e-ISSN 3050-8460
Journal of Dermatology Research

ATHENAEUM SCIENTIFIC PUBLISHERS

*Case Report*

# High Stakes Clinical Case of Necrotizing Fasciitis vs Pyoderma Gangrenosum: Dermatology Saves the Day and Artificial Intelligence (AI) Fails to Diagnose

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Citation: Kosoko-Thoroddsen TSF, et al. High Stakes Clinical Case of Necrotizing Fasciitis vs Pyoderma Gangrenosum: Dermatology Saves the Day and Artificial Intelligence (AI) Fails to Diagnose. J Dermatol Res. 2026;7(2):1-10.

https://doi.org/10.46889/JDR.2026.7207

Received Date: 14-05-2026

Accepted Date: 29-06-2026

Published Date: 06-07-2026



## Abstract

Post-surgical Pyoderma Gangrenosum (PG) is a poorly understood subset of PG precipitated by surgery. Even rarer is PG that affects both skin and muscle. We present a case of Post-Surgical PG (PSPG) complicated by myositis and myonecrosis and superimposed surgical site infection, requiring ICU care and a 24-day hospitalization. After left upper extremity revision surgery, the patient was initially diagnosed with surgical site infection, subsequent necrotizing fasciitis and treated with debridements and broad-spectrum antibiotics. An interdisciplinary team considered a diagnosis of PSPG at Postoperative Day (POD) 12 due to failure of response to ongoing treatment for necrotizing fasciitis. Initiation of high-dose steroids and infliximab halted disease progression. Delayed primary wound closure was performed and patient was discharged on POD 28. One year postoperatively, the patient is well healed with good function and without signs of PG recurrence. Retrospectively, we queried two Artificial Intelligence (AI) platforms to determine whether AI would make the diagnosis of PG earlier in this patient. Remarkably, neither AI platforms considered PG, focusing only on necrotizing fasciitis. Currently, there are only two reports of PSPG with muscle involvement in scientific literature. This case report contributes to the existing knowledge base regarding this rare disease presentation. With this publication, it is hypothesized that AI will make the diagnosis of PSPG in the future and prevent delayed diagnosis and treatment. We conclude that in complex post-surgical cases of infection high suspicion for PSPG is imperative and recommend early multidisciplinary consult.

**Keywords:** Pyoderma Gangrenosum; Post-Surgical Pyoderma Gangrenosum; Infections; Artificial Intelligence; Medical Diagnosis

## Introduction

Pyoderma Gangrenosum (PG) is a rare, poorly understood dermatosis with several hypotheses about its pathophysiology: innate immune system dysregulation, abnormal neutrophil trafficking and autoimmunity [1]. Nevertheless, PG typically presents as a painful skin lesion that rapidly evolves into a necrotic ulcer with violaceous, undermining borders. Up to 78% of patients with PG have comorbidities such as inflammatory bowel disease, rheumatoid arthritis and hematologic disorders. Due to the absence of distinct diagnostic criteria, PG is a clinical diagnosis of exclusion [1].

Post-Surgical PG (PSPG) is a rare subset of PG that occurs in the setting of surgery. A systematic review from 1946 to 2013 found only 220 PSPG cases. Among these patients, 65% had no comorbidities associated with PG. The majority were initially

misdiagnosed with Surgical Site Infections (SSI). Only after no improvement with antibiotics and/or debridement were these patients accurately diagnosed with PSPG, typically by dermatologists [2].

Although PSPG and SSI have similar symptoms, they have diametrically opposite treatments. Serial debridements performed for SSI can worsen PSPG due to pathergy, wherein surgical trauma exacerbates tissue inflammation and necrosis [1]. The systemic immunosuppression employed for PSPG can dampen the immune response to infection [3]. Failure to recognize PSPG can result in a vicious cycle of debridement and pathergic exacerbation, culminating in large tissue defects or even amputation [4,5]. Thus, physicians must adeptly distinguish PSPG from SSI.

Early diagnosis and treatment of PSPG, though paramount, is often difficult and requires a high degree of clinical suspicion. In recent years, the emergence of Artificial Intelligence (AI) in medicine has gained attention as a field of significant potential and growth, specifically in medical diagnosis. Thus, we queried two AI platforms, Washington University's secure ChatGPT and OpenEvidence, to determine whether AI would make the diagnosis of PG in this patient. We hypothesized that AI would make the diagnosis earlier than the treating physicians. Herein, we present a case of PSPG with myositis, myonecrosis and superimposed SSI precipitated by left upper extremity revision nerve surgery that was initially misdiagnosed as necrotizing fasciitis.

