

## Microbiology of Secondary Bacterial Infection in Scabies Lesions

ITZHAK BROOK\*

Department of Pediatrics, Georgetown University School of Medicine, Washington, DC

Received 2 February 1995/Returned for modification 10 April 1995/Accepted 4 May 1995

**Aerobic and anaerobic bacteria were grown from specimens obtained from 30 children with secondarily infected scabies lesions. Aerobic or facultative bacteria only were present in 14 (47%) patients, anaerobic bacteria only were present in 6 (20%) patients, and a mixed anaerobic-aerobic flora was present in 10 (33%) patients. Fifty isolates were recovered (1.7 per specimen); 27 were aerobic or facultative bacteria and 23 were strict anaerobes. The predominant aerobic and facultative bacteria were *Staphylococcus aureus* (nine isolates), group A streptococci (five isolates), and *Pseudomonas aeruginosa* (three isolates). The predominant anaerobes were *Peptostreptococcus* sp. (nine isolates) and pigmented *Prevotella* and *Porphyromonas* spp. (four isolates). Single bacterial isolates were recovered from nine (30%) patients; five of these were *S. aureus*. Sixteen organisms isolated from 12 (40%) patients produced the enzyme  $\beta$ -lactamase. Organisms that resided in the mucous membranes close to or in contact with the lesions predominated in those infections. Enteric gram-negative rods were recovered in leg and trunk lesions. Group A streptococci and *S. aureus* predominated in finger and hand lesions. *Bacteroides fragilis* group and *Clostridium* sp. were isolated from leg lesions, and pigmented *Prevotella* sp. and *Porphyromonas* and *Fusobacterium* spp. were recovered from finger lesions. The polymicrobial etiology of secondarily infected scabies lesions in children and the association of bacterial flora with the anatomical sites of the lesions are demonstrated.**

Secondary bacterial infection in scabies lesions is common. The aerobic and anaerobic bacteriologies of such secondary infection, have not been previously studied. The purpose of this retrospective study was to define the bacteriology of secondarily infected scabies lesions in children.

### MATERIALS AND METHODS

Specimens were obtained from children presenting with secondarily infected scabies lesions. These were manifested by erythema, oozing, vesiculopustular lesions, and pus formation. The diagnosis of scabies was confirmed by scrapping and microscopic examination. The children included in the study were studied by the author between September 1978 and September 1993 in the following hospitals: Children's Hospital National Medical Center and Southeast Medical Center, Washington, D.C., and the Naval Hospital, Bethesda, Md. During the study period, 34 specimens were submitted to a microbiology laboratory. Of these, bacterial growth was present in 30 specimens obtained from 30 children, and only these specimens were included in the final analysis. Of the 30 patients, 18 were boys. The patients' ages ranged from 11 months to 12 years (mean, 5 years and 8 months).

The lengths of the primary scabies infections were obtained from the parents of 27 patients and were between 4 days and 8 weeks (median, 12 days). The length of secondary infection was obtained for 26 patients and was between 2 and 15 days (median, 5 days).

None of the patients had received prior local therapy with antibacterial, antifungal, or antiscabies agents. Clinical data for the patients were noted and were correlated with the microbiologic findings.

Specimens were obtained by swabbing the purulent material from the deeper portion of the lesions after cleaning the surrounding skin with alcohol. All specimens were sent to the laboratory by using Port-A-Cul swabs (BBL, Cockeysville, Md.). The time between specimen collection and inoculation never exceeded 60 min.

Sheep blood, chocolate, and MacConkey agar plates were inoculated for aerobic organisms. The plates were incubated at 37°C aerobically (MacConkey agar) or under 5% CO<sub>2</sub> and were examined at 24 and 48 h. For anaerobic bacteria, the material was plated onto a prereduced vitamin K<sub>1</sub>-enriched brucella blood agar plate, a selective blood agar plate containing kanamycin and vancomycin, an anaerobic blood plate containing colistin and nalidixic acid, and an enriched thioglycolate broth (containing hemin and vitamin K<sub>1</sub>) (13). These were

incubated in GasPak jars (BBL), and the plates were examined at 48 and 96 h and the thioglycolate broth was examined at 14 days.

