

Comparison of Amoxicillin, Doxycycline and Cephalosporin Activity against Human Lower Respiratory Tract Pathogen in Cold Season at South Punjab, Pakistan

Amoxicillin,
Doxycycline and
Cephalosporin
Activity against
Human Lower
Respiratory
Tract Pathogen

M Abbas Naqvi¹, Arifa Hashmi², Shehzeen Fatima², Aneeqa Naz³, Rizwana Kousar⁴
and Muhammad Ibrahim⁴

ABSTRACT

Objective: To compare amoxicillin, doxycycline and cephalosporin activity against human lower respiratory tract pathogen in cold season at south Punjab, Pakistan.

Study Design: A Comparative analytical study.

Place and Duration of Study: This study was conducted at the Pathology Department of Nishtar Medical University, Multan, from October 2021 to February 2022.

Materials and Methods: The study is composed of 400 patients who was suffering from lower respiratory disorders from area of south Punjab, Pakistan, in cold season. Symptoms that have been observed in patients having lower respiratory tract infections with sputum production, tachypnea, cough, chest pain and fever were included in study. We took sputum as a sample from patients and inoculated the sample on selective media. After incubation we performed biochemical testing for the identification of bacterial specie than performed antibiotics susceptibility testing and measured the zone of inhibition of antibiotics and noted it. All data were in entered and analysed in SPSS. Mean was calculated for quantitative variables and frequencies and percentages for qualitative variables.

Results: Mean age of patients was 29.36 ± 10.21 years with 280 (70%) were male and female 120 (30%). Out of 400 samples, bacterial strains were isolated in 250 (62.5%) cases and among gram positive bacteria, we found *Staphylococcus aureus* (n=50, 20%) the most predominant pathogen. Among the isolated gram negative bacteria, *Klebsiella pneumoniae* (n=90, 36 %) was the most predominant pathogen, followed by *Pseudomonas aeruginosa* (n=30, 12 %) and *Escherichia coli* (n=35, 14 %). There were some multiple drug resistance isolates also. We found amoxicillin, the most susceptible drug against available bacterial strains, followed by doxycycline and cephalosporin.

Conclusion: In our study results amoxicillin is found more susceptible drug than doxycycline and cephalosporin against human lower respiratory tract pathogens.

Key Words: Respiratory tract infection, Bacterial infection, Antibiotics, Drug resistant.

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INTRODUCTION

¹. Department of Pathology, Nishtar Medical University, Multan.

². Department of Pathology, Bakhtawar Amin Medical and Dental College, Multan.

³. Department of Pathology, Multan Medical and Dental College, Multan.

⁴. Department of Biochemistry, Bahauddin Zakariya University, Multan.

Correspondence: Dr. M Abbas Naqvi, Professor of Pathology, Nishtar Medical University, Multan.

Contact No: 0300 6326302

Email: drabbas78@gmail.com

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Lower respiratory tract infections are one of most common infections that have the potential to create complications that can cause even death and it is accounting more than 50 million deaths occurred globally per year¹. Lower respiratory tract of human beings include trachea and within lungs, bronchi, bronchioles and alveoli. Symptoms of lower respiratory tract infections are well known such as; sputum production, tachypnea, cough, shortness of breath, chest pain, body ache and fever which infection mostly caused by different bacteria i.e., *Staphylococcus aureus*, *Pseudomonas*, *Klebsiella*, *Haemophilus influenzae*, *Mycoplasma pneumoniae*, *Corynebacterium diphtheriae* and *Bordetella pertussis*². Many viruses are also caused lower respiratory infection, i.e., Para-influenza, Influenza, Syncytial and adinoviruses. Many studies that the misused of antibiotics have been produced antibiotic resistance in developing countries³⁻⁵.

As it has been observed that the climate of south Punjab area of Pakistan is extremely hot and dusty, temperature could reach up to 45°C-50°C and during spring and hot summer season, this area faces wind and dust storms. So that's why we can observe a significant number of patients having lower respiratory tract disorders. That is the reason, it was not difficult to collect samples to study antibiotic resistance of pathogens present in lower respiratory tract. Organisms can enter into lower respiratory tract by inhalation, aspiration or by hematogenous seeding⁶. The pathogen multiplies in or on the epithelium which results as inflammation, it increased the secretion of mucus and impaired mucociliary function; other lung functions may also be affected. In severe bronchiolitis, inflammation and necrosis of the epithelium may block small airways leading to airway obstruction⁷. This study aimed to determine the bacterial pathogens with their antimicrobial susceptibility pattern.

MATERIALS AND METHODS

This comparative analytical study was conducted at pathology department of Nishtar Medical University, Multan, during cold season from October 2021 to February 2022. This study was composed of 400 patients who were suffering from lower respiratory disorders with positive bacterial growth from area of south Punjab, Pakistan. Symptoms that have been observed in patients having lower respiratory tract infections with sputum production, tachypnea, cough, chest pain and fever were included in study. For the purpose to do comparative study of amoxicillin, doxycycline and cephalosporin activity against human lower respiratory tract pathogens, we followed all the standard protocol and methods used in microbiology.

