

RESEARCH

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Staphylococcus aureus and sore nipples

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OBJECTIVE To correlate clinical symptoms and signs of sore nipples with the presence of *Staphylococcus aureus* and to determine the probability of mothers having *S aureus*-infected nipples when these local symptoms and signs are found.

DESIGN Two cohorts of consecutive patients were enrolled regardless of presenting complaint.

A questionnaire was administered to determine the presence and severity of sore nipples.

Objective findings on breast examination were documented. A nipple swab was taken for culture and sensitivity

SETTING Breastfeeding clinic serving patients referred by family physicians, pediatricians, and community health nurses.

PATIENTS A sample of 227 breastfeeding mothers was collected in two cohorts.

MAIN OUTCOME MEASURES Answers to questions about sore nipples, objective findings from physical examination, and results from nipple swabs.

RESULTS Most subjects (51%) had sore nipples, and 45% of subjects had objective findings on examination; 23% of subjects had a positive nipple swab culture; 15% grew *S aureus* on culture. The risk of having *S aureus* colonization was 4.8 times greater if nipple pain was moderate or severe rather than mild. A break in nipple integument associated with cracks, fissures, ulcers, or pus gave a 35% chance of having *S aureus* colonization, five times greater than when the integument was intact.

CONCLUSIONS The study showed that mothers with infants younger than 1 month who complained of moderate to severe nipple pain and who had cracks, fissures, ulcers, or exudates had a 64% chance of having positive skin cultures and a 54% chance of having *S aureus* colonization.

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OBJECTIF Analyser la corrélation entre les signes et symptômes cliniques du mamelon douloureux et la présence de staphylocoques dorés et, en présence de ces signes et symptômes locaux, déterminer la probabilité que le mamelon soit infecté par le s. doré.

CONCEPTION Deux cohortes de patientes consécutives furent recrutées indépendamment de la plainte de présentation. Elles ont rempli un questionnaire pour déterminer la présence et l'importance de la douleur au mamelon. On a documenté les signes objectifs constatés à l'examen du sein. Un écouvillonnage du mamelon fut prélevé pour culture et antibiogramme.

CONTEXTE Clinique d'allaitement desservant les patientes référées par les médecins de famille, les pédiatres et les infirmières de santé communautaire.

PARTICIPANTES Échantillon de 227 mères nonrricières réparties en deux cohortes.

PRINCIPALES MESURES DES RÉSULTATS Réponses aux questions concernant la douleur aux mamelons, les signes objectifs constatés à l'examen physique et les résultats des cultures du mamelon.

RESULTATS Une majorité des mères (51 %) avaient une douleur au mamelon et, à l'examen clinique, on a trouvé des signes objectifs chez 45 % des patientes ; les cultures du mamelon furent positives chez 23% des participantes et 15% des cultures ont révélé du *S. aureus*.

Le risque d'une colonisation par le *S. aureus* était 4,8 fois plus élevé lorsque la douleur au mamelon était modérée ou sévère comparativement à la douleur légère. La rupture de l'intégrité du mamelon associée aux érosions, aux fissures, aux ulcères ou à la présence de pus comportait 35% de risque d'une colonisation par le *S. aureus*, c'est-à-dire cinq fois plus élevé comparativement au mamelon intact.

CONCLUSIONS L'étude révèle que les mères qui allaitent leurs enfants de moins d'un mois, qui se plaignent de douleur modérée ou sévère du mamelon et chez qui on constate des érosions, des fissures, des ulcères ou des exsudats ont un risque de 64% d'avoir une culture positive et un risque de 54% de présenter une colonisation par le *S. aureus*.

ABOUT 80% OF BREASTFEEDING MOTHERS have sore nipples.¹ The medical and nursing literature has, for many years, recommended a variety of treatments ranging from topical application of cold tea bags, carrots, and vitamin E to lanolin and alcohol preparations and air drying; however, the efficacy of these treatments has not been proven. In fact, air drying is now thought to be detrimental because it abstracts water from the skin and precipitates protein, which leaves the skin less pliable and more likely to fissure.

More recently, detailed studies of infant suckling at the breast have illustrated how tongue trauma, due to inappropriate latch, can cause friction against the nipple and result in abrasions and painful nipples. Repositioning can have a dramatic effect and instantaneously remove the pain and discomfort.^{2,3}

At the Vancouver Breastfeeding Centre, we have observed more than 5000 mother-infant pairs. In some cases, nipple pain and ulceration continued despite careful attention to maternal breastfeeding technique. We observed that mothers experiencing nipple cracks and superficial ulceration with serous discharge were often slower to achieve comfortable breastfeeding than mothers without moist cracks and ulcers.

