SAS Journal of Surgery
Abbreviated Key Title: SAS J Surg
ISSN 2454-5104
Journal homepage: https://www.saspublishers.com

OPEN ACCESS

Medicine

Epidemiological, Clinical and Therapeutic Features of Bacterial Dermohypodermatitis and Necrotizing Fasciitis in a Municipality of Northern Benin

Hodonou M. Adrien[1*], Tamou Sambo Bio[1], Hessou G. Auréole[1], Tobomè S. Romaric[2], Hessou K. Thierry[3], Tougbeto C. Dieu-Donné[1], Hinvo Simplice[1], Boukari K. Allassan[3], Allode S. Alexandre[1]

[1]Regional Teaching Hospital of Borgou Alibori (CHUD-B/A), Faculty of Medicine, University of Parakou, Parakou, Benin
[2]Resident of General Surgery, School of Health Sciences Lome, University of Lome, Lome, Togo
[3]Regional Hospital of Atacora, Natitingou, Benin

DOI: 10.36347/sasjs.2023.v09i01.006 | **Received:** 10.12.2022 | **Accepted:** 21.01.2023 | **Published:** 26.01.2023

***Corresponding author:** Hodonou M. Adrien
Regional Teaching Hospital of Borgou Alibori (CHUD-B/A), Faculty of Medicine, University of Parakou, Parakou, Benin

Abstract **Original Research Article**

Background: Dermohypodermatitis is an infectious skin disease affecting dermis and hypodermis, often caused by bacteria. In Benin, these infections are frequent in the northern region, especially in Atacora municipality. ***Objective***: The current study aims to investigate through a multicenter data collection, the epidemiological, clinical and therapeutic features of bacterial dermohypodermatitis and necrotizing fasciitis in Atacora prefecturemunicipality in Benin. ***Method:*** This was a prospective cross-sectional study with descriptive and analytical purposes carried out from February to July 2021 (six months) in the general surgery services of three hospitals in Atacora municipality. Patients were at least 15 years old and diagnosed for non-necrotizing dermohypodermatitis, necrotizing dermohypodermatitis or necrotizing fasciitis. ***Results:*** A total of 48 cases of dermohypodermatitis were recorded throughout the study period. The mean age of the patients was 36 ± 13 years. The sex-ratio (male-out of-female) was 1.4. Farmers accounted for 43.75% of the cases. The median time from the symptoms onset to patient admission into a health care center was 14 days. A disease entry was found in 81.25% of cases, dominated by neglected traumatic wounds (72.92%). The pelvic limb was the most affected (89.58%). Necrotizing forms predominated in two-thirds of the cases (66.67%). The mean LRINEC score was 6 ± 1.08. The common bacteria isolated after swabbing were: *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Peptostreptococcus anaerobius*, *Streptococcus pyogenes*, *Proteus mirabilis* and *Escherichia coli*. Surgical excision of necrotic tissue was performed in 68.75% of patients with a necrotizing form and 40.62% of them have undergone a thin skin grafting afterwards. The hospital stay averaged 36 days [minimum and maximum, 4 and 139 days, respectively]. Mortality rate was 4.17% and sequelae, 9.76%. NSAIDs use (p=0.000), traditional treatment prior to admission into a health care center (p=0.01), ethylism or smoking (p=0.04; p=0.03, respectively), delay at medical attention seeking (p=0.03), and a LRINEC score ≥ 6 (p=0.000) were statistically related to necrotizing forms of dermohypodermitis. ***Conclusion:*** This study confirms the frequency of dermohypodermatitis in Northern Benin in general and especially, in Atacora municipality.

Keywords: Dermohypodermatitis, Necrotizing Fasciitis, Atacora, Benin.

INTRODUCTION

Dermohypodermatitis is an infectious skin disease affecting dermis and hypodermis which bacterial etiology is dominated by β-hemolytic streptococci, especially group A [1]. Two clinical forms are described in the literature [2, 3].

Erysipelas (red skin), which represents the most common form of non-necrotizing bacterial dermohypodermatitis (NNBDH), is a sporadic community-acquired disease with an estimated incidence of 10 to 100 cases per 100,000 inhabitants per year in France [1]. It is clinically characterized by the presence of an inflammatory, erythematous and painful plaque-like lesion occurring in a pyretic context without cutaneous necrosis. It requires medical management with high recurrence.

Necrotizing forms were clinically characterized by the presence of cutaneous necrosis extending beyond the hypodermis and, depending on

the clinical form, may involve superficial fascia, resulting in necrotizing fasciitis (NF), all evolving in a context of sepsis or septic shock. These are serious skin infections which incidence is not accurately known. They are fatal in up to 30% of cases and require urgent medical and surgical management with an increasing risk of death [1, 4].

