

The Profile of Diaper Dermatitis in Infants

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Abstract: Diaper dermatitis is a common condition in infants. The present study aims to describe the profile of diaper dermatitis in infants. A cross-sectional study was conducted between August and December 2018 in several hospitals, community health centers and integrated health service in Medan, Indonesia. Age, gender, birth order, a term or preterm delivery history, feeding history, diaper type used, frequency of diaper changing and defecation, cleansing agents, diaper cream used, location of rash and skin scraping examination with 10% potassium hydroxide preparation were identified. There were forty infants with diaper dermatitis included in the study. Of those, 24 infants (60%) were aged 0-6 months, 21 infants (52.5%) were male, and 25 (62.5%) infants were first child. Further, 38 infants (95%) were born a term, 18 infants (45%) were fed with formula milk, 36 infants (90%) wore disposable diaper, 23 infants (57.5%) had diaper changed <6 times a day, 30 infants (70%) defecated <3 times a day, 17 infants (42.5%) were cleaned with wet wipes, and 25 infants (62.5%) did not use any diaper cream. Eleven infants (27.5%) had a rash in the inguinal area. Skin scraping examination with 10% potassium hydroxide preparation showed positive results in 11 patients (27.5%).

1 INTRODUCTION

Diaper dermatitis is an eruption in the area covered by the diaper, characterized by erythema, scales, red plaque, or erosions of skin. It is commonly known as diaper rash. The covered area includes the lower abdomen, genital organs, waists, inner thighs, buttocks and perianal (Stamatas and Tierney, 2014; Mohamadi et al., 2014).

There are several causes of diaper dermatitis, i.e. skin friction and irritation, urine and feces, increase in skin moist and pH, and zinc deficiency (Coughlin et al., 2014; Blume-peytavi et al., 2014). The three most common types of diaper dermatitis are chafing dermatitis, irritant contact dermatitis, and diaper candidiasis. The prevalence of diaper dermatitis in general population is 7-35% while among hospitalized infants and children is 17-43% (Merrill, 2015). The prevalence among countries varied between 15-84% (Hurdoyal and Pandamikum, 2015;

Li et al., 2012). The incidence of diaper dermatitis is common in infants aged 3-12 weeks and the peak is in infants aged 9-12 months. The rate seems to be similar across male and female (Alonso et al., 2013; Yaduwanshi and Kumari, 2012).

Infant skin is anatomically and physiologically different from adults. Although healthy and term neonates seem to have well-developed skin, the function of the epidermis is not complete yet (Adam, 2008; Merrill, 2015). The epidermis layer of the infant is characterized by thin stratum corneum and thin collagen fibers in the dermis layer. A recent study showed that aterm neonates skin is not competent and still continues to complete the maturation process in the first year of life (Agustinus et al., 2017; Merrill, 2015). The epidermis layer as a skin barrier is not complete yet to prevent water loss and penetration irritants from the environment. Further, the infant has a greater tendency to develop dermatitis. Preterm infant skin has an immature stratum corneum thus more risky to have an

infection (Agustinus et al., 2017; Atherton et al., 2016).

Diaper dermatitis can be diagnosed by complete history taking including the duration, symptoms, risk factors and appearance of the eruption (Lawton, 2014; Shin, 2014). There are several factors associated with diaper dermatitis in infants, including frequency of urination and defecation, frequency of diaper changes, type of diaper, type of cleanser, product applied to skin, diet, diarrhea, recent antibiotic used and any previous diaper dermatitis (Merill, 2015; Lawton, 2014; Shin, 2014; Li et al., 2012). Frequent urination and defecation on covered skin will increase skin pH. Production of frequent liquid feces means the enzyme is greater and can act as irritants along with urease enzyme from the urine. Frequency of urination in neonates is more than twenty times in 24 hours and will reduce to around seven times at 12 months of age. Therefore, frequent diaper changes are important to do for at least every 3-4 hour (Li et al., 2012). Improvement of diaper technology associated with the decrease of the severity of diaper dermatitis. The absorbent gel makes it possible for a disposable diaper to keep skin to be dry and maintain the normal moisture. Cleanser used to cleanse out the rain and feces is also important because it will remove the lipid and feces residue from the stratum corneum (Atherton, 2004; Odio and Thaman, 2014). The use of barrier cream every diaper change aim to reduce friction, wetting and contact with urine and feces. The ideal barrier cream will provide a longlasting lipid shield which protects the skin from irritants. (Atherton, 2004; Merrill, 2015).

