

Comparative study of bacteriology in recurrent tonsillitis among children and adults

Loganathan A, Arumainathan U D, Raman R

ABSTRACT

Introduction: Diagnosis and treatment of acute tonsillitis are one of the most common problems seen at an otorhinolaryngology clinic in both adult and paediatric populations. Much has been written about bacteriology of recurrent tonsillitis but it remains a controversial topic. Despite the fact that tonsillitis is so common, consensus seems to be lacking as to the main causative organism and the differences between children and adults. The tonsillar core bacteriology of 233 patients with recurrent tonsillitis who underwent tonsillectomy from January 2000 to June 2003 is presented.

Methods: The patient population was divided into two groups, namely: the paediatric group and the adult group. 132 patients, whose age was more than 12 years, were in the adult group. 101 patients aged between two and 12 years, were in the paediatric group. The bacteriology of the children and adults were tabulated according to their species, and were compared.

Results: 138 patients grew single pathogenic bacteria in their tonsillar core culture, 52 grew two different pathogenic bacteria, and the rest (43) grew normal bacterial flora. *Staphylococcus aureus* was the most commonly-isolated bacterium and accounted for 40.9 percent of the total cultures isolated; its prevalence was the same in the adults and children. β -haemolytic *Streptococcus* was isolated in 23 percent of subjects, and was predominantly from group A (*Streptococcus pyogenes*). Group A β -haemolytic *Streptococci* was more prevalent in children. *Pseudomonas aeruginosa*, which rarely cause pathogenicity in tonsils, was cultured from nine (3.8 percent) of our study subjects.

Conclusion: This study showed that *Staphylococcus aureus* is the most common

pathogenic bacteria cultured both in adults and children. *Klebsiella pneumoniae*, *Streptococcus pneumoniae*, *Escherichia coli* and *Enterobacter* are more prevalent in adults. *Haemophilus influenzae* and *Streptococcus pyogenes* are more prevalent in children. *Pseudomonas aeruginosa* is not a rare causative organism in recurrent tonsillitis. Since the mechanism of activation of infection in recurrent tonsillitis is unknown, knowing the bacteriology does not help us to treat the disease. However, it may be a stepping stone to eventually understanding whether the bacteria play a role in reactivating recurrent infections. From previous and current studies, there is no relationship between bacteriology and recurrent infections

Keywords: bacteriology, pathogenic bacteria, *Staphylococcus aureus*, tonsillitis, tonsillar core culture

Singapore Med J 2006; 47(4):271-275

INTRODUCTION

The diagnosis and treatment of acute tonsillitis are one of the most common problems seen at an otorhinolaryngology clinic in both adult and paediatric populations. Some of these patients will eventually undergo a tonsillectomy. Tonsillectomy is the commonest surgical procedure in children. About 800,000 tonsillectomies were performed per annum in the USA⁽¹⁾ and about 66,350 in England⁽²⁾. Much has been written about the bacteriology of recurrent tonsillitis but it remains a controversial topic⁽³⁾. Organisms grown from superficial swabs may not be the same as those obtained from the tonsillar core, and there is almost certainly a difference between children and adults^(4,5).

Throat swabs have little value in the diagnosis of the causative organism compared to deep tissue culture in recurrent tonsillitis^(4,6-8). There is strong anatomical evidence for the presence of bacterial

Department of
Otorhinolaryngology
Faculty of Medicine
University of Malaya
Kuala Lumpur 50603
Malaysia

Loganathan A, MS
Lecturer

Arumainathan U D,
FRCS
Associate Professor

Raman R, MS
Professor

Correspondence to:
Dr A Loganathan
Tel: (60) 3 7950 2062
Fax: (60) 3 7955 6963
Email: drloga68@
yahoo.co.uk

biofilms in chronically-diseased tonsils. Because sessile bacteria within biofilms are resistant to host defenses and antibiotics, bacterial biofilms within tonsils may explain the chronicity and recurrent nature of some forms of tonsillitis^(9,10). A comparative study of the histology of tonsils between recurrent tonsillitis and tonsillar hypertrophy by Zhang et al⁽¹¹⁾ showed that reactive lymphoid hyperplasia and presence of chronic inflammatory cells, predominantly lymphocytes, are the two most important features that is seen in patients with recurrent tonsillitis. The part played by viruses in acute tonsillitis is unknown, and in children, it has been felt that an initial viral tonsillitis may predispose to a superinfection by bacteria⁽¹²⁾.