Some risk factors have been described as being associated with the occurrence and worsening of bacterial dermohypodermatitis (BDH) in the Western literature [5-7]. In Africa, literature highlighted the role of voluntary cosmetic skin lightening [8-10], self-medication with non-steroidal anti-inflammatory drugs (NSAIDs) and traditional treatment of traumatic wounds in the case of severe dermohypodermatitis forms [8, 11-13].

In Benin, these infections are frequent, especially in the northern region, and necrotizing forms predominate, but data on the epidemiological and clinical features lack in the literature.

The current study aims to investigate through a multicenter data collection the epidemiological, clinical and therapeutic features of bacterial dermohypodermatitis and necrotizing fasciitis in Atacora municipality in Benin.

METHOD

This was a prospective cross-sectional study with descriptive and analytical purposes carried out from February to July 2021 (six months) in the general surgery services of three hospitals in Atacora municipality at the northwest of Benin and with Togo and Burkina Faso as bordering countries.

Patients were at least 15 years old. Dermohypodermatitis was diagnosed based on Tours consensus conference criteria (France) of 2000. BDH cases' definition according to the Tours consensus conference 2000 organized jointly by the French Dermatology Society (SFD) and the French Language Infectious Pathology Society (SPILF) focused on the following criteria [1]:

- Case of BDH: any inflammatory skin lesion (hot, edematous and painful erythema) of abrupt onset surmounted by an erythematous plaque and/or sometimes bullae or petechial purpura in an infectious context (temperature greater than or equal to 38°C of abrupt onset, associated or not with chills)
- Cases of NNBDH (Erysipelas): cases of BDH without cutaneous necrosis with regression of clinical signs under appropriate antibiotic therapy.
- Case of NBDH: case of BDH with specific cutaneous signs (cyanosis, hemorrhagic phlyctenules, crepitations, sensory disorders with anesthesia or hypoesthesia) and necrosis of the conjunctive and adipose tissue but without involvement of the superficial fascia in a context of sepsis or septic shock without spontaneous regression under antibiotics.
- Cases of necrotizing fasciitis: cases of NBDH with muscular exposure or a case of NBDH in which surgical exploration revealed necrosis of the superficial fascia.

Thus, cutaneous infections with specific germs (Buruli ulcer, cutaneous leishmaniasis) were not included.

We used a non-probability sampling design with exhaustive recording of all cases meeting the diagnostic criteria.

The dependent variable was the existence of a necrotizing form of bacterial dermohypodermatitis. Co-variables included sociodemographic, clinical, biological, therapeutic and progression data.

A survey form pre-designed and a camera have been used for data collection. The survey form was pretested and patients who participated in the pretest were not included in the study.

An individual interview technique has been used to collect sociodemographic data and symptoms on patients. As soon as a patient meeting BDH criteria, was admitted into a center included in the study, his consent was obtained by the referring physicians. This step did not delay the treatment starting. Patients who consent to participate in the study were included in a database and followed up throughout their hospital stay and later.

The survey forms were filled out in each care center by the referring physicians. The latter were thoroughly aware of the study protocol and were trained for data collection procedure.

After checking the consistency of filled survey forms and the database completeness, Epi Info software version 7.2.2.6 (CDC 2018) was used for data entry and analysis. Microsoft Office Excel 2016 was used to construct figures and tables. Quantitative variables were expressed as mean with standard deviation and minimum and maximum values were specified. The median with its interquartile range was rather used for abnormal distribution. Categorical variables were expressed as sizes and percentages. Association measure used was the prevalence ratio (PR) with its confidence interval (95%CI). Pearson's Chi2 and Fisher's exact tests have been applied accordingly to determine correlation between variables with significance level of 5%.

This work was conducted in strict respect of ethical standards and hierarchical rules. In addition, the

Municipality Director of Health of Atacora and the authorities of each target health care center gave their approval. Written or oral consent was obtained from patients included in the current study prior to data collection. All data collected during our survey were used only for the purpose of this study and remain confidential.

RESULT

Epidemiological aspect

A total of 48 cases of dermohypodermatitis were recorded throughout the study period, i.e. 08 cases/month, necrotizing forms were predominant (66.67%). The distribution of patients according to clinical forms was as follows:

- Non-necrotizing bacterial dermohypodermatitis: 16 (33.33%);
- Necrotizing bacterial dermohypodermitis: 14 (29.17%);
- Necrotizing fasciitis: 18 (37.50%) of which 02 (11.11%) were Fournier's gangrene.

Sociodemographic characteristics

The mean age of the patients was 36 ± 13 years with aminimum and a maximum of 15 and 68 years, respectively. The most affected age group was [35; 45[years. Males were the most represented with a sex-ratio (male-to-female) of 1.4.

