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Neonatal Miliaria Pustulosa—A Case Series

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ABSTRACT

Background/Objectives: Miliaria pustulosa is a noninfectious, transient skin eruption of pustules overlying erythematous plaques secondary to obstruction of eccrine glands. There are very few case reports in the literature detailing miliaria pustulosa in neonates. When presenting in neonates, its similarity to life-threatening infections may cause diagnostic confusion. By differentiating this condition from similar presentations, unnecessary treatments and tests in this population may be avoided.

Methods: Retrospective review of the medical records of nine neonates presenting with a pustular eruption diagnosed as miliaria pustulosa. Patients were seen at a children's hospital in Chicago, IL, USA; cases were selected by investigator recall.

Results: In this case series, miliaria pustulosa presents in nine neonates as clusters of eruptive pustules with resolution or significant improvement noted after an average of 2.6 days (range 1–5 days). The average age was 4.6 days (range 1–10 days old) and the average gestational age was 34.7 weeks (range 26.3–40.1 weeks). All patients had pustular outbreaks in areas occluded by swaddling, clothes, or adhesive. Seven patients had geometric lesions that were underlying sites of intravenous (IV) site adhesive or electrocardiogram (EKG) leads.

Conclusions: The consistent morphological features of this pustular eruption at sites of skin occlusion and the transient course in the setting of an otherwise well-appearing infant are strongly suggestive of the diagnosis of miliaria pustulosa. It is important for clinicians to be familiar with this benign presentation and to differentiate it from other neonatal pustular eruptions to minimize invasive tests and treatments in this vulnerable population.

1 | Introduction

Miliaria is a skin disorder caused by a blockage of eccrine glands that leads to retention of sweat in the dermis and epidermis resulting in a papular, vesicular, or pustular eruption [1, 2].

Miliaria has been categorized into subtypes termed miliaria crystallina, miliaria rubra, miliaria profunda, and miliaria pustulosa [1, 3]. The depth of the eccrine duct obstruction and resultant clinical presentation determines the classification. Miliaria occurs frequently in neonates likely due to the relative immaturity of the eccrine structures allowing for obstruction

to occur more readily [2, 4–6]. Preterm infants may be at an increased risk for miliaria pustulosa due to their sweat glands being even more underdeveloped than that of a full-term neonate. Although eccrine sweat glands develop during week 16 of gestation, development of these structures continues after birth, and preterm neonates will take longer to develop full eccrine sweat gland function [7]. A 1982 study of sweating in neonates found that infants with a gestation period longer than 36 weeks were able to sweat on the first day of life, whereas infants born before 36 weeks of gestation were not able to sweat until an average of 13 days post-birth [8]. Additionally, contributors such as a hot humid environment, including possibly the use of warmers

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in hospital nurseries, and excessive clothing or swaddling put the infant population at further risk of this eruption [2]. The incidence of miliaria has been observed to be equal in male and female neonates [9].

The presence of eruptive pustules in a neonate has a wide differential diagnosis including both benign and infectious conditions. Infections may include bacterial, yeast, or viral organisms, some of which can be life threatening in young babies, thus recognizing the various presentations of these entities is critical for healthcare providers [1]. By describing the diagnosis and clinical course of nine neonates with miliaria pustulosa, we aim to help differentiate these serious neonatal pustular eruptions from the benign eruption of miliaria pustulosa, which is essential for limiting testing and unnecessary treatment. Here we present a series of nine neonates presenting with miliaria pustulosa and review the clinical features of this exuberant and often alarming appearing, yet benign eruption.

2 | Materials and Methods

Single-center retrospective review of the medical records of nine newborns with a pustular eruption was subsequently diagnosed as miliaria pustulosa seen at Comer Children's Hospital, Chicago, IL, USA, between January 1, 2017, and February 16, 2023. Information including patient demographics, clinical features, diagnostic tests, treatments, and courses were reviewed. Patients were identified by investigator recall. The University of Chicago Biological Science Division Institutional Review Board approved the protocol.