The composition of normal commensal bacteria of oropharynx and nose, i.e. *Viridans streptococci*, *Bacteroids*, *Fusobacteria*, *Spirochaetes*, *Lactobacilli*, *Veillonella* and other anaerobic cocci, *Actinomyces*, *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Staphylococcus epidermidis*, *Staphylococcus aureus*, and coliforms, such as *Escherichia coli*, *Proteus*, *Klebsiella* and *Pseudomonas*, may be disrupted by frequent use of broad-spectrum antimicrobials, by inhibiting sensitive organisms and allowing overgrowth of the resistant ones. This may cause serious infection by the normal commensals. Despite the fact that tonsillitis is so common, consensus seems to be lacking as to the main causative organisms and its differences in children and adults⁽³⁾.

METHODS

This is a non-randomised prospective study held over 42 months (January 2000 to June 2003). Patients were selected from those who were going for tonsillectomy at the University of Malaya Medical Centre. They were divided into two groups, namely: the paediatric group (patients from two to 12 years old) and the adult group (patients older than 12 years old).

Inclusion criteria⁽¹⁹⁾ were: three or more severe recurrent attacks of tonsillitis in two consecutive years. Patients are considered to have severe illness if at least three associated symptoms, i.e. high fever, snoring during acute attacks, unable to take normal diet, absence from school/work, and admission to hospital, are present. Patients were only included in this study if reactive lymphoid hyperplasia and presence of chronic inflammatory cells, predominantly lymphocytes, was reported histopathologically⁽¹¹⁾. Exclusion criteria were: tonsillectomy done for obstructive sleep apnoea, unilateral enlargement,

Table I. Types of cultures isolated in adults and children and their distribution.

	Single	Mix	Normal respiratory flora	Total
Adult	76	32	24	132
Child	62	20	19	101
Total	138 (59.2%)	52 (22.3%)	43 (18.5%)	233 (100%)

glossopharyngeal neuralgia, less than three attacks per year, and symptoms less than two years. Diabetics and immunocompromised patients were excluded from the study.

Patients who satisfied the criteria by history and clinical examination were subjected to tonsillectomy. Tonsillectomy for all these patients were carried out by the blunt dissection method. All the tonsils were cut into two halves. One-half from each side was sent for histopathology and the other half for core culture. The histopathology was reviewed, and patients who did not have evidence of chronic infection were further excluded. Based on the above criteria, 233 patients were included in this study, out of whom 132 were adults and 101 were children. The bacteriology of the children and adults were tabulated according to their species, and were compared.

RESULTS

Of the 233 patients included in this study, 132 (56.7%) were adults and 101 (43.4%) were children. In the adult group, the male: female ratio was 1:1, while in children, the ratio was 1.4:1. The patients were grouped according to the types of cultures isolated, i.e. single, mixed or normal respiratory flora (Table I). Pathogenic organisms that were cultured from tonsils of single and mixed flora were further grouped according to their species. The total percentage of pathogenic organisms and their differences between adults and children were reviewed.

From the 138 patients in whom a single organism was isolated, *Staphylococcus aureus* was predominantly seen in adults (45.5%); while β -haemolytic *Streptococcus* was predominantly seen in children (39.3%). *Klebsiella pneumonia* (26.0%) was the next most common organism in adults, compared to *Staphylococcus aureus* (36.1%) in children. The other organisms isolated in the single culture were *Haemophilus influenza*, *Streptococcus pneumonia*, *Pseudomonas*, *Enterobacter*, *Escherichia coli* and *Acinetobacter*

Table II. Comparison of various organisms isolated in the single culture group.

Organisms	Adults		Children		Total	
	Count	%	Count	%	Count	%
<i>Staphylococcus aureus</i>	35	45.5	22	36.1	57	41.3
<i>Klebsiella pneumonia</i>	20	26.0	4	6.6	24	17.4
<i>β-haemolytic Streptococcus</i>	8	10.4	24	39.3	32	23.2
<i>Haemophilus influenza</i>	2	2.6	10	16.4	12	8.7
<i>Streptococcus pneumonia</i>	4	5.2	0	0.0	4	2.9
<i>Pseudomonas</i>	3	3.9	1	1.6	4	2.9
<i>Enterobacter</i>	2	2.6	0	0.0	2	1.5
<i>Escherichia coli</i>	2	2.6	0	0.0	2	1.5
<i>Acinetobacter</i>	1	1.3	0	0.0	1	0.7
Total	77	100.0	61	100.0	138	100.0

Table III. Comparison of various organisms isolated in the mixed group.

