



## MORAXELLA CATARRHALIS BACTEREMIA ASSOCIATED WITH THIRD MOLAR SURGERY

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### ABSTRACT

The bloodstream is sterile under normal conditions. Transient bacteremia occurs when bacteria enter the bloodstream. Bacterial species; general health care of the patient; and type of dental procedures are effective on the emergence of bacteremia complications. *Moraxella catarrhalis* is an exclusively human commensal of the upper respiratory tract and oral cavity. As *Moraxella catarrhalis* has been considered as a harmless commensal, very less is known about its pathogenic characteristics and virulence. However its role as a potential pathogen, has long been questioned. The aims of this study were to investigate the prevalence of transient bacteremia caused by *Moraxella catarrhalis* after third molar impactions. Also to find whether *Moraxella catarrhalis* bacteremia can occur even after prophylactic administration of Amoxicillin.

**KEYWORDS:** Moraxella, bacteremia, third molar surgery, antibiotic resistance.



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## INTRODUCTION

*Moraxella catarrhalis* is a fastidious, Gram negative, aerobic bacteria. It is an oxidase positive diplococci. *Moraxella catarrhalis* was earlier called *Neisseria catarrhalis*, *Branhamella catarrhalis* and also *Micrococcus catarrhalis*.<sup>13</sup> The role of this bacteria as a pathogen and causative agent of otitis media in children and pneumonia in adults with COPD (chronic pulmonary obstructive disease) is well documented. *M.catarrhalis* is emerging as a pathogen in the last decade. Also the prevalence of  $\beta$  – lactamase producing strains has increased the level of interest for research in this field. Very few cases of bacteremia due to *M.catarrhalis* has been reported and not much research has been done on, topics on or related to “Bacteremia due to *Moraxella* after dental surgeries”. This bacteria can cause pneumonia, endocarditis, septicaemia and meningitis in immunocompromised hosts. Spread of bacteria from the oral cavity resulting in complications like bacterial endocarditis, has been done on case control studies based on dental procedures as a risk factor<sup>2</sup>. Amoxicillin is the most widely used antibiotic in routine dental practice in India. Amoxicillin prescriptions for routine dental practice follow professional guidelines<sup>31</sup>, and the recommended doses are 1 g every 12 h or 500mg every 8h, for a period of 5-10 days.

### BACTEREMIA

Bacteremia occurs frequently in dental invasive procedures . Transient bacteremia occurs when bacteria enters the blood stream. In healthy individuals , the normal defense mechanisms of the immune system can act on the transient bacteremia caused by bacteria. However, transient bacteremia can result in infective endocarditis in patients with cardiac anomalies and in patients with an immunocompromised immune system<sup>23</sup>. This can be caused by a number of bacteria. The incidence of bacteremia , due to various dental procedures such as flossing, scaling , root planning, rubber dam placement, endodontic treatment, periodontal surgery, tooth brushing, and water

irrigation devices has been documented<sup>1</sup>. Pneumonia in children can be complicated by bacteremia with *M. catarrhalis*).<sup>14,24</sup> Ioannidis et al. have presented data on 58 cases of *M. cattarhalis* bacteremia, including cases in 28 children younger than 12 years. In children with bacteremia, skin lesions such as purpuric and petechial rash were frequent.<sup>24</sup>

### TAXONOMY

*M. catarrhalis* was considered a nonpathogenic member of the resident flora of the nasopharynx previously. It belonged to the nongonococcal, nonmeningococcal neisseriae, which were considered as members of the normal flora. This bacteria was called *Micrococcus catarrhalis* when first described in 1896.<sup>21</sup> It was later renamed *Neisseria catarrhalis*, however the bacterium was subsequently assigned to the new genus *Branhamella* in honour of Sara E. Branham.<sup>12</sup> *B. catarrhalis* was reassigned to the genus *Moraxella* in 1984 as *Moraxella (Branhamella) catarrhalis*.<sup>9</sup>

### EPIDEMIOLOGY

The clinical interest in *M. catarrhalis* is only relatively recent, and many laboratories did not report *M. catarrhalis* as a pathogen in blood after dental procedures, especially when a well-recognized pathogen (e.g., *S. viridans* ) was present as well.

