of investigators to detect bacterial load based on clinical signs and symptoms of infection was only 11%. Fluorescence imaging improved the detection of CIBL 11-fold [12].

The improved ability to detect bacterial load has led to fluorescence imaging guided therapy [13,14]. The authors postulate that delayed healing of open pilonidal ulcers may be secondary to elevated bacterial levels, above CIBL. In addition, in nonhealing wounds up to 80% of bacteria exist in biofilm phenotype [15]. Biofilm bacteria are protected from systemic antibiotics and topical antiseptics [16]. In these two cases, fluorescence imaging guided wound debridement and the

application of a polyhexamethylene biguanide (PHMB-1) based antibiofilm cleanser and topical gel (BIAKOS®, Sanara MedTech Fort Worth, TX). The cleanser and gel contain 0.1% polyhexamethylene biguanide, a surfactant, poloxamer 407, edetate disodium (EDTA), and edetate trisodium (EDTA). The surfactant and EDTAs disrupt the extra-polymeric substance (EPS) that forms the structure of the biofilm. The PHMB can then kill the bacteria. Preclinical studies on biofilms produced by Methicillin-resistant Staphylococcus aureus (MRSA), Pseudomonas aeruginosa and Candida albicans demonstrated that the PHMB-1 cleanser and gel are effective in disrupting immature and mature biofilms and killing the microorganisms that resided in the biofilm [17].

Case Studies

Case One: A 20-year-old Caucasian female without significant past medical history developed an acute pilonidal abscess with multiple sinus tracts. She worked in a hot environment as an industrial welder; otherwise, she had no other risk factors for pilonidal disease. She underwent pilonidal cyst excision and unroofing of the sinus tracts. Postoperatively the wounds were treated with debridement, antibiotics, and moist wound healing. Her wound waxed and waned in size but failed to close. Surgical exploration of the wound failed to reveal retained hair or residual sinus tracts. She was referred to the outpatient wound clinic for a nonhealing wound. Physical examination revealed a healthy female patient with an open area in the sacrococcygeal region distal to a healed scar (figure 1).

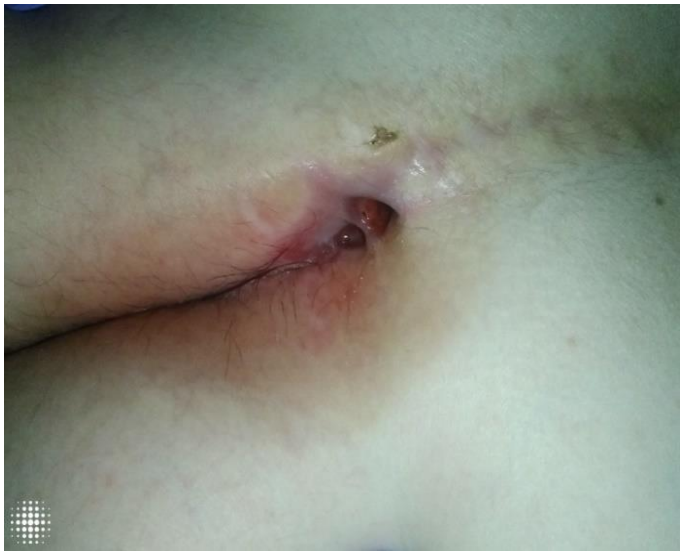

Figure 1: pilonidal ulcer at presentation.

There were no clinical signs and symptoms of infection in the wound or surrounding tissues; however, fluorescence imaging revealed a small area of red fluorescence indicating elevated bacterial load in the distal wound bed (Figure 2).

