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Diagnostic Challenges and Multidisciplinary Management Strategies for Manicure-Induced Subungual Abscess with Acantholytic Changes

Xian Zhang[1], Xianyu Zeng[2]

[1]School of Medicine, Jianghan University, Wuhan, China
[2]Dermatological Department, Wuhan No. 1 Hospital, Wuhan, China
Email: zx15871726803@163.com, whzengxianyu@163.com

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Abstract

Acantholytic changes are a typical manifestation of the loss of intercellular adhesion in the epidermis, often seen in genetic diseases (such as follicular keratosis) or induced by acquired factors such as infections or trauma. This article reports a case of a 27-year-old female patient who presented with redness, swelling, and pain around the left thumb nail, along with a subungual abscess for one month following a manicure. The diagnostic process highlighted the complexity of both clinical and pathological diagnosis. Initial anti-infection treatments were ineffective, and the patient was subsequently treated with surgical debridement and a fasciocutaneous flap transplant. The patient made a good recovery, but histopathology revealed acantholytic cells and disordered keratinization in the epidermis, requiring differentiation from conditions like Darier's disease (follicular keratosis) and secondary changes induced by *Staphylococcus aureus* toxin. This case suggests that: (1) manicure procedures may trigger underlying genetic skin conditions through mechanical injury or chemical irritation; (2) nail fold infections complicated by acantholysis require multidisciplinary collaboration (dermatology, pathology, genetics) and dynamic follow-up data to avoid misdiagnosing rare genetic diseases as other conditions.

Keywords

Acantholysis, Subungual Abscess, Follicular Keratosis, *Staphylococcus aureus*, Multidisciplinary Treatment

1. Introduction

Acantholysis is a hallmark manifestation of epidermal cell adhesion loss, com-

monly observed in genetic disorders (e.g., Darier disease, also known as keratosis follicularis) or acquired factors such as infections and trauma. Its pathological mechanism involves disruption of desmosomal structures and intercellular gap formation, leading to rounded, detached keratinocytes and fluid influx from the dermis, which creates intraepidermal cavities. The etiology of acantholysis varies: Genetic disorders like Darier disease (caused by ATP2A2 gene mutations) are characterized by suprabasal acantholysis combined with dyskeratosis; Infectious conditions (e.g., staphylococcal scalded skin syndrome, SSSS) result from exotoxin-mediated desmosomal degradation; Autoimmune pemphigus involves antibody-driven targeting of desmosomal proteins [1]. In recent years, the incidence of nail art-related complications, such as paronychia and subungual abscesses, has risen significantly. Mechanical trauma or chemical irritants from manicures may unmask latent genetic dermatoses. Darier disease, a rare autosomal dominant disorder, is pathologically defined by acantholytic dyskeratosis [2]. Notably, trauma or infection can activate preexisting adhesion defects in the epidermis, triggering localized manifestations of otherwise subclinical hereditary conditions (e.g., Darier disease or Hailey-Hailey disease). Clinically, this may present as erythema, blisters, or nail bed necrosis, mimicking simple infectious lesions and complicating diagnosis. This article examines a case of subungual abscess with acantholysis following manicure trauma, highlighting diagnostic challenges and multidisciplinary management strategies. The case underscores the necessity of genetic testing (e.g., ATP2A2 screening) and histopathological analysis (distinguishing dyskeratosis from infectious cytolysis) to identify underlying hereditary disorders when acantholysis occurs at trauma sites, thereby avoiding misdiagnosis as isolated bacterial infections. The study aims to enhance clinical recognition of trauma-induced genetic dermatoses and optimize personalized therapeutic approaches.

2. Case Report

The patient was a 27-year-old woman with redness, swelling, and pain for 1 month around the left thumbnail. Prior to the onset of the disease, a manicure operation was performed, and the patient received cefuroxime orally (500 mg bid × 7 days) and topical polymyxin B ointment (topical 3 times daily × 10 days) at an outside hospital, but the redness and swelling were enlarged and phalangeal pain developed. A repeat blood test showed elevated absolute lymphocyte values (3.27×10^9/L), suggesting that the infection was not controlled. At the time of referral to our hospital, the subnail abscess had involved the nail root and was positive for fluctuating sensation on palpation. There was no history of underlying disease or drug allergy.

