ORIGINAL ARTICLE

The Effects of tonsillectomy on the throat microflora: A comparative study of the pre and post operative throat swabs

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Abstract

Introduction: The oral cavity and the throat have a rich and varied microbial flora. In addition to aerobes, many anaerobes and protozoa can also frequently be found. The predominant bacteria are alpha haemolytic streptococci. The aim of this study is to evaluate the effect of tonsillectomy on bacterial colonization of the throat. **Patients and Methods:** Throat swabs of 100 chronic tonsillitis cases were compared to a similar number of control group. Swabs were collected from the patients in two instances i.e pre and postoperative. Throat swab were cultivated aerobically and anaerobically on different types of media. **Results:** The tonsillar infections were more prevelant in children than adults, with no statistically significant difference between males and females. Str.viridans was the most common aerobic isolate in both groups and this result is statistically significant. Mean while streptococcus pyogenes is significantly the predominant pathogenic isolate. In comparison of the number of isolated aerobic bacteria from preoperatiove patients and control group showed numbers of throat flora streptococci, streptococcus viridans and streptococcus salivarius, are higher in control group than the patients, except for Str.mitis. The number of isolated anaerobic bacteria from patients and control group, there is a statistically significant difference at ($p < 0.05$) regarding Actinomyces spp. The comparison of aerobic bacteria isolated pre and post tonsillectomy from patients group (44 patients), all types of Streptococci spp. showed a significant reduction postoperativelly. Comparison of anaerobic bacteria isolated pre and post tonsillectomy, reveals a relative decrease in number of anaerobic bacteria after tonsillectomy. **Conclusion**: Tonsillectomy has clear effects on the throat flora. It changes the micro- flora of the throat through the reduction of most aerobic bacteria and decreasing the anaerobic organisms. We recommend the culture of throat swab as a reliable test for the diagnosis of pathogens in the tonsil surface.

Keywords : throat swab, throat flora, tonsillectomy, streptococci, anaerobes

Introduction

Man is constantly attacked by a myriad of microorganisms that occupy his environment[1]. Some microbes become implanted as colonists (normal flora), some are rapidly lost[2]. The indigenous microflora of the throat, consist of a rich and heterogeneous microbial population, with significant qualitative and quantitativedifferences than those found in closely contiguous sites[3]. There are many anaerobes that live in this area and protozoa can also frequently be found. Both Gram positive and Gram negative bacteria are commonly seen in this area. The distribution of microflora is about 3% pathogenic, 10% opportunistic and 87% beneficial microorganisms (Figure 1)[4]. The predominant bacteria are alpha haemolytic streptococci[5].

Rarely pathogens	Possible pathogens
◻ Non-haemolytic streptococci	◻ Viridans streptococci
◻ Micrococci	◻ B-haemolytic streptococci
◻ Corynebacteria spp.	◻ Str.pneumoniae
◻ Coagulase negative staphylococci	◻ Staph.aureus
◻ Neisseria spp.	◻ C.diphtheriae
◻ Lactobacilli spp.	◻ H.influenzae
◻ Veillonella spp.	◻ M.catarrhalis
	◻ Candida albicans
	◻ Bacteroides
	◻ Peptostreptococci spp.
	◻ Actinomyces spp.

Table 1: Normal distribution of organisms in the throat

Removal of the tonsils is associated with a reduction of pathogenic organisms such as Staphylococcus Aureus. Studies on aerobic and anaerobic flora of tonsils removed from children suffering chronic recurrent tonsillitis, revealed that 83% of them harbor β-lactamase-producing organisms, half of which are anaerobic[6].

The mucous membrane of the pharynx is often sterile at birth but may be contaminated by passage through the birth canal. Within four to twelve hours after birth, Viridans Streptococci become established as the most prominent member of the resident flora and remain so for life[5,6].

The mucosa of the oropharynx in man is asymptomatically colonized by a commensal flora[7]. The predominant organisms in the pharynx, alpha–haemolytic streptococci, Branhamella spp. and Corynebacteria spp., are generally first to appear, followed by small numbers of Streptococcus pneumoniae and species of Haemophilus. Acquisition of these organisms appears to follow the start of breast-feeding and contact with maternal skin[3]. The tonsils are involved in the production of most secretory IgA, which is transported to the surface providing local immune protection[8]. The aim of this study is to evaluate the effect of tonsillectomy on bacterial colonization of the throat.

Patients and Methods:

Throat swabs from 100 patients undergoing tonsillectomy were collected on 2 occasions: one day before the operation and on the 7th to the 10th postoperative day. They were grouped into 2 groups according to age: below 15 years and above 15 years. A similar number of swabs were also collected from 100 control cases from the outpatient department of the teaching hospital of Basra, matched for sex and age, who did not undergo tonsillectomy and do not complain of throat problems. All patients were consented before swab taking for the purpose of the research. A sterile throat swab was rubbed against the tonsil for obtaining the sample. The samples were sent to the laboratory within one hour. For the patients group, antibiotics were not used except on the day of surgery, as perioperative prophylaxis.