**Case Report**

A 52-year-old non-smoker man with past medical history of adrenal insufficiency (managed with twice daily hydrocortisone) with an otherwise non-contributory psycho-social and family history presented with a two-year history of severe left upper extremity neuropathic pain and weakness after undergoing left cubital tunnel, Guyon's canal and carpal tunnel releases at an outside hospital with uneventful wound healing. Revision left cubital tunnel, Guyon canal and carpal tunnel releases were performed with perioperative stress-dose steroids. Significant scarring was encountered intraoperatively, but the case was otherwise uncomplicated.

On Postoperative Day (POD) 3, the patient reported left elbow erythema, warmth and swelling without systemic symptoms. Despite starting oral cephalexin for a presumed SSI, his clinic visit on POD 5 showed worsened peri-incisional erythema, warmth and edema at the wrist and elbow surgical sites (Fig. 1). Drain cultures were obtained and he was admitted to the hospital for Intravenous (IV) antibiotics. The following day (POD 6), purulence was expressed from both surgical sites, prompting urgent Incision and Drainage (I&D). He was managed with wound care, IV antibiotics and stress-dose steroids due to concern for new onset sepsis. The wound did not deteriorate over the next two days and he was transitioned back to his preoperative steroid regimen and oral antibiotics.

Belying this temporary clinical improvement, he soon developed mucoid drainage and worsening peri-incisional symptoms (Fig. 2). Despite wound care, IV antibiotics, high-dose steroids and two additional I&Ds, he required admission to the surgical intensive care unit due to leukocytosis and shock. There was discussion of limb amputation. Additionally, his I&D showed patchy areas concerning for necrotizing fasciitis, expressible purulence and myonecrosis throughout his forearm musculature, requiring sharp debridement (Fig. 3). However, broad infectious laboratory testing was negative, except for cultures from POD 5 positive for Staphylococcus epidermidis (considered a skin contaminant). All OR debridement cultures were also negative. Furthermore, the violaceous, undermining wound borders that progressed after debridement suggested pathergy (Fig. 4). After consultation with the Dermatology team who discussed the possibility of atypical PSPG and assistance from the Infectious Disease teams on POD 12, the patient was diagnosed with PSPG. The pathology reports demonstrated acute inflammation involving skeletal muscle (flexor carpi radialis and flexor digitorum superficialis as well as fibrosis and necrosis of left upper arm soft tissue.

On POD 13 PG treatment was initiated with 125 mg IV solumedrol. Broad-spectrum IV antibiotics were also continued to cover a possibly superimposed SSI. After three days of wound care (wet to dry dressings and negative pressure wound therapy) and high-dose steroids, he underwent limited debridement, where early granulation tissue was observed without evidence of worsening infection or tissue necrosis. Post debridement, he received an infliximab dose. Due to clinical improvement, his wound was closed in stages using elastic vessel loops to provide continuous external tissue expansion, while continuing high-dose steroids. After a second infliximab dose, on POD 28 he was discharged home on a prolonged steroid taper and trimethoprim-

sulfamethoxazole. His follow-up visits at three months (Fig. 5) and one year after his index procedure shows he has healed well. He has good active and passive elbow, wrist, and finger range of motion, and continues to work with hand therapists to improve stiffness. He also continues to have left hand neuropathic pain controlled with stellate ganglion blocks. His clinical course is summarized in detail as shown in Fig. 6.

**Figure 1:** Clinic visit on postoperative day 5. Patient was noted to have worsened peri-incisional erythema, warmth and edema at wrist and elbow surgical sites refractory to oral antibiotics prescribed 2 days prior.