As in other clinical situations, when there is a break in the skin surface, there is a predisposition to a secondary infection due to bacterial contamination. Contaminated wounds are often slower to heal, and the infection can lead to cellulitis or adenitis and subsequent abscess formation.

Our hypothesis was that sore nipples associated with skin breakage, including cracks, fissures, and ulceration, had a higher chance of being contaminated with *Staphylococcus aureus* than nipples that were not sore and cracked.

The purpose of this study was to correlate the clinical symptoms and signs of sore nipples with the presence of *S. aureus* and to determine the probability of mothers having *S. aureus* colonization on their nipples when these local symptoms and signs are found. This study does not attempt to identify causation, nor does it address the management of infected sore nipples.

METHODS

Study design and selection criteria

A prospective study was carried out on two cohorts of consecutive patients referred to the Vancouver Breastfeeding Centre during two separate 3-month periods. They were enrolled at their first

visit, regardless of presenting complaint. Subjective and objective data were collected using a standardized procedure. Ethical approval and informed consent were obtained.

Demographics

The Vancouver Breastfeeding Centre is a clinic that specializes in diagnosing and managing breastfeeding problems. Patients are referred by family physicians, pediatricians, and community health nurses. The patient population is mainly white, but a sizable proportion, approximately 20% to 30%, are Asians. Most patients are well educated and from urban and suburban areas.

A short questionnaire was administered by the lactation consultant or physician at the time of the first visit. Questions pertaining to a history of sore nipples were asked and symptoms ranked according to severity. Objective findings on breast examination were documented and categorized.

Following a standard procedure, a nipple swab was taken from the right nipple when no symptoms or signs were recorded. If symptoms were present, the swab was taken from the most painful nipple, and if there was a break in the skin, the swab was taken directly from it. The swab was taken from an unwashed nipple and before breastfeeding whenever possible.

The sample was sent to the local laboratory in accordance with routine clinical practice. Culture and sensitivity studies followed standard laboratory protocols. "Normal skin flora" was reported for coagulase-negative staphylococci, diphtheroids, α -streptococci, and non- β -hemolytic streptococci. All other organisms were isolated and identified; sensitivities were given for three or fewer organisms.

Table 1. Correlation between clinical symptoms of sore nipples and microbiologic findings (N = 227)

SYMPTOMS	NO.	%	CULTURE RESULTS		
			POSITIVE		NEGATIVE
			S. AUREUS	OTHERS*	
No symptoms	112	49.3	10	7	94
Minor symptoms					
• Tenderness with latch	32	24.7	4	6	47
• Mild pain	24				
Major symptoms					
• Moderate pain	35	26	20	4	35
• Severe pain	24				
History					
• Negative	199	87.7			
• Positive	28	12.3			

* Others include *Candida*, *E coli*, *Streptococcus Group B*, and *Acinetobacter*.

Statistical analysis

Initial data were collected manually: two-way tables were constructed and analyzed with χ^2 tests.

RESULTS

Two hundred fifty-five mothers were enrolled in the study, ranging in age from 18 to 44 years, with a median age of 31. Infant age range was 1 to 324 days, with a median of 22 days. From the mothers enrolled, 28 were excluded from the study because of incomplete data.

Forty-nine percent of subjects were asymptomatic and 51% complained of sore nipples ranging from mild tenderness with latching to severe nipple pain with latching and suckling (*Table 1*). On examination, 55% of all mothers had no objective findings; 17% had minor physical findings on the nipple but had an intact integument, and 28% had breaks in the nipple skin, including cracks, fissures, deep ulceration, or exudate (*Table 2*).

Positive skin cultures including *S aureus*, *E coli*, *Candida*, *Streptococcus* Group B, and *Acinetobacter* were found in 24% of all mothers; 15% of all mothers grew *S aureus* on nipple swab culture (*Table 3*).

Culture results revealed that 100% of the *S aureus* organisms were sensitive to cloxacillin, 12% of cases were resistant to erythromycin, and 80% of cases were resistant to penicillin.

There was no significant relationship between positive *S aureus* culture and a history of painful nipples ($\chi^2 = 1.54, P = 0.21$).

When considering symptoms alone, 21% of mothers with symptoms had positive nipple cultures compared with 15% of asymptomatic mothers (*Table 1*). The relative risk that a mother who had symptoms also had *S aureus* was 2.3.

