

**Original Research Article**

## The Emergence and Importance of *Moraxella Catarrhalis* as Human Respiratory Tract Pathogen and its Antibigram

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**Abstract**

**Background:** *Moraxella catarrhalis* is a Gram-negative diplococcus, commonly found as a normal flora in the human upper respiratory tract. Recently, *M. catarrhalis* has emerged as an important human pathogen in respiratory tract.

**Aims and Objectives:** The present study was conducted to isolate *M. catarrhalis* as potential pathogen of respiratory system and to determine the prevalence with underlying risk factors as well as to establish a proper antibiogram.

**Methods:** A prospective study of 1250 of respiratory specimens, were carried out over a two years' tenure. The identification was done by microscopic examination, culture characteristics, an array of biochemical reaction and Vitek 2 system. The antibiotic sensitivity test was carried out according to the Kirby - Bauer disc diffusion method and their zone size interpretation was carried out by National Committee for Clinical Laboratory Studies (NCCLS) guidelines.

**Results:** A total of 33 clinically significant *M. Catarrhalis* were isolated from the 372 culture positive samples. Most of the isolates were obtained from the patients who were diagnosed as pneumonia (39.39%). *Moraxella catarrahalis* showed good sensitivity to almost all commonly used antibiotics such as Aminoglycosides (96.29%), Amoxicillin-clavulanic acid (93.11%), Ampicillin (92.59%) and Azithromycin (92.59%).

**Conclusion:** *Moraxella catarrhalis* should be considered as significant emerging respiratory tract pathogen especially in elderly patients with underlying risk factors like diabetics mellitus.

**Keywords:** *Moraxella catarrhalis*, Pneumonia, Diabetics mellitus.

## Introduction

*Moraxella (Branhamella) catarrhalis*, is formerly known as *Neisseria catarrhalis* or *Micrococcus catarrhalis*. Initial name *Micrococcus catarrhalis* subsequently changed to *Neisseria catarrhalis*, because of its similarities in phenotype and ecological niche to commensal *Neisseria* species. However, due to limited DNA homology with *Neisseria* species, the bacteria then transferred to a new genus, *Branhamella*. *Branhamella catarrhalis* was subsequently placed in the genus *Moraxella* on the basis of biochemical and genetic relatedness, and *Moraxella catarrhalis* is now the widely accepted name.<sup>(1)</sup>

It is a gram-negative, aerobic diplococcus.<sup>1,2</sup> Earlier it was considered as non-pathogenic member of the resident flora of the nasopharynx. Over the last two to three decades this bacterium has emerged as a genuine pathogen. Recently it is considered an important cause of upper respiratory tract infections in otherwise healthy children and elderly people.<sup>3,4</sup> Moreover, *M. catarrhalis* is an important cause of lower respiratory tract infections, particularly in adults with chronic obstructive pulmonary disease (COPD).<sup>1,5</sup> In immunocompromised hosts, the bacterium also causes several other infections disease including pneumonia, endocarditis, otitis media, septicaemia, and meningitis.<sup>1,3,6</sup> Currently, they also established as a potential nosocomial pathogen in hospital outbreaks of respiratory disease.<sup>7,8</sup> The oral antibiotics are sufficient for the treatment of most *M. catarrhalis* infections. Inducible  $\beta$ -lactamases are present in many isolates.<sup>9,10</sup>

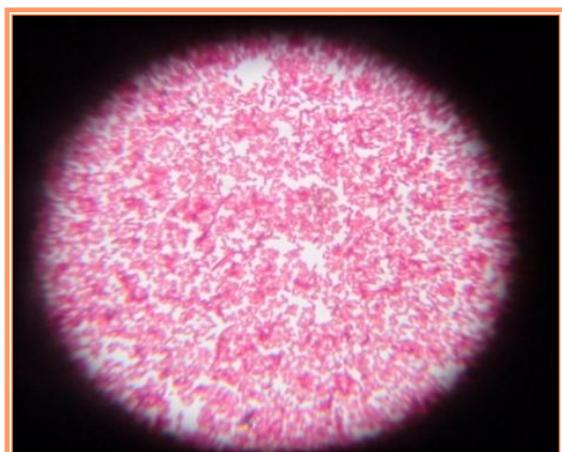
Unfortunately, many times they are overlooked and reported as commensal flora of respiratory tract. The aim of the present study was to isolate *M. catarrhalis* as potential pathogen of respiratory system and to determine the prevalence with underlying risk factors as well as to establish a proper antibiogram.

