Characteristics of Pathogens Recovered from the Tonsils and Adenoids in a Group of Lebanese Children Undergoing Tonsillectomy and Adenoidectomy

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ABSTRACT

A quantitative estimation of isolated bacteria from adenoid and tonsil tissues was carried out in 62 patients undergoing elective tonsillectomy and/or adenoidectomy in a major medical center in Beirut, Lebanon. To determine the prevalent bacterial etiology of infections in these patients, the surface and core tissues were removed or excised from the adenoid and both tonsils and analyzed by culture. Data showed that *Haemophilus* species were prevalent in these infections and most isolates were susceptible to tested antimicrobial agents.

INTRODUCTION

Upper airway obstruction secondary to chronic inflammation or hypertrophy of the adenoid and/or tonsils can lead to grave consequences because of difficulty in breathing. In addition, recurrent infections, especially when there is involvement of the middle ear cleft, can lead to systemic sequelae. Tonsillectomy is considered to be the most common major surgical procedure of the pediatric population.[1]

Resistant bacteria that can cause recurrent infections in the adenoids and tonsils have been an increasing concern over the past decade because of the widespread and prolonged use of antibiotics.[2] It also is evident that the microbiology of adenotonsillitis may vary with geographic location.[3]

Several authors have investigated the microbial flora of the tonsils and adenoids individually, but only a few studies have compared the core flora of the tonsil and adenoid in the same patient.[4] However, no studies have conducted a comparative analysis between the flora of the surface and the core of both tonsils and adenoid in the same

patient. In this study, a quantitative estimation of isolated bacteria from the surface and core of the tonsil and adenoid tissues were carried out in patients undergoing tonsillectomy and adenoidectomy. An antibiogram was performed on *Haemophilus* species, which were found to be the most commonly encountered pathogenic organisms in this study.

METHODS

Patients

The surface and core tissue from the adenoid and both tonsils were analyzed in 62 patients undergoing elective tonsillectomy or/and adenoidectomy at the American University of Beirut Medical Center (AUBMC) from March 1 to October 1, 1999. The male to female ratio was 3:2. Patient ages ranged from 2 years to 30 years, with a mean age of 6 years. Patients were divided into 2 major groups (infectious and obstructive) based on their major presenting complaints.

The infectious group included 43 patients (69%) with a history of chronic adenotonsillitis and who presented mainly because of recurrent febrile sore throat, dysphagia, malodorous breath, purulent rhinorrhea, or chronic cough unresponsive to medical treatment. Regardless of whether these patients exhibited signs or symptoms of obstruction, they were included in the infectious group. In this group, 30 patients (70%) could recall the last antibiotic taken within 3 weeks of surgery. The amoxicillin-clavulanic acid was the most commonly used, followed by cefuroxime and then cefprozil.

The obstructive group included 19 patients (31%) with the main complaints of snoring, mouth breathing, hyponasal speech, or sleep apnea. The patients in this group had no history of recurrent adenotonsillitis.

Depending on the indication for surgery, 25 patients (40%) underwent tonsillectomy and adenoidectomy; 20 patients (32%) tonsillectomy only; and 17 patients (28%) adenoidectomy only. Adenoid tissue was removed with curettage, whereas tonsils were excised with electrocautery dissection.

Before starting the surgical procedure, each of the blood and chocolate agar plates were labeled for the site of specimen to be removed (adenoid vs. tonsil) and type of swab (surface vs. core). While retracting the uvula and soft palate, a swab was taken with a cotton-tipped applicator from the superficial surface of the adenoid and streaked over the first half of each of the agar plates. The same was repeated for both tonsils using the same technique and labeling of the right vs. left tonsil.

Immediately after excision, the adenoid specimen was placed in a Petri dish and held with a forceps. A piece of the core was excised with a knife from the deep surface of the adenoid and streaked over the second half of each of the agar plates and then put into an Averys broth tube. The same procedure was repeated for both tonsils using separate sterile instruments and containers.