We found a highly statistically significant relationship between moderate and severe nipple pain and a positive culture; 41% of mothers with moderate and severe nipple pain had a positive culture, and 34% had *S aureus* ($\chi^2=22.41, P < 0.0001$).

With respect to objective signs, 25% of mothers with nipple findings had a positive culture for *S aureus* compared with 6.5% of mothers with no nipple findings. Relative risk of having *S aureus* when there were objective findings was 3.9 (*Table 2*).

Clinically we had the impression that objective findings could be divided into major and minor findings. Major findings (cracks, fissures, ulcers, or pus on the nipple) seemed to be more likely to accompany *S aureus* infection of the lactating breast than minor findings (isolated findings of erythema, burning pain on light touch, white spots, or milk blisters).

Further analysis showed that 23 of 64 mothers with major objective findings had *S aureus*; that is, there was a 36% probability of having *S aureus* colonization in the presence of cracks, fissures, deep ulcers, or exudates. But in the absence of major findings, only 11 of 163 mothers had *S aureus*; hence, the probability of having *S aureus* in this situation was 6.7%. The chance of having *S aureus* when there were major findings was 4.5 times greater than when there were minor or no findings. Thus, a highly statistically significant relationship between the presence of major objective findings and *S aureus* infection was found ($\chi^2 = 30.75, P < 0.0001$).

Analysis of infant's age as a factor showed that, if the infant was younger than 1 month, there was a 28% chance of a nipple colonization (*Table 4*), whereas if the infant was older than 1 month, there was a 14% chance of a nipple colonization ($\chi^2 = 5.52, P = 0.019$). Considering *S aureus* only, a mother with an infant younger than 1 month had a 19% chance of an *S aureus* colonization compared with a mother whose infant was older than 1 month having an 8% chance of *S aureus* colonization ($\chi^2 = 4.55, P = 0.03$).

If a mother with an infant younger than 1 month complains of moderate to severe nipple pain and has objective findings of cracks, fissures, ulcers, or exudates, she has a 64% chance of a positive skin culture ($\chi^2 = 34.97, P < 0.0001$) and a 54% chance of *S aureus* colonization ($\chi^2 = 37.36, P < 0.0001$).

These results can be summarized as follows.

Table 2. Correlation between objective signs of sore nipples and microbiologic findings (N = 227)

OBJECTIVE FINDINGS	NO.	%	CULTURE RESULTS		
			POSITIVE		NEGATIVE
			S. aureus	OTHERS*	
No signs	124	54.6	8	6	110
Minor signs	39	17.2			
• Erythema with intact surface	16	} 22.9	} 3	} 4	} 32
• Burning pain on light touch	4				
• White spots or milk blisters	11				
• Additional findings [†]	21				
Major signs	64	28.2			
• Cracks or fissures on tip of nipple	37	} 33.0	} 23	} 7	} 34
• Cracks or fissures on circumference	11				
• Deep ulcer on tip of nipple	12				
• Deep ulcer on circumference	4				
• Pus	11				

Total count exceeds 227, as multiple responses were allowed.

* Others include *Candida*, *E coli*, *Streptococcus Group B*, and *Acinetobacter*.

[†] Additional findings include depigmented areas, lumps on the lateral aspect of left nipple, nipple blanche, plaques, or blood blisters.

Table 3. Microbiologic findings (N = 227)

CULTURE RESULTS	NO.	%
Normal skin flora	216	95.2
<i>Candida</i>	6	2.6
<i>E coli</i>	4	1.8
<i>S aureus</i> (light growth)	19	8.4
<i>S aureus</i> (moderate growth)	5	2.2
<i>S aureus</i> (heavy growth)	10	4.4
Others*	10	4.4

Total count exceeds 227, as multiple responses were allowed.

* Others includes *Streptococcus Group B* and *Acinetobacter*

Table 4. Correlation between age of infant and microbiologic findings (N = 227)