## Material and Methods

A prospective study was conducted over a period of 2 years from July 2012 to September 2014 in the Department of Microbiology of Dr. D. Y. Patil Medical College Hospital and Research Centre, Pune, a tertiary care teaching hospital in Western India. A total 1250 specimens including sputum and other respiratory samples (pleural fluid, bronchoalveolar lavage etc.), were processed for microbiological analysis. The samples were taken from the suspected patients, admitted to different wards and various intensive care units (ICU) of this hospital. A detailed history was taken along with the underlying risk factors were also evaluated, such diabetes mellitus, chemotherapy due to malignancy, prolonged hospitalization, prolonged antibiotic therapy, indwelling endotracheal tubes, costal tubes in situ, mechanical ventilation, surgical procedures like tracheostomy and smoking and tobacco addiction. Samples largely included sputum followed by bronchoalveolar lavage (BAL), pleural fluid etc. Samples were mainly collected from patients with lower respiratory tract infections. Screening of sputum samples done on Bartlett's grading system. Bartlett's score one or more than one included in the study and less than one were excluded from the study. In ventilated patients, lower respiratory tract secretions were sent in Luken's trap. Moreover, pleural fluid was collected from inter costal drainage. Tracheal secretions were collected in case of tracheostomy. Samples were transported immediately to the laboratory and processed without further delay.

Direct Gram staining from the samples, was performed to identify the type of organisms present along with pus cells. At the same time Ziehl Neelsen (ZN) staining was done for detection of acid fast bacilli (AFB). Samples were further processed for culture by standard conventional techniques. Specimens were inoculated on Blood agar, Chocolate agar and MacConkey agar and incubated aerobically for 18-24 hours at 37°C. Identifications of isolates were done by Gram stain morphology (Fig-1)

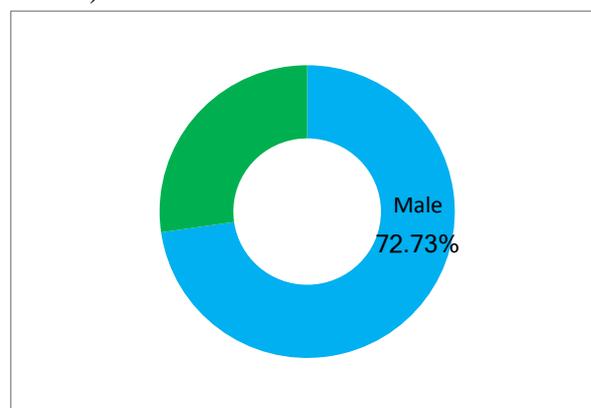
(gram negative diplococci), colony morphology on Blood agar, MacConkey agar and Chocolate agar. Further confirmation was done by positive oxidase test, catalase test, citrate test, hydrolysis of urea, triple sugar iron test (alkaline slant/ no change butt), Oxidation–Fermentation test and absence of motility. Automated microbial identification systems Vitek 2 (Gram negative card, Biomerieux) were used for final identification and confirmation of species. Antibiotic sensitivity testing was done by Kirby-Bauer disc diffusion method on Muller-Hinton media with proper standardization by ATCC control strain.<sup>11</sup> Commercially available Himedia discs were used and their zone size interpretation were carried out by National Committee for Clinical Laboratory Studies (NCCLS) guideline.<sup>12</sup> The antibiotics, which were tested, Ampicillin (10mcg/disc), Azithromycin (15mcg/disc), Cefotaxim (30mcg/disc), Ceftriaxone (30mcg/disc), Gentamicin (10mcg/disc), Amikacin (30mcg/disc), Levofloxacin (5mcg/disc), Ofloxacin (5mcg/disc), Cotrimaxazole (25mcg/disc), Chloramphenicol (30mcg/disc) and Amoxicillin/Clavulanic acid (20/10mcg/disc). The study was conducted after talking permission from hospital Ethical Committee of our institution. The statistical analysis was performed with the help of Microsoft EXCEL for WINDOWS 2007.



**Fig-1:** Gram stain morphology of gram negative diplococci

**Results**

A total 1250 respiratory samples were collected. Among them, 1018 were sputum, followed by 116 were pleural fluids, next to it were endotracheal tubes (45) and tracheal secretions (37) and BAL (34). However, among the total samples, 372 (29.76%) were culture positive. Among this 372 culture positive samples 33 (8.87%) isolates were *Moraxella catarrhalis*. Apart from *Moraxella catarrhalis*, other bacteria were *Klebsiella pneumonia*, *E. coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. Highest number of *M. catarrhalis* were isolated from male pulmonary ward 17 (51.52%) .



**Fig-2:** Gender distribution of the patients (n=33)

The rate of isolation of *M. catarrhalis* was more in males 72.73% (24) than in females 27.27% (9) [Fig-2]. Gender difference is statistically significant (p=0.00902).

