



## A STUDY ON CLINICAL SIGNIFICANCE OF MORAXELLA CATARRHALIS IN CAUSING LOWER RESPIRATORY TRACT INFECTIONS IN ADULTS AND THEIR ANTIMICROBIAL SUSCEPTIBILITY PATTERN IN A TERTIARY CARE HOSPITAL

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**Abstract :** Background of the study - *Moraxella catarrhalis* has now emerged as a pathogen and is now considered as an important cause of lower respiratory tract infection, particularly in adults with chronic obstructive pulmonary disease. Aim of the study - To evaluate the significance of *Moraxella catarrhalis* as a pathogen in causing lower respiratory tract infections, to assess the risk factors and to determine the antibiotic susceptibility pattern of *Moraxella catarrhalis*. Materials and Methods This cross sectional study was conducted at the Institute of Microbiology over a period of 6 months at Madras Medical College, Chennai. A total of 620 sputum samples were collected and processed from patients with suspected to be suffering from lower respiratory tract infection. The sputum samples were subjected to Gram staining, bacterial culture and antimicrobial susceptibility testing of the isolates. *Moraxella catarrhalis* was identified based on the cultural characteristics and identified with the relevant biochemical reactions. The antimicrobial susceptibility testing of *Moraxella catarrhalis* was performed by Kirby Bauer Disc Diffusion method. Result Among 620 samples, the isolation rate of *Moraxella catarrhalis* was 9.35 percentage and was more commonly seen in the age group of 50 and 50 years. Rate of isolation of *Moraxella catarrhalis* was higher in males (62.06 percentage) than in females (37.93 percentage). 95.24 percentage of the isolates were susceptible to amoxicillin clavulanic acid and 17.24 percentage sensitive to ampicillin only. Conclusion Isolation of *Moraxella catarrhalis* in the sputum sample from patients above 50 years of age, in the absence of other well established pathogen should not be disregarded, as they can cause lower respiratory tract infection in these individuals.

**Keyword :** *Moraxella catarrhalis*, Risk factors, Lower respiratory tract infection.

### INTRODUCTION:

*Moraxella catarrhalis*, a Gram Negative aerobic diplococci, was first described in 1896 and was initially known as *Micrococcus* or *Neisseria catarrhalis* and was considered to be a harmless upper respiratory tract commensal,<sup>1</sup> but subsequently gained recognition as an important pathogen. In 1970, it was later renamed *Branhamella catarrhalis* and in 1990 as *Moraxella catarrhalis*.<sup>2</sup> *Moraxella catarrhalis* is an important cause of lower respiratory tract infection, particularly in adults with chronic obstructive pulmonary disease (COPD). Many studies have revealed its involvement in respiratory tract infection like

sinusitis, otitis media, bronchitis and pneumonia and ocular infections in children. In adults, *Moraxella catarrhalis* causes infection like laryngitis, bronchitis and pneumonia in adults.<sup>4,5</sup> The etiological agents of community acquired pneumonia with underlying COPD or history of smoking are *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Pseudomonas aeruginosa*, *Legionella* spp., *Moraxella catarrhalis*, *Chlamydia pneumoniae*. Capacity of *Moraxella catarrhalis* to produce betalactamase enzyme was first noted in 1977 and may cause penicillin resistance in mixed infections by protecting other pathogens which are usually susceptible to betalactam antibiotics.<sup>6</sup> The emergence of *Moraxella catarrhalis* as a pathogen in the last decade together with increasing prevalence of  $\beta$ -lactamase producing strains has renewed interest in this bacterial species.<sup>4</sup>

### AIMS AND OBJECTIVES:

- To determine the significance of *Moraxella catarrhalis* as a pathogen in causing lower respiratory tract infections.
- To assess the risk factors in adults with lower respiratory tract infections.
- To study the antimicrobial susceptibility pattern of the isolates of *Moraxella catarrhalis*.
- To assess the betalactamase production in the isolates of *Moraxella catarrhalis*.

### MATERIALS AND METHODS:

This cross sectional study was conducted at the Institute of Microbiology, over a period of 6 months from June 2013 to November 2013. All inpatients and outpatients attending the various departments in RGGGH, Chennai-3 with symptoms and signs of lower respiratory tract infection such as cough with expectoration, presence /absence of fever, difficulty in breathing, presence of wheeze/crepitus were included in the study population. Sputum samples were collected in a sterile wide mouth container.

### SAMPLE COLLECTION:

The patient was educated regarding the method of using the sterile sputum cups and the importance of collecting deeply coughed out sputum sample. Patients were instructed to brush their teeth, rinse their mouth with saline or water, just before collecting sputum sample. Samples were taken to the microbiology laboratory for processing, as soon as possible.

Only sputum samples of high bacteriological quality were analysed according to Bartlett's grading system.

