Erosive pustular dermatosis of the scalp: A neutrophilic folliculitis within the spectrum of neutrophilic dermatoses

A clinicopathologic study of 30 cases

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Background: It is general opinion that histopathology is nonspecific and of little value in diagnosing erosive pustular dermatosis of the scalp (EPDS).

Objectives: Clinicopathologic correlation of erosive pustular dermatosis of the scalp.

Methods: We reviewed the clinical and pathologic records of patients with a clinicopathologic diagnosis of EPDS between 2011 and 2016 at the Dermatopathology Unit of Turin University.

Results: Thirty elderly patients with EPDS were identified (22 men and 8 women). Androgenetic alopecia was present in 19 of 30 patients. Triggering factors included mechanical trauma in 10 of 30 cases, surgical procedures in 4 of 30 cases, and herpes zoster in 1 of 30 cases. Three patients were affected by autoimmune disorders. The vertex was the most common location. Disease presentation varied markedly from tiny, erosive, scaly lesions to crusted and hemorrhagic plaques, mimicking pustular pyoderma gangrenosum. The pathologic changes differed according to lesion type and disease duration. Interestingly, a spongiotic and suppurative infundibulo-folliculitis was observed in 8 of 30 cases.

Limitations: This was a retrospective study.

Conclusions: We believe that the primary lesion of erosive pustular dermatosis of the scalp is a spongiotic, pustular superficial folliculitis. The clinicopathologic similarities with other neutrophilic dermatoses, such as pustular pyoderma gangrenosum, suggest this condition should be included in this spectrum, where pathergy plays a pathogenetic role. (J Am Acad Dermatol 2019;81:527-33.)

Key words: erosive pustular dermatosis; histology; neutrophilic dermatoses; pathergy; pustular spongiotic infundibular folliculitis; pyoderma gangrenosum; scalp.

Erosive pustular dermatosis of the scalp (EPDS) is an uncommon, pustular, idiopathic disorder that was first described in 1979 by Burton and Pye.[1] Since its initial description, about 100 cases have been reported in literature to date.[2,3] However, it remains to be clarified whether the disease is truly rare or simply underdiagnosed. This disorder typically occurs on the scalp of the elderly, mostly in women. It presents with variably thickened grey or yellow-brownish crusts, covering ≥1 shallow, inflamed erosion(s), with scanty, barely detectable, small pustules.

Although historically referred to as scalp of the elderly, this dermatosis may occasionally occur in

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younger individuals[4] or even children[5] and may affect other skin sites, including the face[3,6] and the extremities.[4] The disease has a chronic and progressive course without spontaneous remission and may involve large scalp regions, ultimately leading to scarring alopecia. Cultures are usually negative; when isolated, microorganisms are a secondary colonization, rather than a primary infection.[7] Its frequent association with local physical injuries, mostly accidental mechanical trauma, on atrophic and sun-damaged skin, suggest a tissue damage–induced immunologic response or immune dysregulation, with the production of a chronic inflammatory reaction.[5,8-10]

Obtaining a skin biopsy specimen is considered to be of little value for the diagnosis of EPDS. The most commonly reported histopathologic features include "atrophy or thickening of the epidermis," "scale crusts," "chronic unspecific inflammation," "plasma cells," "dermal fibrosis," and, occasionally, "spongiform pustules."[11-13] A reduced number of hair follicles, sometimes with evidence of fibrosis or scarring alopecia, may be observed in later stages of the disease.[12,13] There are no specific laboratory tests or microbiologic or pathologic studies, and therefore a diagnosis of EPDS requires close clinicopathologic correlation and the exclusion of other similar conditions presenting on the scalp.

The aim of this study was to delineate the clinicopathologic spectrum of the disease through a review of the clinical and histopathologic features of 30 patients with EPDS. Interestingly, histopathologic changes of follicular-based pustular lesions revealed a spongiotic and suppurative superficial folliculitis, suggesting that in hair-bearing scalp, the primary EPDS lesion is a sterile, vesiculopustular folliculitis. To the best of our knowledge, this is the first study documenting the primary lesions involved in EPDS.

CAPSULE SUMMARY

- Histopathology of primary lesion of erosive pustular dermatosis of the scalp has not been characterized.
- Biopsy specimens of intact follicular pustules reveal spongiotic vesiculopustules affecting the follicular infundibula. Erosive pustular dermatosis of the scalp is a neutrophilic superficial folliculitis, with some clinicopathologic similarities with other pathergic neutrophilic dermatoses, such as pyoderma gangrenosum.