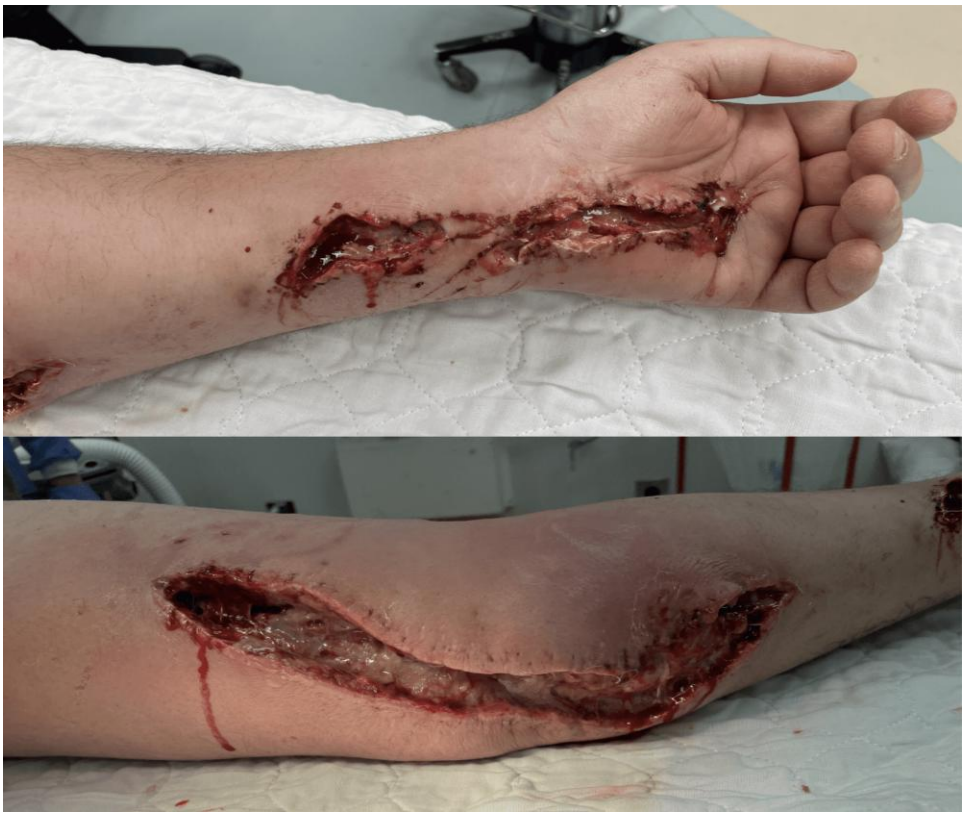

**Figure 2:** Postoperative day 10 after index procedure, postoperative day 4 after initial incision and drainage. Patient developed worsening left upper extremity pain, erythema and edema along with mucoid drainage requiring emergent washout and debridement.

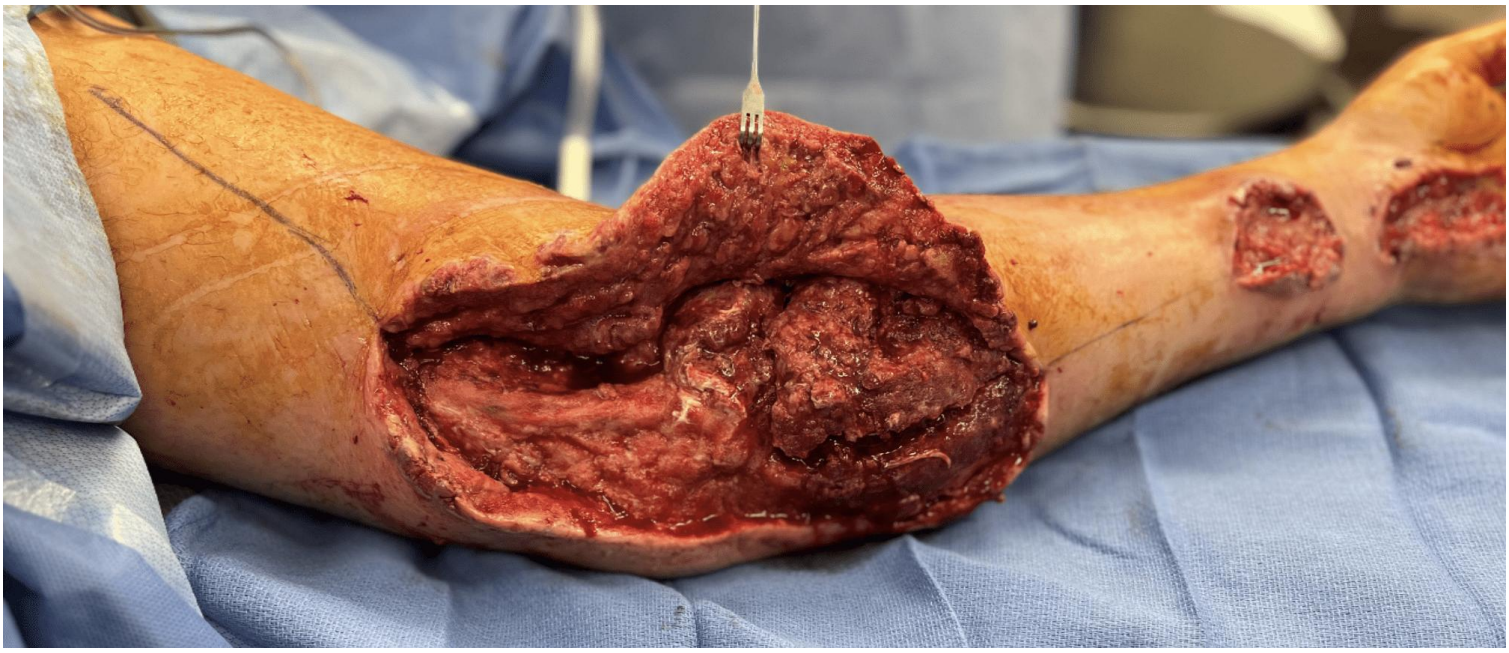

**Figure 3:** Postoperative day 12 after index procedure and postoperative day 6 after initial incision and drainage. Patient noted increasing pain, erythema, edema along with worsening leukocytosis, tachycardia, tachypnea. He was taken to the operating room for washout and debridement, this time with findings concerning for necrotizing fasciitis necessitating radical debridement of palmaris longus, flexor carpi radialis and flexor carpi ulnaris.

