Adult Bacterial Nasopharyngitis:

A Clinical Entity?

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Objective: To investigate bacterial nasopharyngitis as a cause of adult upper respiratory infection.
Design: Prospective case series.
Setting: Walk-in medical clinic of a university hospital.
Patients: 507 patients with cold or flu symptoms, sore throat, or recent cough; 21 control subjects without symptoms of upper respiratory infection.
Measurements and main results: After thorough history and physical examination, the patients underwent nasopharyngeal aspiration and throat culture. Nasopharyngeal specimens were cultured for both bacteria and viruses; antigens for influenza, parainfluenza, and respiratory syncytial virus were sought by enzyme-linked immunosorbent assay (ELISA); serum antibodies to viral respiratory pathogens were determined. Group A beta-hemolytic streptococci grew from the throat specimens of 39 of the 507 patients (8%) or 38 of 334 patients (11%) who had clinical diagnoses of pharyngitis. Thirty-three cases of influenza A, 20 cases of influenza B, and seven cases of parainfluenza infections were diagnosed. Bacteria were cultured from the nasopharyngeal secretions of 284 patients (56%). In contrast to pharyngeal culture, commensal mixed flora were rarely found in nasopharyngeal culture. Nasopharyngeal culture of bacteria usually considered to be respiratory pathogens was significantly associated with the presence of leukocytes. *Streptococcus pneumoniae* (odds ratio 6.0, 95% confidence interval 2.6–14.2), *Moraxella catarrhalis* (odds ratio 12.9, 95% confidence interval 3.1–79.5), and *Hemophilus influenzae* (odds ratio 3.0, 95% confidence interval 1.2–7.4) were all associated with the presence of leukocytes. In contrast, nasopharyngeal culture of coagulase-negative staphylococci, mixed flora, and the documentation of a viral infection were not associated with the presence of leukocytes. For none of 21 control subjects were "pathogenic" bacteria found.
Conclusions: These data suggest that potentially pathogenic bacteria may have a causal role in adult nasopharyngitis, although further data are needed to confirm this hypothesis.
Key words: upper respiratory infection; nasopharyngitis; bacteria.
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UPPER RESPIRATORY INFECTIONS affect millions of people worldwide.[1] Although rarely life-threatening, their symptoms are uncomfortable and unpleasant. They are a common cause of absenteeism from work and of visits to physicians.[2] The common cold is generally considered to be of viral origin, although the etiology of at least half of cases remains obscure despite the most advanced laboratory techniques.[1-6] Only streptococcal pharyngitis and some complications of upper respiratory infection such as acute bronchitis, pneumonia, sinusitis, and otitis media are recognized to have a bacterial origin and warrant treatment with antibiotics. Nonetheless, many practicing physicians prescribe antibiotics for uncomplicated upper respiratory infections.[7-9]

In adults investigations of the etiology of upper respiratory infection have not included bacterial culture of nasopharyngeal secretions. Instead, researchers have focused on throat culture for group A streptococci, viruses, and mycoplasma and on nasopharyngeal sampling for viral detection and culture.[3, 5, 10] In children, however, investigations of the etiology of upper respiratory infections have frequently included bacterial culture of nasopharyngeal secretions, and bacterial nasopharyngitis is considered to be both a distinct entity[11, 12] and a contributing factor to complications such as otitis media and pneumonia.[13, 14] In a prospective case series of adult patients with upper respiratory infection, we were surprised to find an increased number of leukocytes in nasopharyngeal secretions associated with the presence of bacteria considered to be pathogens only in the lower respiratory tract. This suggests that bacterial infection of the upper respiratory tract may occur in adults.

METHODS

From March 1, 1988, to February 28, 1990, patients who presented to the walk-in medical clinic of the University Hospital of Geneva, Switzerland, with complaints of cold or flu symptoms, sore throat, or recent cough were eligible for the study. Patients were excluded from the study if they showed any clinical or radiologic evidence of pneumonia. Twenty-one patients with no recent history of upper respiratory infection were included as control subjects. All patients gave informed consent to participate in the study.