Treatment of diaper dermatitis varies depending on the severity and etiology. Current practice including the most recent guideline on neonatal skin care from the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN, 2013) recommends five approaches for prevention and treatment of diaper dermatitis. The approaches are nonpharmacologic solutions easily summarizes into the "ABCDE" that include air, barrier, cleansing, diapering, and education. The first is to expose the diaper area frequently to air as much as possible. Apply barrier cream to skin for infants at risk of diaper dermatitis or whenever diaper dermatitis is present. The skin should be cleansed gently with water and soft cloth or wipes at every diaper change. Use of superabsorbent diaper is recommended and the diaper should be changed as soon as the diaper is soiled at least every 3 hours during the day and once during the night. Parents must be educated for diaper hygiene and good skin practices (Merill, 2015;

Pogacar et al., 2018; Serdaroglu and Ustunbas, 2010).

Diaper dermatitis can improve in a couple of days with good skin practices. A skin infection may develop if diaper dermatitis is not managed well. One of the most common infection occurred is caused by fungal. *Candida* is fungal that often infects skin with diaper dermatitis. When it is suspected, the skin scraping examination with 10% potassium hydroxide can be done to identify the fungal structure such as hyphae, pseudohyphae or spore (Bonifaz et al., 2016). If it is confirmed, topical antifungal can be given as the choice for treatment for diaper dermatitis.

Several studies in Indonesia has been conducted to evaluate parents knowledge about diaper dermatitis (Ullya et al., 2018; Kusumastuti and Alfiyanti, 2017; Jahidin, 2015) however studies on the profile of diaper dermatitis in infants and skin scraping examination with 10% potassium hydroxide to find fungal infection are still limited.

The aim of this study is to describe the profile of diaper dermatitis in infants at health service centers in Medan, Indonesia. The health service centers included in this study are the hospital, community health center (known as Puskesmas) and integrated health service center (known as Posyandu).

2 METHODS

This cross-sectional study was conducted between August and December 2018 at one General Hospital, one Hospital Women and Children, two community health centers and integrated health service centers (Posyandu in the two Puskesmas area) in Medan, Indonesia. Subjects were infants who were inpatient at the two hospitals, and infants who were attending the two Puskesmas and Posyandu. Inclusion criteria included infants aged 0-24 months, wore a diaper and had diaper dermatitis at the time of the study. Exclusion criteria included infants who used the antifungal topical cream on skin covered by the diaper and had oral antibiotics at the time of the study. Forty patients who were fulfilled the selection criteria participated in the study.

Parents or guardians were given written informed consent before enrolment of the children to the study. The required information was being asked to the parents or guardians and then the diaper rash was observed carefully. Skin scrapping was collected with a sterile pot and analyzed at the clinical microbiology laboratory in the General Hospital. Samples were labeled with name, age, and gender.

Skin scraping sample was prepared with 10% potassium hydroxide preparation and examined under a microscope. Microscopic findings were used to identify the presence of fungi, i.e. hyphae, and spore they were confirmed as a positive result.

Data processing using Statistical Package for the Social Science (SPSS) version 22.0 was presented descriptively to see the percentage of profile diaper dermatitis in infants in the present study.

The protocol of this study has been approved by the Ethics Committee of Faculty of Medicine, Universitas Sumatera Utara with ethical clearance No: 446/TGL/KEPK FK USU-RSUP HAM/2018.