Laboratory Testing

The specimens were taken immediately to the microbiology laboratory for aerobic inoculation and incubation. All plates were incubated overnight at 37°C under aerobic conditions. Chocolate agar plates were incubated under 5% CO_2 tension. Bacteria were isolated, identified at the species level, subcultured, and stored at –70°C. Only bacterial isolates from the surface and the core of both tonsils and adenoid, identified as *Haemophilus influenzae* and *Haemophilus parainfluenzae* were subjected to subsequent antibiotic susceptibility testing according to the NCCLS guidelines. The antimicrobial agents used included amoxicillin, amoxicillin/

Table 1. Prevalent Bacteria in the Infectious Group

	Procedure				
	Tonsillectomy 13	Adenoidectomy 12	T&A 18	Total 43	% of Grand Total
Organism					
Neisseria species	39	11	75	125	31.4
Streptococcus species	35	10	53	98	24.6
Alpha Haemolytic *Streptococcus*	13	5	25	43	10.8
Streptococcus Group A	1	1	7	9	2.3
Streptococcus pneumoniae	0	1	2	3	0.8
Haemophilus species (other than Hi and Hpi)	12	2	45	59	14.8
Haemophilus influenza	3	0	8	11	2.8
Haemophilus parainfluenza	1	3	4	8	2
Staphylococcus species	16	8	16	40	10
Moraxella species		0	2	0	2 0.5
		Grand Total		398	

T=Tonsillectomy
A=Adenoidectomy
Hi=*H. influenzae*
Hpi=*H. parainfluenzae*

clavulonate, ciprofloxacin, cefexime, erythromycin, and trimethoprim-sulfamethoxazole.

Results

All specimens examined histologically under the light microscope showed normal adenoid and tonsillar structure and the overlying mucosa showed no obvious differences in activity similar to another investigation.[5]

In the infectious group, 398 bacterial isolates were recovered from the tonsils and adenoid; in the obstructive group, 151 bacterial isolates were recovered (Tables 1 and 2).

In this study, multiple pathogens were seen more commonly (2 or 3 per specimen) than a single pathogen by itself, with an average number of isolates of 2 organisms per tonsil vs. 1.8 organisms per adenoid.

Two isolates per specimen were recovered in 145 specimens and 3 isolates per specimen in 76 specimens from both the adenoid and tonsils. The most frequently isolated organisms were nonpathogenic *Neisseria* species, S*treptococcus* species, and -hemolytic S*treptococcus viridans*. Other frequently isolated aerobes included *Haemophilus* species amd *Staphylococcus aureus.*

The percentage of each pathogen isolated in the infectious group was compared with that in the obstructive group. No significant difference could be found in the numbers and types of pathogens identified in the 2 groups (Table 1).

A comparison between the flora of the surface and the core of each tonsil with the adenoid per patient was conducted, which defined *matching* between 2 specimens as having either exactly the same bacteria in specimens containing 1 or 2 isolates, or at least 2 bacteria identi-

Table 2. Prevalent Bacteria in the Obstructive Group

	Procedure				
	Tonsillectomy	**Adenoidectomy**	**T&A**	**Total**	**% of Grand**
	7	5	7	19	**Total**
Organism					
Neisseria species	20	6	21	47	31.1
Streptococcus species	16	0	24	40	26.5
Alpha Haemolytic *Streptococcus*	4	6	5	15	9.9
Streptococcus Group A	0	0	2	2	1.3
Streptococcus pneumoniae	0	0	1	1	0.66
Haemophilus species (other than Hi and Hpi)	8	2	9	19	12.6
Haemophilus influenza	2	1	3	6	4
Haemophilus parainfluenza	1	1	2	4	2.6
Staphylococcus species	4	0	6	10	6.6
Moraxella species	0	0	3	3	2
Morraxella catarrhalis	0	0	1	1	0.66
Pseudomonas aeuroginosa	0	0	1	1	0.66
Corynebacterium species	0	2	0	2	1.3
		Grand Total		151	

T=Tonsillectomy
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cal in specimens containing 3 isolates. *Nonmatching* is defined as having at least 2 bacteria different in specimens containing 3 isolates or completely different bacteria in the remaining specimens. Percentages of matching and nonmatching are shown in Figures 1 and 2, respectively.

Eighty-eight specimens were collected from 6 different tonsillar sites in 32 patients. Fifty-five of 88 specimens (62.5%) grew *H influenzae* and 33 (37.5%) grew *H parainfluenzae*. Consequently, 20 of 32 patients had *H influenzae* (62.5%), and 12 had *H parainfluenzae* (37.5%). Ten of 32 patients (31%) showed a variation in susceptibility patterns among the different tonsillar *Haemophilus* isolates collected per patient.[6] Six (60%) of these patients had *H influenzae* and 4 (40%) had *H parainfluenzae* infections. The remaining 22 of 32 (69%) patients had *Haemophilus* isolates that did not show a variation in susceptibility patterns among the different tonsillar sites per patient (data not shown). Fourteen of these patients had *H influenzae* infections (64%) and 8 with *H parainfluenzae* infections (36%).

