



Review Article

The Skin Battle: Exploring The Depths Of Pyoderma Diagnosis, Treatment, And Management Strategies

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ABSTRACT

Pyoderma is a prevalent dermatological condition encompassing a range of primary and secondary skin infections. Primary pyodermas, which include impetigo, folliculitis, furuncle, carbuncle etc., pose a significant burden in dermatological practice. Secondary pyodermas comprise conditions like infected pemphigus, infected contact dermatitis, and infected scabies, often compounding the clinical complexity. The most frequently isolated organism in pyoderma is *Staphylococcus aureus*, which can be methicillin-sensitive (MSSA) or methicillin-resistant (MRSA). MRSA is a concerning healthcare-associated pathogen, and many isolates exhibit multidrug resistance. The pathophysiology of skin infections primarily involves disruptions in the skin's barrier, enabling pathogenic microbes to enter and triggering systemic reactions. Secondary infections occur when these pathogens invade diseased skin, and the specific pathogenesis varies based on the primary condition. Diagnosing bacterial pyodermas primarily relies on visual examination, occasionally supplemented by culture tests to confirm the presence of the causative organism. Treatment objectives encompass halting the progression of infection, alleviating discomfort, managing recurrent furunculosis, ensuring cost-effective interventions with minimal adverse effects, and swiftly eradicating severe infections. Antibiotics play a pivotal role in achieving these goals, serving as the primary treatment choice. Topical agents like mupirocin and erythromycin are often employed to cleanse affected lesions, eliminating the source of infection and reducing the potential for spread. In cases of extensive or severe infection, systemic antibiotic therapy becomes essential, administered either orally or via injection, to ensure effective eradication of the pathogen. This highlights the importance of early diagnosis, appropriate antibiotic choice, and comprehensive management to prevent complications and reduce the disease burden, antimicrobial resistance.

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INTRODUCTION

Pyoderma refers to a skin infection categorized into two main types: primary and secondary pyoderma. Primary pyoderma occurs when bacterial pathogens colonize the skin directly, without any underlying cause. Some examples of primary pyodermas include folliculitis, furuncle, impetigo, and carbuncles. On the other hand, secondary pyoderma typically occurs as a result of an outbreak of a primary skin disease. Examples of secondary pyoderma include infections related to atopic dermatitis, scabies, and tropical ulcers. The most common bacteria responsible for these infections include *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas*, and coryneform bacteria [1,2]. Bacterial skin infections are one of the most common infectious diseases globally. Some of the frequently reported skin infections are as follows.

Table no.1: Disease with primary skin lesion

S.no	Disease with primary skin lesion
1.	Pityriasis rosea
2.	Secondary syphilis
3.	Folliculitis
4.	Impetigo
5.	Acne

Table no.2: Disease with secondary skin lesion

S.no	Disease with secondary skin lesion
1.	Infected eczema
2.	Infected psoriasis
3.	Infected pemphigus
4.	Infected scabies

Impetigo is a highly contagious superficial skin infection that often affects children between the ages of two to five years. It can be categorized into two forms: bullous and non-bullous. These skin lesions have a high transmission rate, especially among children[3,4,5,6].

Folliculitis is a frequently encountered and typically harmless inflammation of the hair follicles. This condition results in the formation of

a pustule or red papule on the skin's surface, usually around hair-bearing areas[7].

Carbuncle is a cluster of infected hair follicles, typically consisting of two or more furuncles, that spreads into the nearby skin and deeper subcutaneous tissue. It appears as a red, painful, swollen lump with numerous pus-filled openings on the skin's surface.

Furuncle, commonly known as a boil, is a painful and inflamed bump on the skin filled with pus. This infection starts within a hair follicle and can extend outward as it becomes more severe[8,9,10].

Paronychia is a nail infection often caused by the breakdown of the protective barrier between the nail and the surrounding nail fold. This condition can introduce harmful bacterial microbes into both finger and toe nails[11,12].

Cellulitis is a bacterial infection affecting the skin and soft tissues. It develops when the body's defense mechanisms are compromised due to factors like diabetes, obesity, or aging. The symptoms, including redness, swelling, warmth, and tenderness, are non-specific and can vary in severity[3].