3 | Results

A total of nine patients clinically diagnosed with neonatal miliaria pustulosa were included (six females, three males). The mean age at diagnosis was 4.6 days (range 1–10 days old). The sites of involvement included the trunk and extremities (Table 1). The mean gestational age of the patients was 34.7 weeks (range 26.3–40.1 weeks). Out of nine patients, five (56%) were born before 37 weeks. All nine of the patients were cared for in the neonatal intensive care unit (NICU) with an average NICU stay of 15.7 days (range 2–69 days). Eight out of nine patients (89%) were treated with a warmer for thermoregulation while in the NICU. Two of the patients have a twin (unaffected and not part of the case series). Six patients had racial or ethnic data available; four patients were Hispanic/Latino, and two patients were Black.

The clinical morphology was strikingly similar in all cases, presenting as clustered pustules on an erythematous patch on the extremities or trunk (Figure 1).

The clinical characteristics are summarized in Table 1. In six of the nine patients (67%), the eruption was more geometrically shaped and located under the site of an electrocardiogram (EKG) lead (six patients) or an intravenous (IV) adhesive (one patient). In five of the nine patients (56%), the eruption occurred in a “kissing” pattern between the arm and the thorax or in the inguinal crease; in these cases, the occlusion that led to the outbreak was from the body parts involved. Follow-up ranged

from 1 to 5 days with an average follow-up time of 2.6 days for 89% (8/9) of cases, at which time the associated symptoms (pustules, erythema, etc.) had resolved or significantly improved. Following the initial outbreak, no patients were reported to have miliaria pustulosa develop elsewhere on the body.

All nine patients received testing of the pustular contents to assess for potential bacterial etiologies, and seven patients also received additional tests for viral or fungal etiologies, all of which were negative for each of the patients. Eight of the patients (89%) were treated with antibiotics, antifungal agents, or both. Six patients (67%) were treated with topical antibiotic ointments (mupirocin or bacitracin) to address the possibility of a bacterial infection. Two patients (22%) were treated with low-potency topical steroids to reduce inflammation. Two patients (22%) received IV fluconazole until the fungal culture was confirmed negative, two patients (22%) received IV antibiotics until the bacterial culture was confirmed negative, and one patient received IV acyclovir until the herpes simplex virus (HSV) and varicella-zoster virus (VZV) polymerase chain reaction (PCR) tests were confirmed negative. In all cases, the medical team and families were instructed to avoid excess occlusion of the skin from topical ointments, clothing, swaddling and to avoid overheating the child. No patients were reported to have long-term symptoms. One patient, Patient 1, was discharged the same day that she was seen by the dermatology team; subsequent follow-up was not available.

4 | Discussion

Miliaria, in general, is relatively common in infants [2]. This population is particularly susceptible to developing this condition due to immature sweat glands in the setting of being kept comprehensively clothed and bundled, and often being exposed to warm, humid environments [2]. In neonates, these factors can lead to eccrine duct obstruction and the subsequent pustular eruption of miliaria pustulosa [1, 2]. In our series, five out of nine (56%) of the patients were born prematurely (before 37 weeks of gestation). However, all nine patients were cared for in the NICU before being discharged home. Eight patients were placed under a radiant warmer, and one patient was also placed on a warming mattress in the NICU. The use of warmers in the NICU, as well as adhesives such as EKG leads and IV tape, represent common risk factors for miliaria pustulosa: excessive heat and occlusion.

The most commonly recognized forms of miliaria are miliaria crystallina and miliaria rubra, but the presence of pustules differentiates miliaria pustulosa from these other subtypes [1, 3]. Miliaria crystallina is a superficial eccrine obstruction that presents as transparent, delicate vesicles on otherwise normal-appearing skin, and miliaria rubra is a mid-epidermal eccrine obstruction that presents as collections of pinpoint pink papules [1, 3]. Miliaria pustulosa is characterized by superficial pustules that arise from obstruction of the sweat glands, in the setting of presumably underdeveloped sweat glands of neonates [2]. In a study of 100 neonates presenting with pustular eruptions, miliaria pustulosa was the most common condition, making up 17% of cases [5]. Typical sites of involvement of neonatal miliaria pustulosa include the flexures, trunk, neck, and other areas commonly

TABLE 1 | Characteristics of miliaria pustulosa cases.

