

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Miliaria: An Update.

Manju Nagpal¹, Gursharn Singh¹, Paramjot¹, and Geeta Aggarwal^{2*}.

¹College of Pharmacy, Chitkara University, Chandigarh- Patiala Road, Rajpura- 140401, Punjab, India

²Delhi Pharmaceutical Sciences and Research University, Sector 3, Pushpvihar, New Delhi-110017

ABSTRACT

Miliaria is an inflammatory disorder of skin particularly in humans, which is characterized by multiple small lesions at the site of sweat pores, brought about by the blockage of sweat ducts and the resulting escape of sweat into various levels of the skin. Thus it arises from obstruction of the sweat ducts. Miliaria is most common in hot, humid conditions but may occur in desert regions. There are different types of miliaria possible which are mainly based on the level of obstruction of sweat glands. The disease is mainly treated with antimicrobial, steroids, antibiotics in case of allopathic treatment. The herbal and Ayurvedic treatment options are also available in the market. This review discusses the types of miliaria, its pathophysiology, epidemiology and treatment options available.

Keywords: Miliaria, Heat rash, Dermatitis, Papules

**Corresponding author*



INTRODUCTION

Miliaria is a common disorder of the eccrine sweat glands. These glands are present all over the body and form a water based secretion that primarily helps to cool the body. Miliaria occurs in conditions of increased heat and humidity and is caused by blockage of the sweat ducts, which results in the leakage of sweat into the epidermis or dermis [1]. The 4 types of miliaria are classified according based on the level at which obstruction of the sweat duct occurs:

Miliaria Crystallina

It is the mildest form, usually the blisters aren't itchy or painful and the spots tend to disappear within a few hours or days. This is the least itchy form of the condition and there may not be any itch at all. The rash may simply be a curious event that you notice on your skin. The superficial vesicles are not associated with an inflammatory reaction [2].

Miliaria Rubra

In this type of miliaria, obstruction occurs deeper within the epidermis and results in extremely pruritic erythematous papules (i.e itchy skin with redness and inflammation forming papules which don't contain puss). The spots are just a few millimetres in size and may look like tiny blisters. Several crops of spots usually appear in different parts of the body. They occur mostly where there is friction with clothes. They can be very itchy - although it may be more of an intense prickling sensation. Some areas of skin become red. The rash may occur within days of coming into a hot climate. However, often the rash does not appear until weeks or months have passed in the hot climate. The rash tends to go within a few days if you get out of the hot environment and stop sweating [3,4].

On the affected areas of skin there is a reduced amount of sweat, or no sweat at all. You may feel tired and become intolerant of heat. If you continue to sweat and the rash covers a large part of your body then you have a small risk of developing a high temperature (fever) and/or heat exhaustion. This is because you are not able to sweat properly to get rid of body heat.

Miliaria Profunda

Ductal obstruction occurs at the dermal-epidermal junction in this. Sweat leaks into the papillary dermis and produces subtle asymptomatic flesh-colored papules. It is the least common form, usually in adults after repeated events of miliaria rubra. It is caused when the blockage of the sweat ducts occurs at the level of the middle layer of the skin (the dermis). Bigger lumps develop on the skin when you sweat. These tend to be flesh colored as they are deeper than the miliaria rubra form. There is little itch with this type of miliaria but there is a greater risk of developing a fever and heat exhaustion if much of the skin surface is affected.

Miliaria Pustulosa

When pustules develop in lesions of miliaria rubra, the term miliaria pustulosa is used. Also called as white/yellow heat rash (miliaria pustulosa). Pustules form due to inflammation and bacterial infection. The fluid inside the pustules contain puss. Miliaria pustulosa is preceded by another dermatitis that has produced injury, destruction, or blocking of the sweat duct. These pustules may be the first signs of a skin infection [5].

PATHOPHYSIOLOGY

Basically Prickly heat (miliaria) is due to blockage of sweat ducts. You have thousands of sweat glands that lie just under the skin surface. These secrete sweat on the surface of the skin. If the sweat duct of these glands get blocked, the sweat seeps into the skin rather than being secreted on the skin. This causes tiny pockets of swelling (papules) which cause miliaria (Figure 1).