Acne and acne vulgaris are conditions that affect pilosebaceous follicles, where hair follicles become combined with oil and dead skin cells. Both can lead to inflammatory and non-inflammatory lesions, primarily appearing on the face. Acne vulgaris is a more severe form of acne[13,14].

Bacterial super-infections arise when secondary bacterial pathogens invade. This skin condition often follows primary dermatoses, initial nonbacterial skin infections, traumatic injuries, ulcers, cutaneous infestations, autoimmune disorders, and various other skin-related ailments[15].

Subacute eczema, often a secondary infection, is a frequently encountered Condition. It represents an intermediate phase between acute and chronic eczema, characterized

by symptoms ranging from mild to intense itching. This condition typically heals without scarring when the underlying cause is removed.

Table no.3: Diseases presenting as subacute eczema

S.no	Diseases presenting as subacute eczema
1.	Intertrigo
2.	Diaper dermatitis
3.	Irritant contact dermatitis
4.	Nipple eczema
5.	Stasis dermatitis

Intertrigo is an inflammatory skin condition that develops in areas prone to friction, often accompanied by itching, burning, and stinging sensations. While candida is the most frequent secondary infection, bacteria, fungi, or viruses can also be responsible. Diaper dermatitis, on the other hand, arises from prolonged diaper wetness, making the area susceptible to microbial invasion [14]. Scabies, a highly contagious condition, can lead to secondary infections either as a result of the initial infection or due to scratching.

Among sexually transmitted bacterial disease, syphilis is a contagious bacterial infection which is commonly encountered, transmitted through direct contact with lesions. It is categorized into three main stages: primary syphilis, secondary syphilis, and tertiary syphilis [14].

Etiology:

The etiology of pyoderma diseases is influenced by various factors, with evolving trends in their causative agents being reported [1]. Common culprits behind these skin infections include *Staphylococcus aureus*, *Streptococcus pyogenes*, and coryneform bacteria. Approximately 80% of non-bullous impetigo cases are attributed to *s.aureus*, but occasionally, group A β -hemolytic streptococci and methicillin-resistant *s.aureus* (MRSA) are also implicated, especially in crowded regions and among hospitalized patients [4]. Folliculitis can be caused by both

methicillin-sensitive and methicillin-resistant forms of this bacteria, and *Pseudomonas aeruginosa* can trigger follicular inflammation, known as "hot tub" folliculitis. Anaerobic bacteria are sometimes responsible for carbuncles [7]. Acne and acne vulgaris are often linked to *Propionibacterium acnes* and *Cutibacterium acnes*, respectively [13].

Syphilis, caused by *Treponema pallidum*, is primarily a sexually transmitted disease transmitted through vaginal, anogenital, and orogenital contact. In rare instances, it can also be transmitted through non-sexual means such as blood transfusion or direct contact with infected skin [16].

Epidemiology:

Impetigo constitutes approximately 10% of skin diseases in individuals under 18 years old. While it can affect people of all age groups, it is most commonly found in children aged 2-5 years, with young children under the age of 2 accounting for nearly 90% of bullous impetigo cases [17,18]. Despite follicular inflammations being common, not all patients seek medical attention, making it challenging to interpret epidemiological data [8]. Acne typically emerges during the teenage years, with males experiencing a higher occurrence than females, and around 20% of acne cases progress to severe forms [13,19]. Paronychia is more prevalent in middle-aged women than in men (3:1) and often affects individuals who spend extended periods in wet environments [7]. According to the statistics from the centers for disease control and prevention (CDC), men aged 20-29 have the highest incidence of primary and secondary syphilis [16].

Pathogenesis:

The skin becomes susceptible to microbial invasion due to predisposing factors like a high bacterial concentration, excessive moisture, poor blood supply, the presence of bacterial nutrients, and damage to the protective corneal layer. The

nature and severity of infection are influenced by both the type of microorganism and the site of infection [20].

Common pathophysiology of skin infections involves primary infections occurring when there are disruptions in the skin's barrier, enabling microbes to enter and triggering systemic reactions. Secondary infections occur when pathogenic bacteria invade diseased skin, and the specific pathogenesis varies depending on the primary condition[2].