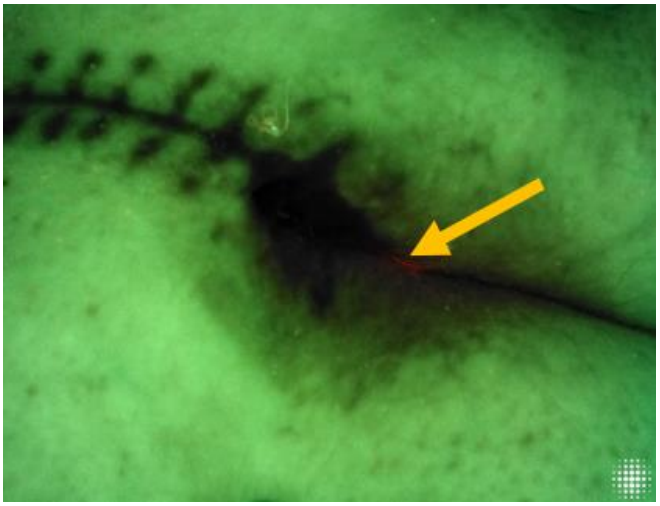

Figure 2: fluorescence image at presentation demonstrating red fluorescence (arrow).

The treatment plan included cleansing the ulcer with PHMB-1 cleansing solution, followed by the daily application of PHMB-1 gel. She was seen biweekly in the wound care center. The wound responded immediately with a decrease in surface area and resolution of bacterial fluorescence (figure 3).

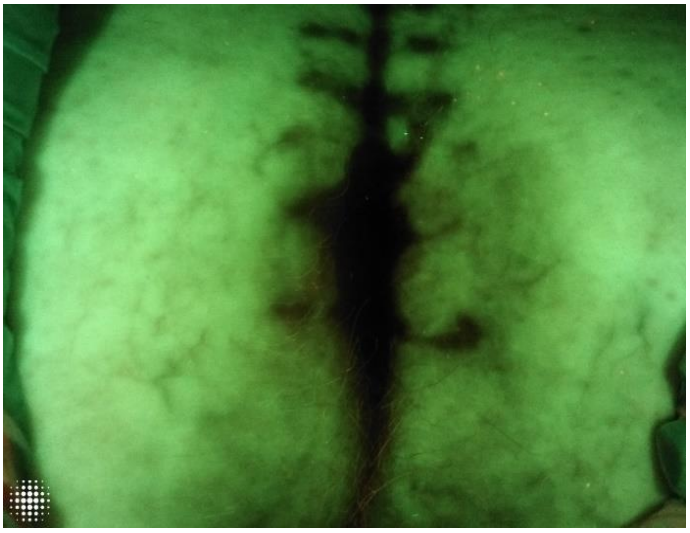

Figure 3: Bacterial fluorescence cleared after treatment with PHMB-1.

The patient was permitted to return to work. Her healing process stalled when she increased her work duties, but she went on to complete closure in 12 weeks with the antibiofilm regimen (figure 4). A follow up call 6 months later confirmed that she remained healed without recurrent pilonidal disease.

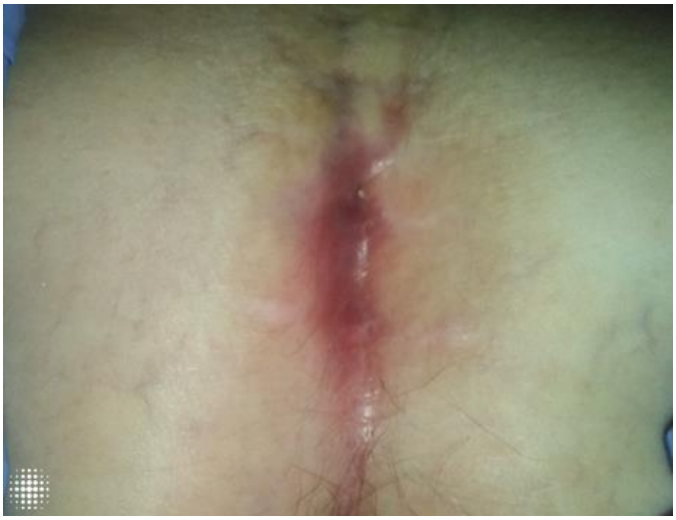

Figure 4: Healed pilonidal ulcer.