Organisms	Adults		Children		Total	
	Count	%	Count	%	Count	%
<i>Staphylococcus aureus</i>	24	37.5	18	45.0	42	40.4
<i>Klebsiella pneumonia</i>	12	18.8	9	22.5	21	20.2
<i>β-haemolytic Streptococcus</i>	12	18.8	1	2.5	13	12.5
<i>Haemophilus influenza</i>	4	6.3%	6	15.0%	10	9.6%
<i>Streptococcus pneumonia</i>	5	7.8%	1	2.5%	6	5.8%
<i>Pseudomonas</i>	2	3.1%	3	7.5%	5	4.8%
<i>Enterobacter</i>	3	4.7%	1	2.5%	4	3.9%
<i>Escherichia coli</i>	2	3.1%	0	0.0%	2	1.9%
<i>Acinetobacter</i>	0	0.0%	1	2.5%	1	1.0%

(Table II). From the 52 patients in whom a mixed culture was isolated, more than one organism was isolated from each patient which occurred in different permutations and combinations. But the type of organisms and its prevalence in adults and children were similar to that of the single culture (Table III).

Overall (i.e. from the total organisms cultured from single and mixed cultures), the commonly-isolated organisms from adults were *Staphylococcus aureus* (41.8%), *Klebsiella pneumonia* (22.7%) and *β-haemolytic Streptococcus* (14.2%); while in children, *Staphylococcus aureus* (39.6%), *β-haemolytic Streptococcus* (32.7%) and *Haemophilus influenza* (15.8%) were commonly isolated. *Klebsiella pneumonia*, *Streptococcus pneumonia* and *Enterobacter* were more prevalent in adults; while *β-haemolytic Streptococcus* and *Haemophilus influenza* were more prevalent in children. *Streptococcus pneumonia* was isolated

from ten patients (4.3%), out of which nine are from adults. *Escherichia coli* was isolated from four of the tonsillar cores of adults but none from the paediatric age group. *Pseudomonas aeruginosa* was seen in nine patients, out of which a single organism was cultured in four of the patients; the incidence is the same in both adults and children (Table IV). *β-haemolytic Streptococcus*, including from Group A and G, was found in tonsillar cores of 53 (21.9%) cultures. Predominantly Group A was isolated in 47% of the cultures and it was found to be prevalent in children. Group C was prevalent in adults (Table V).

DISCUSSION

In their study in 1991, Gaffney et al⁽⁵⁾ found that *Haemophilus influenza* was the single most common bacterium isolated from the centre of the tonsil (referred to as the tonsil core), and this

Table IV. Overall comparison of various types of organisms between adults and children.

Organisms	Adults		Children		Total	
	Count	%	Count	%	Count	%
<i>Staphylococcus aureus</i>	59	41.8	40	39.6	99	40.9
<i>Klebsiella pneumonia</i>	20	14.2	33	32.7	53	21.9
<i>β-haemolytic Streptococcus</i>	32	22.7	5	5.0	37	15.3
<i>Haemophilus influenza</i>	6	4.3	16	15.9	22	9.1
<i>Streptococcus pneumonia</i>	9	6.4	1	1.0	10	4.1
<i>Pseudomonas</i>	5	3.6	4	4.0	9	3.7
<i>Enterobacter</i>	5	3.6	1	1.0	6	2.5
<i>Escherichia coli</i>	4	2.8	0	0.0	4	1.7
<i>Acinetobacter</i>	1	0.7	1	1.0	2	0.8

was more prevalent in children. *Staphylococcus aureus* was the next most commonly isolated bacterium. Mixed pathogens were found throughout all age groups and *β-haemolytic Streptococcus* from Group A to G were found in 22%, out of which 62% was from Group A. Bacteriology of the tonsillar core may change with age, and it was found that *β-haemolytic Streptococci* was more common in children than in adults⁽¹³⁻¹⁵⁾. The incidence of *β-haemolytic Streptococcus* Group A variety was the most prevalent group, followed by Group C^(5,16).