Figure 1 shows the distribution by age group. Farmers accounted for43.75% of the patients and percent patients living in rural areas was 83.33%.

Clinical and biological aspects

- **Time from symptoms onset to patient admission to a health care center**

One third of the patients had initially consulted a peripheral health care center within a median of 05 days (IQR: 2.5 - 15.5) after appearance of early symptoms. The median from the symptoms onset to patient admission to into a health care center in this study was 14 days (IQR: 7-21) with 2 and 59 days as minimum and maximum, repsectively. Half of the patients were admitted more than 2 weeks after the first symptoms onset (Figure 2).

- **Reason for admission and circumstance of occurrence**

Painful inflammatory skin swellings were the first reason for admission in half of the patients, followed by necrotic wounds (47.92%). Trauma was the most frequent circumstance of occurrence (72.92%). They were dominated by foreign material punctures (39.60%) and traffic accidents (29.16%).

- **Physical checkup**

The day they were admitted into a health care center, 28 patients (58.33%) were with sepsis and 3 with septic shock (6.25%).

An entry portal was found in 81.25% of cases. Neglected traumatic wounds were the most frequent entry portal (72.92%). An inguinoscrotal hernia in the necrotic phase was the entry portal for one (01) case of Fournier's gangrene.

Pelvic limb was the most affected organ (89.58%), leg was the most affected segment (47.92%). Pelvic limb was entirely affected in 8.33% of cases. A diffuse location of the trunk was observed in one case (2.08%).

The main skin signs were an area of necrosis (66.67%) and serous phlyctenules (43.75%). Hemorrhagic phlyctenules were reported in one patient (2.08%). All NBDH and NF lesions (66.67%) were classified as Wong stage 3.

- **Laboratory Risk Indicator for Necrotizing fasciitis (LRINEC) score**

The mean LRINEC score was 6 ± 1.08 with 4 and 8 as minimum and maximum value, respectively. This score was greater than or equal to 6 in 68.75% of patients.

- **Biological aspect**

Microbiological evidence was established in 12 patients with necrotizing forms (25.00%) by cytobacteriological checkup after swabbing the lesions. Polymicrobial infection (NBDH-NF type I) was found in 06 cases (50.00%). A monomicrobial infection (NBDH-NF type II) was detected in 02 cases (16.66%). The bacteria species isolated were: *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Peptostreptococcus anaerobius*, *Streptococcus pyogenes*, *Proteus mirabilis* and *Escherichia coli*.

Therapeutic aspect

As soon as they were admitted into a target health care center, 23 patients (47.92%) received systematic tetanus serotherapy followed by tetanus sero-prevention. Anticoagulant treatment was associated with the treatment of 03 patients (6.25%) with thromboembolic risk. All patients admitted with septic shock received medical intensive care.

Parenteral antibiotic therapy included metronidazole (91.67%), ampicillin (52.08%) and ceftriaxone (47.92%). Relay of parenteral treatment was done with a combination of Amoxicillin-Metronidazole in 37.50% of cases and Amoxicillin-Cotrimoxazole in 29.19% of cases.

Surgical excision consisted of necrosectomy till healthy areas in patients with necrotizing forms of dermohypodermatitis. It was performed in 22/32 (68.75%) of patients with NBDH-NF. The median time from admission to surgical excision of necrotic tissue was 4.5 days (IQR: 01 - 08) with 12 hours and 21 days as minimum and maximum values, respectively.

Dermal-epidermal thin skin grafting on residual clean ulcers was performed in 13/32 (40.62%) of patients with NBDH-NF. The mean time from admission to grafting was 85.5±25 days with extremes of 45 and 135 days, 17/32 (53.12%) patients with NBDH-NF underwent directed healing.

Outcome Aspect

The mean length of hospital stay for patients with NNBDH was 11.4±6.3 days with minimum and maximum values of 4 and 21 days, respectively. The median length of hospital stay was 36 days (IQR: 17 - 85) with minimum and maximum values of 4 to 139 days in NBDH-NF patient, respectively. Mortality was 04.17% throughout the study period.

With a median follow-up of 29 days (IQR: 8-61), 75.61% of the patients who were officially discharged were declared healed without sequelae, 04 (9.76%) had sequelae: failure to heal, unsightly scarring, tendon retraction.

Factors associated with the occurrence of necrotizing forms of dermohypodermatitis

Factors significantly associated with necrotizing forms of dermohypodermatitis found in this study are presented in Table I.