Case Two: A 24-year-old active healthy male presented with a longstanding pilonidal cyst. His only risk factor for pilonidal disease was the large amount of hair in the truncal region. He underwent an uneventful pilonidal excision in the operating room. On post operative day 6 the pilonidal wound dehisced. There were no clinical signs or symptoms of infection. The surgeon suspected that the wound separated due to the patient's active lifestyle. The patient was followed in the surgical clinic. He underwent debridement, daily dressing changes and the application of topical antiseptics; however, healing of the ulcer wound failed to progress. He was referred to the wound clinic for further evaluation and management. On presentation, he had an open wound in the sacrococcygeal region (figure 5). Examination revealed a granulating wound without clinical signs or symptoms of infection. There were no sinus tracts or retained hair. Fluorescence imaging revealed a blush at the inferior border of the ulcer (figure 6). The treatment plan included debridement of the wound bed and application of PHMB-1 cleanser followed by daily application of the PHMB-1 gel. The patient was followed weekly with clinical examination and fluorescence imaging. The bacterial fluorescence cleared in four weeks, after which his follow up was changed to biweekly. He achieved complete closure in 3 months (figure 7), despite his continued vigorous activity level. His pilonidal ulcer remains healed at 3 months.

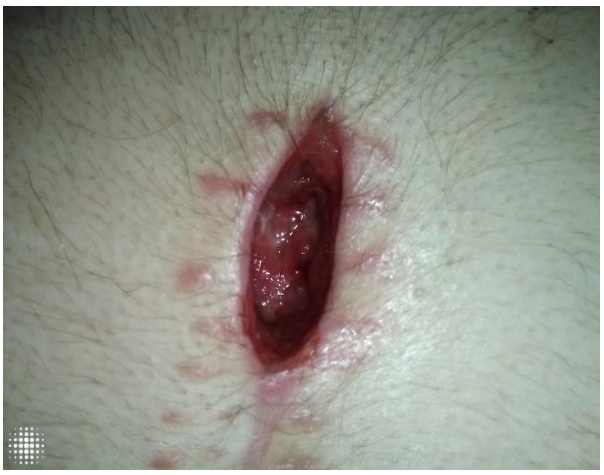

Figure 5: Nonhealing pilonidal ulcer.

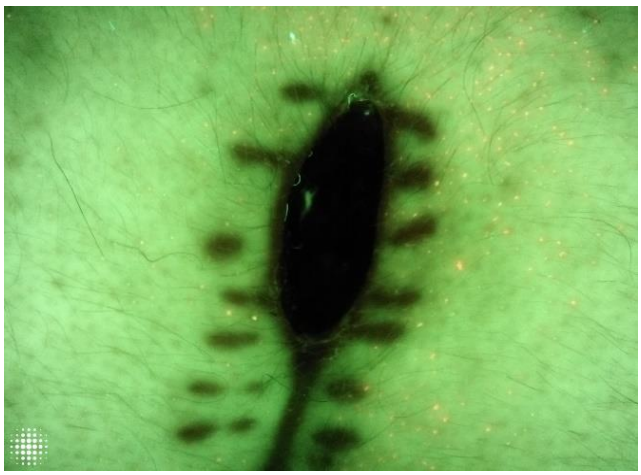

Figure 6: Fluorescence imaging at presentation to the wound clinic.

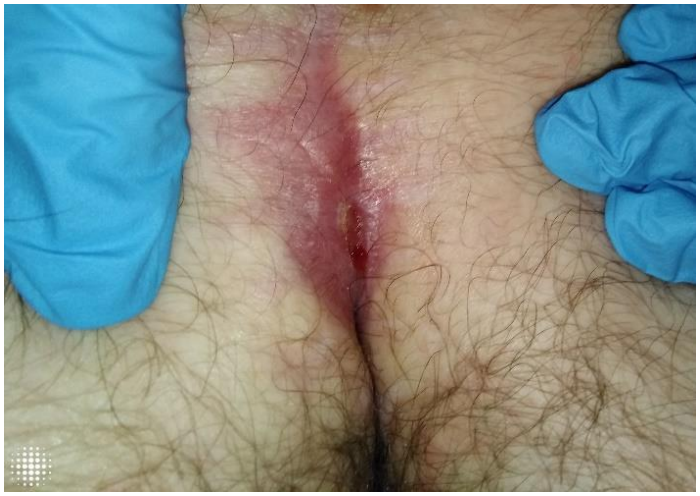

Figure 7: Healed pilonidal ulcer.