Anaerobic and aerobic bacteria were identified by previously described techniques (10, 13).  $\beta$ -Lactamase activity was determined by the chromogenic cephalosporin analog 87/312 methodology (11). Clinical and historical information was correlated with the microbiologic data.

### RESULTS

Aerobic bacteria only were present in 14 specimens (47%), anaerobic bacteria only were present in 6 specimens (20%), and mixed aerobic and anaerobic flora were present in 10 specimens (33%). A total of 50 isolates (27 aerobes, 23 anaerobes) were recovered (average, 1.7 isolates per specimen; 0.9 aerobes and 0.8 anaerobes per specimen) (Table 1).

Nine (30%) of the infections yielded only one organism. *Staphylococcus aureus* accounted for 5 (56%) of these infections. Three specimens yielded pure cultures of a single anaerobe. The isolates recovered in these cases were one isolate each of *Bacteroides fragilis*, *Prevotella intermedia*, and *Peptostreptococcus* species.

Table 1 shows the types of bacteria that were isolated. *S. aureus* was present in nine (30%) infections. Although *S. aureus* was isolated from all areas, it predominated in the fingers and hand. *S. aureus* mixed with anaerobic bacteria was recovered in three instances, and two of these were with *Peptostreptococcus* species. Group A streptococci were recovered from the fingers and hands. All of the gram-negative aerobic rods (*Pseudomonas aeruginosa* and *Escherichia coli*) were recovered from the leg and trunk.

The predominant anaerobic bacteria were *Peptostreptococcus* species (nine isolates). *Peptostreptococcus* species were isolated from all sites, whereas members of the *B. fragilis* group and *Clostridium* sp. were only recovered from the legs. All of the pigmented *Prevotella* and *Porphyromonas* species and *Fusobacterium* species were recovered from the fingers.

$\beta$ -Lactamase activity was detected in 16 isolates recovered from 12 (40%) patients. These were all isolates of *S. aureus* and

\* Corresponding author. Mailing address: P.O. Box 70412, Chevy Chase, MD 20813-0412.

TABLE 1. Isolation of organisms from 30 secondarily infected scabies lesions at different anatomical locations

Organism	No. of organisms from the following anatomical sites <sup>a</sup> :				Total no. of isolates
	Fingers (n = 13)	Hand (n = 6)	Leg (n = 6)	Trunk (n = 5)	
<b>Aerobic bacteria</b>					
<i>Staphylococcus aureus</i>	6	2	1		9
<i>Staphylococcus epidermidis</i>	2				2
<i>Streptococcus</i> spp.	2				2
Group A <i>Streptococcus</i>	3	2			5
Group D <i>Streptococcus</i>			1		1
<i>Escherichia coli</i>			2		2
<i>Enterobacter</i> sp.			1		1
<i>Proteus</i> sp.				1	1
<i>Pseudomonas aeruginosa</i>			1		3
<i>Klebsiella pneumoniae</i>				1	1
Total aerobes					27
<b>Anaerobic bacteria</b>					
<i>Peptostreptococcus</i> sp.	3	2	1	3	9
<i>Propionibacterium acnes</i>	2	1		1	4
<i>Clostridium</i> spp.			2		2
<i>Eubacterium</i> spp.					
<i>Bacteroides fragilis</i> group			2		2
Pigmented <i>Prevotella</i> and <i>Porphyromonas</i> spp.	4				4
<i>Fusobacterium</i> sp.	2				2
Total anaerobes					23
Total isolates	24	7	11	8	50

<sup>a</sup> Numbers in parentheses are numbers of specimens.

the *B. fragilis* group, two of three *P. aeruginosa* isolates, one of two *E. coli* isolates, and two of the four pigmented *Prevotella* and *Porphyromonas* spp.

## DISCUSSION

The present report highlights the diversity of the microbiology of secondarily infected scabies lesions.

*S. aureus*, the most prevalent aerobic bacterium, was recovered from all anatomical locations. In contrast, organisms that reside in the mucous membranes close to or in contact with the site of the lesions predominated in those lesions. In this fashion, enteric gram-negative rods, group D streptococci, members of the *B. fragilis* group, and *Clostridium* sp. were found most often in leg lesions. The most probable sources of these organisms are the rectal and vaginal orifices, where they normally reside (7). Group A streptococci, pigmented *Prevotella* and *Porphyromonas* species, and *Fusobacterium* species were most commonly found in lesions of the fingers. These organisms probably reached the fingers from the oral cavity, where they are part of the normal flora (12), when the fingers were placed in the mouth. These organisms were found to predominate in paronychia for the same reason (2). A similar distribution of bacterial flora was observed in cutaneous abscesses of adults and children (4, 8) and in burns in children (6).