MATERIALS AND METHODS

A retrospective study using material from the files of the Dermatopathology Unit of the University of Turin (Italy) was carried out for patients who had been given a diagnosis of EPDS between 2011 and 2016. The histopathologic specimens were collected from a total of 56,000 skin biopsy specimens, and 30 cases were retrieved and examined. The specimens were sectioned vertically, and 4 to 6 sections from the vertical blocks were prepared for each patient, according to the protocol adopted by our laboratory when a single biopsy specimen is obtained. Even though the combination of transverse and vertical sections may increase the diagnostic yield in alopecia, vertical sections provide more diagnostic information in alopecia of suspected cicatricial origin because the entire skin depth, and thus some epidermal findings, papillary dermis, and subcutaneous fat can be evaluated more accurately.[14]

The entire skin depth, and thus some epidermal findings, including hyperkeratosis and other changes at the dermoepidermal junction, papillary dermis, and subcutaneous tissue, can be evaluated more accurately.

The diagnosis of EPDS was based on close clinicopathologic correlation in all cases. Criteria for the EPDS diagnosis were as follows: a clinical association of erosions, pustules, scales, and crusts on the scalp, negative microbiologic studies, and histopathologic exclusion of any other inflammatory skin disorder. Data as to gender, age at diagnosis, duration of the disease before diagnosis, topography, triggering factors, associated local and systemic diseases, treatment, and outcome, were obtained from the patients' clinical notes. Clinical images were available for observation in all cases. Periodic acid–Schiff, Ziehl–Neelsen, Gram, and Giemsa histochemical stains had been performed, along with bacterial and fungal tissue cultures, in all cases. Direct immunofluorescence study had also been performed in 3 cases. All patients had a monthly follow-up until symptom remission, followed by visits every 3 months. No institutional review board or human participant approval was required because this was a retrospective study.

RESULTS

Clinical data

Briefly, a total of 30 patients were enrolled—22 men ranging from 63 to 89 years of age (average age, 76 years) and 8 women ranging from 69 to 90 years of age (average age, 81 years)—with a 2.75:1 male to female ratio. All patients were in good health for their age with negative HIV serology. Disease duration

