Original Research

Middle ear infection in children and its association with dental caries

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Abstract

Introduction. Middle ear infection affects mostly infants and children, associated with elevated level of S. mutans, which increases the chances of developing caries.

Aim. To evaluate the difference in level of Streptococcus mutans between normal children & children affected by middle ear infection.

Method. This descriptive study was carried out on 120 children aged 5 years and younger. They were selected randomly from schools and medical hospitals. S. mutans was counted from saliva sample and a questionnaire was given to be filled by their parents about the feeding method, pattern and specific childhood illness.

Result. Out of 120 children examined, 62 were boys and 58 were girls. Mean CFU in middle ear infection group was 5.60+9.53, whereas in children with no middle ear infection it was 1.70+3.34. Unpaired 't' test revealed statistically significant difference among the two groups (p value = 0.001).

Conclusion. S. mutans count was comparatively higher in children having middle ear infection rather than non-infected children, which may cause dental caries in the future.

Keywords: middle ear infection, S. mutans, dental caries, mitis salivarius agar

Introduction

The term "childhood disease" may first bring to mind pneumonia, malaria or diarrhea, which are some of the leading causes of death in children under five years worldwide. Otitis Media (OM) or Middle Ear Infection (MEI) is an umbrella term which covers all inflammation of the middle ear without reference to etiology or pathogenesis [1]. Middle ear infections and dental caries are not leading causes of mortality in children, but both diseases are highly prevalent around the globe and are the most commonly diagnosed childhood illnesses [2,3]. It is a condition that affects mostly infants and young children peaking during the first 3 years of life, with 80% of children having had at least one otitis media episode by the age 3 years and 50% have had at least three episodes, while fewer had a first episode after 3 years of age [4,5]. Researche has proved that the prevalence of otitis media ranges anywhere between 62-84% in children [3,6,7]. This condition may be attributed to the structural and functional immaturity of the Eustachian tube and an immature immune system [6,8]. It has been associated with elevated levels of salivary mutans streptococci and with a significantly higher risk for developing dental caries, because primary teeth continue to calcify throughout the first year of life [9,10,11].

It is hypothesized that middle ear infection occurring during this period may cause some damage to the ameloblasts and this may result in the formation of hypoplastic primary teeth which increase their caries susceptibility. Previous studies on dental caries demonstrated the role of salivary mutans streptococci as a predictor and marker for caries risk [12]. High level of mutans streptococci in the saliva tends to have early colonization of these organisms in children. Children colonized by *Mutans streptococci* at an early stage developed more caries than those colonized at a later stage [13]. The colonization of S. mutans may influence the colonization of S. pneumonia in the nasopharynx. The vice versa relation such as middle ear and nasopharyngeal colonization may influence teeth development during childhood [14]. Culturing Mutans streptococci from children's saliva has high utility in caries risk assessment. Salivary mutans streptococcus culture may be more effective, simpler and less time consuming [15].

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Thus, the purpose of the present study is to evaluate the level of Streptococcus mutans in middle ear infected and non-infected children which would be beneficial for dental and medical providers to identify children at high risk for dental caries.

Materials and method

This descriptive study was carried out on 120 randomly selected children aged 5 years and younger from schools, ENT clinics, pediatric and medical hospitals. Children whose parents agreed to participate in the study (had an informed consent signed by parents/guardian as well as the ethical committee clearance) were included. In control subjects, children having neither middle ear infection nor dental caries were included. Children with craniofacial abnormalities and any other severe medical problem were excluded from the study. Children with middle ear infection were categorized by age and gender as, 0-1 years, 1-2 years, 2-3 years, 3-4 years, 4-5 years, and the middle ear infection was assessed by medical specialists [ENT].

Parents of 120 children were asked questions about the history of previous ear infection. Questions included child's age, oral hygiene, frequency of brushing, use of fluoride supplements, method of feeding, frequency of feeding, frequency of common cold and specific childhood illness etc. The questionnaire was filled up by the parents. After answering the questionnaire clinical saliva samples were then collected from the children.

Unstimulated saliva from children was collected in a sterile saliva container (Figure 1). The study was carried out on two groups, Group 1 included children having middle ear infection and Group 2 included non infected children. The saliva samples once collected were labeled accordingly and transferred to microbiology lab for further processing.

Each sample was centrifuged at 3000 rpm for 10 minutes using Remi centrifuge. The supernatant was discarded and deposits were subjected for further culturing.