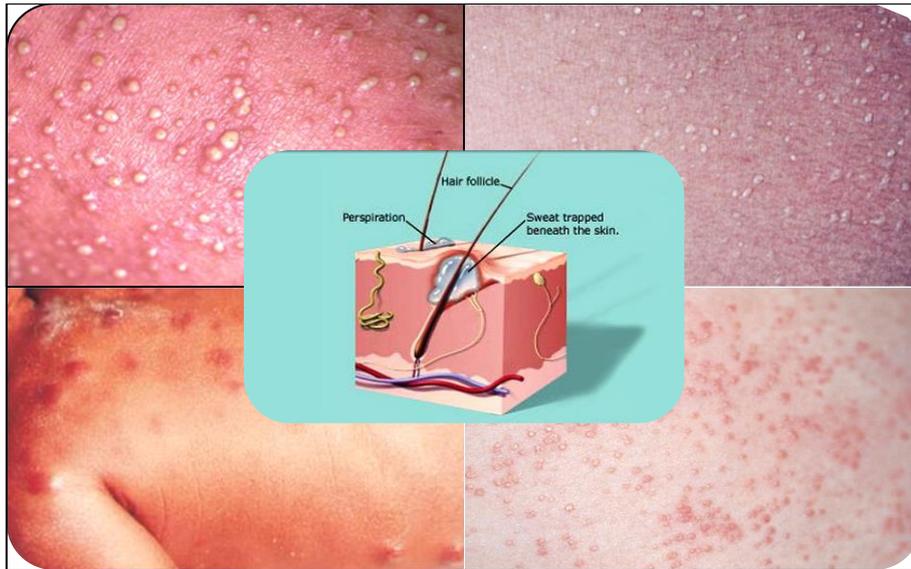


Figure1: Types of miliaria

The various events involved are as follows [6,7]

- ◆ Blockage of sweat gland ducts
- ◆ Retention of the sweat into skin
- ◆ Disruption of duct cell

Blockage of sweat gland ducts:

Basically Miliaria occurs when the sweat gland ducts get plugged due to dead skin cells or bacteria such as *Staphylococcus epidermidis*. (a common bacterium that occurs on the skin which is also associated with acne). Acute inflammation of sweat ducts is caused by blockage of pores by macerated skin. In susceptible persons, including infants, who have relatively immature eccrine glands, over-hydration of the stratum corneum is thought to be sufficient to cause transient blockage of the acrosyringium (most superficial region of sweat gland duct). There is also evidence that *Staphylococcus epidermidis*, which may be present in higher numbers on macerated, occluded skin, produces a polysaccharide substance that may obstruct the delivery of sweat to the skin.

Histological examination of blockage of duct-

Histological study showed a PAS-positive diastase resistant amorphous mass deep within the acrosyringium after 2 days of occlusion, accompanied by a periductal dermal infiltration of leukocytes. After another 2 days the duct became clogged by an amalgam of degenerating leukocytes. This impaction sloughed after about 3 weeks as a result of epidermal renewal. Colonies of bacteria were never found within the ducts. It is postulated that cocci secrete a toxin which injures luminal cells and precipitates a cast within the lumen. Infiltration by leukocytes creates an impaction which completely obstructs the passage of sweat for several weeks.

Retention of sweat into the skin:

If hot humid conditions persist, the individual continues to produce excessive sweat, but he or she is unable to secrete the sweat onto the skin surface because of ductal blockage. This blockage results in the leakage of sweat en route to the skin surface, either in the dermis or epidermis, with relative anhidrosis. When the point of leakage is in the stratum corneum or just below it, as in miliaria crystallina, little accompanying inflammation is present, and the lesions are asymptomatic. In miliaria rubra, the leakage of sweat into the subcorneal layers produces spongiotic vesicles and a chronic periductal inflammatory cell infiltrate in the

papillary dermis and lower epidermis. In miliaria profunda, the escape of sweat into the papillary dermis generates a substantial, periductal lymphocytic infiltrate and spongiosis of the intra-epidermal duct.