Case no.	Sex	Age	Gestational age	Race/ethnicity	Location of outbreak	Clinical description	Diagnostic tests	Medical treatment	Outcomes (time until resolution or significant improvement)
1	F	5 days old	40 weeks and 1 day	Hispanic/Latino	Right lower abdomen (Site of EKG lead)	Linear cluster of pustules	Bacterial culture-negative Fungal smear and culture-negative HSV PCR-negative	Mupirocin ointment	N/A patient did not return
2	F	10 days old	36 weeks	Hispanic/Latino	Left flank (Site of EKG lead)	Cluster of pustules on an erythematous base in a rectangular configuration	Bacterial culture-negative	Mupirocin ointment	Rash resolved after 3 days
3	F	5 days old	36 weeks and 1 day	No demographic information listed	Right dorsal hand and wrist (Site of IV dressing)	Intact and flaccid pustules on an erythematous patch	Bacterial culture-negative HSV PCR-negative VZV PCR-negative	Acyclovir IV Hydrocortisone ointment	Rash resolved with peeling after 2 days
4	F	2 days old	26 weeks and 2 days Twin gestation	No demographic information listed	Back	Ill-defined erythematous plaque with overlying intact and eroded pustules	Bacterial culture-negative Fungal culture-negative HSV PCR-negative VZV PCR-negative	Fluconazole IV Hydrocortisone ointment Vaseline to erosion and surrounding skin, Vaseline gauze and dressing	Rash resolved after 4 days
5	F	3 days old	39 weeks and 5 days	Hispanic/Latino	Right axilla	Coalescing flaccid pustules on an erythematous base encompassing axillary region of upper arm and torso	Bacterial culture-negative HSV PCR-negative	Mupirocin ointment	Rash resolved after 3 days
6	M	5 days old	35 weeks and 2 days	Hispanic/Latino	Left axilla Left abdomen (Site of EKG lead)	Coalescing flaccid pustules on brightly erythematous patches encompassing axillary region of upper arm and torso. Left abdomen with well-demarcated red patch with overlying pustules.	Bacterial culture-negative	Bacitracin ointment	Significant improvement noted after 1 day
7	F	3 days old	39 weeks	No demographic information listed	Right trunk and upper right arm	Coalescing flaccid pustules on brightly erythematous patches.	Bacterial culture-negative Fungal culture-negative	Cephalexin IV Mupirocin ointment	Improvement noted after 4 days

(Continues)

TABLE 1 | (Continued)

Case no.	Sex	Age	Gestational age	Race/ethnicity	Location of outbreak	Clinical description	Diagnostic tests	Medical treatment	Outcomes (time until resolution or significant improvement)
8	M	10 days old	30 weeks and 6 days	Black/African American	Abdomen, lower chest (Site of EKG lead), left arm, groin	Confluent and clustered pinpoint pustules on ill-defined erythematous patches	Bacterial culture-negative Fungal culture-negative HSV PCR-negative	Clindamycin IV Fluconazole PO Mupirocin ointment	Rash resolved after 5 days
9	M	3 days old	39 weeks Twin gestation	Black/African American	Bilateral upper chest (Sites of EKG leads) Right inguinal crease	Grouped coalescing flaccid pustules with underlying erythema.	Bacterial culture-negative Fungal culture-negative	No medications give	Improvement noted after 1 day

covered by clothing [2, 5]. These locations were all involved in our patients. Interestingly, seven of our patients presented with geometric lesions at sites of occlusion from monitoring leads and adhesives, highlighting the importance of recognizing medical devices as an underlying etiology of neonatal miliaria pustulosa.

The histopathology of miliaria pustulosa demonstrates an obstruction of the eccrine duct at the dermal-epidermal junction with a keratin plug in combination with varying amounts of inflammation [1, 10, 11]. The obstructed eccrine duct eventually ruptures and sweat moves into the epidermis surrounding the duct [11]. However, miliaria pustulosa is generally a clinical diagnosis and histologic confirmation is usually not indicated [1, 3].