INFANT AGE (D)	CULTURE RESULTS		
	POSITIVE*		NEGATIVE
	S AUREUS†	OTHERS	
0 to 30	27	12	102
>30	6	4	64

* $\chi^2 = 5.52, P = 0.019.$
† $\chi^2 = 455, P = 0.030.$

- A history of painful nipples that had resolved had no predictive value for present *S aureus* colonization of lactating breasts.
- An asymptomatic mother had a 9% chance of having *S aureus* on her nipple.
- A mother with mild nipple tenderness had a 7% chance of having *S aureus*.
- A mother with moderate to severe nipple pain had a 34% chance of having *S aureus*.
- Within the group of symptomatic mothers, the risk of having *S aureus* was 4.8 times greater if there were major symptoms than if there were minor symptoms.
- With the exception of two mothers with white spots or milk blisters, all mothers with objective findings had sore nipples.
- Among mothers with sore nipples, if there was a break in the nipple integument associated with cracks, fissures, ulcers, or pus, the chance of having *S aureus* colonization was 36%. This was 5 times higher than mothers without a break in the integument.
- Mothers of infants younger than 1 month had a 19% probability of having a *S aureus* colonization, and this was 2.4 times the probability if the infant was older than 1 month.
- Mothers with infants younger than 1 month who complained of moderate to severe nipple pain and who had objective findings of cracks, fissures, ulcers, or exudates had a 64% chance of having a positive skin culture and a 54% chance of having *S aureus* colonization.

DISCUSSION

It is generally accepted that transient nipple soreness is normal for breastfeeding mothers in the early postpartum period. Increasing or persisting discomfort beyond the first week can be caused by several factors. These include inappropriate latch, abnormal infant sucking patterns, infant tongue-tie (where the frenulum is attached too near the tip of the tongue), or dermatitis of the nipple; however, such factors as frequency and duration of feeding, skin colour, hair colour; and nipple preparation do not seem to make a difference in preventing tenderness.⁴

Results of this study showed that 51% of all mothers attending a breastfeeding clinic had sore nipples and that sore, cracked nipples correlated strongly with the presence of *S aureus*.

Staphylococcus aureus is an organism of moderate virulence that is easily transmitted by contact or via airborne routes. It is present in the anterior nares of approximately 35% to 50% of normal people in the community.⁵ The pathologic conditions caused by *S aureus* are due to direct invasion through breaks in the skin and mucous membranes. Duncan and Walker⁶ recognized in 1940 that superficial skin infections could lead to a deeper cellulitis, adenitis or mastitis, or “flushed breast” when there was a breach in the mucous membrane, such as a cracked nipple. Symptomless colonization of wounds is at least as common as clinical sepsis, and it does not necessarily delay wound healing. Experimental evidence has shown acute

inflammation to result from placing small numbers of *S aureus* on the skin after the outer epidermal layers have been stripped off by the repeated application and removal of adhesive tape.⁷

The conditions necessary to produce a severe lesion are that the area is kept moist, serum exudes from the surface, leukocytes do not migrate to the exudate before the lesion is established, and few competing organisms are present.⁵ This situation correlates well with a traumatized nipple after poorly positioned breast-feeding. This is compounded by the high humidity that favours local multiplication of staphylococci on the skin surface.

Puerperal mastitis is said to affect 1.4% to 8.9% of nursing mothers presenting with general malaise, chills or sweats, and fever.⁸ However, half of affected patients do not have fever or systemic symptoms, but only localized symptoms and signs of inflammation.

This study has identified the risk of *S aureus* colonization on the nipples of breastfeeding mothers experiencing moderate and severe nipple pain with cracks, fissures, ulcers, and exudates, whose infants are younger than 1 month of age. Early identification of these at-risk mothers would permit early treatment for *S aureus* and hence decrease morbidity. Wound healing could be enhanced, cellulitis or adenitis avoided, and resolution of symptoms hastened if the *S aureus* infections were eradicated.

Current treatment recommendations for painful nipples fundamentally revolve around correct positioning and latch of the infant at the breast to prevent further tongue trauma to the nipple; however, there are cases where this does not lead to complete resolution of the problem and a dermatologic approach should be used.^{9,10} This involves identifying any underlying condition, such as eczema or Paget's disease, and detecting any superimposed infection with organisms such as *Candida* or *S aureus* and instituting the appropriate therapy.

The treatments employed in this study were correction of position and latch with or without local or systemic antibiotics or antifungal agents as dictated by the swab result.

In this study we did not evaluate the association of other types of breast pain with microbiologic findings on the nipples. No attempt was made to identify the site of origin of the pathogens. A detailed history of previous topical or systemic antibiotics used was not obtained. Based on our clinical experience, very few mothers use topical antibiotic ointments on their nipples, but some mothers use lanolin or other topical lubricants.

It cannot be concluded from this study that *S aureus* is the causal organism in the problem of sore nipples; however, the organism could contribute to delayed healing. A subsequent study is under way to establish the effectiveness of improved breastfeeding technique in management of nipple pain and to compare this with local and systemic antistaphylococci therapy. •

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