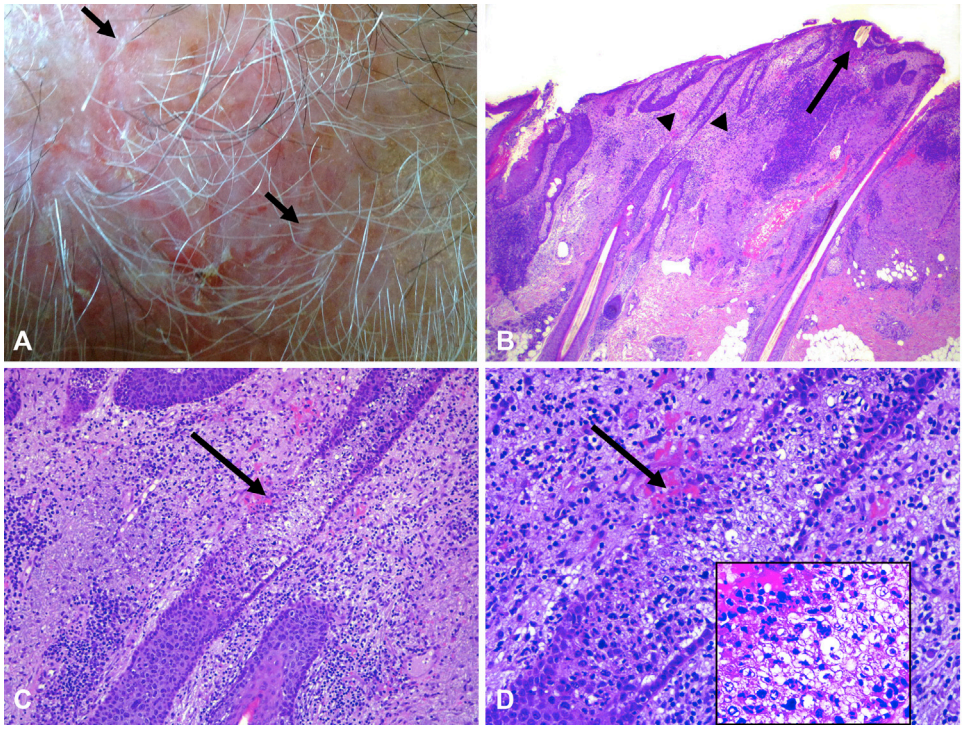

Fig 1. Erosive pustular dermatosis of the scalp **A**, Follicular pustules (arrows) and erosions on an atrophic scalp with androgenetic alopecia. **B**, Biopsy specimen obtained from a follicular pustule reveals eroded epidermis and dense perifollicular inflammatory infiltrate. Note the convergence of adjacent follicular infundibula (dotted arrows), with 2 hairs emerging from a single follicular opening (arrow). **C**, Neutrophilic microabscess within a partially destroyed follicular infundibulum (arrow). **D**, Marked intrafollicular spongiosis (arrow) with a high influx of neutrophils and extravasated erythrocytes (inset).

before diagnosis ranged from 3 to 36 months (average, 15 months). The lesions were either concentrated in 1 area (19/30) or involved multiple sites (11/30). The vertex was the most commonly affected site.

The disease varied in severity from mild forms, with localized, tiny, slightly erosive, crusting lesions to diffuse, thick, crusted, hemorrhagic plaques. Follicular-based pustules were observed in 8 patients with mild to moderate androgenetic alopecia hair loss (Fig 1, *A*).

Variable scarring alopecia was evident in all patients and was positively correlated with disease duration. Subjective symptoms, such as slight burning or itching, were reported in only a few patients. The most common clinical diagnosis was squamous cell carcinoma (SCC) (13 cases). Other diagnoses included basal cell carcinoma (3 cases), actinic keratosis (5 cases), autoimmune bullous disease (3 cases), and Langerhans cell histiocytosis (1 case), while 2 patients had not been given any prebiopsy clinical consideration. Only 3 patients had been given a clinical diagnosis of EPDS.

Predisposing/triggering factors included: severe androgenetic alopecia in 19 patients (15 men, 4 women), and 17 of 19 patients had severe clinical signs of actinic damage. A history of accidental mechanical trauma was reported in 10 patients, while 4 had had scalp surgery for nonmelanoma skin cancer. One patient developed EPDS 1 year after scalp herpes zoster. The local associated conditions were actinic keratoses (6 cases), basal cell carcinoma (2 cases), SCC (1 case), and chronic discoid lupus erythematosus (1 case). The mean time lapse between the triggering event and the onset of the dermatosis was about 22 months, except for 1 patient (case 3), who reported having had mechanical trauma 18 years before the onset of EPDS. One patient was affected by autoimmune hypothyroidism, 1 by collagenous colitis, and 1 by undifferentiated collagen vascular disease. No patient had a history of pathergy.

The topical application of high-potency steroid (clobetasol propionate 0.05% ointment) was initially prescribed. It was applied overnight in all patients, with a marked improvement after 4 weeks in most