DISCUSSION

The palatine tonsils and pharyngeal adenoids are part of Waldeyers tonsillar ring. As such, it is generally accepted that the microbial flora of these struc-

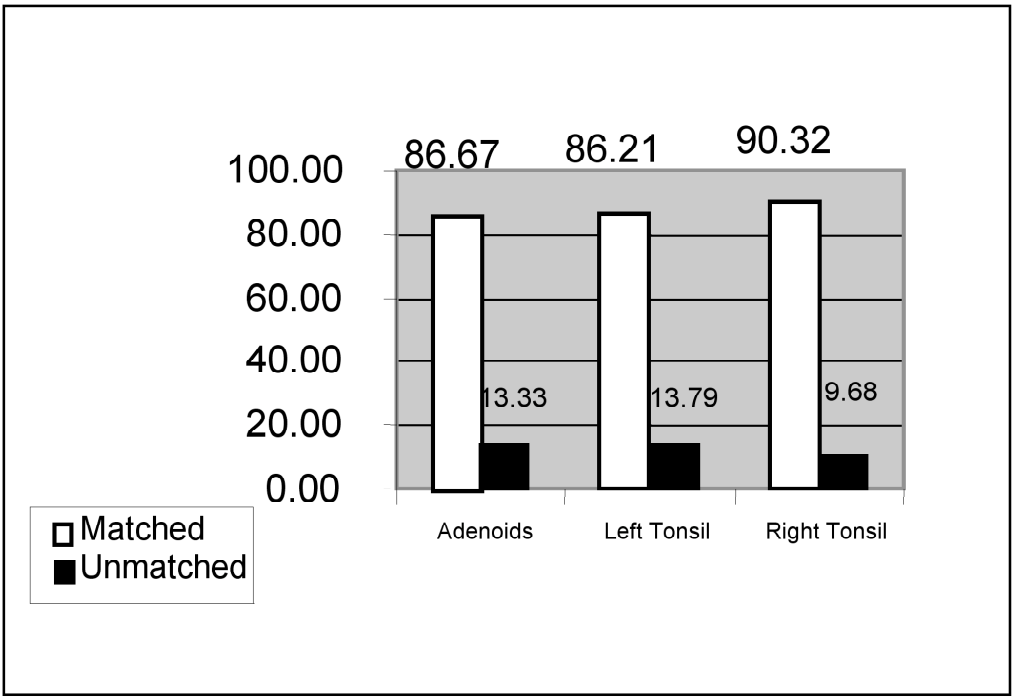

Figure 1. Percentage of surface vs. core specimens matching in the infectious group

tures are identical, but little evidence exists to support this.[4]

In this study, the flora of the surface and the core of the same tissue was compared separately and then between both tonsils as well as each of the tonsil and adenoid separately. This is different from other studies where the authors have investigated the microbial flora of the tonsils and adenoids individually, or have compared only the core flora of the tonsil and adenoid in the same patient.[4]

In this study, multiple pathogens (2 or 3 per specimen) were seen more commonly than a single pathogen by itself, with an average number of isolates of 2 organisms per tonsil vs. 1.8 organisms per adenoid, which is comparable to another study.[4] Two isolates per specimen were recovered in 145 specimens and 3 isolates per specimen were recovered in 76 specimens from both the adenoid and tonsils. This is true for most reports describing the bacteriology of the adenoids.[5-7-11] The interaction between pathogens has also been thought to be synergistic.[12]

The most frequently isolated organisms were nonpathogenic *Neisseria* species, S*treptococcus* species, and □-hemolytic *S viridans.* Other frequently isolated aerobes included *Haemophilus* species, S *pneumoniae,* and *S aureus*. These organisms have been identified as predominant organisms in previous studies of tonsil and adenoid flora.[13]

Bacterial species such as □-hemolytic S *viridans*, nonhemolytic *Streptococci*, commensal *Neisseria* species, coagulase-negative staphylococci, and diphteroids are commonly considered the basic flora of the oropharynx and nasopharynx,[5,7,10,15] and were considered nonpathogenic in our study.

Potential pathogenic bacteria including *Haemophilus* species, *S aureus,* and *S pneumoniae* also were described in different studies looking at the bacteriology of the adenoid and the tonsil,[5,7,10,15] and were adopted in the current study.