Folliculitis results from infection of hair follicles, although it can also due to inflammation of ingrown hairs [8]. Paronychias mostly occur due to trauma and nail-biting, where organisms enter the moist nail area, leading to colonization and infection outbreaks [21,22].

In adolescents, hormonal influences can trigger the release of pro-inflammatory cytokines in the case of acne vulgaris, providing an opportunity for microbial invasion, with symptoms ranging from mild to moderate[23].

Clinical presentation:

Syphilis patients may initially present with genital and non-genital chancres, and primary lesions may resolve without treatment. However, untreated primary syphilis can progress to secondary and tertiary stages. In the later stages, such as tertiary syphilis, which often lacks clinical manifestations, detection typically relies on serological tests [16].

Impetigo

The lesions are typically without symptoms, and the areas most frequently affected are the skin around the nose, mouth, and limbs. Non-bullous lesions begin as small fluid-filled vesicles, which quickly transform into pustules that rupture, resulting in purulent discharge. They eventually dry to form distinctive honey-colored or golden-yellow crusts. Bullous impetigo, which begins as vesicles, progresses into bullae filled with yellow fluid. These lesions can be concentrated in one area or scattered widely.

Folliculitis

Initially, they manifest as painless, swollen, red masses, often found in areas prone to friction. These clusters of itchy papules then progress into tender pustules, which typically rupture within a few days but eventually heal without leaving scars [8,14,20].

Furuncles

The condition presents as painful, swollen bumps, with lesions initially starting as red papules that swiftly enlarge into inflamed draining nodules. These nodules maintain their painful nature for several days before becoming fluctuant. Sometimes, yellowish pus may become visible within the skin. The primary sites of infection are typically the face and neck, including the nape of the neck [14,20].

Carbuncle

Typically, it presents as a red, erythematous, and painful nodule, often accompanied by multiple pustules overlying it, forming painful follicular masses. These pustules may rupture due to minor trauma, friction, or pressure, resulting in the development of a crust [24,25,26].

Pitted keratolysis: It is characterized by numerous punched-out depressions, this condition is mostly asymptomatic, although painful, plaque-like lesions can manifest in both adults and children [14].

Paronychia:

Superficial infections are marked by the buildup of purulent material behind the cuticle, resulting in painful redness and swelling of the lateral nail fold. Symptoms often include erythema, swelling, and tenderness in the lateral nail fold [21].

Cellulitis:

The clinical presentation encompasses varying degrees of erythema, edema, pain, warmth, and tenderness. In many cases, cellulitis is accompanied by fever and leukocytosis [13].

Acne:

Acne can manifest as a range of polymorphic lesions falling within grades I to IV, including comedones, papules, pustules, nodules, and cysts [27].

Secondary infections[14]:

Subacute eczema

Erythema and scaling manifest in diverse patterns, with the intensity of redness varying according to the infection's severity. Symptoms can present as well-defined plaques with erosion, hyperpigmented plaques, patches, or papules with mild oozing.

Irritant contact dermatitis

This condition is defined by a red base and the presence of satellite pustules alongside dull, irregularly shaped nodules. Stasis eczema is typically accompanied by moderate to intense itching.

Scabies

In secondary infections, the most common symptoms include pinpoint erosions and pustules, with occasional nodules. Additionally, scaling and erythema may also manifest at the primary infection site.

Treatment of skin infections

Antibiotics[16]

Antibiotics play a pivotal role and are the primary choice for treating bacterial skin diseases. These antibiotics are derived from microorganisms and work to inhibit or eradicate microbial growth. With few exceptions, most antibiotic categories exhibit activity against both gram-positive and gram-negative microbes.

Beta-lactam antibiotics

The penicillins:

Penicillins, a group of beta-lactam antibiotics, are indispensable in the treatment of bacterial diseases and remain the preferred drugs for a wide range of infectious conditions. Penicillin G, in particular, exhibits antimicrobial efficacy against both aerobic and anaerobic organisms, with a notable

susceptibility of treponema pallidum to this antibiotic.