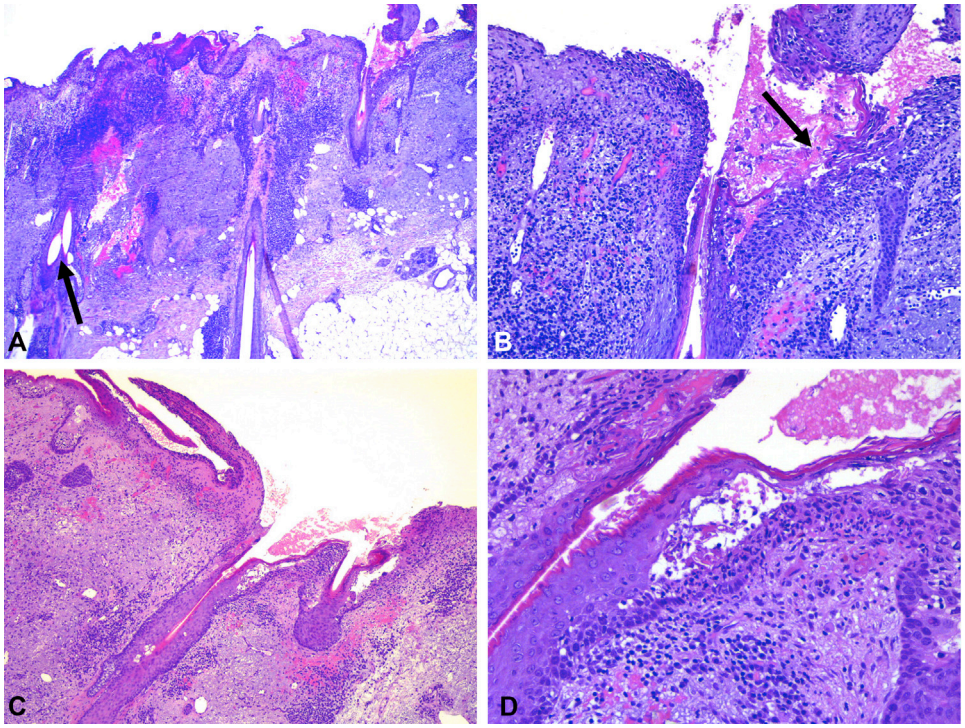

Fig 2. Erosive pustular dermatosis of the scalp. **A**, Diffuse epidermal erosion with underlying suppurative infundibulo-folliculitis. Two follicles converge toward a common opening (arrow). **B**, Involvement of the follicular opening by spongiform pustules with erosion formation (arrow). **C**, Atrophic and eroded follicular opening. The superficial dermis is edematous with hemorrhage and perifollicular infiltrate. **D**, Subcorneal infrafollicular vesicle containing many neutrophils and erythrocytes. Direct immunofluorescence study did not reveal intercellular immunoglobulin deposits.

cases. Therefore, the treatment was tapered to twice weekly applications for 3 months, after which it was suspended. Low-dose systemic prednisone (0.5 mg/kg/day) was administered for 2 weeks, with gradual tapering, in 3 patients who were not responsive to topical steroids. Sun protection and avoidance of physical trauma were encouraged in all patients. Relapses occurred in all cases after treatment withdrawal. Therefore, the therapy was started again and, at an average follow-up of 3 years, most patients showed good disease control with twice weekly clobetasol propionate 0.05% ointment applications as maintenance therapy.

Histopathology

Thirty cases of EPDS were identified from a total of 56,000 skin biopsy specimens over a 5-year period, accounting for about 0.05 % of the total and 1.2% of all scalp biopsy specimens. A 5- to 6-mm punch biopsy specimen had been obtained in all but 1 case, where SCC had been suspected. Therefore, a large scalpel excision was performed. The pathologic changes differed according to the type of lesion from which the specimen was obtained (pustule, crust, erosion, granulation tissue, or scarring alopecia) and the severity of androgenetic alopecia.

Briefly, in 22 of 30 cases the changes were nonspecific and included atrophic, eroded or thickened epidermis, and overlying scale crust. Epidermal hyperplasia was mostly irregular with loss of rete ridge pattern, hypergranulosis, and hyperkeratosis. Neutrophilic spongiosis, focally forming small spongiform pustules, were observed in the spinous zone of the epidermis and in the follicular openings of miniaturized hair follicles, when still present (4 cases). Eroded areas mostly showed subepidermal fibrin deposition, while necrosis of the superficial epidermis was absent in all but 1 case. Dermal changes included granulation tissue with suppuration and hemorrhage, variable fibrosis and hair loss, and mixed inflammatory infiltrate of lymphocytes, neutrophils, and plasma cells. Occasionally, hair shaft remnants, surrounded by granulomatous infiltrate, were observed. These cases were mostly from scalp biopsy specimens of patients with severe androgenetic alopecia or total baldness.

Interestingly, in patients with a hair-bearing scalp, pathology identified 8 cases with a dense infiltrate of neutrophils and lymphocytes around and within the infundibula of multiple, adjacent terminal hair follicles in concert with prominent infundibular spongiosis and focal or total disruption of the follicle wall. Spongiform pustules were also evident on the top of some follicular orifices (Figs 1, *B* and 2, *A*). One case had confluence of follicular spongiform pustules within the epidermis, which formed a large intraepidermal blister filled with neutrophils, together with hints of vasculitis. The merging of ≥2 hair shafts into 1 infundibulum was observed in 6 of 8 patients (Figs 1, *B* and 2, *A*). The interstitial dermal infiltrate contained mainly neutrophils admixed with many lymphocytes, macrophages, plasma cells, and rare eosinophils. The lower portions of the hair follicles were unaffected.

In 1 case, histopathologic specimens obtained from an excisional biopsy produced various changes throughout the different tissue inclusions, ranging from spongiform pustules within follicular ostia in the hyperplastic epidermis at the periphery of the crusted lesion, to spongiform pustule formation within buds of regenerating follicles and epidermis on the surface of granulation tissue.