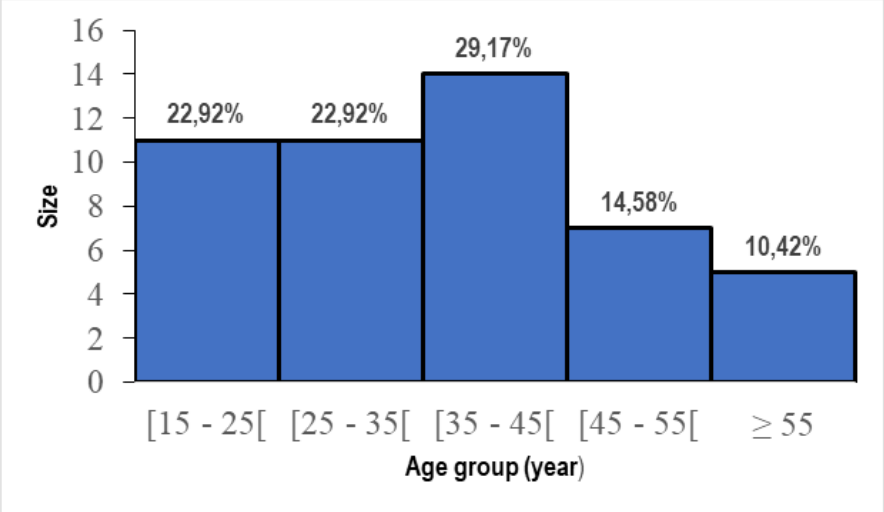


Figure 1: Age distribution of patients diagnosed with BDH and NF in Atacora municipality, Benin in 2021 (N =48)

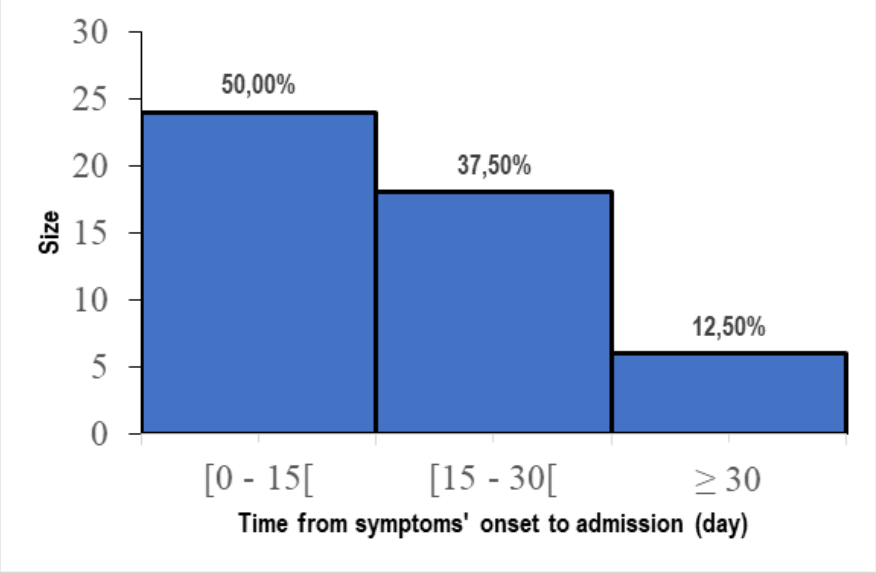
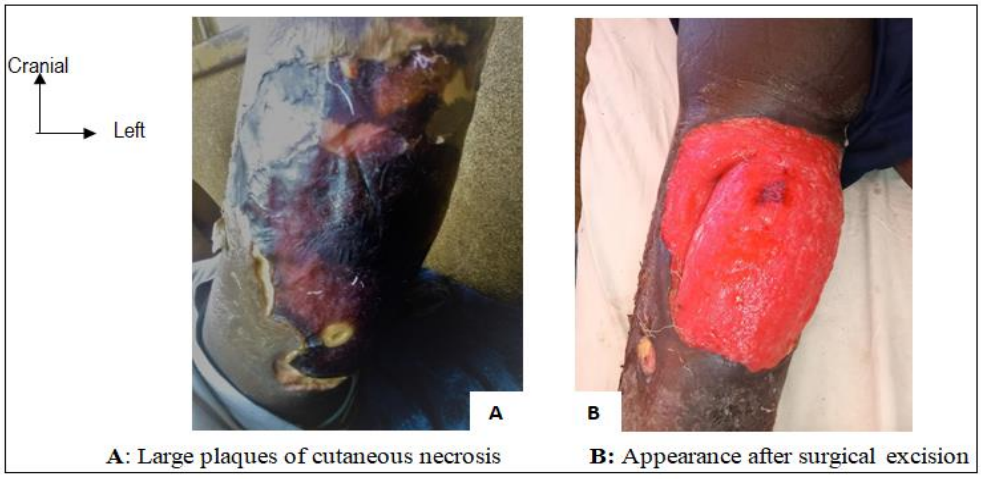