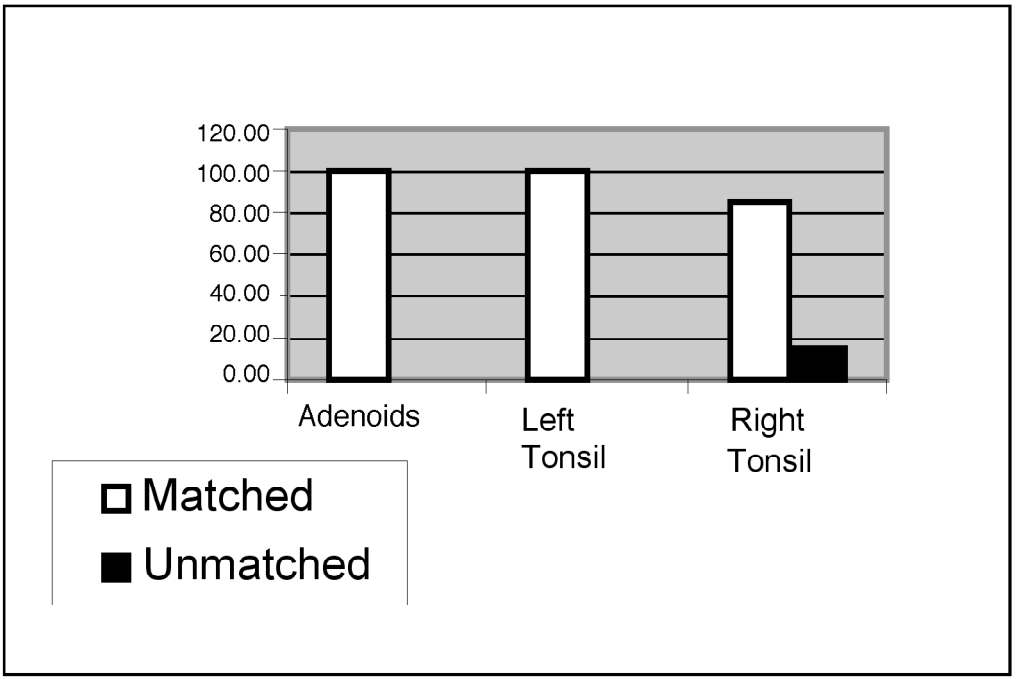

Figure 2. Percentage of surface vs. core specimens matching in the obstructive group

In this evaluation, *H influenzae* was the most common potential pathogen cultured in the adenoids and tonsils, similar to other reports.[5-7-11] In fact, current research using hybridization and polymerase chain reaction has found *H influenzae* in 82% to 100% of the adenoids in patients with or without adenoid hypertrophy.[16,17]

Some studies have shown that the bacterial etiology is *Streptococcus* group A in 30% of cases,[18-20] whereas other investigations have shown that the etiology is *H influenzae* (20% to 40%).[21-23] *H influenzae* (33%) and possibly *H parainfluenzae* (20%) are implicated as potent causative etiology of tonsillar disease mostly in countries with antibiotic abuse.

The high prevalence of *H influenzae* and *H parainfluenzae* encountered in our patients as well as some cases reported in the literature,[21-23,24] may reveal that both agents could be the etiology for recurrent tonsillar disease in resistant patients. The isolation of other bacteria like *Neisseria* and other *Streptococcus* species were recognized to be apart of the benign commensal flora.[21,25]

Upper airway obstruction from hypertrophy and recurrent adenotonsillitis can lead to grave sequelae if these conditions are left for observation or additive courses of antibiotic without being offered the best timely intervention. The documentation of changes over time in the microbial flora of the core of recurrently inflamed tonsils indicates a need for monitoring of this flora in the community.[3]

The antimicrobials exhibiting efficacy superior to that of penicillin in eradicating group A beta-hemolytic streptococcus (GABHS) and the high prevalence of β-lactamase secreting microbes in recurrent tonsillitis mandate the need to consider a combination of amoxicillin and clavulanic acid or second generation cephalosporin.[3] It also is known that the chronically inflamed tonsils and adenoids contain more scar

tissue after each infection, causing an impairment of antibiotic penetrability into their core[26] and more resistance.

Our results support previous observations and suggest that, in cases of chronically inflamed tonsils and adenoids that have failed to respond to antibiotic treatment or hypertrophy causing obstructive apnea, surgical intervention should be considered.[26]

It can be concluded that adenoids need not be removed routinely during the removal of tonsils in children presenting with tonsillitis but they should be removed in children with secretory otitis media.[5]

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