Danielides et al⁽¹⁷⁾ reported a case of recurrent tonsillitis caused by *Pseudomonas aeruginosa* which they found to be rare. Anaerobic bacteria were present in a significant number of acutely inflamed tonsils, compared to healthy children⁽¹⁸⁾. In 132 adults and 101 children in which the core tonsillar bacteriology was studied, mixed pathogens were seen in 22.2% of patients, predominantly in adults (13.7%). Gaffney et al⁽⁵⁾ observed similar findings. Predominantly *Staphylococcus aureus* was cultured in both adults and children with an almost equal incidence. Brook et al⁽²⁰⁾ observed a similar prevalence.

In adults, the next common organisms were *Klebsiella pneumonia*, *β-haemolytic Streptococcus*, *Streptococcus pneumonia* and *Haemophilus influenza*; while in children, the next common organisms were *β-haemolytic Streptococcus* followed by *Haemophilus influenza* and *Klebsiella pneumonia*. *Klebsiella pneumonia* was isolated from 22.1% of adult cultures. Previous publications in the literature of core cultures do not report the significance of *Klebsiella pneumonia* in their studies. The prevalence of *Klebsiella pneumonia* is low (5.0%) in children compared to adults.

Table V. Prevalence of different types of β-haemolytic Streptococcus in adults and children.

β HS	Adult	Children	Total
Group A (pyogens)	3 (15%)	22 (67%)	25 (47%)
Group B	5 (25%)	7 (21%)	12 (23%)
Group C	10 (50%)	2 (6%)	12 (23%)
Group G	2 (10%)	2 (6%)	4 (8%)
Total	20 (100%)	33 (100%)	53 (100%)

Haemophilus influenza was found only in 10.0% of total cultured organisms, compared to other studies by Gaffney et al⁽⁵⁾, Surow et al⁽²¹⁾ and Lidroos⁽²²⁾. They found that *Haemophilus influenza* was the most common organism cultured, followed by *Staphylococcus aureus*. Gaffney et al⁽⁵⁾ isolated *Haemophilus influenza* from 72% of core culture samples; however, the prevalence of *Haemophilus influenza* according to age group was similar to this study.

β-haemolytic Streptococcus was the second most common organism isolated from children and was more prevalent, compared to adults. The prevalence of Group A *β-haemolytic Streptococcus* (*Streptococcus pyogens*) was similar to the studies by Brook and Foote⁽¹⁴⁾, and Ramirez et al⁽¹⁶⁾. Unlike this study, Gaffney et al⁽⁵⁾ found Group A *β-haemolytic Streptococcus* to be more prevalent in adults. The prevalence of Group B, Group C and Group G *β-haemolytic Streptococcus* differed in all previous studies, which we feel may represent a geographical difference^(5,14).

Klebsiella pneumonia and *Escherichia coli* were seen more commonly in adults compared to children. This may be due to transient colonisation of these organisms in adults secondary

to repeated use of antibiotics⁽²³⁾. *Klebsiella pneumonia* was more common than *Haemophilus influenza*, compared to previous studies^(5,21,22); the difference may be due to a wider use of antimicrobials in this region and the multi-resistant characteristic of *Klebsiella pneumonia* compared to *Haemophilus influenza*⁽²⁴⁾. This may bring about colonisation of these resistant organisms, giving rise to recurrent infections. *Streptococcus pneumonia* was found in ten patients, out of which nine were from adults, compared to Gaffney et al⁽⁵⁾ who reported a higher prevalence in children. The incidence of recurrent tonsillitis secondary to *Pseudomonas* was not rare in our study compared to previous papers^(5,14,17).

18% of the patients did not grow any pathogenic organisms even though the histopathological criteria were observed in the inclusion criteria. The histopathological criteria for chronic bacterial tonsillitis thus showed a significant false positivity. This may be due to the shortcomings of this study whereby no anaerobic cultures were done in all the core tissue samples, due to the difficulties and errors arising from delay in delivery time, exposure of sample to air and longer culture time. However, Gaffney et al⁽⁵⁾ found that strict anaerobic species were isolated in significant numbers from the tonsil core in 5% out of 120 patients, but were present in superficial culture in all. Anaerobes were present in moderate to heavy numbers in 32% of superficial swabs overall and this was more frequently seen in older age groups. In conclusion, we feel that more studies are needed in a better-controlled environment to understand the bacteriology of recurrent tonsillitis.