Additional features were evaluated in our series. Sebaceous glands were atrophic in 7, normal in 1, and not evaluable in the remaining patients. As to the hair cycle, 7 patients were in catagen, 4 in anagen, and it was not possible to evaluate the hair cycle in the remaining patients. Scarring fibrous tracts were identified in 14 patients and fibrous streamers maintaining vascularity in 2 patients. Actinic degeneration was observed in 22 of 30 patients, and subepidermal clefting was observed in 10 of 30 patients.

No microorganisms were identified by periodic acid–Schiff, Ziehl–Neelsen, Gram, and Giemsa histochemical staining in any case. Direct immunofluorescence study had been performed in 3 patients, and all were negative.

DISCUSSION

EPDS is often neglected by standard dermatology and dermatopathology textbooks. However, recent interest in this entity[15] and an increase in reporting it have raised the likelihood that EPDS is more common than was previously imagined, even though its incidence remains unknown.[2,3,12] Our series of 30 cases was collected from a total of 56,000 skin biopsy specimens within a 5-year period, accounting for about 1.2% of the total scalp biopsy specimens. In a hair and scalp pathology referral center, the calculated incidence of EPDS over 7 years of observation was 0.59%.[16] These data suggest that the real prevalence of this entity is higher than previously estimated. Indeed, diagnosis of EPDS requires a high index of clinical and pathologic suspicion and a careful clinicopathologic correlation. In fact, EPDS had previously been clinically suspected in only a few patients in our series (3/30), and the final diagnosis was reached after careful exclusion of other dermatoses based on histology examination, direct immunofluorescence study, and microbiologic analyses.

The results of our study partly confirm and further expand previous observations on EPDS. The dermatosis affected patients mostly in their eighth decade of life, with chronic actinic damage and androgenetic alopecia. Conversely to the published literature, which reports a female predominance,[1,4,11,12,17] ours was male. The clinical picture in our case series varied markedly amongst all patients, ranging from mild or localized scalp involvement, resembling actinic keratoses or SCC, to severe and diffuse scalp involvement, with thick, yellow-brownish or hemorrhagic crusting, erosions, and pustulation, resembling an infectious process or pyoderma gangrenosum (PG). The pustules were barely detectable in milder cases.

The dermatosis had developed over several months or even years and had run a chronic course with alternating spontaneous remission and reactivation. A history of local trauma was reported in about 50% of cases, confirming that tissue damage plays a triggering role in EPDS pathogenesis. The presence of androgenetic alopecia, observed in 19 patients (63%) in our series, may also have a concausal role. Although some studies have reported an association between EPDS and autoimmune diseases,[4,12,18,19] only 3 of our patients had such an association, suggesting that a direct pathogenetic link is questionable.

EPDS seems to be a distinct clinicopathologic entity. However, its histopathologic findings are given little relevance in the literature, where most of the authors purely state that microscopic findings are nonspecific.[11-13] Moreover, even though alopecia is a common clinical feature of EPDS, histopathologic involvement of follicles is rarely mentioned in reports. Although Pye et al[1] initially highlighted destruction of hair follicles, it remains to be elucidated whether pustular lesions in EPDS are follicular, epidermal, or both. Moreover, no clear underlying erosion mechanism has yet been defined.

In the present study of 30 patients, we investigated any close clinicopathologic correlation for EPDS lesions. Biopsy specimens that had been taken from the erosive, crusted, or cicatricial lesions

showed a varying combination of recurring, seemingly unspecific changes, in line with previous observations. It is noteworthy that these findings were mostly from patients with severe androgenetic alopecia or complete baldness. Conversely, in patients where biopsy specimens has been obtained from pustular lesions on a hair-bearing scalp, histopathology revealed a spongiform, pustular infundibular folliculitis.