Figure 2: Distribution of patients diagnosed with BDH and NF in Atacora municipality according to the time from the onset of symptoms to admission of the patient into a health care center, Benin in 2021 (N =48)

Table I: Factors associated with the occurrence of necrotizing forms of dermohypodermatitis in Atacora municipality, Benin in 2021 (N = 48)

Occurrence of cutaneous necrosis								
		Yes		**No**				
	Total	**n**	**%**	**n**	**%**	**PR**	**95% CI**	***p-value***
Use of NSAIDs							***0.000****	
Yes	37	31	83.78	06	16.22	9.22	[1.41- 60.05]	
No	11	01	09.09	10	90.91	1		
Traditional treatment							***0.01****	
Yes	35	27	77.14	08	22.86	2	[0.98- 4.08]	
No	13	05	38.46	08	61.54	1		
Ethylism							***0.04****	
Yes	12	11	91.67	01	8.33	1.60	[1.13 – 2.17]	
No	36	21	58.33	15	41.67	1		
Smoking							***0.03****	
Yes	13	12	92.31	01	7.69	1.61	[1.16 – 2.24]	
No	35	20	57.14	15	42.86	1		
Time from symptoms' onset to admission							**0.03***	
≥ 15 days	24	20	83.33	04	16.67	1.67	[1.07- 2.58]	
< 15 days	24	12	50.00	12	50.00	1		
LRINEC score							***0.000****	
≥ 6	33	30	90.91	03	9.09	6.82	[1.87- 24.89]	
< 6	15	02	13.33	13	86.67	1		



A: Large plaques of cutaneous necrosis **B:** Appearance after surgical excision

Figure 1: Necrotizing fasciitis of the posterior face of the left thigh caused by splinter puncture

Figure 4: Necrotizing fasciitis of the right hemi-trunk in a 35-year-old baby mother after traditional treatment of a breast abscess (Appearance before and after surgical excision)

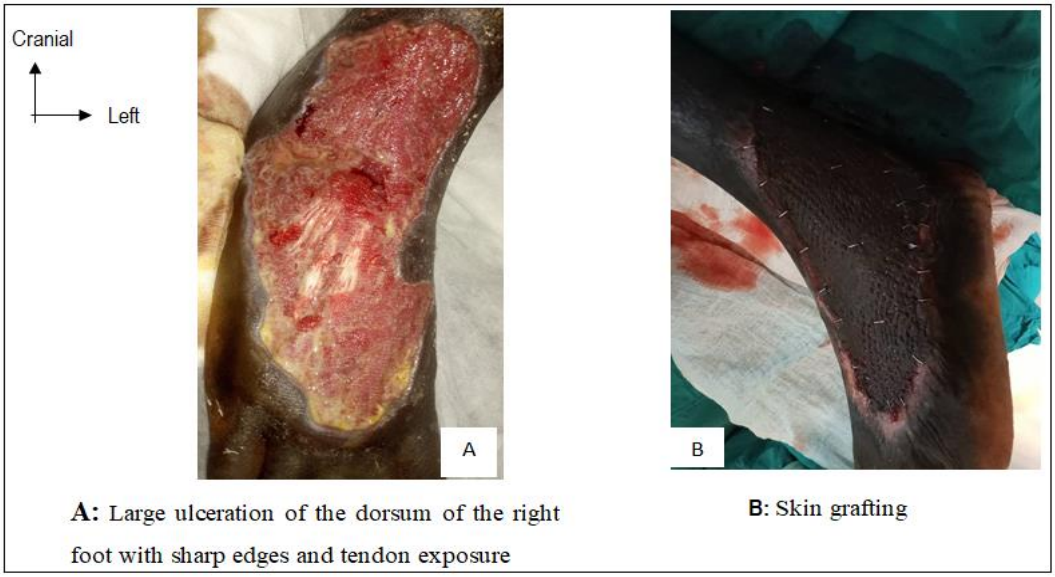


Figure 2: Necrotizing dermohypodermatitis of the dorsum of the right foot following a neglected traumatic wound