Clinical Data

A thorough history was taken and a physical examination was performed for each study participant by one of several participating housestaff physicians using a specific questionnaire. History of exposure to school-age and preschool children, other sick people at home or at work, cigarette use, and relevant past medical problems was obtained. The presence and duration of

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symptoms such as fever, headache, rhinitis, sore throat, cough, hoarseness, myalgias, arthralgias, and photophobia were noted. General physical status, temperature, pulse, and results of physical examination of the oropharynx, tympanic membranes, sinuses, and lungs were recorded. Repeat physical examination was performed at a follow-up visit two weeks later and total duration of symptoms and use of medications were noted.

Specimen Collection

Aspiration of the nasopharynx was performed at the initial clinical visit by inserting a 5-mm soft plastic catheter from a Lukens specimen container (Argyle, Sherwood Medical, Tullamore, Ireland) into the posterior nasopharynx and using simple wall suction to aspirate the secretions. The secretions were then rinsed from the plastic catheter using 6 mL of sterile saline and processed within one hour in the laboratory. The secretions and rinse solution were vortexed for one minute and were processed as outlined below.

A throat culture was also obtained by rubbing a Culturette II swab stick (Marion Scientific, Kansas City, MO) firmly against the tonsilar fossa. This was sent to the microbiology laboratory for analysis within six hours.

Cytologic and Bacteriologic Studies

Two hundred to four hundred microliters of the nasopharyngeal secretions were cytocentrifuged and stained with Gram and Giemsa stains. All smears were analyzed by the same technician. The nasopharyngeal secretions and the throat specimens were cultured on sheep blood agar, chocolate agar, colistin–nalidixic acid agar, and Thayer-Martin agar for 48 hours for aerobic organisms. Anaerobic organisms were cultured on Centers for Disease Control agar and on sheep blood agar with a disk of bacitracin and trimethoprim–sulfamethoxazole in the primary streaking. Mycoplasma was cultured on biphasic medium. Chlamydia was not cultured. Bacteria were identified using standard methods.

Virologic Studies

Two milliliters of the vortexed nasopharyngeal secretions was transferred to 1 mL of viral transport medium (L-15 Leibowitz medium, 2% bovine serum albumin [BSA], penicillin [100 IU/mL], neomycin [200 μg/mL], bacitracin [2 IU/mL], gentamicin [5 μg/mL], and amphotericin B [0.125 μg/mL]) and was sent to the Institut für Klinische Mikrobiologie und Immunologie in St. Gallen, Switzerland, for analysis.

An enzyme-linked immunosorbent assay (ELISA) was used to detect adenovirus, respiratory syncytial virus, parainfluenza viruses types 1, 2, and 3, and influenza viruses types A and B.[15] Virus isolation was accomplished by inoculation of primary monkey kidney cells (African green monkey, ViroMed, Minnetonka, MN), vero cells (American Type Culture Collection [ATCC], CC181), Hep-2 cells (ATCC, ccl 23), human embryonic lung fibroblasts (Flow Laboratories, Irvine, Scotland), and Ohio HeLa cells (MRC Common Cold Unit, Salisbury, England).

Serologic Studies

Acute and convalescent serum specimens were obtained at the initial and follow-up visits. Complement fixation was used to test for antibodies to adenovirus, respiratory syncytial virus, parainfluenza viruses types 1, 2, and 3, influenza viruses types A and B, and *Chlamydia pneumoniae*. Immunofluorescence was used to test for IgM antibodies to Epstein-Barr virus (Savyon, Tel Aviv, Israel). An ELISA was used for the determination of IgM antibodies to cytomegalovirus (Medac, Hamburg, Germany) and to rubella virus (Abbott Laboratories, North Chicago, IL). Microimmunofluorescence was used to test for IgG and IgM antibodies to *C. pneumoniae*.[16]

Statistical Analysis

Statistical comparisons were performed using Statcalc, a statistics program available through Epi Info.[17] All p-values reported are two-sided.

RESULTS

Patient Population

Of 12,384 patients seen in the outpatient medical clinics, 507 (4.1%) met selection criteria and were enrolled in the study. The average age of the patient at the time of entry was 33.3 years (range 15.2 to 83.3 years), and 276 (54%) were men. One hundred ninety-eight (39%) were smokers, and 167 (33%) had contact with preschool or school-age children. Three hundred thirty-four (66%) patients came to their follow-up visits an average of 13 days after the initial visit. Of those, 312 had blood samples drawn at the second visit for convalescent serologic study.