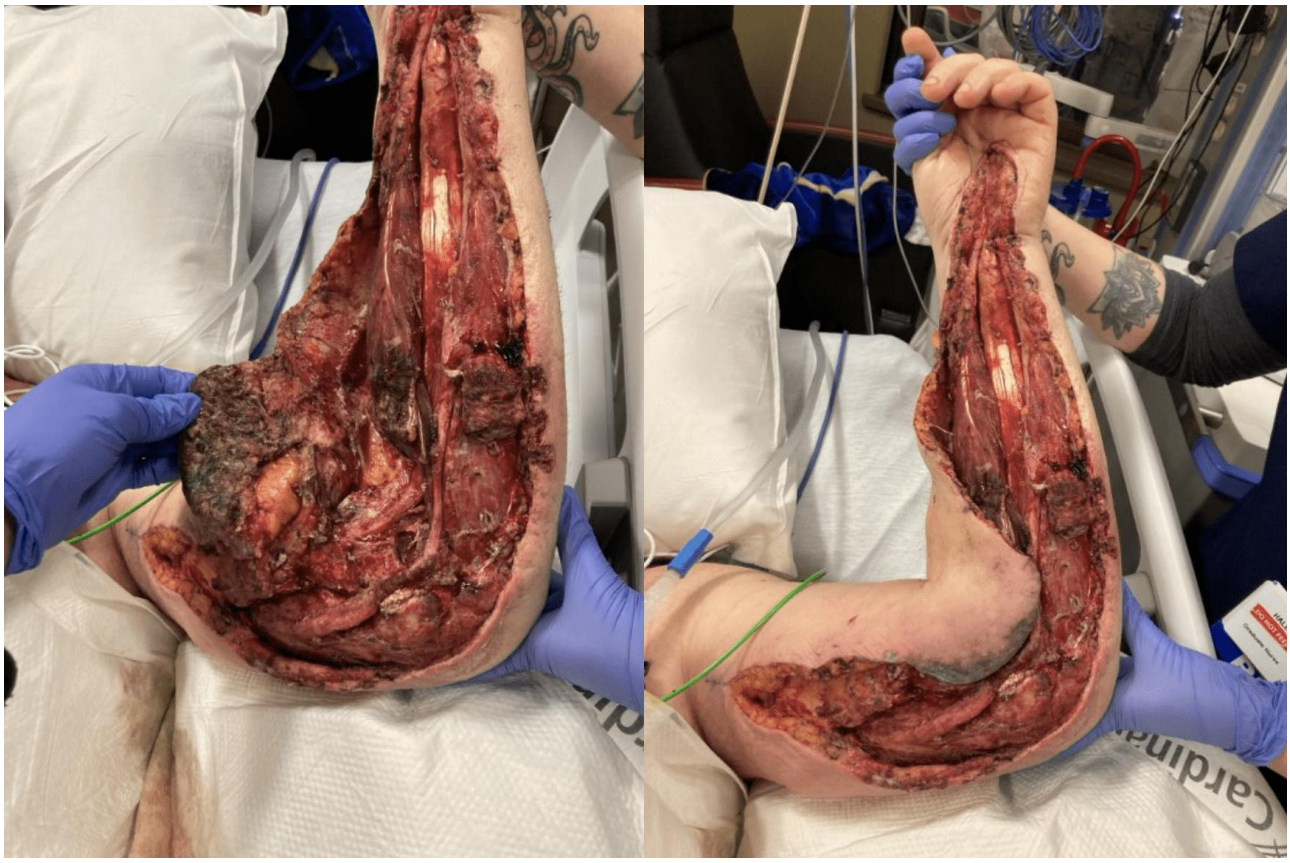

**Figure 4:** Bedside physical examination findings one day after radical debridement of left upper extremity showed marginal necrosis at the cut edges of muscle where the flexor pronator mass was previously resected. Discolored gray tissue was observed on the underside of his skin flap along with purple discoloration to the wound edges and local ulcerations at the wound periphery. Some necrosing skin also declared itself at the periphery of the anterior flap. These findings raised suspicion for postoperative pyoderma gangrenosum.