**Table 1:** Age distribution of the patients (n=33)

Age group	Number (%)
<30 years	4 (12.12%)
31-40 years	7 (21.21)
41-50 years	12 (36.36%)
51-60 years	5 (15.15%)
>60 years	5 (15.15%)

*Moraxella* infection was found to be more in old age group, 41 to 50 years (36.36%) [Table-1]. The age difference is not statistically significant (p=0.18179)

**Table 2:** Underlying pulmonary pathology in patients with *Moraxella* infection (n = 33)

Underlying pulmonary pathology in patients with <i>Moraxella</i> infection	Number (%)
Pneumonia	13 (39.39%)
COPD	11 (33.33%)
Pulmonary tuberculosis	4 (12.12%)
Bronchiectasis	3 (9.09%)
Lung carcinoma	2 (6.06%)

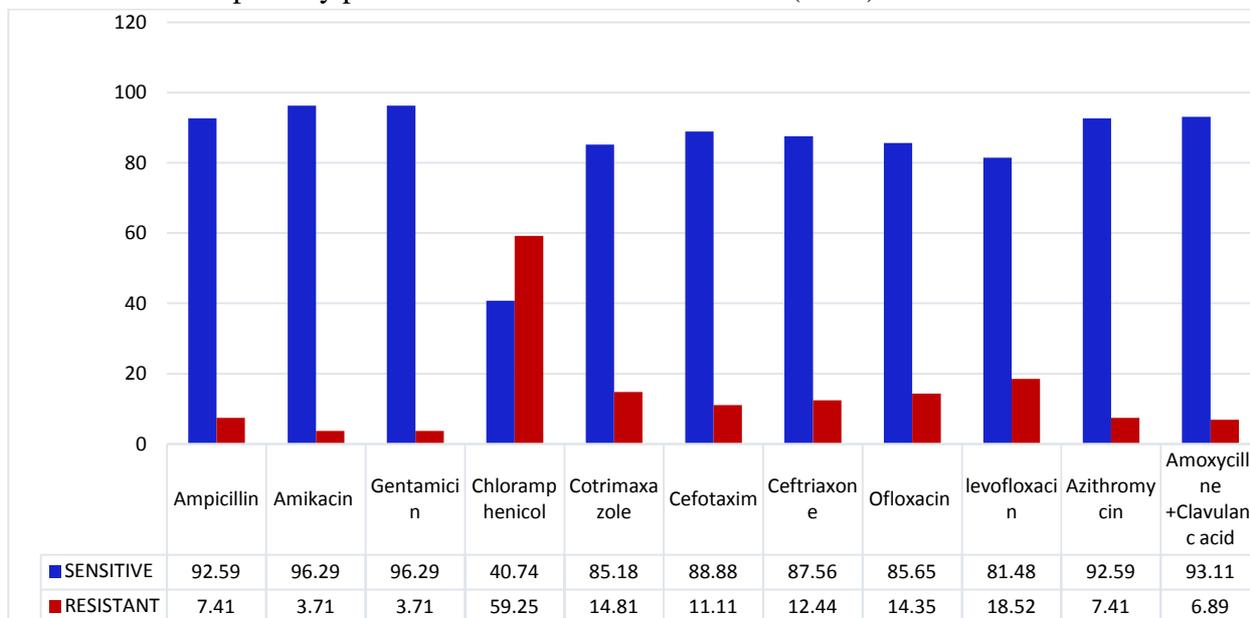
Pulmonary pneumonia (39.39%) and COPD (33.33%) were the two most frequent causes for *Moraxella* infection. Whereas pulmonary tuberculosis (12.12%), bronchiectasis (9.09%) and carcinoma of lung (6.06%) were among other causes [Table 2]. Difference in underlying pulmonary pathology is statistically significant (p=0.00406).

**Table 3:** Risk factors wise distribution of *Moraxella* infection (n = 33)

Risk factors	Number (%)
Diabetics mellitis (DM)	10 (30.3%)
Mechanical ventilation	7 (21.21%)
Prolonged hospitalization	6 (18.18%)
Indwelling intravascular catheters	6 (18.18%)
Smoking and tobacco addiction	4 (12.12%)

In this study diabetics mellitis (DM) (30.3%) played the most potential risk factor for *Moraxella* infection followed by mechanical ventilation (21.21%), next to it were prolonged hospitalization (18.18%) and indwelling intravascular catheters (18.18%) [Table 3]. Difference in risk factors is not statistically significant (p=0.573168).

**Fig-3:** Antibiotic susceptibility pattern of *Moraxella cattarahalis* (n=33)



*Moraxella cattarahalis* showed good sensitivity to almost all commonly used all antibiotics such as Amoxycillin-Clavulanic (93.11%), Ampicillin (92.59%), Azithromycin (92.59%), Gentamicin (96.29%) and Amikacin (96.29%) showed good sensitivity.