At the initial clinical visit, the patients were given one or more clinical diagnoses by the housestaff physician. The diagnoses given were: pharyngitis ($n = 334$, 66%), rhinitis ($n = 221$, 44%), bronchitis ($n = 123$, 24%), laryngitis ($n = 53$, 10%), sinusitis ($n = 44$, 9%), conjunctivitis ($n = 23$, 5%), otitis media ($n = 11$, 2%), and mononucleosis ($n = 5$, 1%). More than one diagnosis was given in 234 (46%) of the cases.

Cytologic Studies

Cytologic examination was performed on 453 of the 507 nasopharyngeal specimens. Two hundred thirty-five patients (52%) had ten or more leukocytes per high-powered field in their nasopharyngeal secre-

TABLE 1
Bacterial Investigations in the 507 Cases Studied

	Nasopharyngeal Culture			Pharyngeal Culture	
	n	(%)	*n* as Sole Isolate	*n*	(%)
Gram-positive bacteria	216	(43%)		102	(20%)
Coagulase-negative staphylococci	74	(15%)	29	4	(0.8%)
Corynebacterium species	66	(13%)	0	0	(0%)
Streptococcus pneumoniae	58	(11%)	27	29	(6%)
Staphylococcus aureus	51	(10%)	23	19	(4%)
Group A streptococci	10	(2%)	5	39	(8%)
Group C or G streptococci	2	(0.4%)		5	(1%)
Other streptococci	6	(1.2%)		9	(2%)
Gram-negative bacteria	104	(21%)		155	(31%)
Hemophilus influenzae	44	(9%)	15	32	(6%)
Moraxella catarrhalis	35	(7%)	15	8	(2%)
Neisseria meningitidis	10	(2%)	3	12	(2%)
Enterobacteriaceae	9	(2%)	3	20	(4%)
Hemophilus parainfluenzae	3	(0.6%)		83	(16%)
Bordetella species	1	(0.2%)		0	(0%)
Other gram-negative bacteria*	5	(1%)		16	(3%)
Mycoplasma	0	(0%)		2	(0.4%)
Fungi					
Candida species	9	(2%)	3	18	(4%)
Mixed flora†	47	(9%)		502	(99%)
No organism cultured	223	(44%)		3	(0.6%)

*Other gram-negative bacteria include nonfermenting organisms, *Bacteroides melaninogenicus*, Fusobacterium species, *Neisseria gonorrhoeae*, and Acinetobacter species.
†Mixed flora is a mixture of light growth of Corynebacteria, streptococci, Neisseria species, and anaerobes.

tions, 55 (12%) fewer than ten leukocytes, and 163 (36%) no leukocyte. Epithelial cells were noted in the nasopharyngeal secretions of 317 patients (70%) and ciliated cells in the secretions of 136 (30%) patients. One or more kinds of cells were seen in 407 (90%) of the specimens.

Epithelial cells were present in the secretions of 153 of 235 patients (65%) with ten or more leukocytes, and in the secretions of 164 of 218 patients (75%) with fewer than ten leukocytes ($p = 0.029$). Ciliated cells were present in the secretions of 121 of 235 patients (51%) with ten or more leukocytes, but in the secretions of only 15 of 218 patients (7%) with fewer than ten leukocytes ($p<0.001$). Bacteria were present on Gram stain in the secretions of 123 of 235 patients (52%) with ten or more leukocytes, but in the secretions of only seven of 218 patients (3%) with fewer than ten leukocytes ($p<0.001$).

Bacteriologic Studies

Results of nasopharyngeal and pharyngeal cultures are summarized in Table 1. The most frequently cultured organisms from the nasopharynx were: coagulase-negative staphylococci, Corynebacterium species, *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Hemophilus influenzae*, and *Moraxella catarrhalis*. Only 9% of the patients grew "mixed flora," a mixture of light growth of Corynebacteria, streptococci, *Neisseria* species, and anaerobes. Forty-four percent of the cultures were sterile. In contrast, the most frequently cultured organisms from the pharynx were *Hemophilus parainfluenzae*, group A streptococci, *H. influenzae*, *S. pneumoniae*, Enterobacteriaceae, and *S. aureus*. Only three cultures were sterile, and 99% grew "mixed flora."