Eccrine duct disruption:

The primary pathogenic process in miliaria is eccrine duct disruption.

Excessive sweating leads to overhydration of the stratum corneum, which in turn leads to acrosyringial occlusion.

- ◆ Ducts become dilated under pressure and ultimately rupture
- ◆ Often seen in areas of friction
- ◆ This produces superficial vesicles in malpighian layer of skin on a red base
- ◆ May progress to miliaria profunda (white papules) if duct ruptures a second time

However, sweating alone is not enough to produce duct disruption and miliaria. Elevated concentrations of sodium chloride on the skin, high humidity, occlusive clothing may lead to eccrine duct disruption from maceration of the stratum corneum and ultraviolet radiation induced damage to epidermal cells may also cause ductal disruption. Eccrine duct damage caused by high sodium content may lead to miliaria crystallina in the setting of hypernatremia. In late-stage miliaria, hyperkeratosis and parakeratosis of the acrosyringium are observed. A hyperkeratotic plug may appear to obstruct the eccrine duct, but this is now believed to be a late change and not the precipitating cause of the sweat duct blockage [8].

Role of bacteria:-

Some people are more prone to miliaria than others. It seems that a germ (bacterium) called *Staphylococcus epidermidis* may play a role. This bacterium lives harmlessly on the skin and miliaria is not an infection. However, this bacterium makes a sticky substance. This substance combined with excess sweat and dead skin cells may cause the blockage. Resident skin bacteria, such as *Staphylococcus epidermidis* and *Staphylococcus aureus*, are thought to play a role in the pathogenesis of miliaria. Patients with miliaria have 3 times as many bacteria per unit area of skin as healthy control subjects. Periodic acid-Schiff-positive diastase-resistant material has been found in the intraductal plug that is consistent with staphylococcal extracellular polysaccharide substance (EPS). In an experimental setting, only the strains of *S. epidermidis* that produce EPS can induce miliaria [6]. *Candida albicans* was also found present sometimes at the site of miliaria

EPIDEMIOLOGY

Prickly heat (miliaria) can develop in anyone at any age. However, it is most common in children and babies, as their immature sweat glands are more prone to becoming blocked. It is particularly common in newborn babies but soon clears. Another common time for the rash to occur is when people travel to a warmer climate and sweat more than usual. Miliaria can also occur in cooler climates when sweating is a problem. For example, people who lie on their back for long periods due to illness may get miliaria on their back. This can occur after having a stroke or a major operation. It can also occur if you are wearing too many clothes or the bedding is too warm. Miliaria is seen in all age groups and sexes worldwide. Miliaria profunda is seen mostly in adults while miliaria crystallina and miliaria rubra occur in both children and adults.

Miliaria crystallina occurs in 1.3% to 4.5% of infants and congenital cases have been described. Miliaria rubra affects 4% of neonates [9]. A survey showed that pediatric patients in north eastern India showed an incidence of miliaria up to 1.6% [10]. Miliaria crystallina and rubra occur globally while miliaria profunda is usually only seen in tropical environments. Miliaria crystallina is most commonly seen in febrile diseases, situations in which occlusive clothing prevents dissipation of heat and moisture such as in bundled infants, after sunburn under hot and humid climatic conditions, and in newborns immediately after delivery in the setting of maternal fever. In addition, miliaria crystallina has been associated with underlying hypernatremia both in adults and children. Miliaria rubra occurs most commonly in hot and humid environments with use of occlusive clothing, affecting up to 30% of individuals with a maximal incidence after 2 to 5 months of exposure to a tropical environment.

In miliaria profunda occurs due to following multiple episodes of miliaria rubra. Miliaria profunda is usually only seen in tropical environments. Miliaria occurs in individuals of all races, although some studies show that Asians, who produce less sweat than whites, are less likely to have miliaria rubra.