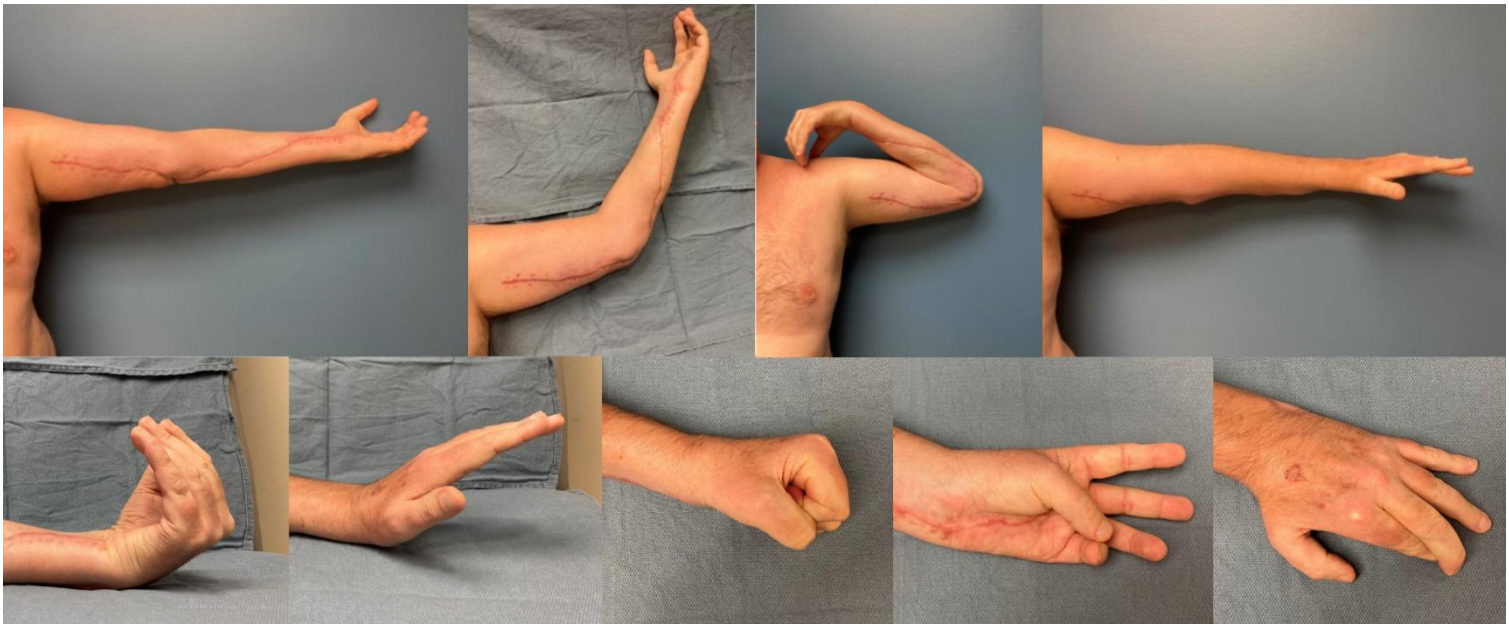

**Figure 5:** Three months after index revision operation. All incisions are well-healed. Patient has good active and passive elbow, wrist and finger range of motion.