#### SAMPLE PROCESSING:

Sputum samples collected in a sterile wide mouth containers were observed for their macroscopic appearance and processed as per Standard operating procedures. Sputum samples were not rejected based on the macroscopic appearance. Gram's stain was done to grade the sample as per Bartlett's grading system for assessing the quality of the samples as follows:

**BARTLETT'S GRADING SYSTEM:**

No.of neutrophils per 10X field	Grade
<10	0
10-25	+1
>25	+2
Presence of mucus	+1
No.of epithelial cells per 10X field	Grade
10-25	-1
>25	-2

Samples with a final score of greater than zero were considered suitable for culture, as there was little or no contamination with saliva. All sputum samples were cultured on 5% Sheep blood agar, Chocolate agar and Nutrient agar. The inoculated plates were incubated at 37°C for 18 to 24 hours in candle jar, under 3 -5% CO<sub>2</sub>. Pure culture or predominant growth of *Moraxella catarrhalis* from sputum samples in all the culture plates was considered to be significant. *Moraxella catarrhalis* appearing as Gram Negative Diplococci in Gram staining. On chocolate agar plate *Moraxella catarrhalis* produce colonies which are large nonpigmented or gray, opaque, smooth, friable with "Hockey puck" consistency in which colony may be moved intact over the surface of agar. appearing as Gram Negative Diplococci. Biochemically *Moraxella catarrhalis* reduces nitrate to nitrite, oxidase test positive and does not ferment sugars like glucose, lactose, sucrose and maltose. Antimicrobial susceptibility testing was done by Kirby-Bauer Disc Diffusion technique.

#### RESULTS:

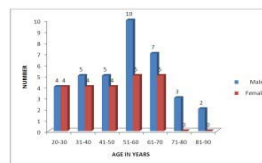
Out of 620 samples processed during the study period, *Moraxella catarrhalis* was isolated in 58 samples (9.35%). Rate of isolation of *Moraxella catarrhalis* was higher in males (62.06%) when compared to females (37.93%). The risk factors studied were age, habit of smoking, underlying lung disease and systemic diseases. Patients above 50 years of age seen in (33) [56.89%] of the isolates and other risk factors include chronic obstructive pulmonary disease [29.31%], Smoking [25.86%], Diabetes mellitus [13.79%].

**Table 1: Age and Sex-Wise Distribution of Patients with *Moraxella catarrhalis* infection (n=58)**

Age in years	Male	Female	Total	
20-30	4	4	8	13.80%
31-40	5	4	9	15.52%
41-50	5	4	9	15.52%
51-60	10	5	15	25.86%
61-70	7	5	12	20.69%
71-80	3	-	3	5.17%
81-90	2	-	2	3.44%
	36 (62.06%)	22 (37.93)	58	100%

Majority of the patients were in the age group of 51-60 years and males were predominately affected than females.

**Chart 1: Age and Sex-Wise Distribution of Patients with *Moraxella catarrhalis* infection**

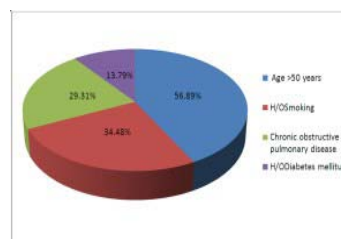


**Table 2: Analysis of Risk Factors for *Moraxella catarrhalis* Infection (n=58)**

Risk factors	Number of patients	Percentage
Age >50 years	33	56.89%
H/O Smoking	20	34.48%
Chronic obstructive pulmonary disease	17	29.31%
H/O Diabetes mellitus	8	13.79%

Age more than 50 years followed by the habit of smoking was the most common risk factors for *Moraxella catarrhalis* infection.

**Chart 2: Analysis of Risk Factors for *Moraxella catarrhalis* Infection**



**Table 3: Isolation of *Moraxella catarrhalis* in Patients with Lower Respiratory Tract Infections (n=620)**

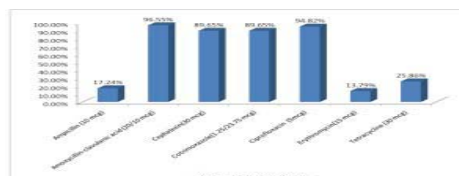
S.No.	Culture result	No. of cases	Percentage
1.	Positive	58	9.35%
2.	Culture positive for other bacteria	454	73.26%
3.	Normal throat commensals grown	109	17.5%

**Table 4: Antimicrobial Susceptibility Pattern of *Moraxella catarrhalis* isolates (n=58)**

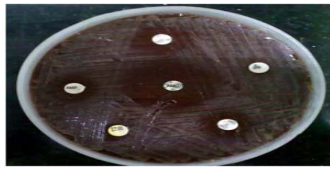
Antibiotics	Sensitive	Percentage
Ampicillin (10 mcg)	10	17.24%
Amoxycillin-clavulanic acid (20/10 mcg)	56	96.55%
Cephalexin (30 mcg)	52	89.65%
Cotrimoxazole (1.25/23.75 mcg)	52	89.65%
Ciprofloxacin (5 mcg)	55	94.82%
Erythromycin (15 mcg)	8	13.79%
Tetracycline (30 mcg)	15	25.86%

96.55 % of isolates were sensitive to Amoxycillin-clavulanic acid followed by ciprofloxacin 94.82%.