The recovery of multiple organisms from 21 of the 30 (70%) patients illustrates the polymicrobial nature of the infection

and the potential for synergy between the different microbial isolates. Polymicrobial infections are known to be more pathogenic for experimental animals than those involving single organisms (9). Several studies documented the synergistic effect of mixtures of aerobic and anaerobic bacteria in experimental infections (1, 5, 9).

The present study demonstrates the presence of  $\beta$ -lactamase-producing organisms in secondarily infected scabies lesions. These organisms not only survive penicillin therapy but can also protect penicillin-susceptible bacteria from penicillin by releasing the free enzyme into the infected tissue or pus (3).

Although local application of antiscabies insecticide therapy is the mainstay of therapy, management of secondary bacterial infection is essential. Local application of antibacterial agents and drainage of pus are important components of the treatment of this complication. However, therapy of serious infections should include the administration of systemic antimicrobial therapy. This could be important in the event of a poor response to therapy or spread of the infection.

The exact pathogenic role of the organisms isolated from secondarily infected scabies lesions has not yet been determined. Although many of these organisms can also be recovered from the skin surfaces, their recovery from scabies lesions may signify that they induce secondary infection. Further studies by quantitative microbiology and assessment of antimicrobial agents effective against aerobic and anaerobic bacteria are warranted to explore their contribution to the inflammatory process.

## ACKNOWLEDGMENTS

I acknowledge the laboratory support of and I thank L. Calhoun, P. Yocum, J. Perry, and E. Frazier for technical assistance and Patricia Wojciechowski for secretarial assistance.

## REFERENCES

1. Altmeier, W. A. 1942. The pathogenicity of the bacteria of appendicitis. *Surgery* **11**:374-378.
2. Brook, I. 1981. Bacteriology of paronychia in children. *Am. J. Surg.* **141**:703-705.
3. Brook, I. 1984. The role of beta-lactamase-producing bacteria in the persistence of streptococcal tonsillar infection. *Rev. Infect. Dis.* **6**:601-607.
4. Brook, I., and S. M. Finegold. 1981. Aerobic and anaerobic bacteriology of cutaneous abscesses in children. *Pediatrics* **67**:891-895.
5. Brook, I., V. Hunter, and R. I. Walker. 1984. Synergistic effects of *Bacteroides*, *Clostridia*, *Fusobacteria*, anaerobic cocci, and aerobic bacteria on mortality and induction of subcutaneous abscess in mice. *J. Infect. Dis.* **149**:924-928.
6. Brook, I., and J. Randolph. 1981. Aerobic and anaerobic flora of burns in children. *J. Trauma* **21**:313-318.
7. Gorbach, S. L. 1971. Intestinal microflora. *Gastroenterology* **60**:1110-1116.
8. Meislin, H. W., S. A. Lerner, M. H. Graves, et al. 1977. Cutaneous abscesses: anaerobic and aerobic bacteriology and outpatient management. *Ann. Intern. Med.* **97**:145-151.
9. Meloney, F. L. 1931. Bacterial synergy in disease processes. *Ann. Surg.* **22**:961-981.
10. Murray, P. R., E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Tenover (ed.). 1995. *Manual of clinical microbiology*, 5th ed. American Society for Microbiology, Washington, D.C.
11. O'Callaghan, D. H., A. Morris, S. M. Kirby, and A. H. Shingler. 1972. Novel method for detection of beta-lactamase by using a chromogenic cephalosporin substrate. *Antimicrob. Agents Chemother.* **1**:283-288.
12. Socransky, S. S., and S. D. Manganiello. 1971. The oral microbiota of man from birth to senility. *J. Periodontol.* **42**:485-496.
13. Summanen, P., E. J. Baron, D. M. Citron, H. M. Wexler, and S. M. Finegold. 1993. *Wadsworth anaerobic bacteriology manual*, 4th ed. Star Publishing, Belmont, Calif.