The skin is an immunologic organ with a barrier function, and any disruption of its integrity leads to a cascade of events that attempt to eliminate invading pathogens, damage repair, and restorefhomeostasis.[20] It may be speculated that, in EPDS, any type of local trauma, either alone or in combination with predisposing factors, like skin atrophy caused by chronic sun damage or androgenetic alopecia, might have impaired skin wound healing mechanisms. This may have led to a local immunologic dysregulation and abnormal neutrophil chemotaxis or chemoattractants and cytokine production against epidermal or follicular antigens. Patients with EPDS, in contrast to the self-limited inflammation associated to disrupted skin, might experience persistent cellular influxes into a previously injured scalp, with continuous formation of infundibular vesicopustules, quickly turning into erosions and crusting, even if the triggering factor took place much earlier.[21] The response to topical and systemic steroids and dapsone further supports a local neutrophilic dysregulation.[1,3,9,21]

EPDS is mainly a clinical diagnosis made after ruling out other conditions by histologic examination and microbial cultures.[3] The most common differential diagnosis is SCC. However, depending on the clinical presentation, the differential diagnosis includes mainly kerion, folliculitis decalvans, pemphigus, cicatricial pemphigoid, impetiginized eczema, pustular psoriasis, dermatitis artifacta, and pustular PG.

Interestingly, pustular PG is a rare variant of PG, frequently associated with inflammatory bowel disease and characterized by multiple, small, sterile, sometimes folliculocentric pustules on an erythematous base, most frequently involving the extremities and the upper trunk and, occasionally, the scalp.[22-27] In pustular PG, lesions do not usually develop into frank ulcerations and may regress without scarring. Similarly to PG, patients with EPDS have generally had an inciting event, such as a trauma, suggesting that a pathergic-like phenomenon may be operative[28] and the erosions may start as follicular vesiculopustules with rapid growth,[29] leading to epidermal erosions and crusting. Histopathologically, a folliculo-centered neutrophilic infiltrate with infundibular pustules may be observed in both diseases (personal observation).[26,27,30,31]

In conclusion, EPDS is a rare condition that may be easily misdiagnosed as SCC, resulting in unnecessary surgery, making an early diagnosis crucial. The diagnosis largely depends on the recognition of the evolving clinical features with histopathologic support. Microscopic changes vary according to lesion type, evolution stage, biopsy site, and severity of baldness. If biopsy specimens are obtained from scarring or eroded and crusted balding scalp areas, the histopathologic changes will consequently correlate with these clinical aspects. Conversely, if biopsy specimens are obtained from intact follicular pustules from hair-bearing scalps, the pathology results will most likely show a spongiotic and pustular superficial folliculitis.

On the basis of our study and previous observations, we believe that EPDS is basically a neutrophilic-mediated skin disorder, where pustules may be infundibular, surface epidermal, or both, most likely depending on the severity of the baldness and the presence of terminal hairs. Therefore, we propose that EPDS be included in the spectrum of neutrophilic dermatoses, a group of autoinflammatory skin disorders with frequent overlapping clinicopathologic features and possible association with some peculiar systemic diseases. The frequent development of EPDS after trauma further supports a pathogenetic link of the condition to other neutrophilic dermatoses where pathergy may play a role, such as PG.[32] Additional studies are warranted to clarify the underlying pathogenetic mechanism of EPDS.

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REFERENCES

1. Pye RJ, Peachey RD, Burton JL. Erosive pustular dermatosis of the scalp. *Br J Dermatol*. 1979;100:559-566.
2. Broussard KC, Berger TG, Rosenblum M, et al. Erosive pustular dermatosis of the scalp: a review with a focus on dapsone therapy. *J Am Acad Dermatol*. 2011;66:680-686.
3. Van Exel CE, English JC. Erosive pustular dermatosis of the scalp and nonscalp. *J Am Acad Dermatol*. 2007;57(2 suppl):S11-S14.
4. Patton D, Lynch PJ, Fung MA, et al. Chronic atrophic erosive dermatosis of the scalp and extremities: a recharacterization of erosive pustular dermatosis. *J Am Acad Dermatol*. 2007;57:421-427.
5. Siegel DH, Holland K, Phillips RJ, et al. Erosive pustular dermatosis of the scalp after perinatal scalp injury. *Pediatr Dermatol*. 2006;23:533-536.
6. Mervak JE, Gan SD, Smith EH, et al. Facial erosive pustular dermatosis after cosmetic resurfacing. *JAMA Dermatol*. 2017;153:1021-1025.
7. Caputo R, Veraldi S. Erosive pustular dermatosis of the scalp. *J Am Acad Dermatol*. 1993;28:96-98.
8. Grattan CE. Erosive pustular dermatosis of the scalp following zoster ophthalmicus. *J R Coll Gen Pract*. 1988;38:470-471.