TREATMENT OF MILIARIA

Allopathic Treatment

In general the rash of miliaria will resolve without intervention if it is in mild form. As miliaria is caused in hot and humid conditions thus the primary treatment and prevention for miliaria is to control heat and humidity so that excessive sweating doesn't occurs. This can be done by removing occlusive clothing, moving to a cooler climate, limiting activity, frequent cool showers or baths with mild soaps and providing air conditioning.

In most of the cases the pimple like blisters are formed containing fluid inside of them, it is recommended to drain that fluid out of them either at home in a sterile environment or by means of a medical procedure. If the fluid is not drained then the fluid increases in viscosity and the blisters may become red and spread underneath the skin, making the conditions more adverse. When proceeding to drain the fluid at home then firstly the area affected should be sanitized and then followed by draining the blister by a sterilized needle or lancet [11].

Various topical formulations are available in the market to treat heat rash, in the form of lotions, ointments, powders, gels. These all generally include a cleansing agent, an antiseptic or antimicrobial, a cooling agent, anti inflammatory agent and an anti-pruritic agent with some additives for fragrance or color.

Cleansing agents are used in various dermatological disorders to remove dead skin, sebum, dirt and even moisturize the skin. The cleansing of the skin helps to clear the obstruction of the sweat gland's ducts and thus treating miliaria. Soothing agents nourishes and soothes the skin and anti microbial agents are used to eliminate and stop the growth of micro organisms such as *S.epidermis* and *S.aureus* which play a major role in causing miliaria by blocking the sweat gland duct. The anti-pruritic, anti inflammatory and cooling agents are used to get relieved from symptoms of miliaria like itch, redness and inflammation of the skin [11,12].

In addition to these agents, mild topical steroids like corticosteroids and hydrocortisone are also used to relieve the symptoms. Generally steroids work by reducing inflammation and and soothing the irritation.

Some of the widely used components include calamine (for soothing the skin), menthol as an anti-pruritic and cooling agent, boric acid and neem are used as an antimicrobial and zinc oxide as antiseptic and for its wound healing properties. Ingredient like turmeric provide various benefits as they act as cleansers ,speed up wound healing, natural antiseptic, anti-pruritic, and also provides anti inflammatory action.

The application of lanolin topically, shows great improvements in patients with miliaria profunda [13].

Except of topical applications, miliaria can also be treated by help of oral medication. Retinoids ,vitamin C and vitamin A have shown variable rate of success in treatment , but no controlled trials have been done to show the magnitude of effectiveness of these systemic therapies.

Herbal Treatment

The most common remedies for prickly heat rash include oatmeal bath, gentle massage with aloe vera gel, and application of paste of baking soda, sandalwood powder, fuller's earth, margosa leaves, neem leaves and basin. The pastes are made either by mixing the fine powder of the ingredient with water or rose water. A mixture of chamomile and powdered calendula mixed with cornstarch is also very effective and soothes the skin. These remedies mostly work by moisturizing and soothing the skin along with providing a mild antimicrobial and anti-pruritic action. In case of miliaria profunda and miliaria pustulosa it is recommended to seek a medical professional [14, 15, 16].

Formulations

Various formulations are available in the market to treat miliaria, like ointments, gels, lotions, creams, powders etc (Table 1). Out of all these the powder preparations are widely used as powders remain for a longer time over the skin and kill bacteria dispersed into the bed of the powder applied, also it provides a dry surface which is a major aspect as dry surface leads to better healing of miliaria [10].

Preparations like ointments and creams are preferably made with aqueous base rather than an oily base because aqueous base provides many advantages as it provides faster absorption, easy spreading over skin and thus easy applications, they don't breakout unlike oil based formulations, they don't leave any marks and doesn't clog the skin pores. Whereas the oil based creams or ointments can clog the skin pores or form a layer over a skin which is unwanted in treatment of miliaria.