Results:

The patients group included 54 males and 46 females, while the control group had 45 males and 55 females. There was no significant difference in the number of patients in relation to age and sex ($X^2 = 1.6$; $p > 0.05$) . Comparing the number of isolated aerobic bacteria, we found that Streptococcus Viridans and Streptococcus Salivarius were significantly higher in the control group than the patients group in the preoperative period, while the number of Streptococcus mitis was comparable. However, alpha haemolytic Streptococci were the predominantly isolated microorganism in both groups.

Beta hemolytic Streptococcus pyogenes occupies the second position of the isolated microorganisms, it was the commonest pathogen isolated from patients group in the preoperative period. There was a statistically significant difference regarding Streptococcus viridans, Streptococcus mitis, Streptococcus pyogenes, Streptococcus pneumoniae and Staphylococcus aureus ($p< 0.01$) between the preoperative patients group and the control group. On the other hand, there was no significant difference observed regarding other types of aerobic bacteria, including Streptococcus salivarius, Neisseria, Staphylococcus epidermidis, Klebsiella, Diphtheriae, Eubacteria, Moraxella, Nocardia, Micrococci and Arcanobacteria spp. ($p> 0.05$). Furthermore, other types of normal flora such as Staphylococcus epidermidis, Diphtheriae and micrococci were relatively low in the patients group. However, Enterococci, Moraxella and Arcanobacteria spp. were marginally lower in the control group. Isolation rates of Nocardia spp. was comparable in both groups (Table 2).

Aerobic Bacteria	Patient (100)		Control (100)		P<
	Mean x10³	SD	Mean x10³	SD	
Streptococcus Viridans	7.8900	23.4550	16.8600	25.9794	0.01
Streptococcus Salivarius	20.2000	34.0632	21.2000	31.4777	0.008
Streptococcus Mitis	17.9700	26.8149	9.5100	16.4731	0.83
Streptococcus pyogenes	8.5900	20.1078	0.7200	3.0751	0.0
Streptococcus pneumoniae	5.3700	18.0463	0.4300	3.0855	0.008
Neisseria	8.5300	16.2303	7.1100	12.3296	0.487
Staphylococcus Epidermidis	1.1800	5.9973	2.0400	5.9270	0.309
Staphylococcus Aureus	1.0200	3.6570	0.1200	0.6401	0.016
klebseilla	6.000	0.3120	0.1100	0.5667	0.44
Diphtheriae	1.3600	9.8970	3.3300	11.1129	0.187
Enterococci	1.8182	7.2932	0.5500	2.8933	0.108
Moraxella	1.3900	5.1833	0.5100	2.1719	0.119
Nocardia	0.3600	2.3204	0.6700	2.9680	0.412
Micrococci	0.5000	1.8559	1.2100	7.8397	0.379
Arcanobacterium	1.300	4.9103	0.9600	4.3483	0.605

Table 2: Comparison of the number of isolated aerobic bacteria from patients before tonsillectomy and control group.

Regarding the number of isolated anaerobic bacteria, only Actinomyces spp. had a statistically significant difference ($p < 0.05$) between the preoperative patients group and the control group. The rest of the anaerobic species showed no significant difference between the two groups.

Anaerobic bacteria	Patient (100)		Control (100)		P<
	Mean x10³	SD	Mean x10³	SD	
Peptostreptococci	12.2100	25.3514	8.8100	16.2392	0.260
Peptococci	2.2400	6.8580	0.9400	3.5980	0.095
Veillonella	1.8200	5.3548	2.7300	11.2903	0.467
Bacteroides	2.8000	8.5067	3.4900	6.2385	0.514
Fusobacteria	1.2700	5.9099	0.6000	2.6667	0.303
Actinomyces	2.2500	6.3966	4.1700	7.3568	0.050
Lactobacilli	1.3900	5.6602	0.3600	1.0202	0.075
Eubacteria	o.1400	1.0733	0.1100	0.5486	0.804

Table 3: Comparison the number of isolated Anaerobic bacteria from patients and control group.

Regarding the isolated yeast species, there was a highly significant statistical difference in the isolation rates of yeast in the preoperative patients group and control group ($p < 0.05$) (Table 4).

Yeast	Patient (100)		Control (100)		P<
	Mean x10³	SD	Mean x10³	SD	
Pt.(100)	3.1600	9.1847	0.4900	1.7724	0.005

Table 4: Comparison the number of Yeasts isolated from preoperative patients group and control group.