Discussion

Pilonidal disease challenges surgeons. It has a predilection for young, otherwise healthy, patients who may develop hard-to-heal ulcers that persist for weeks to months [2]. Surgeons continue to debate definitive surgical and nonsurgical treatment modalities [1]. The wound specialist is often called on to assist in the management of recalcitrant pilonidal ulcers.

The two cases presented here highlight the importance of biofilm in open pilonidal ulcers. Previously under-recognized in acute wounds, chronic wound management has focused on the disruption of biofilms to promote healing [16]. Bacteria favor the biofilm phenotype in open wounds [15]. Bacteria, particularly staphylococcus and pseudomonas, form a microscopic extra-polymeric substance (EPS) that attaches to the wound bed [18]. Bacteria in the EPS are resistant to systemic and topical antibiotics as well as most antiseptics used in wound cleansing [19]. The presence of biofilm impedes wound healing [20]. It is possible that the presence of biofilm in some pilonidal ulcers inhibit wound closure.

The advent of fluorescence imaging permits point-of-care identification of planktonic and biofilm-based bacteria in acute and chronic wounds [9]. It identifies bacterial biofilm in the absence of clinical signs and symptoms of infection [9,12]. In both cases the wounds exhibited bacterial fluorescence indicating bacterial levels that delay healing. The detection of CIBL of bacteria permitted a biofilm focused treatment regimen: debridement in the area of fluorescence and the use of a biofilm disrupting agent. This real time imaging technique may benefit patients with recalcitrant pilonidal ulcers.

The patients in this small case study failed oral antibiotics and topical antiseptic therapy, prior to the use of an antibiofilm agent. There have been several negative studies on the use of topical gentamycin in the treatment of pilonidal ulcers following excision [21,22]. This is not surprising: topical antibiotics and antiseptics do not penetrate biofilm EPS [23]. As a result, they are less effective in treating nonhealing pilonidal ulcers. The eradication of biofilms requires a multimodal approach that begins with debridement to mechanically disrupt the biofilm. Debridement is followed by the use of a topical combination agent, such as PHMB-1, that contains surfactants to disrupt the remaining biofilm. The exposed bacteria are subsequently killed by antimicrobials in the PHMB-1. This may explain why the biofilm-based care used in these two cases worked when other topical antiseptics, including full strength Dakin's solution, failed.

Risk factors for recurrent pilonidal disease include family history, increased number of sinuses, and ulcer size [24]. Additionally, retained hair and untreated sinuses impede wound healing [3]. These case studies suggest that untreated biofilm may also play a role in nonhealing and perhaps recurrence. Further studies using fluorescence imaging in conjunction with biofilm-based wound care are underway.

The limitation of this report is that the observations are based on only two case studies. It is difficult to draw conclusions or make treatment recommendations given the small sample size. The authors hope that the findings presented here spur interest in further study on a biofilm-based approach to recalcitrant pilonidal ulcer. The manufacturers of the PHMB-1 have reformulated the PHMB-1 specifically for use in the operating room (BIASURGE Advanced Surgical Solution, Sanara MedTech Inc., Fort Worth, Texas). The authors are evaluating the new formulation in the treatment of pilonidal ulcers.

Conclusions

Two cases seen in the wound clinic in 2023 suggest that a biofilm-based treatment regimen guided by fluorescence imaging may promote the healing of recalcitrant pilonidal ulcer.

Funding and disclosures: none.

None of the authors has a conflict of interest.

Consent declaration statement: The patients gave consent for the use of their information including photography in this publication.

Acknowledgements – none.

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