Table1: Herbal treatment available in market

Name	Company	Ingredient	Application	Reference
Prickly heat baby powder	Himalaya	Khus-khus, yashada bhasma, jaitun oil, vatada, ushira	Powder is gently applied on the skin surface	17
Magicool plus Prickly heat spray	France Med. pharma	Aqua, Allantoin, MeOthoxymethane, Betain, hesperidin, Menthyl lactate, Oryzanol	Aerosol is sprayed on the affected area	18
Prickly heat spray	Naissance	Aqua, Hamamelis virginia, Alcohol, Anthemis nobilis oil, Eucalyptus oil, Lavandula angustifolia oil	Aerosol is sprayed on the affected area	19
Dermacool plus cream	Dermacool	Aqua, White soft Paraffin, Emulsifying Wax, Paraffinum Liquidum, Menthol, Phenoxyethanol	Apply on low quantity and gently massage on the skin	20
Snake brand Prickly heat powder	The British dispensary.co	Talc, Kaolin, Camphor, Menthol, Triclocarban, C177491, C177492	Apply gently on the skin	21
Resinol medicated ointment	Resical.inc	Petrolatum, Resorcinol, Calamine, Cornstarch, Lanolin, Zinc oxide	Gently massaged over the effected area	22
Praval pishti	Patanjali	Coral calcium, Rose water	Taken orally twice a day with dose not exceeding 2500 mg	23

AYURVEDIC TREATMENT

It is considered as an holistic concept and a natural system of health management which has been originated 5000 years ago. Ayurveda creates an overall health and takes into consideration that body, mind and soul is interconnected. The state of being is based on the principle of doshas in Ayurveda. The three doshas are- Vatta, Pitta and Kapha. Any imbalance in any of these doshas will lead to a diseased state. These doshas are further comprised of different elements (Table 2). According to ayurveda the world is made of 5 fundamental elements, these are aakash (ether),vaayu (wind), agni (fire), jal (water),and prithvi (earth) [24, 25] .

Table 2: Different elements in doshas in Ayurveda

Name of dosha	Element 1	Element 2
Vata	Earth	Air
Pitta	Fire	Water
Kapha	Water	Earth

Vata dosha is concerned with the body's motion, the pitta dosha is concerned with body's metabolism and kapha dosha is concerned with body's structure.

The Pitta dosha is further of 5 types - these are pachaka, ranjaka, sadhaka, alochaka , bhrajaka. The bhrajaka type is responsible for them maintaining skin color, texture, and temperature and hence the miliaria or heat rash occurs due to the imbalance in bhrajaka-pitta dosha. Various other symptoms of pitta dosh imbalance include visual problems, peptic ulcer, skin diseases, premature baldness, excessive body heat, acne, boils, and inflammatory bowel disease. Therefore all the remedies which are used to balance pitta dosha can be used to treat miliaria.

The treatment can be done both externally by application of various oils, pastes and other remedies or by internal intake of various Bhasma, Rasa etc [26, 27].

External remedies include application of various oils, powders, emulsions and pastes over the effected area. these oils include Chandanadi taila, Durvadi taila and Himasagara tailam. Paste of Durva, chandana, and ushira is made using rose water and applied over the area where the prickly heat has affected the skin. The emulsion of onion juice and ghee are also effective and used by application over the affected area. Other ingredients used in making these remedies include coconut oil, turmeric powder, lemon juice, red sandalwood powder, coccum juice etc.

Internal remedies include: Kamadugdha with mouktika (contains coral and pearls), Chandrakala rasa (possess usheera and ketaki) , Godanti bhasma (medicated ash of gypsum), Gulkhand (rose and sugar), Sarivadyasava (contains Indian sarsaparilla), Chandanasava (acts as a coolant), Usheerasava (has potent diuretic properties), Pravala bhasma (formulation of coral) [28]. These all internal remedies generally reduce sweating and act as a coolant to reduce the symptoms and treat miliaria.

UPDATES IN TREATMENT OF MILIARIA

Bansod *et al.*, 2010 investigated that anti-microbial compounds in human sweat are an important diagnostic and therapeutics for the treatment of skin diseases like miliaria (29). Use of topical steroids for treatment of miliaria is most recommended because of their anti-inflammatory properties. The physicians move top antibiotics and antifungals for prevention of secondary infection. The physicians may prescribe oral antibiotics and antihistaminics if required.