3 RESULTS

A total of 40 patients were included in this study. Of those, 13 patients were enrolled at the General Hospital (8 male, 5 female), 6 patients were at Women and Children's Hospital (3 male, 3 female), 2 patients were at the Puskesmas (2 male), and 19 were at the Posyandu (8 male, 11 female).

Demographic characteristics are described in Table 1. Infants aged 0-6 months was the most prevalent of all age groups ($n=24$, 60%), and the male was found to be more common ($n=21$, 52.5%). Of those, most were first child ($n=25$, 62.5%).

Table 2 showed the profile of diaper dermatitis in infants as follows: born at full-term ($n=38$, 95.0%), infants fed with formula milk ($n=18$, 45.0%), worn disposable diaper ($n=36$, 90%), frequency of diaper change <6 times a day ($n=23$, 57.5%), frequency of defecation <3 times a day ($n=30$, 75.0%), cleansed using wet wipes ($n=17$, 42.5%) and did not use a diaper cream ($n=25$, 62.5%).

On rash examination, we found that the most common location of the rash was inguinal area ($n=11$, 27.5%), as shown in Table 3.

Skin scraping examination with 10% potassium hydroxide showed positive result only in 27.5% of infants ($n=11$). The assay also found hyphae in 2 samples, pseudohyphae in 9 samples. And there was no spore identified (Table 4).

Table 1: Demographic Characteristic of Infants

Characteristics	Place of Study				Total	%
	General Hospital	Women and Children Hospital	Puskesmas	Posyandu		
Gender						
Male	8	3	2	8	21	52.5
Female	5	3	0	11	19	47.5
Age (month)						
0-6	7	6	1	10	24	60.0
7-13	6	0	1	7	14	35.0
14-20	0	0	0	1	1	2.5
21-24	0	0	0	1	1	2.5
Birth Order						
1 st	6	5	0	14	25	62.5
2 nd	6	1	0	2	9	22.5
≥ 3 rd	1	0	2	3	6	15.0

Table 2: Profile of Diaper Dermatitis in Infants

Profile	Place of Study				Total	(%)
	General Hospital	Women and Children Hospital	Puskesmas	Posyandu		
Delivery history						
A term	11	6	2	19	38	95.0
Preterm	2	0	0	0	2	5.0
Feeding history						
Breastfeeding	3	2	1	11	17	42.5
Formula milk	7	3	1	7	18	45.0

Breastfeeding and formula milk	3	1	0	1	5	12.5
Type of Diaper						
Cloth diaper	0	0	0	3	3	8.3
Disposable diaper	13	6	1	16	36	90.0
Modern cloth diaper	0	0	1	0	1	1,7
Frequency of diaper changing						
<6 times/day	5	3	1	14	23	57.5
≥6 times/day	8	3	1	5	17	2.5
Frequency of defecation						
<3 times/day	8	4	0	18	30	75.0
≥3 times/day	5	2	2	1	10	25.0
Cleansing agents						
Water only	4	2	0	7	13	32.5
Water and soap	2	1	1	6	10	
Wet wipes	7	3	1	6	17	42.5
Diaper cream						
Never	7	6	0	12	25	62.5
Always	1	0	0	1	2	5.0
Sometimes	5	0	2	6	13	32.5

Table 3: Location of Diaper Dermatitis Rash

Location of Rash	Place of Study				Total	%
	General Hospital	Women and Children Hospital	Puskesmas	Posyandu		
Genitalia	0	0	0	4	4	10.0
Pubic	1	0	0	2	3	7.5
Inguinal (R/L)	5	1	1	4	11	27.5
Femoral (R/L)	0	0	0	1	1	2.5
Perineum	1	0	0	0	1	2.5
Perianal	3	2	1	4	10	25.0
Gluteal	2	3	0	2	7	17.5
Genitalia and public	1	0	0	2	3	7.5
Inguinal and femoral	0	0	0	0	0	0