### ANTIMICROBIAL SUSCEPTIBILITY

*Moraxella catarrhalis* shows  $\beta$ -lactamase-mediated resistance to penicillins. A large international study, the Alexander Project 1996–1997, revealed that 100% of isolates were susceptible to amoxicillin-clavulanic acid, cefixime, chloramphenicol, ciprofloxacin, and ofloxacin.<sup>6,20</sup> For some antibiotics (cefaclor, ceftriaxone, and doxycyclin) a small increase (<0.5%) in the incidence of resistant strains was noted over the years. The clinical relevance of this increase is still unknown. Of note, strains that produce  $\beta$ -lactamase are expected to be resistant to penicillin, ampicillin, amoxicillin, and piperacillin.<sup>6</sup>

### ***β*-Lactamase Production**

The first  $\beta$ -lactamase-positive strain was isolated in 1976. By 1980, however, 75% of *M. catarrhalis* isolates from the United States produced  $\beta$ -lactamase.<sup>17</sup> Moreover, a trend toward reduced susceptibility to four  $\beta$ -lactam antibiotics, penicillin G, ceftriaxone, amoxicillin-clavulanic acid, and imipenem is observed. Given the high percentage of strains that produce  $\beta$ -lactamase, clinicians should assume that all isolates of *M. catarrhalis* are resistant to amoxicillin,<sup>26</sup> ampicillin, piperacillin, and penicillin.<sup>26</sup>

### **INDIRECT PATHOGENICITY OF MORAXELLA CATARRHALIS**

$\beta$ -Lactamase produced by *M. catarrhalis* protects the bacteria from penicillin therapy and also has the capacity to inactivate penicillin therapy of concomitant infections by serious airway pathogens such as *S. pneumoniae* and/or nontypeable *H. influenzae*.<sup>10</sup> This phenomenon is referred to as the indirect pathogenicity of *M. catarrhalis*. Treatment failures have been reported in such cases, which shows that all cultures positive for *M. catarrhalis* should be reported regardless of whether pure or mixed cultures were isolated.<sup>35</sup>

### **VIRULENCE**

Not much is known about the virulence traits of *M. catarrhalis*.

### **Adherence**

The general mechanism of cellular adherence of *M. catarrhalis* to host cell surfaces has been studied. The presence or absence of fimbriae did not influence the capacity of the bacterium to adhere or to cause hemagglutination.<sup>5</sup>

### **Capsule**

The presence of a polysaccharide capsule has been previously suggested. Unlike the situation in many other bacterial pathogens, the capsule is not detectable when colonies of *M. catarrhalis* are examined on agar plates<sup>3</sup>. More research is necessary to definitely demonstrate the presence of a capsule and to define its role, in virulence.

## **MATERIALS AND METHODS**

### **Ethical Approval**

This study was approved by the Ethical committee of SRM University, Chennai, India. The purpose of the study was explained and a written consent was obtained from all the patients included in the study, before collection of sample from the patients. This study was carried out in the Department of Microbiology, SRM Dental College and Hospital – Ramapuram, SRM University, Chennai, India. The study comprised of 50 patients, selected from patients who came to the Dept. of Oral and Maxillofacial Surgery, SRM Dental College and Hospital. All the 50 patients had been given Amoxicillin 24 hours before impaction and all the patients were scheduled to undergo impaction.

### **Blood Collection and Processing**

Before sampling the patients skin was cleaned with antiseptic – povidone iodine and 70% iso propyl alcohol and allowed to dry before collection of blood sample – to avoid risk of contamination. Each blood sample was collected (5 ml) was collected using an IV cannula (BD Venflon – Becton Dickinson India (P) Ltd) placed in the antecubital vein. Before collection of blood samples, local anesthetic injection 2% lidocaine was given, then the first blood sample was collected. After the impaction, the second sample was collected 30 seconds after completion of the impaction procedure and the third sample was collected 15 min later. Blood samples were inoculated into the culture media bottles (Hi-media BHI broth with 5% SPS).

### **Microbiological Analysis**

The blood culture bottles were transferred to the Department of Microbiology, SRM University within 10 minutes of collection. Blood samples which were collected were incubated for 48 hours at 37°C. Culture bottles were examined for turbidity and subcultures were done on blood agar plates. The streaked plates were incubated at 37°C for 24-48 hrs and observed for growth of bacterial colonies.

**ISOLATION AND IDENTIFICATION**

The following criteria have been used to distinguish *M. catarrhalis* from other bacterial species:<sup>18,32</sup>

Gram stain: In typical Gram stains, *M. catarrhalis* presents itself as a gram-negative diplococcus with flattened abutting sides. The bacterium has a tendency to resist destaining.

Colony morphology: Lack of pigmentation of the colony on blood agar; that the Colonies on blood agar are nonhaemolytic, round, opaque, convex, and greyish white. The colony remains intact when pushed across the surface of the agar.