Category	Few examples
1.Penicillin	Ampicillin, amoxicillin, benzathine, penicillin, Cloxacillin, amoxicillin clavulanate.,
2.Cephalosporin	Cephalexin, cefotaxime, cefadroxil, ceftriaxone.,
3.Tetracycline	Doxycycline, minocycline.,
4.Macrolides	Erythromycin, azithromycin.,
5.Fluoroquinolones	Ciprofloxacin, levofloxacin.,
6.Sulphonamides	Silver sulphadiazine, sulfasalazine.,
7.Miscellaneous	Fusidic acid, mupirocin

Penicillinase-resistant penicillins like cloxacillin effectively inhibit the growth of penicillinase-resistant staphylococci but do not provide utility against gram-negative microorganisms. On the other hand, aminopenicillins such as amoxicillin and ampicillin exhibit broader activity, targeting both gram-positive and gram-negative microbes.

Cephalosporin

Cephalosporins, categorized as beta-lactam antibiotics, offer a broad spectrum of activity. First-generation cephalosporins are highly effective against bacterial infections due to their activity against *S. pyogenes* and methicillin susceptible *Staphylococcus aureus* (MSSA). In contrast, third-generation cephalosporins excel in their activity against streptococci.

Macrolides:

Erythromycin typically exhibits bacteriostatic properties but can become bactericidal at high concentrations against susceptible organisms. It demonstrates reasonably effective activity against streptococci.

Tetracycline:

Tetracyclines, a group of derivatives, demonstrate broad-spectrum antibacterial activity. They maintain promising efficacy against both *Methicillin-Susceptible Staphylococcus aureus*

(MSSA) and Methicillin-Resistant *Staphylococcus aureus* (MRSA). Additionally, tetracyclines exhibit activity against various spirochetes, including *Treponema pallidum*.

Fluoroquinolones:

These agents offer extensive antimicrobial coverage, with the higher-tier drugs displaying heightened efficacy against streptococci. They prove effective when administered orally for treating a diverse range of infectious conditions.

Mechanism of action

Quinolone antibiotics work by inhibiting bacterial DNA gyrase and topoisomerase IV, leading to the suppression of DNA synthesis.

Sulphonamides[16]:

Sulfonamides find primary use in treating acne and related disorders, and they exhibit their mechanism of action by competitively antagonizing structural analogues of p-aminobenzoic acid (PABA) in the synthesis of folic acid.

Mupirocin:

Mupirocin is strictly intended for topical application and serves as an effective bactericidal agent, demonstrating notable activity against *S. pyogenes*, *Methicillin-Susceptible Staphylococcus aureus* (MSSA), and *Methicillin-Resistant Staphylococcus aureus* (MRSA).

Mechanism of action

It works by reversibly binding to and inhibiting isoleucyl tRNA synthase, consequently disrupting protein synthesis.

Fusidic acid:

Fusidic acid is an antibiotic used to treat skin infections, primarily targeting staphylococcal bacteria. Its mechanism of action involves inhibiting protein synthesis, which effectively hinders both peptide translocation and ribosome disassembly.

Management of bacterial infectious diseases:

Desired outcomes[20]:

1. Halting the infection's onward progression and averting future occurrences.
2. Alleviating discomfort and enhancing the appearance of lesions.
3. Managing recurrent furunculosis is crucial, especially in cases of chronic furunculosis that may pose treatment challenges.
4. Delivering cost-effective treatment with minimal to no adverse effects.
5. Swiftly eradicating severe infections and forestalling potential complications.

Pyoderma[28]:

Usually, repeated cleansing of the affected lesions using topical agents helps eliminate the infection source and reduces its potential spread to nearby skin areas. Topical treatments like mupirocin and erythromycin are employed for this purpose. In cases of widespread infection, systemic antibiotic therapy becomes essential, administered either orally or via injection.