REFERENCES

- Palumbo FM. Pediatric considerations of infections and inflammations of Waldeyer's ring. *Otolaryngol Clin North Am* 1987; 20:311-6.
- Barr G. Further thoughts about tonsillectomy. *Ir Med J* 1989; 82:142-3.
- Cowan DL, Hibbert J. Scott-Brown's Otolaryngology. Vol 5. 6th ed. London: Butterworth Heinemann, 1997:2.
- Ylikoski J, Karjalainen J. Acute tonsillitis in young men: etiological agents and their differentiation. *Scand J Infect Dis* 1989; 21:169-74.
- Gaffney RJ, Freeman DJ, Walsh MA, et al. Differences in tonsil core bacteriology in adults and children: a prospective study of 262 patients. *Resp Med* 1991; 85:383-8.
- Robinson AC, Hanif J, Dumbreck LA, et al. Throat swabs in chronic tonsillitis: a time-honoured practice best forgotten. *Br J Clin Pract* 1997; 51:138-9.
- Brodsky L, Nagy M, Volk M, et al. The relationship of tonsil bacterial concentration to surface and core cultures in chronic tonsillar disease in children. *Int J Paed Otolaryngol* 1991; 21:33-9.
- Kurien M, Stanis A, Job A, et al. Throat swab in the chronic tonsillitis: how reliable and valid is it? *Singapore Med J* 2000; 41:324-6.
- Chole RA, Faddis BT. Anatomical evidence of microbial biofilms in tonsillar tissues: a possible mechanisms to explain chronicity. *Arch Otolaryngol Head Neck Surg* 2003; 129:634-6.
- Osterlund A, Pops R, Nikkila T, et al. Intracellular reservoir of *Streptococcus pyogenes* in vivo: a possible explanation for recurrent pharyngotonsillitis. *Laryngoscope* 1997; 107:640-7.
- Zhang PC, Pang YT, Loh KS, et al. Comparison of histology between recurrent tonsillitis and tonsillar hypertrophy. *Clin Otolaryngol* 2003; 28:235-9.
- Everett, M. T. The cause of tonsillitis. *Practitioner* 1979; 223:253-259.
- Polvogt LM, Crowe SJ. Predominating organisms found in cultures from tonsils and adenoids. *J Am Med Assoc* 1929; 92:962-4.
- Brook I, Foote P. Comparison of the microbiology of recurrent tonsillitis between children and adults. *Laryngoscope* 1986; 96:1385-7.
- Nandi S, Kumar R, Ray P, et al. Clinical score card for diagnosis of Group A streptococcal sore throat. *Indian J Paediatr* 2002; 69:471-5.
- Ramirez A, Peidroia D, Lopez A, et al. Beta-hemolytic streptococci in tonsil hypertrophy and recurrent tonsillitis. *Enferm Infecc Microbiol Clin* 1997; 15:315-8.
- Danielides V, Patrikakos G, Milionis JH, et al. An unusual case of recurrent tonsillitis due to *Pseudomonas aeruginosa*. *Acta Otorhinolaryngol Belg* 2001; 55:203-5.
- Reilly S, Timmis P, Beeden AG, et al. Possible role of the anaerobe in tonsillitis. *J Clin Pathol* 1981; 34:542-7.
- Darrow DH, Siemens C. Indications for tonsillectomy and adenoidectomy. *Laryngoscope* 2002; 112(8 Pt 2 Suppl 100):6-10.
- Brook I, Yocum P, Foote P. Changes in the tonsillar bacteriology of recurrent tonsillitis: 1977-1993. *Clin Infect Dis* 1995; 21:171-6.
- Surrow JB, Handler SD, Telian SA, et al. Bacteriology of tonsil surface and core in children. *Laryngoscope* 1989; 99:261-6.
- Lidroos R. Bacteriology of the tonsil core in recurrent tonsillitis and tonsillar hyperplasia – a short review. *Acta Otolaryngol Suppl* 2000; 543:206-8.
- Sleigh JD, Timbury MC. *Medical Bacteriology*. 4th ed. Edinburgh: Churchill Livingstone, 1994:197.
- Sharma R, Sharma CL, Kapoor B., Antibacterial resistance: current problems and possible solutions. *Indian J Med Sci* 2005; 59:120-9.