Oxidase production and DNase production.

Failure to produce acid from glucose, maltose, sucrose, lactose and fructose.

Growth at 22°C on nutrient agar.

Failure to grow on modified Thayer-Martin medium.

Reduction of nitrate and nitrite.

Neisseria Identification kits (Microxpress – Tulip diagnostics (P) Ltd, India)

**RESULTS**

Of the 50 patients tested 37 patients had detectable bacteremia in blood samples collected after 30 seconds after third molar impaction, which was seen to persist even after 15 minutes after surgery (Table 1). Bacteremia due to *Moraxella catarrhalis* was detected in 32 of the patients, showing a prevalence rate of 64% (Table 3). Table 4 shows the bacterial species which were isolated, where *Moraxella catarrhalis* was the most common bacteria isolated.

**Table 1**

***Bacteremia was detected in 37 cases 30 seconds after third molar surgery and persisted after 15 minutes. 13 patients were negative for bacteremia.***

Time	Bacteremia positive	Bacteremia negative
Before Impaction	0	0
After 30 sec	37	13
After 15 min	37	13

**Table 2**

***MORAXELLA CATARRHALIS BACTEREMIA AFTER THIRD MOLAR SURGERY***

NO. OF PATIENTS TESTED	No. positive for <i>Moraxella catarrhalis</i> bacteremia	Prevalence rate of <i>Moraxella catarrhalis</i> bacteremia.
50	32	64%

**Table 3**

***BACTEREMIA DUE TO OTHER BACTERIA AFTER THIRD MOLAR SURGERY***

NO. OF PATIENTS TESTED	No. positive for bacteremia due to other bacteria	Prevalence rate of bacteremia due to other bacteria.
50	5	10%

**Table 4**

***BACTERIA ISOLATED***

BACTERIA	No.of Isolates	Prevalence rate
<i>Moraxella catarrhalis</i>	32	64%
<i>Streptococcus viridians</i>	03	6%
<i>Staphylococcus epidermidis</i>	02	4%

## DISCUSSION

The present study confirms our hypothesis showing that *Moraxella catarrhalis* can cause bacteremia after third molar surgeries and that premedication with Amoxicillin does not seem to prevent bacteremia by *Moraxella catarrhalis*. This study showed results similar to Okabe et al., 1990; where the frequency of bacteremia after tooth extraction was 72%. Similar to their study this study shows that bacteremia is prevalent if more than 5 ml of blood was lost during surgery.<sup>30</sup> In a study done by Ioannidis J P et al., 1995, the spectrum and significance of bacteremia due to *Moraxella catarrhalis* was studied in patients with underlying respiratory disease using similar materials and methods as the present study, where skin lesions were seen in patients with bacteremia, however in contrast our study is done in patients who underwent dental surgery and no skin lesions were observed in patients with bacteremia.<sup>24</sup> In a similar study done by P. Diz et al., blood samples were collected from healthy adults, in a similar manner to our study, before and after tooth extractions to evaluate the comparative efficacies of three antibiotics – Amoxicillin, Clindamycin, Moxifloxacin, whereas the present study was done to find the prophylactic efficacy of only Amoxicillin.<sup>31</sup> D. Ready et al demonstrated that a diverse collection of amoxicillin resistant bacteria are present in the oral cavity by conducting studies on the oral microbiota of young children. Similar to this study premedication did not prevent

bacteremia from occurring after dental surgical procedures.<sup>15</sup> In a study based on vascular access related infections by Anandhilakshmi et al, it was found that most of the bacteria isolated from blood were skin micro-organisms unlike the present study where all the bacteria isolated from blood were normal oral micro-organisms.<sup>4</sup>

## CONCLUSION

Bacteria was isolated from 37 patients of the 50 patients tested, of which 32 cases were due to *Moraxella catarrhalis*. The prevalence rate of bacteremia due to *Moraxella catarrhalis* was found to be 64%. It has become evident over the past decades that *M. catarrhalis* has significant pathogenic potential. *Moraxella catarrhalis* which forms part of the normal oral commensals can cause bacteremia after third molar surgeries. Our findings suggest that *Moraxella catarrhalis* bacteremia can occur after third molar extractions even after prophylactic administration of Amoxicillin. Pre-medication shortly before extraction does not seem to prevent entry of *Moraxella catarrhalis* into the blood stream. *Moraxella catarrhalis* can therefore, act as a dangerous pathogen as it shows resistance to Amoxicillin. The importance of alternative drugs such as ceftriaxone, ciprofloxacin, azithromycin and levofloxacin need to be examined.

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