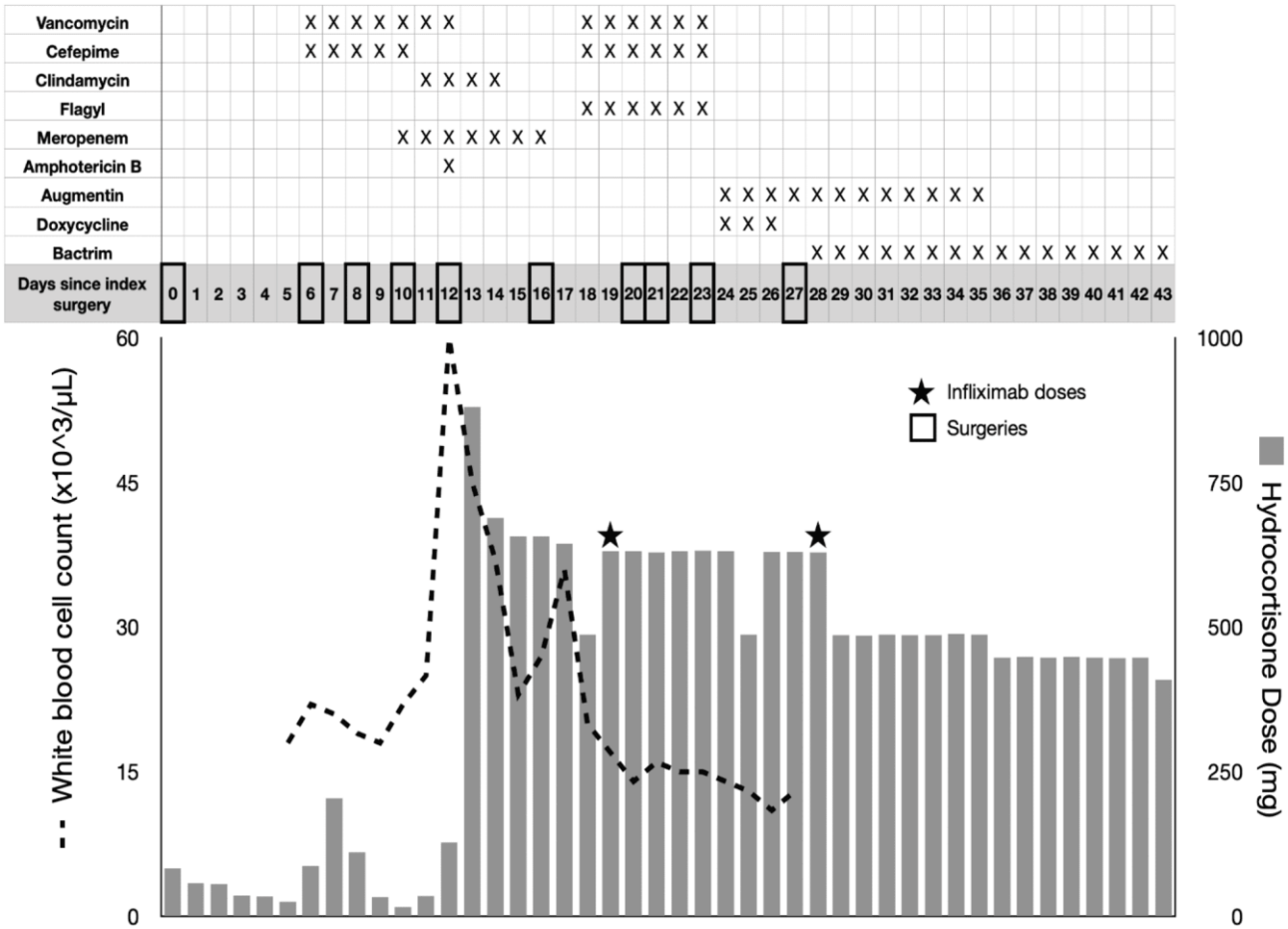


**Figure 6:** Summary of the patient's clinic course highlighting: antibiotic regimen, steroid dosing (in hydrocortisone equivalents as this was his home medication), infliximab dosing, leukocyte count and procedures. The antibiotic regimen is shown in the table at the top. The x-axis represents the time elapsed since the index surgery, noting the days of admission (POD 5) and discharge (POD 28) and the day(s) the diagnosis of PSPG was made and treatment initiated (POD 12-13). The days surrounded by boxes represent surgery dates. The white blood cell count is represented on the graph by a dashed line with the y-axis on

the left. The hydrocortisone dose is represented on the graph by gray bars with the y-axis on the right. The timing of the two infliximab doses is represented by stars. Bactrim was prescribed for a total of three weeks to coincide with the patient's three-week steroid taper after discharge on postoperative day 28.

**Discussion**

*Diagnostic Pearls*

Here we report a severe case of PSPG involving the skin and muscle after revision cubital tunnel, Guyon's canal and carpal tunnel releases. Due to the patient's initial presentation with surgical site edema, erythema and pain, we were concerned for SSI and necrotizing fasciitis. However, because of deterioration of clinical status requiring ICU admission despite aggressive medical and surgical management, mostly negative cultures and symptom recurrence after steroid tapering, we considered other non-infectious etiologies. Additional clinical features that supported a PSPG diagnosis were violaceous, undermining wound borders and shock [6]. There are no specific laboratory or histopathological markers currently associated with PSPG. Laboratory testing, imaging and biopsy can help narrow the differential [1].

Notably, our patient did not have any history of inflammatory bowel disease, rheumatoid arthritis or hematologic disorders, comorbidities all associated with PG [1]. Also, he previously received a total hip arthroplasty with uneventful wound healing. It is estimated that 65% of PSPG patients have no risk factors. Moreover, only 12% of PSPG cases occur after orthopedic surgery [2]. PSPG has developed in five patients after carpal tunnel release and one after cubital tunnel release [7-12]. Thus, aside from a previous history of PSPG, there is no way to reliably predict which patients may develop PSPG. Furthermore, PSPG can also occur after breast, cardiothoracic and abdominal surgeries. Regardless of the surgery performed, surgeons need to consider PSPG if postoperative patients exhibit symptoms resistant to antibiotics and debridements.