R=right, L=left

Table 4: Skin Scrapping Examination with 10% potassium hydroxide

Result	Microscopic Finding			Total	%
	Spore	Hyphae	Pseudohyphae		
Positive	0	2	9	11	27.5
Negative	0	0	29	29	72.5

4 DISCUSSION

This study described the diaper dermatitis profile in infants attending the General Hospital, Women and Children's Hospital, Puskesmas and Posyandu in Medan, Indonesia. In the present study, subjects with diaper dermatitis were aged between 0-24

months. Infants aged between 0 and 6 months was the most prevalent among other age groups. The prevalence of diaper dermatitis was likely to decrease correspondingly with the increase of infant's age. This condition is associated with the incompetent stratum corneum of the neonates. A recent study has shown that full maturation of stratum corneum might not be complete until one

year of age (Nikolovski et al., 2008). It has also been associated with the skin pH of the neonates. At birth, the pH has been reported to be around 7.80, which is higher than 5.7 measured in adults. However, the level of Ph declines after several weeks of life (Yosipovitch et al., 2000; Horowitz et al., 2013; Fluhr et al., 2012). The development of stratum corneum and the decline of skin pH to be more acidic are important as the barrier function and as an antimicrobial defense of the skin. Therefore, younger infants are more prone to be at risk for dermatitis. Nevertheless, some other studies have described that diaper dermatitis was frequently found among infants aged 6 to 12 months which might be associated with feeding (Hurdoyal and Pandamikum, 2015; Yaduwanshi and Kumari, 2012). Li et al., (2012) reported the incidence of diaper dermatitis tends to increase along with the increase of age and the peak was infants aged 19-24 months. Adalat et al., (2007) found infants aged 12-24 months aged to be the most prevalent followed by aged 6-12 months. Infants aged higher than six months has given solid foods diet, causing the adaptation process of the digestive tract and also the change of digestive enzyme (Hurdoyal and Pandamikum, 2015; Yaduwanshi and Kumari, 2012).

Diaper dermatitis is a common condition found in infants and children. The prevalence and incidence varied among countries around the world. It is associated with many risk factors such as type of diaper, duration of diaper use, skin hygiene practice, and different childcare practices (Andrini, 2016; Merrill, 2012).

In this study, male infants were more common. Several previous studies reported the same results (Hurdoyal and Pandamikum, 2015; Frilasari, 2016; Mohamadi et al., 2014). Other studies stated that gender is not significantly different compared to the control subjects (Li et al., 2012; Elfaituri et al., 2016). But in contrast to those studies, Yaduwanshi and Kumari (2012) and Blanco and van Rossem (2013) reported female subjects are greater in infant's diaper dermatitis.

In the present study, we found that most infants are the first child in the family. This might be due to the lack of experience and knowledge of baby care. New parents often follow the method of babysitting by the grandparents, but some of them do not look for information online or ask experienced friends. This often happens because most working parents entrust the baby to the grandparents when they are at work. However, this theory still needs to be studied to prove the relationship.

We also found that infants born at a term gestational pregnancy age to be more common. This is in accordance with a previous study stating that healthy, a term neonate's skin does not completely mature to function as a barrier toward irritants and infections (Adam, 2008; Merrill, 2015; Agustinus et al., 2017). Infants who were fed with formula milk also had more diaper dermatitis in this study. It has been reported that breastfed children have a lower prevalence of diaper dermatitis because their feces have a higher pH, lower digestive enzyme activity and less urease-producing bacteria than formula milk-fed children (Yoshioka et al., 1983).

Further, infants with a disposable diaper with diaper changes <6 times a day had more diaper dermatitis in this study. Li et al., (2012) reported the same findings. This is due to the skin covered by diaper get more moisture and humidity which can lead to maceration. Thus, frequent diaper changes are good to maintain skin dryness.