9. Ena P, Lissia M, Doneddu GM, et al. Erosive pustular dermatosis of the scalp in skin grafts: report of three cases. *Dermatology*. 1977;194:80-84.
10. Grattan CE, Peachey RD, Boon A. Evidence for a role of local trauma in the pathogenesis of erosive pustular dermatosis of the scalp. *Clin Exp Dermatol*. 1988;13:7-10.
11. Semkova K, Tchernev G, Wollina U. Erosive pustular dermatosis (chronic atrophic dermatosis of the scalp and extremities). *Clin Cosmet Investig Dermatol*. 2013;6:177-182.
12. Starace M, Loi C, Bruni F, et al. Erosive pustular dermatosis of the scalp: clinical, trichoscopic, and histopathologic features of 20 cases. *J Am Acad Dermatol*. 2017;76:1109-1114.e2.
13. Allevato M, Clerc C, del Sel JM, et al. Erosive pustular dermatosis of the scalp. *Int J Dermatol*. 2010;48:1213-1216.
14. Özcan D, Özen Ö, Seçkin D. Vertical vs. transverse sections of scalp biopsy specimens: a pilot study on the comparison of the diagnostic value of two techniques in alopecia. *Clin Exp Dermatol*. 2011;36:855-863.
15. Parsons AC, Hurt MA, Sperling LC, et al. Erosive pustular dermatosis. In: Parsons AC, Hurt MA, Sperling LC, et al., eds. *An Atlas of Hair Pathology with Clinical Correlations*. 2nd ed. New York & London: Informa Healthcare; 2012:171-173.
16. Stan TR, Starace M, Bruni F, et al. Erosive pustular dermatitis of the scalp: case series. *Clin Dermatol*. 2014;2:59-63.
17. López V, López I, Ramos V, et al. Erosive pustular dermatosis of the scalp after photodynamic therapy. *Dermatol Online J*. 2012;18:13.
18. Yamamoto T, Furuse Y. Erosive pustular dermatosis of the scalp in association with rheumatoid arthritis. *Int J Dermatol*. 1995;34:148.
19. Watanabe S, Takizawa K, Hashimoto N, et al. Pustular dermatosis of the scalp associated with autoimmune diseases. *J Dermatol*. 1989;16:383-387.
20. Melikoglu M, Uysal S, Krueger JG, et al. Characterization of the divergent wound-healing responses occurring in the pathergy reaction and normal healthy volunteers. *J Immunol*. 2006;177:6415-6421.
21. Guarneri C, Vaccaro M. Erosive pustular dermatosis of the scalp following topical methylaminolaevulinate photodynamic therapy. *J Am Acad Dermatol*. 2009;60:521-522.
22. Ruocco E, Sangiuliano S, Gravina AG, et al. Pyoderma gangrenosum: an updated review. *J Eur Acad Dermatol Venereol*. 2009;23:1008-1017.
23. Kikuchi N, Hanami Y, Ohtsuka M, et al. Pustular pyoderma gangrenosum: report of two cases. *J Dermatol*. 2015;42:542-543.
24. Leger M, Newlove T, Chu J, et al. Pustular pyoderma gangrenosum. *Dermatol Online J*. 2011;17:17.
25. Chia MW, Teo L, Tay YK, et al. Pustular pyoderma gangrenosum: an uncommon variant which is easily misdiagnosed. *Dermatol Online J*. 2008;14:21.
26. Barnes L, Lucky AW, Bucuvalas JC, et al. Pustular pyoderma gangrenosum associated with ulcerative colitis in childhood. Report of two cases and review of the literature. *J Am Acad Dermatol*. 1986;15:608-614.
27. Callen JP, Woo TY. Vesiculopustular eruption in a patient with ulcerative colitis. Pyoderma gangrenosum. *Arch Dermatol*. 1985;121:399-402.
28. Bhat RM. Pyoderma gangrenosum: an update. *Indian Dermatol Online J*. 2012;3:7-13.
29. Wollina U. Pyoderma gangrenosum - a review. *Orphanet J Rare Dis*. 2007;2:19.
30. O'Loughlin S, Perry HO. A diffuse pustular eruption associated with ulcerative colitis. *Arch Dermatol*. 1978;114:1061-1064.
31. Marsden JR, Millard LG. Pyoderma gangrenosum, subcorneal pustular dermatosis and IgA paraproteinaemia. *Br J Dermatol*. 1986;114:125-129.
32. Marzano AV, Borghi A, Wallach D, et al. A comprehensive review of neutrophilic diseases. *Clin Rev Allergy Immunol*. 2018;54:114-130.