Regarding the values of aerobic bacteria isolated in the preoperative and postoperative patients groups, all types of Streptococci spp. showed a significant reduction in the later group. The rest of the aerobic organisms, except Nisseria spp., showed significant reduction postoperatively. There was a significant statistical difference in species of Streptococci i.e. Str.mitis, Str.pyogenes and Neisseria spp. at ($p < 0.01$) except for (Str.viridans) (Table 5).

Aerobic bacteria	Mean	SD	*p*<
Str.viridans	8.0682 * 5.7500 **	0.2500 1.2045	0.324
Str.salivarius	14.1136 4.3182	23.2281 13.1216	0.020
Str.mitis	17.5227 7.2273	25.9270 13.5421	0.012
Str.pyogenes	12.4773 1.5682	26.1120 4.1056	0.006
Str.pneumoniae	7.8409 1.4318	24.0377 6.0976	0.045
Neisseria	2.0909 9.5909	4.1474 19.0597	0.013
Sta.epidermidis	1.1591 0.6364	3.3959 2.0583	0.392
Sta.aureus	9.091 1.4545	0.2908 4.7713	0.063
Klebsiella	0.2500 0.1273	0.9912 0.7315	0.149
Diphtheriae	0.7273 0.2273	2.7900 1.5076	0.249
Enterococci	0.6364 0.8409	2.8456 3.5368	0.744
Moraxella	2.3182 1.3409	14.3361 0.5099	0.386
Nocardia	1.1364 0.1364	7.5378 0.5099	0.386
Micrococci	0.1136 0.4091	0.3868 1.9086	0.302
Arcanobacterium	0.2500 1.2045	0.9675 4.038	0.138

Table 5: Comparison of aerobic bacteria isolated pre and post tonsillectomy from patients group.

Comparison of anaerobic bacteria isolated pre and post operatively revealed a relative decrease in number after tonsillectomy. There was no statistically significant difference in most types except for Peptostreptococci and Actinomyces ($p < 0.05$) (Table 6).

Anaerobic bacteria	Mean	SD	*p*<
Peptostreptococci	19.4545 * 6.7045 **	34.3494 15.4988	0.026
Peptococci	1.4091 0.7955	4.5817 2.2781	0.128
Veillonella	1.8636 1.0000	4.8589 3.0270	0.121
Bacteroides	2.7727 1.6136	9.9203 6.4021	0.506
Fusobacteria	1.1136 1.3409	5.8318 8.2995	0.884
Actinomyces	4.0455 1.2273	8.9416 3.1613	0.040
Lactobacilli	0.9545 1.0909	3.9588 4.0681	0.855
Eubacteria	0.2273 4.545	1.5076 0.3015	0.323

Table 6: Comparison of anaerobic bacteria in the pre and post operative patients group.

Comparison of yeast isolated pre and post operatively in patients group showed no statistical significant difference. The most predominant pathogenic bacteria in all patients was Streptococcus pyogenes, which comprised 23.3% in patients < 15 years old and 29.9% in patients >15 years old. On the other hand, the most predominant bacterial flora in all patients was Neisseria spp., which comprised 64.1% in patients < 15 years old and 59.8% in patients > 15 years old.

Types of flora	< 15 years old (%)		> 15 years old (%)		Total %	
Str.viridans	44	42.7	28	28.9	72	36.0
Str.salivarius	52	50.5	61	62.9	113	56.5
Str.mitis	52	50.0	57	58.8	109	54.5
Neisseria	66	64.1	51	52.8	117	62.0
Staph.epidermidis	29	28.2	15	15.5	44	22.0
Diphtheriae	13	12.6	5	5.2	18	9.0
Enterococci	9	8.7	7	7.2	16	8.0
Moraxella	20	19.4	13	13.4	33	16.5
Nocardia	6	5.8	7	7.2	13	6.5
Micrococci	16	15.5	11	11.3	27	13.5
Arcanobacterium	11	10.7	9	9.3	20	10.0

Table 7: The most predominant bacterial flora isolated among the study population

Discussion:

In diagnostic microbiology, it is important to distinguish between a patient commensal flora and the causative agents of an infection. This is not always as an easy process, since in some cases microbes are normal flora at certain anatomical location, but are considered pathogens when isolated from other sites[5]. The surface of tonsil is constantly exposed to oral secretions with their attendant flora and surface culture is likely to grow these organisms. Despite controversy, swabbing of the tonsillar surface as a culture specimen to determine the organism responsible for infection is still used in practice[9-13].