*Myonecrosis in PSPG*

Although PG typically only affects the skin, this patient exhibited myositis and extensive muscle necrosis of the left upper extremity. Post-surgical pyoderma gangrenosum was first reported in 1924, but PSPG associated with myositis and myonecrosis was first reported in 2014 in a patient who underwent shoulder surgery [13,14]. To date, there has been one other report of muscle-involved PSPG, also after an upper extremity surgery [10]. The mechanism of muscle involvement in PSPG remains unknown [1,13]. Regardless, it is important that muscular involvement should not rule out PG.

*Medical Management*

There is no single treatment for PG. In fact, PG lesions may require multiple medication trials and can take years to fully heal [1,13]. The severity and distribution of PG lesions should inform treatment. The treatment regimen is generally two-pronged: decrease inflammation and perform wound care without triggering pathergy [1].

Topical treatments, such as corticosteroids, tacrolimus and cyclosporine, can treat mild and superficial PG lesions when applied to the lesion's borders. Intralesional corticosteroids and systemic treatment are other successful PG treatment modalities. That said, providers should limit injections to reduce the likelihood of further pathergy [1].

Systemic immunosuppression with oral corticosteroids, cyclosporine and TNF-alpha inhibitors are first-line treatments for severe PG. A small randomized clinical trial has shown infliximab infusions yield a significant clinical response in patients with classic PG starting two weeks after treatment [15]. Second-line systemic treatments include biologic agents, granulocyte apheresis, alkylating agents and intravenous immunoglobulins. Providers can also consider other adjunctive systemic treatments, such as anti-neutrophil agents, antimicrobials, mycophenolate mofetil, azathioprine and methotrexate. Before commencing systemic immunosuppression, it is critical to ensure that malignancy and infection are not contributing to the patients' clinical picture and to consider the adverse effects [1,13].

Appropriate wound care that avoids pathergy is essential for PSPG treatment. PG lesions are usually managed with moisture-retentive dressings, such as normal saline wet-to-dry compresses, hydrogels and films. However, highly exudative PG lesions may benefit from absorptive dressings, like hydrocolloids, foams and alginate fibrous dressings. In some cases, topical nicotine, benzoyl peroxide and hydrogen peroxide have been instrumental in treating PG [13]. Negative Pressure Wound Therapy (NPWT) and hyperbaric oxygen therapy have also been used in PG patients as adjuncts to surgery [1].

Although PG lesions are susceptible to infection, empiric antimicrobial therapy is not recommended due to risk of delayed wound healing and antimicrobial resistance. It is likely that PSPG patients will have already received antibiotics due to initial concern for SSI. Culture and susceptibility results should guide the management of any superimposed infections. Topical antibiotic ointments can be useful but may induce contact dermatitis or keratinocyte damage. Oral and intravenous antibiotics are indicated for any deep tissue infections [1].

*The Role of AI in Medical Diagnosis*

We hypothesized that Artificial Intelligence (AI) would make the diagnosis of PG in our patient earlier than POD 12-13, which is when the Dermatology and Infectious Disease teams made the diagnosis. When we queried two AI platforms with patient data (history of present illness, past medical history, past surgical history and daily updates including vitals, physical exam, labs, medications and culture results) neither AI platforms ever made the diagnosis! The results of this query are surprising yet reassuring. There is a role for AI in medicine (interpretation of medical imaging and lab results, virtual patient care, documentation, genomics and drug discovery), but there is harm in relying on it. This query emphasizes that while AI may be efficient and aid in decision-making, it is not always accurate. Physicians should exercise caution when using AI, especially for high stakes scenarios for which AI may fail to provide the correct diagnosis as in this case. Even with advancements in AI, there is still a role for quaternary referral centers with specialists and multidisciplinary care in diagnosing and treating patients.

*The Role of Multidisciplinary Teams*

In the case of our patient, adequate diagnosis and treatment initiation was not achieved until nearly a week after hospital admission, requiring extensive collaboration among dermatologists, plastic surgeons, intensivists, endocrinologists and infectious disease physicians. This is commonly observed in the literature: Post-surgical pyoderma gangrenosum diagnosis is typically made after multidisciplinary team discussions or consults to dermatology, rheumatology or plastic surgery [2,13]. Post-surgical pyoderma gangrenosum is a complex disease process that benefits from a multidisciplinary team to facilitate earlier diagnosis and treatment, thereby curtailing morbidity associated with misdiagnosed PSPG.