The deposits were cultured on Mitis Salivarius agar (Figure 2). The media was weighed and 25 gram powder mixed with 250 ml of distilled water and then autoclaved at 120 °C under 15 Lbs pressure for 15 minutes and then 1% tellurite (Hi media M 259) was added and poured on sterile petriplates (Borosil) and kept for solidifying at room temperature inside laminar air flow (pre sterilized by UV). Then the deposits were plated in the media by spread plate method using sterile swab (Hi Media). The plates were incubated for 24 hours at 37 °C inside incubator. After 24 hours the plates were taken out and colonies were counted using digital colony counter (Hi media) and calculations were done accordingly (Figure 3). The colonies were also checked by gram staining method. Smear was prepared in cleaned and washed glass slides from the colonies of each plate.

Figure 1. Collection of unstimulated saliva sample.

Figure 2. Deposits cultured on selective media Mitis Salivarius agar.

Figure 3. Digital colony counter.

Statistical analysis

The data thus obtained were compiled and arranged by entering into Microsoft Excel spread sheet. The data was transferred to SPSS version 16.0 for statistical analysis.

Frequency distribution and descriptive statistics was calculated. Chi square test was used to assess the mean difference in the two groups. Unpaired t-test was used to compare the difference in mean colony forming unit among the two groups. Confidence intervals were escaped 95% overall and p value ≤0.05 was considered to be statistically significant.

Results

The study compared the mean colony forming unit (CFU) between the two groups. The group with Middle ear infected children showed a mean CFU of 5.6013 which differed significantly (p-value=0.001) from non-infected children group (mean CFU = 1.6707) as presented in Table I.

Responses of parents to various questions in the questionnaire are presented in Table II.

The health of teeth and gums were found to be average in all the middle ear infected children (100%) whereas mixed responses were found in non infected children. The oral health status of 57% (34) of non infected children were found to be very good and 43% (26) were good .The difference was statistically significant (p-value.001). 90% of the population (54) of non-infected group cleaned their teeth once in a day and rest 10% (6) cleaned their teeth more than once whereas all children in the infected group always cleaned their teeth once a day. When the participants were asked which material they used to clean their teeth both groups 100% reported tooth brush and toothpaste. No significant difference was observed in the frequency of tooth-brushing and the method of mouth cleaning between the two groups. When asked how often in the last 12 months have they experienced pain and discomfort in their teeth and gums, 13% in group 1 children responded occasionally, 77% children never and the rest of the parents responded that they didn't remember their child feeling uneasy during the last 12 months which was found to be statistically significant (p-value 0.01).

Table I. Comparison of mean CFU among the two Groups.

Group	N	Mean CFU	Std. Deviation	T Value	P Value
1	60	5.6013	99.53		
2	60	1.6707	34.32	20.44	0.001*

Table II. Responses to Questions.

Question 1	How would you describe the health of your teeth and gums	
	Middle Ear Infection	No Infection
Very Good	0	34
Good	0	26
Average	60	0
Chi Square Value	60.000	
P Value	0.001*	

Question 2	How often do you clean your teeth	
	Middle Ear Infection	No Infection
Once a Day	54	60
More than once	6	0
Chi Square Value	3.158	
P Value	0.237	

Question 3	Which material do you use to clean your teeth	
	Middle Ear Infection	No Infection
Tooth Brush and Tooth paste	60	60
Chi Square Value	----	
P Value	----	

Question 4	How often in the last 12 months have you experienced pain and discomfort in your teeth and gums	
	Middle Ear Infection	No Infection
Occasionally	8	0
Never	46	60
Don't Remember	6	0
Chi Square Value	7.925	
P Value	0.01*	

Table III assesses the frequency of various suspected risk factors in the development of middle ear infection in group 1 study subjects which depicted the ear findings, age distribution , method of feeding, frequency of feeding and frequent history of cold. In ear findings, age distribution 0-1 years, 1-2 years, 2-3 years, 3-4years and 4-5 years was taken and frequency distribution exhibited in infected children were 6.67%, 26.67%, 16.67%, 26.67% and 23.33% respectively. Regarding the method of feeding, 91% of children were bottle fed, while 3% children were breast fed and the remaining 6% recorded combination feeding. In frequency of feeding, 77% were fed every 2-3 hours, 13% during bed time and 10% on demand. In response to history of frequent colds, 100% parents agreed that their children suffered from cold in early childhood.

Table III. Frequency of various suspected risk factors in the development of middle ear infection.