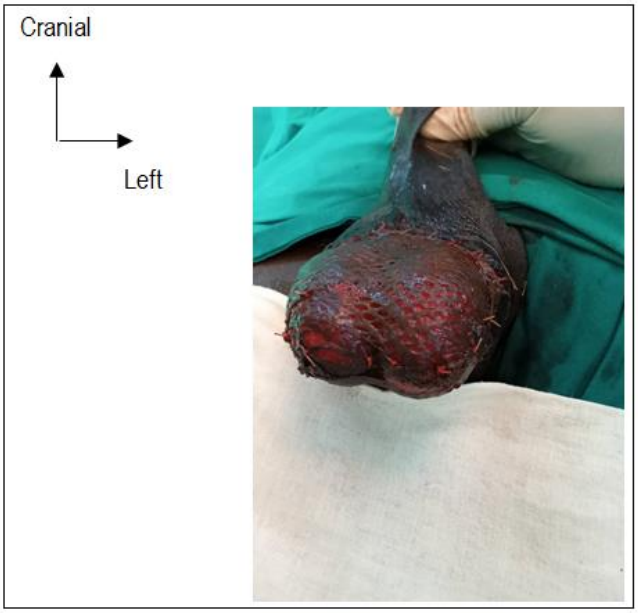


Figure 6: Skin grafting on clean bursal ulcer following a fournier's gangrene

DISCUSSION

Epidemiological aspect

The epidemiological feature of the patients diagnosed with dermohypodermatitis in this study occurred mainly in young male patient in his forties, and who was farmer.

The mean age of the patients in this study was 36 ± 13 years. The [35-45[years age group was the most represented. Similar findings have been reported in other African studies [14-18]. Actually, patients diagnosed with dermohypodermatitis in sub-Saharan Africa are young people between 35 and 45 years of age, which represents the most active population, more prone to microtrauma, which are potential microbials'entry portals. Because of their farm activities, men are more easily exposed to trauma that causes wounds becoming secondarily infected. The predominance of farmers could be explained by the importance of agriculture in the economic activities of the studied municipality [19].

Clinical aspect

The median time from symptoms onset to patients' admission to a health care center was 14 days. Half of our patients consulted more than 2 weeks after symptoms onset. Our findings were consistent with those obtained by Niyondiko *et al*., [15] in Burundi in 2021, Tobomè *et al*., [14] in Benin in 2019 and Diédhiou *et al*., [20] in Senegal in 2013 who reported 17.13 ± 1.91 days, 19.5 ± 8.7 days and 12.8 days, respectively. These different time length were in accordance with the therapeutic pathway followed patients prior to their admission to a health care center.

The preferred location of dermohypodermatitis was the pelvic limb, representing the most frequent topography [1, 21, 22]. In the studies of Dossouvi *et al*., [18] in Togo in 2018, Kaba *et al*., [23] in Côte d'Ivoire in 2020 and Lunar *et al*., [24] in Kenya in 2020 a respective location to the pelvic limbs was found in 81.4%, 81.81% and 88.05% of cases. These findings were directly related to patients' profession, who were mostly farmers in the current and therefore expose their pelvic limbs to microtrauma due to the lack of personal protective equipment.

An entry portal was found in 81.25% of cases, dominated by neglected traumatic wounds (72.92%). The circumstances in which these wounds occurred, were dominated by foreign material punctures. The existence of an entry portal has already been demonstrated as a local risk factor for dermohypodermatitis [1, 8, 13]. Authors describe a break in the protective skin barrier as a gateway to the disease [25]. The solutions of cutaneous continuity represent a breach allowing the entrance of germs. The importance of neglected traumatic skin wounds could be partly explained by socio-occupational habits, ignorance of the possible complications of a wound, a precarious economic condition and difficultaccess to primary care, with the corollary of a lack of early management of traumatic wounds [8].

Factors associated with the occurrence of necrotizing forms of dermohypodermatitis

In this study, necrotizing forms predominated in more than half of the cases (66.67%). Patients who took an NSAID before admission were 9 times more likely to develop necrotizing dermohypodermatitis. A case-control study conducted by Pitché *et al*., [13] in several sub-Saharan African countries in 2021 also showed a significant relationship between NSAID use and the occurrence of necrotizing dermohypodermatitis ($p < 0.0001$; OR= 7.85). NSAIDs inhibit defense mechanisms, suppressing fever and increasing cytokine production by host cells. These effects cover up the infection symptoms and clinical signs, delaying diagnosis and appropriate treatment. In our case, non-steroidal anti-inflammatory drugs were freely available on the streets and in the markets, and their consumption and delayed management contribute to the occurrence of necrotizing forms.

Patients who started traditional treatment before admission were twice as likely to develop a necrotizing form of dermohypodermatitis. The use of a traditional treatment in this case by local application was a worsening factor of an initially non-necrotizing lesion. Lesions treated by local application of a poultice are likely to become infected, thus speeding up their progression towards necrosis.