**Chart 4: Antimicrobial Susceptibility Pattern of *Moraxella catarrhalis* isolates**



**Fig 1 : Antimicrobial susceptibility pattern of *Moraxella catarrhalis***



#### AMP-Ampicillin, AMC- Amoxycillin-clavulanic acid DISCUSSION:

*Moraxella catarrhalis* is a Gram negative aerobic diplococcus, which is frequently found as a commensal of the upper respiratory tract and has been recovered exclusively from humans<sup>8</sup>. Rate of isolation of *Moraxella catarrhalis* in the present study was higher in males (62.06%) than in females (37.93%) with a male to female ratio of 1.63:1 (**Table 1**) which is correlating with the study by Tamang et al., 2005 in which male : female ratio was 1.78 :1.9 This increase in male preponderance was probably due to the habit of smoking.<sup>10,11,12,13</sup> In the present study, the occurrence of *Moraxella catarrhalis* infection was maximum in patients of 50 years and above (56.89%) (**Table 2**) According to the study conducted by Gillian M Wood<sup>14</sup> et al and Anita KB et al<sup>15</sup>, age was a critical determinant of the pathogenic significance of the isolates of *Moraxella catarrhalis*. With advancing age, the pathological significance of the isolates becomes greater. (**Table 1**) which is comparable to the present study. The reason for higher isolation of *Moraxella catarrhalis* in elderly patients may be due to decreased systemic immunity in old age, decreased local immunity in the respiratory tract due to smoking and underlying chronic obstructive airway diseases like bronchitis, bronchiectasis, bronchial asthma in which normal protective ciliary motility in the respiratory tract destroyed.

The other risk factors which are associated in the current study were H/O smoking (34.48%) underlying COPD (29.31%) and past H/O Diabetes mellitus (13.79%), (**Table 2**). This finding was supported by the study conducted by Anita K.B et al<sup>15</sup> 2011 in which the percentage of risk factors for the above variables were 68%, 16%, 37%, 18.2 % respectively. Among 620 sputum samples processed during the study period *Moraxella catarrhalis* was isolated in 58 samples (9.35%), similar isolation rate by Anita K.B et al.,<sup>15</sup> 2011 and by Tamang et al.,<sup>9</sup> 2005 where the isolation rate of *Moraxella catarrhalis* was 6.9%. In the present study, (**Table 4**) *Moraxella catarrhalis* isolates were susceptible to antibiotics in the following order : amoxicillin-clavulanic acid (96.55%), ciprofloxacin (94.82%), cotrimoxazole and cephalexin (89.65%), tetracycline (25.86%), erythromycin (13.79%) and ampicillin (17.24%) which correlates with the study by Ramana et al.,<sup>20</sup> 2012 in which susceptibility of *Moraxella catarrhalis* to amoxicillin clavulanic acid was 100%, followed by ciprofloxacin (80%) and ampicillin (30%). In this study, *Moraxella catarrhalis* isolates were susceptible to ampicillin in only 17.24% of the cases, but were however sensitive to amoxycillin – clavulanic acid in 96.55% of cases. This shows that majority of the *Moraxella catarrhalis* isolates (82.75%) were beta lactamase producers as was seen in several studies.<sup>16,17,18</sup> In a study by Jackubicz et al, 1997 ampicillin resistance was reported in 66.7% of the isolates of *Moraxella catarrhalis*, but however isolates were sensitive to amoxicillin – clavulanic acid which agrees with the present study. In a study by Thornsberry et al<sup>19</sup>, 1996-1997 most of the *Moraxella catarrhalis* isolates were sensitive to amoxycillin-clavulanic acid, ceftriaxone and levofloxacin (100%) and least sensitive to ampicillin. This shows most of the *Moraxella catarrhalis* isolates were betalactamase producers and were sensitive to combination of amoxicillin-clavulanic acid which is similar to the current study.

#### CONCLUSION:

Over the last few decades *Moraxella catarrhalis* has emerged as a genuine pathogen and is now considered as an important cause of lower respiratory tract infection in adults. The present study

concludes that isolation of *Moraxella catarrhalis* should be considered as an important lower respiratory tract pathogen, especially in patients above 50 years of age and with underlying chronic lung disease. *Moraxella catarrhalis* should be given due importance as majority of them were betalactamase producers and appropriate antibiotics especially betalactam / betalactamase inhibitor combination is necessary to treat the patient.