Question 5	Ear Findings (Age Distribution)
0-1 year	6.67%
1-2 year	26.67%
2-3 year	16.67%
3-4 years	26.67%
4-5 years	23.33%
Question 6	**Method of feeding**
Breast Feeding	3%
Bottle Feeding	91%
Both	6%
Question 7	**Frequency of feeding**
Every 2-3 hours	77%
During bed time	13%
On demand	10%
Question 8	**Frequent Colds**
Yes	100%
No	--

Discussion

The present study indicated that the risk of early childhood caries was found to be significantly higher in children who were diagnosed with middle ear infections. In the present study when salivary levels were compared in between the two groups, mean colony forming unit in middle ear infection group was 5.60±9.53, whereas in children with no middle ear infection, it was 1.70±3.34. Statistically significant difference among the two groups (p-value=0.001) was found. Higher mutans streptococci levels in early childhood increase the risk of early childhood caries and dental caries in subsequent years. Also some studies gave mixed results. In their study on preschool children, Nelson et al. reported that there was no association between ear infections and dental caries despite the fact that the mean number of ear infections in children with dental caries being greater than in children with no dental caries [16]. The findings of the present study were similar to the findings of the study by Alaki et al., which demonstrated an association between otitis media and dental caries [14]. The study found that children with otitis media, were at 11% higher risk (HR=1.11, p=0.05) for developing caries after the first year of life. In young children who used feeding bottles there was an increase in the establishment of *Streptococcus mutans* and *Streptococcus pneumonia* colonies, which are accountable for otitis media and dental caries as was reported by Knuuttila and Makinen, Vadebonocoeur et al. and Kontiokari et al [17,18,19]. In another study done by Meurnan and Pienihakkinen, reported that higher Mutans streptococci scores have been found correlated to the caries incidence in preschool children [20]. The present study found that the oral hygiene level was average in middle ear infected children as compared to non-infected children who had good oral hygiene. The results of this study are in agreement with previous investigations of Reisine and Psoter that employed clinical measurement of plaque levels which showed good oral hygiene to be associated with lower incidence of caries [21].

Ingemansson Hultquist et al. found that tooth brushing was not significantly associated with the presence of Mutans streptococcus [22]. By contrast, the present study agreed with the results presented by Zhou et al., who found that colonization of Mutans streptococcus in 8 to 32 month old children was associated with poor oral hygiene [23]. Earlier colonization by Mutans streptococcus in young children generally translates into increased caries rates Kohler et al [24].

The present study also agreed with the earlier findings of Nelson et al. that parents take young children for a dental visit only when they perceive problems. Our findings suggest assessing the risk of young children for timely referral to dental services [16].

In the present study ear infection was seen most commonly in 2 and 3 years old children with 26% frequency distribution. On the other hand, Teele et al. have found that children 2 years old and below to be the most affected while Nelson et al. found it to be between ages 4 and 5 years [25,16]. Probably a uniform age wise distribution of cases and controls would give more relevant information in this direction.

In case of feeding method, higher otitis media was associated with bottle fed children with population of 91% as compared to breast fed children (3%).This may be due to bottle feeding which is considered harmful, as it generates negative pressure in mouth which is transmitted up to middle ear resulting in fluid buildup and gets infected and further contributes to early childhood caries. In frequency of feeding, 77% in group 1 fed 2-3 hours, 13% during bed time and 10% on demand which is in agreement with the findings of Sangeetha et al [26]. In the present study boys were found to have higher ear infection as compared to girls and this finding is similar to the findings of Sangeetha et al [26].

However, further study is warranted to assess the longitudinal caries occurrence trajectories of children with intermediary Mutans Streptococci level for greater clinical judgment.

Conclusion

Based on this study's findings the following conclusion can be drawn: increased level of Mutans streptococcus count in early childhood with other suspected contributing risk factor increases the risk of early childhood caries and dental caries in future. This study also provides some evidence on the nature of the connection between early childhood caries and one of common early childhood infections (middle ear infection) and may be used for caries risk assessment.

In an era of increasing interdisciplinary collaboration, recognizing young children at risk for caries occurrence is of interest to both dental and pediatric primary care providers and thus recognizes children who would benefit from timely dental care and intensive caries management. Salivary culture of Mutans streptococci is a clinically valuable tool in young children for the identification of those at high risk of caries incidence and development including children who does not yet display visual evidence of cavities.

Therefore evaluation of caries risk is most important as it gives an opportunity to improve hygiene, diet and important preventive measures in an exposed population.

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