In the present study, most infants did not have diarrhea at the time of the study. Diarrhea may be an important risk factor to develop diaper dermatitis. Frequent exposure to liquid feces is associated with greater amounts of an enzyme which pass with the feces (Atherton, 2001).

Wet wipes have been used widely as an alternative to cleansing the skin. In this study, parents or guardians had already worn wet wipes as an alternative to water and soap. The use of wet wipes consider to be better in reducing the occurrence of diaper dermatitis is infants (Ehretsmann et al., 2001). Diaper creams may also provide a protective lipid film that prevents exposure to irritants (Stamatas and Tierney, 2014). Diaper cream should be applied at every diaper change for infants at risk of developing diaper dermatitis and whenever diaper dermatitis is present (Atherton, 2016; Noonan et al., 2006). In this study, parents did not yet use any diaper cream because of the lack of information on the function of diaper cream as a protector for infant skin.

The location of diaper dermatitis rash was found greater in the inguinal area, followed by the perianal area. Andrini (2016) also reported that inguinal to be the most affected area in diaper dermatitis subjects. The rash in covered diaper skin often appears in the area which contacts with diaper and gets more friction. The skin folds and convex area of gluteal are also frequently affected because of the high humidity (Adam, 2008; Alonso et al., 2013).

Most infants with diaper dermatitis were found at the Posyandu in this present study. Posyandu is a place which health activities organized from, by and

for communities assisted by health workers from Puskesmas. It primarily starts to serve not only babies and toddlers but also the elderly. Baby health services specifically in weighing and immunization is common, but baby caring is not done routinely.

Skin scraping examination is easy, cheap and can be done immediately. The examination is important to identify fungal infection, thus clinicians can choose the appropriate treatment for diaper dermatitis. The sensitivity of this test is about 60%, thus the possibility to detect fungal infection is still high (Mutiawati, 2016; Sari et al., 2013). The percentage of skin scraping examination with 10% potassium hydroxide preparation in this study is different from the previous study. Blanco and van Rossem (2013) has shown that the positivity of diaper dermatitis in infants was 59%. The role of fungal infection in diaper dermatitis has been studied in other studies. The most common fungal infection associated with diaper dermatitis is *Candida*, especially *Candida albicans*, which has been reported in more than 80% of cases (Klunk et al., 2014; Ferrazini et al., 2003). Normally the number of *Candida* in the diaper area without dermatitis is low and yeasts are isolated in <4% of cases, while they are present between 70 and 92% of children with diaper dermatitis (Adalat et al., 2007; Adam, 2008).

There are a few limitations in this study. First, the numbers of samples enrolled in this study was relatively small. Second, there is no control subjects participated in this study. However, this study showed that diaper dermatitis is a common problem during infancy and fungal infection is still common to present as a secondary infection. The further comprehensive study is needed to be done.

5 CONCLUSION

1. The proportion of diaper dermatitis in this study was greater among infants aged 0-6 months, the male was found to be the most common compared to female, and the first child was also commonly found.
2. The present study showed that most infants with diaper dermatitis were born a term, fed with formula milk, wore a disposable diaper, had a diaper changed <6 times a day, defecated <3 times a day, cleansed with wet wipes and did not use any diaper cream.
3. The location of rash in the diaper dermatitis varied in this study. Inguinal was the most affected area, followed by the perianal area.

4. The percentage of fungal infection in the diaper dermatitis in this study was 27.5% as confirmed by a skin scraping examination with 10% potassium hydroxide preparation.

6 SUGGESTION

1. Special care for infants with diaper dermatitis in the hospital needs to be done carefully by doctors and nurses in the pediatric room.
2. Joint care of pediatrician and dermatologist for the prevention and treatment of infants with diaper dermatitis in hospital needs to be done continuously (integrated care).
3. Health workers in Puskesmas and Posyandu need to be trained about the good skin care practice for infants so that they can educate the parents.
4. Fungal culture examination as the gold standard can be done in further study to explain the role of fungal as the cause of diaper dermatitis.

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