#### REFERENCES:

1. Jawetz E, Melnick JL, Adelberg EA eds. The Neisseria. Review of Medical Microbiology, 25th edition Lange Med Publications. Los Altos, Calif
2. Berk SL., From Micrococcus to *Moraxella*: The reemergence of *B. catarrhalis*. Arch Intern Med 1990;150:2254-7.
3. Hager, H., A. Verghese, S. Alvarez, and S. L. Berk. 1987. *Branhamella catarrhalis* respiratory infections. Rev. Infect. Dis. 9:1140-1149.
4. Verduin, M., C. Hol, A. Fleer, Hansvandijk, and Alexvanbelkum. 2002. *Moraxella catarrhalis*: from emerging to established pathogen. Clin. Microbiol. Review. 15:125-144
5. Catin BW. *Branhamella catarrhalis*: an organism gaining respect as a pathogen. Clin Microbiol Rev. 1990 ;3:293-320.
6. Murphy TF, Parameshwaran GI. *Moraxella catarrhalis*, A Human Respiratory Tract Pathogen. Clinical Infectious Disease. 2009 ;49:124-31.
7. Bailey and Scott's Diagnostic Microbiology ,12 th edition .St.Louis, Missouri , Mosby, 2007.
8. Timothy F .Murphy . *Branhamella catarrhalis* :Epidemiology ,surface antigenic structure and immune response. Microbiological reviews, 1996;60:267-279.
9. Prevalence of *Moraxella catarrhalis* infections of the lower respiratory tract in elderly patients. 2005;3 :39-44.
10. Barreiro, B., L. Esteban, E. Prats, E. Verdager, J. Dorca, and F. Manresa. 1992. *Branhamella catarrhalis* respiratory infections. Eur. Respir. J. 5:675-679
11. Collazos, J., J. de Miguel, and R. Ayarza. 1992. *Moraxella catarrhalis* bacteremic pneumonia in adults: two cases and review of the literature. Eur. J. Clin. Microbiol. Infect. Dis. 11:237-24
12. DiGiovanni, C., T. V. Riley, G. F. Hoyne, R. Yeo, and P. Cooksey. 1987. Respiratory tract infections due to *Branhamella catarrhalis*: epidemiological data from Western Australia. Epidemiol. Infect. 99:445-453.
13. Hager, H., A. Verghese, S. Alvarez, and S. L. Berk. 1987. *Branhamella catarrhalis* respiratory infections. Rev. Infect. Dis. 9:1140-1149.
14. Gillian M Wood, Barbara C Johnson, Joseph G. McCormack. *Moraxella catarrhalis*: Pathogenic significance in respiratory tract infections treated by community practitioners. Clinical infectious diseases, 1996; 22:632-6
15. Anita K.B., Faseela T.S, Yashvanth K Rai, Chaithra S. Malli, Srikara Malli. *Moraxella Catarrhalis*: An Often Overlooked Pathogen of the Respiratory Tract. Journal of Clinical and Diagnostic Research. 2011 June, Vol5(3): 495-497
16. Anton F Ehrhardt, Rene Russo. Clinical resistance encountered in the respiratory surveillance programme (RESP) study: A review of implications for the treatment of community acquired respiratory tract infections. The American Journal of Medicine. 17 Dec 2001;111(9A):31S.
17. Manninen R, Huovinen P, Nissinen A. The Finnish Study Group for Antimicrobial Resistance. Increasing antimicrobial resistance in *Streptococcus pneumoniae*, *Hemophilus influenzae* and *Moraxella catarrhalis* in Finland. Journal of Antimicrobial Chemotherapy. 1997;40:387-392
18. H. V. Prashanth , R. M. Dominic Saldanha \*, Shalini Shenoy *Moraxella catarrhalis* - A Rediscovered Pathogen Int J Biol Med Res. 2011; 2(4): 979- 981

19. Thornsberry C, Ogilvie P, Kahn J, Mauriz Y. Surveillance of antimicrobial resistance in *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis* in the United States in 1996–1997 respiratory season. *Diagn Microbiol Infect Dis.* 1997;29:249–257. [PubMed]
20. B.V.Ramana and Abhijit Chaudhury Antibiotic sensitivity pattern of *Moraxella catarrhalis* at a tertiary care hospital. *Int. J. of Pharm. & Life Sci.* 2012;3(7):1805-1806.
21. Koneman's colour atlas and Textbook of Diagnostic Microbiology. 6th edition. phases of diagnostic cycle. pg:16-17.
22. Bailey and Scott's Textbook of Diagnostic Microbiology, 12th edition –pg 451