Growth of group A β-hemolytic streptococci from the pharynx was considered to indicate streptococcal pharyngitis, occurring in 38 of 334 (11%) patients with a clinical diagnosis of pharyngitis and in one of 173 (0.6%) patients without a clinical diagnosis of pharyngitis. Nine of the patients with pharyngitis and a positive pharyngeal culture also grew group A streptococci from the nasopharynx. One patient with pharyngitis grew group A streptococci from the nasopharynx but not the pharynx.

Virologic Studies

The results of virologic studies of the 312 patients who had two serum specimens drawn are summarized in Table 2. The most frequent pathogens documented

TABLE 2

Viral Investigations for 312 Patients from Whom Two Serum Samples Were Obtained

Virus	Serologic Study: Fourfold Rise In IgG	Serologic Study: Elevated IgM	Virologic Study: Antigen Positive	Virologic Study: Culture Positive	Number of Patients (%)
Cytomegalovirus		0			0 (0%)
Epstein-Barr virus		1			1 (0.3%)
Adenovirus	2				2 (0.6%)
Influenza A virus	27			7	31 (10%)
Influenza B virus	20		1	1	20 (6%)
Parainfluenza 1, 2, and 3 viruses	6		1	2	7 (2%)
Respiratory syncytial virus	2				2 (0.6%)
Rubella virus	1	1			1 (0.3%)
Echovirus				2	2 (0.6%)
TOTAL	58	2	2	12	66 (21)

were influenza A and influenza B. Other cases of viral infection included parainfluenza virus, Epstein-Barr virus, adenovirus, respiratory syncytial virus, echovirus, and rubella. No rhinovirus was cultured. Only four additional cases were diagnosed in patients with one serum specimen drawn: two patients grew influenza A virus; one patient grew adenovirus from the nasopharynx; and, in one patient, IgM for Epstein-Barr virus was detected.

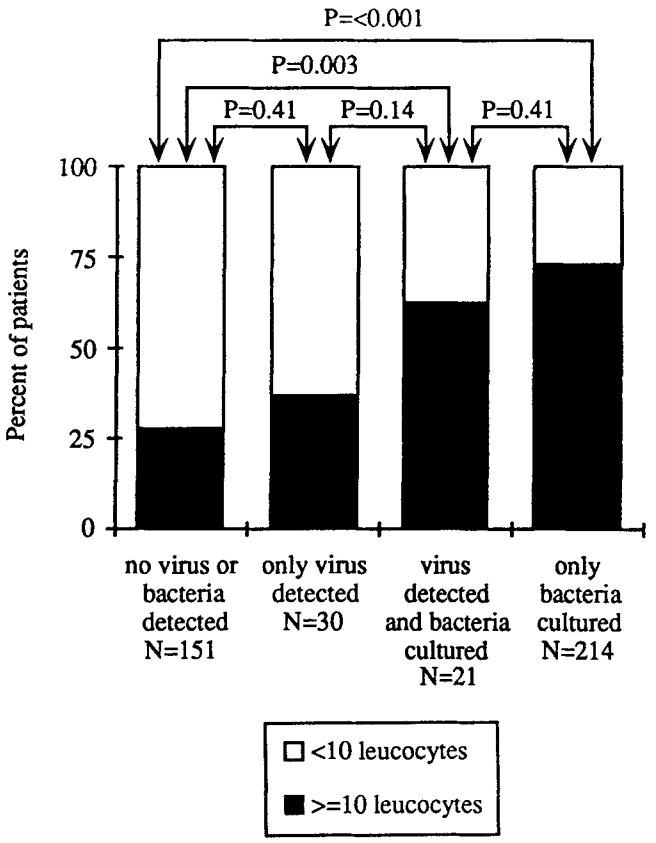

FIGURE 1. Percentages of patients with increased leukocytes by type of nasopharyngeal infection, excluding those with previous antibiotic treatment or for whom leukocytes were not counted.

Chlamydia Serologic Studies

No infection with *C. pneumoniae* was demonstrated by a fourfold rise in IgG titer detected by complement fixation for the 312 patients with two serum specimens available. In addition, no infection was demonstrated by microimmunofluorescence to IgG or IgM antibodies for 55 patients tested at random.