Table no.5: Acceptable antibacterial agents for treatment of bacterial Skin infections

Disease	Acceptable antibacterial agents for treatment of bacterial Skin infections[28]
Folliculitis	Cloxacillin, dicloxacillin, erythromycin
Furuncles	Cloxacillin, dicloxacillin, erythromycin, nafcillin, methicillin, Cephalexin
Carbuncles	Cloxacillin, dicloxacillin, erythromycin, nafcillin, methicillin, Cephalexin
Impetigo	Erythromycin, penicillin, mupirocin (topical only), cloxacillin, Dicloxacillin, cephalixin
Cellulitis	Dicloxacillin, cephalosporin, nafcillin
Pitted keratolysis	Topical erythromycin solution or whitfield ointment

Impetigo[29,30,31]:

Topical antibiotics, either alone or in combination with systemic antibiotics, serve as the treatment approach for impetigo. This antibiotic treatment effectively reduces the risk of complications arising from primary lesions. Initiating a 5- to 10-

day course of oral antibiotics can expedite the healing process.

In mild cases, a topical antibiotic like 2% fusidic acid cream is applied three times daily for 7–10 days. However, if Methicillin-Resistant Staphylococcus is suspected, 2% mupirocin cream or ointment is used, applied two or three times daily for 5–10 days (with the recommended regimen being twice daily for 5 days). For severe cases, systemic antibiotics such as erythromycin or cephalexin are recommended.

Newer agents like retapamulin ointment, used for 5 days, have gained approval as the first-line treatment for mild impetigo cases that do not involve multiple lesions.

Folliculitis[32,33]:

Mild cases with a few pustules often resolve naturally with proper skin hygiene practices. The preferred treatment involves topical antibiotics. However, for deeper folliculitis like furunculosis and carbunculosis, or when the skin is extensively affected, oral antibiotics such as cephalexin and dicloxacillin can be considered as management options.

Furuncle:

The application of local heat offers relief from discomfort and aids in pinpointing the lesion. Given the deep-seated nature of the infection, systemic antibiotics are necessary, and the recommended treatment duration typically ranges from 1 to 2 weeks [8].

Carbuncle:

The treatment approach for carbuncles parallels that of furuncles. Primary oral antibiotics often include dicloxacillin and cephalosporins. In cases where *Methicillin-Resistant Staphylococcus aureus*(MRSA) is suspected, oral antibiotics like tetracyclines may be considered.

Pitted keratolysis:

Effective antibiotics, including mupirocin ointment or cream and fusidic acid cream, are available treatment options. Oral erythromycin

serves as an alternative choice. Medications like topical erythromycin solution or clindamycin solution are also employed in the treatment of this condition [14].

Acne vulgaris:

Topical therapy:

Topical retinoids are frequently employed as a primary treatment option for mild acne vulgaris, with recommended application once daily, ideally in the night. Alternative treatment options encompass benzoyl peroxide, azelaic acid, and salicylic acid. In instances of moderate to severe acne vulgaris, oral isotretinoin, oral antibiotics, and oral hormonal therapies are typically preferred choices.

Doxycycline, taken at 100mg twice daily, serves a dual purpose as both an antibiotic and an anti-inflammatory agent, effectively managing inflammation. Minocycline capsules offer a once-daily dosing option. In some cases, alternative antibiotics like amoxicillin, erythromycin, and trimethoprim/sulfamethoxazole are considered. If bacterial overgrowth is observed, ciprofloxacin or other antibiotics may be prescribed[34,35].

Syphilis[16]:

The treatment of syphilis with penicillin G proves highly effective for primary, secondary, and latent syphilis lasting less than one year. Typically, 1–3 weekly intramuscular (IM) doses of 2.4 million units of penicillin G benzathine are administered. Secondary infections are managed with systemic antibiotics, primarily through oral or injection routes, as preferred.

CONCLUSION

Pyoderma is a prevalent and diverse group of skin infections encountered in dermatological practice. The study of pyoderma highlights the importance of early diagnosis, appropriate antibiotic choice, and comprehensive management to prevent complications and reduce the disease burden. As this field continues to evolve, ongoing research and advancements in treatment strategies are

essential to improve patient outcomes and address the challenges posed by pyoderma in dermatological practice. Furthermore, it is crucial to address pyoderma not only to improve patient outcomes but also to mitigate the emerging threat of antimicrobial resistance. With the overuse and misuse of antibiotics, especially in the context of treating skin infections like pyoderma, bacteria are increasingly developing resistance to these drugs.

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