**Discussion**

The recognition of *M.catarrhalis* as emerging respiratory pathogen was delayed in the past 2 to 3 decades as it is counted as normal commensal flora of human body. In USA and in European countries many studies have been done on this

organism but unfortunately in developing countries like India, very few studies have been done till date. Often *M.catarrhalis* is misdiagnosed as *Neisseria*, because the gram stain and colony morphology of *M.catarrhalis* is indistinguishable from commensal *Neisseria*. Recently, In different studies *M.catarrhalis* has been diagnosed as significant lower respiratory tract pathogen with an isolation rate of 4.5% to 20%.<sup>[10,13,14,15,16,17]</sup> Similarly in our study the isolation rate is 8.87%, which is very alarming. In the present study, out of 33 isolates majority of the isolates 25 (75.76%) yielded from sputum and

rest 24.24% isolates were from respiratory samples other than sputum (BAL, tips of endotracheal tubes, endotracheal secretions). In another study in 2011 in India, revealed that out of 110 sputum, 13 cases revealed *Moraxella catarrhalis* as alone pathogen, where as in 36 cases *Moraxella catarrhalis* were associated with *Streptococcus pneumonia* and *Haemophilus influenza*.<sup>13</sup> Another study done in 2012 by Abdullah FE *et al*, isolated 39 (5.02%) isolates of *Moraxella catarrhalis* out of 776 sputum samples.<sup>18</sup> So, comparing all these data indicates the alarming incidence of *M.catarrhalis* as potential lower respiratory tract pathogen.

The rate of isolation of *M.catarrhalis* was more in male (72.73%) rather than female (27.27%). This finding correlates with the study of Alex Aiswariya *et al*.<sup>10</sup> The infection is also common in age group of 41 to 50 years, comprising 36.36%. Different studies have proved that the age of the patient is a critical determinant of *M.catarrhalis* infection, more the advanced age is, there will be a high chance of having this infection.<sup>10,17,19</sup>

Pneumonia (39.39%) and COPD (33.33%) are the two most common underlying pathology in majority of the patients from whom *M.catarrhalis* was isolated. The patients, who were diagnosed with pneumonia with lower or upper lobe consolidation, among these 13 (39.39%) patients seven were on mechanical ventilation in ICU over a long period. This finding concludes that *M. catarrhalis* is emerging as hospital acquired infection.

These organisms are most commonly isolated from those, who have some serious risk factors, such as patients who are on mechanical ventilation in ICU, already a known case of diabetic mellitus, prolonged hospitalization, endotracheal intubation, catheterization and those who are addicted to smoking and tobacco. We have noticed in our study among all the mentioned risk factors, DM (30.3%) play a pivotal role as underlying risk factor,

### Sensitivity pattern of *Moraxella catarrhalis*

The present study showed that 96.29% isolates revealed sensitivity to Aminoglycosides (Amikacin and Gentamicin). Similarly a study done by Siddesh B Sirwar *et al* revealed a 100% sensitivity to Gentamicin.<sup>20</sup> In the present study, around 93.11% isolates were sensitivity to Amoxicilline-Clavulanic acid, followed by 92.59% to Azithromycin and Ampicillin. Similarly, Abdulla FE *et al* reported 100% sensitivity to 76.9% sensitivity to Ampicillin.<sup>18</sup> A study by Alex A *et al* showed 90% sensitivity to Azithromycin and 85% sensitivity to Amoxicillin-Clavulanic acid.<sup>10</sup> In this study Cefotaxime accounting for 88.88%, ceftriaxone for 87.56% and Cotrimaxazole for 85.18%. Similarly, another study by Abdulla FE *et al* reported 90% susceptibility to Cotrimaxazole as well as 100% sensitivity to Cefotaxim.<sup>18</sup> In contrast a study by Patel PH *et al* revealed only 50 % sensitivity to Cotrimaxazole.<sup>21</sup> In the current study, Quinolones group of antibiotics revealed a good sensitivity pattern as 85.65% and 81.48% *M.catarrhalis* are sensitive to Ofloxacin and Levofloxacin, respectively. Similarly another study proved 80% sensitivity to Levofloxacin.<sup>10</sup> However, only Chloramphenicol show the lowest sensitivity, accounting for 40.74%; where as in comparison to this study, another study revealed 100% sensitive to Chloramphenicol.<sup>20</sup>

### Conclusion

Global increase in prevalence of *M.catarrhalis* has drawn our attention to this commensal of nasopharynx (upper respiratory tract) to an important emerging pathogen to lower respiratory tract infections for last 20 to 30 years. The most important finding of this study is that, *M.catarrhalis* is gaining its importance as lower respiratory tract infections especially pneumonia in elderly patients. Though in our study we merely found resistance strain but we should keep in mind that other studies published revealed a considerable number of resistance strain to many broad spectrum antibiotics. So it is now high time

that proper identification of *M. catarrhalis* should be carried out along with continued surveillance of antimicrobial susceptibility.

### Disclosure

The authors report no conflicts of interest in this work.

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