Association of Microorganisms with Leukocytes

The association of culture of bacteria from the nasopharynx, streptococcal pharyngitis, and viral infection (influenza A, influenza B, parainfluenza) with ten or more leukocytes per high-powered field in nasopharyngeal secretions is summarized in Table 3. Analysis was performed for 416 patients; 54 patients for whom leukocytes were not counted and 37 patients who had already been treated with antibiotics were not included. Streptococcal pharyngitis and influenza A and B and parainfluenza infection were not associated with increased leukocytes in the nasopharyngeal secretions. However, *S. pneumoniae*, *M. catarrhalis*, *H. influenzae*, group A streptococci, and *S. aureus* were associated with ten or more leukocytes per high-powered field in nasopharyngeal secretions. The number of colony-forming units of the organism isolated was independent of the number of leukocytes in nasopharyngeal secretions (data not shown).

The difference in the numbers of leukocytes associated with bacterial and viral infections is more clearly illustrated in Figure 1. An increased number of leukocytes was found in 73% of the patients with only bacteria cultured from the nasopharynx and in 62% of the patients with both bacteria cultured and virus detected from the nasopharynx. In contrast, only 37% of the patients with a viral infection and sterile nasopharyngeal secretions had ten or more leukocytes in nasopharyngeal secretions. This is not statistically different from the results for patients with sterile nasopharyngeal secretion and no viral infection.

Association of Clinical Parameters with Increased Leukocytes in Nasopharyngeal Secretions

To examine the association of clinical parameters with ten or more leukocytes per high-powered field in the nasopharyngeal secretions, we performed univariate and multivariate analysis of all the clinical information obtained for the 416 patients who had not already received antibiotic treatment and for whom leukocytes were counted. Results are summarized in Table 4. History of runny nose ($p = 0.002$) and rhinitis on physical examination ($p = 0.02$) occurred significantly more frequently in patients with an increased number of leukocytes in the nasopharyngeal secretions. There was no association with several clinical parameters that might alter the nasopharyngeal flora and therefore increase the number of leukocytes in nasopharyngeal secretions. These include age, history of tobacco abuse, duration of illness prior to seeking medical attention, history of sinusitis, asthma or chronic bronchitis, and clinical diagnosis of sinusitis or otitis media. Multivariate analysis did not change the interpretation of the data (not shown).

Of the nasopharyngeal aspirates of the 21 control subjects, ten were sterile; *S. aureus* was cultured in two; Corynebacterium in seven; and coagulase-negative staphylococci in five. An increased number of leukocytes was seen in two (9%) on direct examination.

DISCUSSION

In our study, more than half of the patients with upper respiratory infections had an increased number of leukocytes in the nasopharyngeal secretions associated with the culture of *S. pneumoniae*, group A streptococci, *S. aureus*, *H. influenzae*, and *M. catarrhalis* from the nasopharynx. An increased number of leukocytes was not associated with diagnosis of viral infection or with the diagnosis of streptococcal pharyngitis. These results raise the possibility of bacterial infection or superinfection of the nasopharynx ("bacterial nasopharyngitis").

Univariate analysis of clinical signs and symptoms revealed that only rhinitis was associated with an increased number of leukocytes in the nasopharyngeal secretions. On the other hand, we did not detect any clinical parameter that might alter the nasopharyngeal flora and/or the inflammatory reaction during upper respiratory infection. In particular, there was no association with a history or current diagnosis of sinusitis, otitis media, tobacco abuse, or chronic respiratory infection.