Dermatological examination revealed a well-defined, red-brown linear erythematous rash approximately 1.5 mm wide along the longitudinal axis of the left thumbnail. A subungual abscess was observed at the nail root, accompanied by swelling and tenderness in the surrounding area. No ulceration or purulent discharge was present (**Figure 1**).

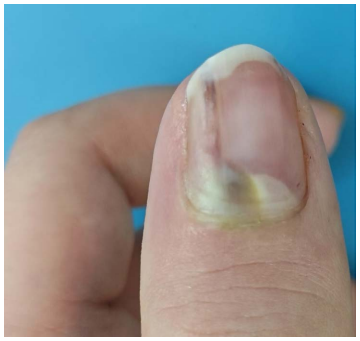


Figure 1. A red-brown linear erythematous rash along the longitudinal axis of the left thumb nail, with a subungual abscess at the nail root.

Laboratory studies were within normal limits, except for an absolute lymphocyte count of 3.27×10^9/L. Coagulation profile, liver and kidney function tests, and electrolyte levels were all normal. Radiographic evaluation of the left thumb revealed no abnormalities in the bone structure. Microbiological analysis of the discharge identified *Staphylococcus aureus*. Histopathological examination demonstrated hyperkeratosis with evidence of old hemorrhage, acantholysis above the basal layer, numerous dyskeratotic cells in the epidermis, and lymphocytic infiltration in the dermis (**Figure 2**). Based on the clinical presentation and diagnostic findings, the case was consistent with a possible diagnosis of follicular keratosis (Darier's disease).

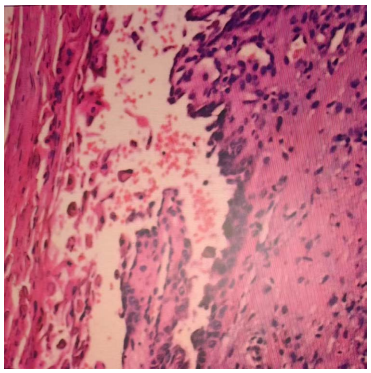
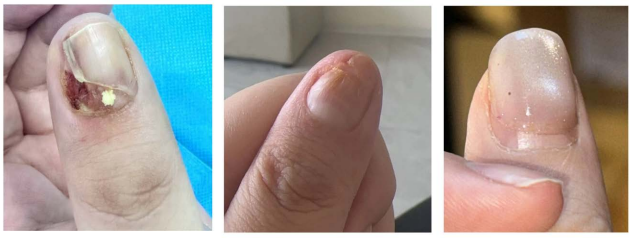


Figure 2. Histopathology: Acantholysis, with dyskeratotic cells observed (HE × 40).

After 10 days of antibiotic therapy, no improvement was observed. Given the risk of osteomyelitis due to the persistent abscess, surgical debridement was performed, followed by a fasciocutaneous flap transplantation [3].

Follow-up evaluations on the day of discharge and at 3 and 4 months postoperatively demonstrated successful healing of the nail bed with no signs of recurrent infection. Complete regeneration of the nail plate was observed, and the longitudinal erythema had resolved (**Figure 3**). The patient did not exhibit any new skin lesions on the trunk or scalp. Annual follow-up appointments have been scheduled to monitor for potential hereditary lesions.



(a) (b) (c)

Figure 3. (a) On the day of discharge; (b) Postoperative nail bed healing at 4 months; (c) Postoperative nail bed healing at 3 months.

3. Discussion

Darier's disease (Darier-White disease) is a rare autosomal dominant genetic skin disorder caused by mutations in the ATP2A2 gene, leading to abnormal adhesion between keratinocytes and keratinization defects. According to Yeshurun *et al.*, the global prevalence of this disease is approximately 1 in 55,000 [4]. Its typical pathological features include acantholytic hyperkeratosis [5], which closely matches the histopathological findings of the patient in this case. However, it must be differentiated from other genetic diseases such as familial benign chronic pemphigus (Hailey-Hailey disease) and transient acantholytic dermatosis (Grover's disease) [6]. Hailey-Hailey disease typically manifests as flaccid blisters in friction-prone areas (e.g., axillae, groin), with histopathology demonstrating "dilapidated brick wall" pattern acantholysis. In this case, the localized lesions without blister formation exclude this diagnosis [7]. Grover disease (transient acantholytic dermatosis) is generally self-limited, unrelated to trauma, and histopathologically lacks dyskeratotic cells [8], rendering it inconsistent with the present findings (**Table 1**).