CONCLUSION

For the prevention of miliaria, clothing must be properly laundered to adequately remove detergent residue. While in hot environments, individuals with sensitive skin should take the necessary precautions such as regular changing of uniforms and good personal hygiene to ensure that their skin remains as dry and clean

as possible and drinking lots of fluids. It is also important that they seek medical advice as soon as skin irritation or rash appears to initiate the necessary medical procedures.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. Madhu Chitkara, Vice Chancellor, Chitkara University; Dr. Ashok Chitkara, Chancellor, Chitkara University; Dr. Sandeep Arora, Director, Chitkara College of Pharmacy for providing necessary facilities and support.

REFERENCES

- [1] <http://dermnetnz.org/hair-nails-sweat/miliaria.html>
- [2] William DJ, Timothy BG. *Andrews' Diseases of the Skin: clinical Dermatology*. Saunders Elsevier. 2006.
- [3] <https://patient.info/in/health/prickly-heatheat-rash-miliaria>
- [4] <http://emedicine.medscape.com/article/1070840-overview>
- [5] Bologna JL, Rapini RP. *Dermatology*. Gulf Professional Publishers.
- [6] Mowad CM, McGinley KJ, Foglia A, Leyden JJ. *J. Am. Acad. Dermatol.* 1995; 33 (1): 729-733.
- [7] <https://www.dermnetnz.org/topics/miliaria/>
- [8] Hambrick GW, Microanatomy of miliaria crystallina - George W. hambrick, JR, M.D and Harvey Blank, M.D
- [9] Moosavi Z, Hosseini T. *Pediatr Dermatol.* 2006; 23(1):61-3.
- [10] Huda M, Saha P. *Indian J Dermatol.* 2009; 49:189.
- [11] https://en.wikipedia.org/wiki/Miliaria#cite_note-pmid-7593770-8
- [12] Mukhopadhyay P. *Indian J Dermatol.* 2011; 56(1): 2-6.
- [13] Kirk JF, Wilson BB, Chun W, Cooper PH. *J Am Acad Dermatol.* 1996; 5(2):854-6.
- [14] <https://healdove.com/alternative-medicine/10WaystoCurePricklyHeatRashwithNaturalHomeRemedies>
- [15] <http://www.top10homeremedies.com/home-remedies/home-remedies-prickly-heat.html>
- [16] Todd C. Jude. *Herbal Home Remedies*. Jain Publishers, 2002, pp.105 .
- [17] <http://www.himalayastore.com/babycare/prickly-heat-baby-powder.htm>
- [18] <https://www.tesco.ie/groceries/Product/Details/?id=272492766>
- [19] <https://www.enaissance.co.uk/prickly-heat-and-heat-rash-spray>
- [20] <http://www.expresschemist.co.uk/dermacool-plus-2-menthol-in-aqueous-cream-100g.html>
- [21] <http://www.livinginmajor.com/snake-brand-prickly-heat-powder>
- [22] <http://resical.com/resinol/label-information/>
- [23] <https://www.ayurtimes.com/praval-pishti-coral-calcium-benefits-side-effects/>
- [24] Spear HE, Garivaltis H. *The everything guide to ayurveda*. Adams Media, 2012, pp 1-8.
- [25] *Ayurveda Basics for The Absolute Beginner [Achieve Natural Health and Well Being through Ayurveda Advait*, 2014.
- [26] Walter SK. *Ayurvedic tongue diagnosis*. Motilal Banarsidass Publishers, 2007, pp. 480
- [27] Sharma H, Clark CS. *Ayurvedic healing-Contemporary Maharishi Ayurveda Medicine and Science*, Second Edition, Singing Dragon, 2011, pp 35-39.
- [28] <http://easyayurveda.com/2015/08/17/prickly-heat-ayurvedic-treatment-medicines-remedies/>
- [29] Bansod SD, Shembekar VS, Barbole RS, Chavan RS, Suryawanshi Y, Shende S and Jamalpure SS. *Journal of Biotechnology and Bioinformatics.* 2010; 1 (2): 258-266.