Methodologically, there are a few factors that may have confounded the correlation of increased leukocytes with the culture of pathogens. First, the nasopharynx may not have been accurately sampled in all cases. However, 90% of specimens contained some sort of cellular material. Furthermore, the presence of epithe-

TABLE 3

Organisms Associated with Ten or More Leukocytes per High-powered Field in the Nasopharyngeal Secretions of 416 Patients without Previous Antibiotic Treatment for Whom Leukocytes Were Counted

	Species Present			Species Absent				
Organism	*n*	*n* (%) with ≥10 Leukocytes		*n*	*n* (%) with ≥10 Leukocytes		Odds Ratio (95% CI)	
Gram-positive bacteria								
Coagulase-negative staphylococci	55	31	(56%)	361	190	(53%)	1.2	(0.6–2.1)
Corynebacterium species	51	34	(67%)	365	187	(51%)	1.9	(1.0–3.7)
Streptococcus pneumoniae	53	45	(85%)	363	176	(48%)	6.0	(2.6–14.2)
Staphylococcus aureus	44	31	(70%)	372	190	(51%)	2.3	(1.1–4.8)
Group A streptococci								
Nasopharynx	10	9	(90%)	406	212	(52%)	8.2	(1.1–175)
Pharynx	38	23	(61%)	378	198	(52%)	1.4	(0.7–2.9)
Gram-negative bacteria								
Hemophilus influenzae	33	25	(76%)	383	196	(51%)	3.0	(1.2–7.4)
Moraxella catarrhalis	28	26	(93%)	388	195	(50%)	12.9	(3.1–79.5)
Neisseria meningitidis	8	7	(88%)	408	214	(52%)	6.4	(0.8–49.8)
Fungi								
Candida species	9	9	(100%)	407	212	(52%)	15.7	(0.9–270)†
Mixed flora*	38	24	(63%)	378	197	(52%)	1.6	(0.8–3.3)
Viral infections								
Influenza A	29	12	(41%)	387	209	(54%)	0.6	(0.3–1.4)
Influenza B	11	5	(45%)	405	216	(53%)	0.7	(0.2–2.8)
Parainfluenza 1, 2, and 3	5	2	(40%)	411	219	(53%)	0.6	(0.1–4.3)

*Mixed flora is a mixture of light growth of Corynebacteria, streptococci, Neisseria species, and anaerobes.
†Odds ratio calculated by the continuity correction.

TABLE 4

Characteristics of Patients with Ten or More Leukocytes in Their Nasopharyngeal Secretions and Characteristics of Other Patients, Excluding Those with Previous Antibiotic Treatment or for Whom Leukocytes Were Not Counted

	≥10 Leukocytes (n = 221)		>10 Leukocytes (n = 195)		Odds Ratio (95% CI)	
Personal history of:						
Sinusitis	35	(16%)	22	(11%)	1.5	(0.8–2.7)
Chronic obstructive pulmonary disease	9	(4%)	6	(3%)	1.3	(0.4–4.3)
Asthma	14	(6%)	15	(8%)	0.8	(0.4–1.8)
Tobacco abuse	90	(41%)	75	(38%)	1.1	(0.7–1.7)
Clinical symptoms						
Fever ≥38°C	80	(36%)	83	(43%)	0.8	(0.5–1.2)
Runny nose	157	(71%)	110	(56%)	1.9	(1.2–2.9)
Lasting five days or more before first visit	86	(39%)	70	(36%)	1.1	(0.8–1.7)
Physical findings						
Cough					0.9	(0.6–1.3)
Absent	103	(47%)	84	(43%)		
Dry	70	(32%)	82	(42%)		
Productive	48	(22%)	29	(15%)		
Rhinitis					1.6	(1.1–2.4)
Absent	93	(42%)	105	(54%)		
Serous	105	(48%)	77	(39%)		
Purulent	23	(10%)	13	(7%)		
Abnormal lung examination	24	(11%)	14	(7%)	1.6	(0.8–3.3)
Abnormal sinus examination	33	(15%)	19	(10%)	1.6	(0.9–3.1)
Clinical diagnosis of:						
Pharyngitis	131	(59%)	121	(62%)	0.9	(0.6–1.4)
Sinusitis	21	(10%)	10	(5%)	1.9	(0.8–4.6)
Otitis media	8	(4%)	2	(1%)	3.6	(0.7–25.0)

lial cells was inversely correlated with the recovery of leukocytes, suggesting that the absence of leukocytes and bacteria was not due to a sampling error. The presence of ciliated cells was strongly correlated with the presence of leukocytes. It is possible that inflammation, reflected as an increased number of leukocytes, leads to sloughing of ciliated cells.