Alcoholism or smoking status was significantly associated with the occurrence of necrotizing forms ($p = 0.04$; $p = 0.03$ respectively) and these patients were 1.6 times more likely to progress towards similar forms reported in this study. The case-control study carried out by Pitché *et al*., [13] in several sub-Saharan African countries in 2021 confirmed our observations. According to these authors, alcoholism and smoking, as well as HIV infection, could have a negative influence on the immune system, which could lead to the spread of necrosis, worsening of the infection and slowing of healing [13, 26]. However, there were not enough pathophysiological mechanisms explaining this influence.

CONCLUSION

The current study confirms the frequency of dermohypodermatitis in Northern Benin in general and especially, in Atacora municipality. These pathologies are routinely found in clinical practice in this municipality. Farmers were the most affected socio-professional category. The importance of necrotizing forms was related to the therapeutic pathway undertaken by patients, thus delaying their admission into hospital. Self-medication with non-steroidal anti-inflammatory drugs and applicationof traditional treatment were found as factors that worsen lesions due to their concealing effect.

REFERENCES

1. Société de Pathologie Infectieuse de Langue Française (SPILF) Et Société Française de Dermatologie (SFD). (2000). Conférence de consensus: érysipèle et fasciite nécrosante. *Med Mal Infect*, 30(4), 245-272.
2. Binder, J. P., Revol, M., & Servant, J. M. (2007). Dermohypodermites bactériennes nécrosantes et fasciites nécrosantes. EMC - Tech Chir - Chir Plast Reconstr esthétique, 2(3), 1-11. DOI: 10.1016/s1286-9325(07)44483-1
3. Begon, E. (2013). Érysipèle, dermohypodermites bactériennes et fasciites nécrosantes. *EMC – Dermatologie*, 8(2), 1-10. DOI: 10.1016/S0246-0319(13)22265-X
4. Chosidow, O., & Bourgault-Villada, I. (2001). Dermohypodermites bactériennes nécrosantes et fasciites nécrosantes. *Réanimation*, *10*(3), 276-281. DOI: 10.1016/s1286-9325(07)44483-1
5. Dupuy, A., Benchikhi, H., Roujeau, J. C., Bernard, P., Vaillant, L., Chosidow, O., ... & Bastuji-Garin, S. (1999). Risk factors for erysipelas of the leg (cellulitis): case-control study. *Bmj*, *318*(7198), 1591-1594. DOI: 10.1136/bmj.318.7198.1591
6. Zerr, D. M., Alexander, E. R., Duchin, J. S., Koutsky, L. A., & Rubens, C. E. (1999). A case-control study of necrotizing fasciitis during primary varicella. *Pediatrics*, *103*(4), 783-790. DOI: 10.1542/peds.103.4.783
7. Mills, M. K., Faraklas, I., Davis, C., Stoddard, G. J., & Saffle, J. (2010). Outcomes from treatment of

necrotizing soft-tissue infections: results from the National Surgical Quality Improvement Program database. *The American journal of surgery*, *200*(6), 790-797. DOI: 10.1016/j.amjsurg.2010.06.008