When evaluating a neonate presenting with a pustular eruption, several differential diagnoses may be considered, including noninfectious and infectious etiologies [2]. Noninfectious causes of pustular eruptions in neonates to differentiate from miliaria pustulosa may include transient neonatal pustular melanosis (TNPM), erythema toxicum neonatorum (ETN), epidermolysis bullosa (EB), noninfectious folliculitis, and contact dermatitis [2, 5]. The localized presentations and lack of secondary findings such as hyperpigmented macules and collarettes of scales help to differentiate TNPM and ETN. The sparing of classic trauma-prone areas such as the hands, feet, and diaper region make EB less likely. Additionally, some of these entities can be differentiated by microscopic review of a smear of the contents of a pustule: in miliaria pustulosa most of the cells visualized are lymphocytes; in TNPM, a smear of the pustular contents will display predominantly neutrophils with some eosinophils; and in ETN, a smear will show almost exclusively eosinophils [3, 10, 11].

Infectious causes of pustular eruptions in neonates include bacterial, fungal, or viral pathogens. Bacterial infections that may present with pustules include impetigo, staphylococcal pustulosis, congenital syphilis, or secondary bacterial infections complicating a primary dermatologic condition or wound [2, 11]. Folliculitis is another common pustule-forming condition, due to both fungal and bacterial organisms [1, 2]. Folliculitis may present similarly to miliaria pustulosa, but the pustules will be folliculocentric, whereas in miliaria pustulosa the pustules are non-follicular [1, 2]. Congenital, as well as neonatal, candidiasis can also present with pustules [2]. Congenital candidiasis tends to be a more widespread eruption of macules, papules, pustules, and occasionally bullae; pustules on the palms and soles can be a helpful diagnostic finding [2]. Neonatal candidiasis is more often a localized eruption in the diaper area, sometimes accompanied by oral thrush. Viral causes of neonatal pustules include HSV and VZV, both of which are serious and concerning causes of disease in a neonate [1, 2]. HSV and VZV eruptions tend to be more vesicular than pustular, becoming punched out erosions with hemorrhagic crusting that is not seen in miliaria [1, 2].

Before testing for infectious etiologies came back negative, eight out of nine patients in this series were treated with antibiotics, antifungal agents, antiviral agents, or low-potency steroids to address these differential diagnoses. All antiviral and antifungal medications were discontinued after negative diagnostic tests were confirmed. It is important for medical professionals who care for



FIGURE 1 | Representative photos of patients 2, 5, 6, and 7 (from top left to bottom right) demonstrating grouped and coalescing flaccid pustules on erythematous patches at sites of occlusion due to body parts or exogenous devices.

neonates in the NICU to be aware of their potential increased risk for developing miliaria pustulosa and keep this in mind as they weigh treatment options for a pustular eruption in these patients.

Miliaria pustulosa is a generally benign and self-limited condition, resolving without intervention within several days [1, 2]. Management includes lowering the ambient temperature of the neonate's environment and employing the use of breathable cotton clothing to decrease the tendency for the child to sweat [3, 5]. Precautions should be taken to prevent secondary infection of any open erosions with the use of topical antibiotic agents as needed. The data from this case series indicates that occlusion from medical devices such as monitor probes or dressings to secure intravenous catheters can be a potential cause of miliaria pustulosa in neonates. These and other sources of occlusion, as well as the shape and location of the eruption, the body parts involved, and the general status of the infant, should be considered

when assessing a pustular rash in neonates. These features can help clinicians differentiate dangerous etiologies of pustular eruptions from miliaria pustulosa and limit unnecessary investigations and treatments.

This study has several limitations, including the small sample size, the selection of participants by investigator recall, the retrospective nature, and the lack of complete follow-up for several of the patients. It is important for clinicians to be familiar with this benign and common presentation of miliaria pustulosa in neonates to avoid unnecessary invasive tests and treatments in this vulnerable population.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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