Table 1. Differential diagnosis of acantholytic disorders.

Differential Diagnosis	Supporting Evidence	Contradictions
Darier's disease	Acantholysis; longitudinal erythema	No family history; absence of systemic lesions
Hailey-Hailey disease	Acantholysis	Localized lesions, non-frictional sites
Grover disease	Acquired acantholysis	Self-limiting; no dyskeratosis

Although Darier's disease primarily manifests as verrucous papules in seborrheic areas such as the trunk and scalp, nail involvement is one of its significant clinical signs. Yeshurun *et al.* reported that 93% of Darier's disease patients have nail changes, including red-white longitudinal striations (82%), V-shaped defects (61%), and subungual hyperkeratosis (56%) [9]. The red-brown linear erythematous rash observed in the left thumb nail of this patient is consistent with the nail changes seen in Darier's disease, warranting a high degree of suspicion for the

condition.

However, manicures may cause mechanical damage to the nail matrix, resulting in lesions similar to longitudinal hemorrhage or fissures (*i.e.*, traumatic onychodystrophy), which complicates the differential diagnosis. This patient exhibited characteristics that do not align with typical Darier's disease: (1) No family history: Approximately 70% of Darier's disease patients have a positive family history [9], but this patient had no relevant family history; (2) No systemic skin lesions: There were no verrucous papules or seborrheic crusts found on the trunk, scalp, or other areas; (3) Localized lesions: The lesions were limited to the nail fold on one side, without multiple nail abnormalities. Localized Darier's disease, a rare subtype, may present as isolated nail or mucosal lesions, often misdiagnosed as infection or trauma-induced [8].

Although the patient lacks typical family history and systemic skin lesions, the pathology revealing acantholytic hyperkeratosis necessitates exclusion of Darier disease through ATP2A2 gene sequencing. As the patient declined genetic testing, we plan to dynamically monitor the progression of skin lesions during follow-up. The diagnosis could be confirmed if verrucous papules develop on the trunk or if ATP2A2 mutations are detected [9]. Notably, patients with Darier disease are prone to bacterial or viral infections due to epidermal barrier defects [7]. In this case, the patient had a clear history of manicures prior to onset (mechanical trauma potentially activating latent genetic defects), and Staphylococcus aureus was cultured from secretions, suggesting possible coexistence of secondary infection with genetic predisposition. Therefore, in clinical cases of periungual infection following trauma accompanied by acantholysis, genetic testing should be prioritized to confirm the diagnosis, and clinicians should remain vigilant regarding the possibility of trauma-induced hereditary dermatoses.

When pathology and clinical manifestations are inconsistent, it is recommended to follow up with the patient over the long term to observe the development of typical Darier's disease skin lesions (e.g., seborrheic keratotic papules on the trunk). If necessary, genetic testing (ATP2A2 mutation screening) can be performed to confirm the diagnosis [10].

In this case, the subungual abscess complicated by acantholysis suggests that Darier's disease cannot be entirely excluded, despite the lack of typical systemic symptoms. Therefore, careful differentiation between infection and genetic skin diseases is required. Although a definitive diagnosis of Darier's disease could not be made, the subungual abscess and bone pain indicated deep infection. Surgical debridement and flap transplant helped avoid the risk of osteomyelitis, restored nail bed function, and reduced the risk of deformity. The patient is still under follow-up care.

In this case, the manicure procedure acted as an initiating factor, where gel nail removal and nail plate polishing may have disrupted the nail fold barrier, triggering local keratinization abnormalities. Chemical solvents (such as acetone) may have further exacerbated epidermal separation. This highlights the potential risk

of manicures triggering nail lesions in Darier's disease. Therefore, when encountering "treatment-resistant subungual infections" in clinical practice, the possibility of an underlying keratinization disorder should be considered. Pathological biopsy combined with genetic testing can help prevent misdiagnosis.

This case underscores the need for clinicians to pay attention to the interaction between trauma, infection, and underlying genetic defects in diagnosis and treatment. Multidisciplinary collaboration (including dermatology, pathology, genetics, etc.) and dynamic follow-up are essential for accurate diagnosis and treatment, ultimately improving patient outcomes and quality of life.

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Authors' contributions: X. Z. and X. Y. Z. designed the case report and drafted the manuscript. X. Y. Z. helped to modify the manuscript. All authors read and approved the final manuscript.

Informed consent: The patient's written consent has been signed/obtained.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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