8. Pitché, P., Diatta, B., Faye, O., Diané, B. F., Sangaré, A., Niamba, P., ... & Tchangaï-Walla, K. (2015, November). Facteurs de risque associés à l'érysipèle de jambe en Afrique subsaharienne: étude multicentrique cas-témoins. In *Annales de Dermatologie et de Vénéréologie* (Vol. 142, No. 11, pp. 633-638). Elsevier Masson. DOI: 10.1016/j.annder.2015.08.003
9. Gathse, A., & Ntsiba, H. (2006). Etude rétrospective de 53 érysipèles hospitalisés au CHU de Brazzaville, Congo. *Bulletin de la Société de pathologie exotique*, *99*(1), 3-4. DOI: 10.3185/pathexo2727
10. Thierno, M. T., Diop, N. G., Niang, S. O., Boye, A., Sy, T. N., & Gueye, A. D. (2001). Dermohypodermite bactérienne et dépigmentation artificielle: A propos de 60 cas observés au Sénégal. *Les Nouvelles dermatologiques*, *20*(10), 630-632.
11. Cisse, M., Keïta, M., Toure, A., Camara, A., Machet, L., & Lorette, G. (2007, October). Dermohypodermites bactériennes: étude monocentrique rétrospective de 244 cas observés en Guinée. In *Annales de Dermatologie et de Vénéréologie* (Vol. 134, No. 10, pp. 748-751). Elsevier Masson. DOI: 10.1016/S0151-9638(07)92530-2
12. Diallo, M., Niasse, M., Diatta, B. A., Diop, A., Ndiaye, M., Ly, F., & Dieng, M. T. (2017). Profile of Bacterial Dermohypodermitis in Senegal over a 30-year period. *International Journal of Dermatology and Clinical Research*, *3*(1), 22-25. DOI: 10.17352/2455-8605.000022
13. Pitché, P., Diata, A. B., Faye, O., Tounkara, T. M., Niamba, P., Mouhari-Toure, A., ... & Saka, B. (2021, September). Risk factors associated with necrotizing fasciitis of the lower limbs: A multicenter case-control study. In *Annales de Dermatologie et de Vénéréologie* (Vol. 148, No. 3, pp. 161-164). Elsevier Masson. DOI: 10.1016/j.annder.2020.08.056
14. Tobome, S. R., Otchoun, U. P., Ahononga, B. C., Hodonou, M. A., Haoudou, R., & Hessou, T. K. (2019). Dermohypodermites et fasciites nécrosantes au Bénin: Particularités en zone rurale. *Cah du Cbrst- Médecine Santé Publique*, 16(3), 88-107.
15. Niyondiko, J. C., Niyonkuru, E., Ndayizeye, G., Nimubona, S., Baramburiye, C. P., & Bazira, L. (2021). Necrotizing Fasciitis in Low Income Countries: About 23 Cases of Bujumbura Hospitals. *Open Journal of Orthopedics*, *11*(02), 33-39. DOI: 10.4236/ojo.2021.112004
16. Saka, B., Kombaté, K., Mouhari-Toure, A., Akakpo, S., Boukari, T., Pitché, P., & Tchangaï-Walla, K. (2011). Bacterial dermohypodermitis and necrotizing fascitis: 104-case series from Togo. *Medecine Tropicale: Revue du Corps de Sante Colonial*, *71*(2), 162-164.
17. Dioussé, P., Ndiaye, M., Dione, H., Bammo, M., Sow, O., Seck, F., ... & Ka, M. M. (2017). Bacterial dermohypodermitis at the Thies Regional Hospital, Senegal (West Africa): A retrospective study of 425 cases. *Our Dermatology Online*, *8*(3), 233-236. DOI: 10.7241/ourd.20173.70
18. Dossouvi, T., Moumouni Abd-el, K., Amavi, A., Mouhari-Toure, A., Amouzou, E. G., & Dosseh, D. (2018). Bacterial Necrotizing Dermohypodermitis (BNDH) and Necrotizing Fasciitis (NF) in Surgical Area at CHU-Kara (Togo). *Open Access J Surg*, 9(5), 1-5. DOI: 10.19080/OAJS.2018.09.555772
19. Institut national de la statistique et de l'analyse économique (INSAE). (2016). Cahier des villages et quartiers de ville du département de l'Atacora (RGPH-4, 2013).
20. Diédhiou, D., Leye, M. M. M., Touré, M., Boiro, D., Sow, D., Leye, Y., ... & Ka-Cissé, M. (2013). Dermohypodermites bactériennes à Dakar: rétrospective de 194 cas suivis en Médecine interne à la clinique médicale II. *Revue Africaine et Malgache de Recherche Scientifique/Sciences de la Santé*, *1*(1), 31-35.
21. Rea, W. J., & Wyrick Jr, W. J. (1970). Necrotizing fasciitis. *Annals of surgery*, *172*(6), 957-964. DOI: 10.1097/00000658-197012000-00005
22. Lortat-Jacob, A. (2000). Hypodermites et fasciites nécrosantes des membres chez l'adulte. Prise en charge chirurgicale. *Médecine et Maladies Infectieuses*, *30*, 438s-445s. DOI: 10.1016/S0399-077X(01)80046-9
23. Kaba, L., Assere Yao, A., Sica, A., Ochou, G., & Kodo, M. (2020). Necrotising fasciitis of extremities in a plastic surgery unit in tropical setting. *J Afr Chir Orthop Traumatol*, 5(1), 2-8.
24. Lunar, J., Ranketi, S. S., Owino, B., Oloo, M., & Parker, R. K. (2020). Necrotizing Fasciitis: A Predictable Burden in Rural Kenya. *World Journal of Surgery*, *44*(9), 2919-2926. DOI: 10.1007/s00268-020-05581-4
25. Tianyi, F. L., Mbanga, C. M., Danwang, C., & Agbor, V. N. (2018). Risk factors and complications of lower limb cellulitis in Africa: a systematic review. *BMJ open*, *8*(7), e021175. DOI: 10.1136/bmjopen-2017-021175
26. Joseph, E. E., Isidore, K. Y., Patrice, G. I., Abdoulaye, S., Sarah, K., Alex, K., ... & Celestin, A. K. (2014). Comparative Study of Necrotizing Bacterial Dermohypodermitis or Necrotizing Fasciitis Depending on the HIV Serostatus in Abidjan (Cote d Ivoire). *Journal of Clinical & Experimental Dermatology Research*, *5*(5), 1-4. DOI: 10.4172/2155-9554.1000234