## Conclusion

Post-surgical pyoderma gangrenosum is commonly misdiagnosed as surgical site infections due to overlapping clinical features. Therefore, an early multidisciplinary approach is essential for prompt diagnosis and treatment. Myositis and myonecrosis should not preclude a diagnosis of PG. Post-surgical pyoderma gangrenosum can be managed with topical and/or systemic corticosteroids, TNF-$\alpha$ inhibitors and local wound care. Once the wound has stabilized, closure can be completed while on perioperative steroids. This case report also highlights the pitfalls of AI in medical diagnosis and the importance of multidisciplinary care along with the input of the patient and patient's family when caring for patients with suspected PSPG, to facilitate early diagnosis and treatment and prevent significant morbidity.

## Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

## Funding Statement

Funding was provided by the Foundation for Barnes-Jewish Hospital.

## Acknowledgement

We would like to thank doctors Amy C.M. Musiek, MD; Elvin H. Geng, MD, MPH and Julie M. Silverstein, MD for their expertise in the care of this patient.

## Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Ethical Statement

The project did not meet the definition of human subject research under the preview of the IRB according to federal regulations and therefore was exempt.

**Informed Consent Statement**

Informed consent was obtained from all participants included in the study.

**Authors' Contributions**

All authors contributed equally to this paper.

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**Supplementary Files**

Patient (Family) Perspective: Living Through Post-Operative Pyoderma Gangrenosum

I am writing to share my husband's perspective during his 24-day hospitalization for pyoderma gangrenosum (PG) following nerve repair surgery. He would write this himself, but because of the high doses of medication he received during his hospitalization and the emotional trauma of his health journey, I am offering our experience from my point of view. I was at his bedside every moment of his 24-day hospital stay.

We were filled with hope and relief when world-renowned Dr. Susan Mackinnon agreed to operate on my husband. After years of debilitating nerve pain following his initial carpal and cubital tunnel releases, Dr. Mackinnon validated the reason for the pain: dense scar tissue entrapping his nerves. The operation to reposition the nerve went smoothly, and we were discharged home the following day, optimistic about his recovery.

Within a couple of days, however, he developed redness, swelling, and pain in his arm. We were seen in clinic and readmitted for surgical intervention. This began a devastating cycle: each surgery brought brief relief followed by a rapid return of pain, redness, and swelling-each recurrence worse than the last.

About twelve days into this ordeal, I sat with my husband in the pre-anesthesia area. He looked at me and said quietly, "I don't want you to drive home by yourself." I reassured him that I wouldn't leave the hospital without him, but his next words chilled me: "This is not going well. I don't think I'm going to make it. I can smell death." A first assistant in cardiothoracic surgery for 30 years-he knew what dying patients looked like and what dead tissue smelled like.

An hour after surgery began, the resident called me. She explained that they were finding extensive dead tissue in his arm and feared necrotizing fasciitis. Dr. Mackinnon told me that they didn't know if they could stop it-and if they did, it might require amputation.

Through tears, I told her our wish was "life over limb". His arm was left open, and he was transferred to the ICU, where I waited in fear and uncertainty.

Dr. Mackinnon brought in her colleagues Dr. Pet and Dr. Fox to consult. I felt comfort knowing that the best minds in medicine were working together to save his life and his arm.

In the loneliness of the ICU, a glimmer of hope appeared. The team began to consider a rare but possible diagnosis: PG, which paradoxically worsens with debridement and antibiotics but can respond to high-dose steroids. If they treated for PG and were wrong, my husband would almost certainly lose his arm-and possibly his life.

In the middle of the night, a Dermatology resident came to examine his arm. She carefully removed the dressing and took photographs to send to her attending, Dr. Musiek. Dr. Musiek's preliminary impression was PG. High-dose steroids were started immediately while we anxiously waited and watched the next few hours.

The next several days were a delicate balance-titrating steroids, closely monitoring the wound, and carefully removing only the most necrotic tissue. Soon, it became clear they were on the right track: his wound began to improve.

The dressing changes were brutal. At first, I couldn't bring myself to look at the wound. It extended from his armpit to the palm of his hand. I have been a nurse for 30 years, and it was by far the most gruesome wound I have ever seen. But day by day, with skilled care, perfectly timed surgical debridement, and teamwork, we began to see healing.

They thought he would certainly need skin grafting to close the wound due to the vast tissue loss and damage. The team continued with surgical debridement and dressing changes, very slowly closing the wound with each trip to the operating room. Due to the skillfulness of the surgeons, they were able to completely close the wound, from armpit to palm prior to his discharge

from the hospital.

Despite the progress, there remained great uncertainty about his long-term outcome. Given the extensive removal of muscle tissue, there was little confidence that his arm would ever function well again. With determination, skilled therapy, and the remarkable surgical reconstruction, he regained full use of his arm. Without the knowledge, skill, and collaboration of Dr. Mackinnon, Dr. Pet, Dr. Musiek, and the entire care team, my husband's outcome surely would have been devastating. We are forever grateful for their brilliant minds, healing hands and compassionate hearts.