In this study, we found that the Strains of Streptococcus salivarius were prevalent in throat flora and increase significantly with age, and were isolated at a significantly higher rate from healthy control group. This might explain that they may contribute to the greater resistance of adults than children to streptococcal infections[14]. In the same time, many strains of Streptococcus viridans are considered to be inhibitory to Streptococcus pyogenes, thus GABHS are less isolated in healthy individuals[14]. Both Streptococcus viridans and Streptococcus salivarius were lower in patients than in control, due to the effect of pathogenic organisms on the normal flora. In contrast, Streptococcus mitis was higher in patients than in control group, because of uncertain role of this bacterium[14].

Haemophilus influenzae was isolated from tonsillar surface in two cases only. This is in agreement with other studies, which found a higher isolation rate of H. influenzae in cultures obtained from tonsillar core tissue rather than ordinary throat cultures[15].

Kuhn found a higher concentration of H.influenzae and Staphylococcus Aureus in hypertrophic tonsil and obstructive tonsillar hypertrophy as compared to recurrent tonsillitis[16]. This observation may explain the low isolation rate of H. influenzae recorded in this study. There was no significant difference between control and patient groups in respect to anaerobic pathogens, with Peptostreptococci forming the most frequently isolated organism. Most of these organisms can survive easily, as they are relatively resistant to the antibiotics usually prescribed for recurrent tonsillitis[17]. Actinomyces a predominant normal flora species of oral cavity, proved to be significantly higher in patients group [18, 19]. It can be attributed to disturbance in the microbial flora in patients, which leads to alteration of flora. Thus, candida can cause superinfection of the oropharynx[2,20]. It is well known that, after tonsillectomy all types of pathogenic bacteria considered as a causative agent for tonsillitis are decreased in number[21]. This fact is compatible with the results of the present study. Manolis, 1994, found most of the potentially pathogenic bacteria were beta-lactamase producer. After surgery, these pathogenic bacteria were quantitatively reduced and their isolation rate was lower. Furthermore, bacteria considered as normal inhabitants showed an increase in their frequency[22].

In this study, Streptococcus salivarius, mitis, pneumoniae, pyogenes and Neisseria spp. were statistically higher in patients than in control group.We also found that the most frequent isolates of throat flora in children was Neisseria spp., since young children may drink large volumes of milk. Among Neisseria spp., strains of N. lactamica are unique in their ability to use lactose. This characteristic may enhance population of Neisseria in throats of younger children. Unlike N. gonorrhea and N. meningitidis, N. lactamica has not been implicated as a primary pathogen, although it may be an apportunistic pathogen[33].

The only exception was Staphylococcus aureus, since this organism was found in the tonsil core rather than on surface culture[23]. This might indicate that pharyngeal swab cultures do not reliably reflect the presence of pathogens[15,24]. Neisseria spp. was increased post operatively, this is probably concievable as this organism occupies vacant niche of other pathogenic bacteria. Isolation rates of Peptostreptococci and Actinomyces spp. were significantly decreased after tonsillectomy. These anaerobic bacteria might be involved in recurrent tonsillitis when Streptococcus pyogenes is not the cause[17].

The most predominant pathogenic bacteria in children and adult patients were Streptococcus pyogenes. Nevertheless, literature mentioned that the etiology of recurrent tonsillitis in adults might differ from that in children, because of prolonged courses of antimicrobials given to adults and the changes in tonsillar tissue that occur in this age group[25].

Children infected with Streptococcus pyogenes may have fewer inhibitory strains than who are not infected, the presence of these interfering bacteria may play a role in preventing GABHS infection[26]. Other studies have shown that infection by GAS is common in children, because the detection rate of inhibitory alpha streptococcus in healthy children as well as patients with tonsillitis was lower than in adults[27]. Several pathogens, especially Staphylococcus aureus, M catarrhalis and H.influenzae can produce beta-lactamase. This polymicrobial infection this can prevent eradication of GABHS with penicillins[8].

The quantitative analysis of the normal flora is useful because this methodology might reveal whether the bacteria recovered from the throat show the pathogenicity or not[28]. However, the rate of detection of such bacteria differs in the literature[29-31].
The commensal flora can be affected by host factors such as age or antibiotic usage but will in itself also affect its host [32]. In addition to being a source of resistance starins, it will also protect the host against exogenous, non-commensal pathogens. This protection is the result of three characteristic of the commensal flora. It will hinder the establishment of new pathogens on the mucosa (termed colonization resistance), it will specifically the immune system and it will induce formation of protective antibodies[7].

In conclusion, tonsillectomy has clear effects on the numbers of oropharyngeal micro- flora causing reduction of most aerobic and anaerobic bacteria. In addition, the pathogenic bacteria were quantitatively reduced postoperativly and their isolation rate was lower. By comparing the throat swabs of the patients and control, throat swab can be a reliable method to detect pathogens on the tonsil surface.

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