Other problems with specimen collection and handling include difficulty in homogenizing nasopharyngeal secretions. The specimens analyzed microscopically and cultured for bacteria and viruses may not have been comparable. However, if homogenization had been more uniform, the association between bacteria and leukocytes would have become even stronger. Another difficulty is that differing amounts of nasopharyngeal secretions were aspirated and diluted with the same amount of saline, resulting in variable concentrations of microorganisms and leukocytes.

In addition, relatively few viral infections were diagnosed in our study. Almost all cases were diagnosed by serologic means, precluding diagnosis in the 38% of patients who did not have a second serologic examination. Very few infections were diagnosed by antigen detection or by viral culture. No rhinovirus or coronavirus infection was cultured at all. However, the rate of viral diagnosis in patients with two sera examined was 21%, comparable to the rate of 25% obtained by Huovinen et al. in a recent study of patients with pharyngitis.[5] In this study, as in ours, the bulk of the diagnoses were made by serologic means, with very few made by antigen detection or culture.

The overall rate of viral diagnosis was well below the rate of 23% obtained by Eggenberger[18] in a recent study of upper respiratory infections in children using only antigen detection at the same viral laboratory after a similar transport time. Antigen detection may be less successful in adults than in children for a couple of reasons. The immune response of adults may be more swift and effective than that of children, neutralizing the viral antigen and making diagnosis by this method more difficult. Furthermore, adults may wait longer to seek medical attention than children do, rendering the detection of viral antigen in nasopharyngeal secretions less likely.

Most viral upper respiratory infections are felt to be caused by rhinovirus.[1,2] Because rhinovirus was not successfully cultured, we cannot eliminate the possibility that this virus is associated with an increased number of leukocytes. However, this seems unlikely since none of the other viral infections was associated with a significant number of leukocytes.

Chlamydia pneumoniae has recently gained recognition as a cause of respiratory tract infection, especially of the lungs.[19,20] In our study, no infection with

C. pneumoniae was demonstrated. This may be because patients with pneumonia were excluded.

In children, purulent bacterial nasopharyngitis is recognized and has been studied extensively.[11-13] It is felt to be caused by β-hemolytic streptococci, *H. influenzae*, and pneumococci and should be managed with antibiotics.[12] Hypothesizing the existence of bacterial nasopharyngitis in adults, the most likely bacteria would be those that are not part of the normal nasopharyngeal flora and those that are known to cause infection in the lower respiratory tract. Jousimies-Somer et al. compared the nasal swab cultures of 183 healthy military recruits with those of 185 military recruits who had acute maxillary sinusitis.[21] The culture of *S. pneumoniae* increased from 1% to 25% and that of *H. influenzae* increased from 4% to 61% between the healthy military recruits and the recruits with sinusitis. In contrast, the culture of Corynebacteria decreased from 43% to 19% and the culture of *S. aureus* decreased from 36% to 18%. The cultures of coagulase-negative staphylococci and *M. catarrhalis* remained about the same in both groups studied. In our study, potentially pathogenic bacteria were not cultured for any of the control subjects.

On the other hand, it is possible that the presence of pathogenic bacteria and increased leukocytes in the nasopharnx may be secondary to colonization of already inflamed nasal mucosa, rather than the pathogenic bacteria causing inflammation and an increased number of leukocytes in the nasopharynx. It is also possible that certain bacteria, such as *S. aureus*, may have been introduced into the nasopharyngeal aspirate as the sampling catheter passed through the anterior nares.

Our data suggest that *S. pneumoniae*, *M. catarrhalis*, and *H. influenzae* may be a cause of bacterial infection in the nasopharynx, whereas *S. aureus* is only weakly associated with the presence of leukocytes. Group A streptococci have been shown to be pathogenic in the nasopharynx of young children,[11] but have so far not been cultured in adults.

More investigation is required to determine whether the presence of bacteria and leukocytes in the nasopharynx in adults really means bacterial nasopharyngitis. If it exists, recognition and treatment would be important. Bacteria in the nasopharynx may lead to descending infections, such as bronchitis and pneumonia. Antibiotic treatment could shorten the duration of upper respiratory infections caused or exacerbated by bacteria and possibly prevent more serious lower respiratory tract infections. Although many physicians already treat adults who have uncomplicated upper respiratory tract infections with antibiotics, only a controlled prospective study using placebo and antibiotics could resolve the issue.

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