We asked patient to lie over his/her tummy and cough hard so that purely sputum sample could be obtained. Patients have awarded to best time for the sputum sample collection is morning. We also took care of not mixing sputum and saliva together. We collected sample in a sterilized plastic container. The container was not containing CPC transport medium, kept in a temperature range of 2°C to 8°C and protected from heat and sunlight. Sample containers were kept in a cool shady place and brought to laboratory as soon as possible. The containers which were having CPC medium were not kept in cool place because on low temperature sample will be ruined by the crystallization of CPC. So such sample containers should be kept at room temperature and protected from heat and light. Once sample is brought to lab, they were inoculated on 3 agar media. That were blood agar media, chocolate agar media and MacConkey agar media.

We took sputum as a sample from patients and inoculated the sample on blood agar, chocolate agar and MacConkey agar, and incubated it for 24-30 hours at 37°C. After incubation, bacterial colonies were

observed on petri plates. Next step we done was gram staining. We observed both gram positive and negative bacteria. For identification of bacterial species, we performed biochemical testing. For gram positive cocci, we performed catalase and coagulase testing. For gram negative bacteria, we performed TSI test, citrate test, SIM test and oxidase test. After the identification, we performed antibiotics susceptibility testing. For this purpose, Mueller Hinton agar was used. Amoxicillin, doxycycline and cephalosporin were placed on the agar plate and incubated for over-night at 37°C. After this, we measured the zone of inhibition of antibiotics and noted it on pre-designed proforma. All data were entered and analysed in SPSS. Mean was calculated for quantitative variables and frequencies and percentages for qualitative variables.

RESULTS

Mean age of patients was 29.36 ± 10.21 years with majority of 280 (70%) were male and female 120 (30%). Majority of population were belonged to urban areas. (Table 1). Out of 400 samples, bacterial strains were isolated in 250 (62.5%) cases and among gram positive bacteria, we found *Staphylococcus aureus* (n=50, 20%) the most predominant pathogen. Among the isolated gram negative bacteria, *Klebsiella pneumoniae* (n=90, 36%) was the most predominant pathogen, followed by *Pseudomonas aeruginosa* (n=30, 12%) and *Escherichia coli* (n=35, 14%). There were some multiple drug resistance isolates also. Between all three antibiotics, amoxicillin, Doxycycline and Cephalosporin, we found amoxicillin the most susceptible drug against all the considered bacterial strains. Among 250 isolates, 125 isolates were found sensitive against amoxicillin which makes 50% of the total. 75 isolates were found sensitive against Doxycycline which makes 30% of the total and less isolates were found sensitive against cephalosporin. (Table 2).

Table No. 1: Demographic characteristics and clinical isolates in patients.

Characteristic	Mean \pm SD N (%)
Age (years)	29.36 \pm 10.21
Gender	
Male	280 (70 %)
Female	120 (30 %)
Residential area	
Urban	297 (74.2 %)
Rural	103 (25.8 %)
Pathogens (n=250)	
<i>Staphylococcus aureus</i>	50 (20 %)
<i>Klebsiella pneumoniae</i>	90 (36 %)
<i>Pseudomonas aeruginosa</i>	30 (12 %)
<i>Escherichia coli</i>	35 (14 %)
Others	45 (18 %)

Table No.2: Susceptibility of bacterial pathogens to antibiotics. (n=250)

Antibiotics	Sensitivity		R	I	S
	No. of isolates	% of isolates	Zone (mm)	Zone (mm)	Zone (mm)
Amoxicillin	125	50	<15	16-20	>21
Doxycycline	75	30	<10	11-13	>14
Cephalosporin	50	20	<14	15-17	>18

R=resistant, I=intermediate, S=sensitive.

DISCUSSION

Many studies reported that the early and accurate diagnosis of respiratory infections in all age groups can help to patient's good health as well as reduce the morbidity, mortality rate and drug resistance. Another hand continuous surveillance of respiratory infections and pattern of antibiotic resistance in causative bacterial pathogens also help to physician for better management. No doubt respiratory tract infections are one of most common which affect millions of people in all over the world. In our study results mean age of patients was 29.36 ± 10.21 years with majority of 280 (70%) were male while female 120 (30%). Of 400 samples of our study, bacterial strains were isolated in 250 (62.5%) cases. Supportive to our study results reported from Kibera and Pakistan (69.7%) and 59.1%)⁸⁻⁹. However lower results to our study finding were reported from Gebre et al conducted a study in LRTI adult patients who isolated 33.5% positive culture from sputum¹⁰. Similarly an Ethiopian study reported 40% and extremely lower rate of LRTI was reported from Nepal, Sri Lanka and India 30.4%, 29.4% and 26.3% respectively¹¹⁻¹⁴ while higher frequency of pathogen with LRTI 95.4% was reported from Kenya¹⁵. This difference due to variation of climate and socioeconomic condition, as well as study population and duration of study as reported by different studies¹⁵⁻¹⁸. Our south Punjab area of Pakistan is extremely hot and dusty, temperature could reached up to 45°C-50°C and during spring and hot summer season, this area faces wind and dust storms. So that's why we can observe a significant number of patients having lower respiratory tract disorders. Mostly organisms can enter into lower respiratory tract by inhalation, aspiration or by hematogenous seeding. The pathogen multiplies in or on the epithelium which results as inflammation, it increased the secretion of mucus and impaired mucociliary function; other lung functions may also be affected. In severe bronchiolitis, inflammation and necrosis of the epithelium may block small airways leading to airway obstruction.

Our study results showed *Staphylococcus aureus* (n=50, 20%) the most predominant pathogen. Among the isolated gram negative bacteria, *Klebsiella pneumoniae* (n=90, 36%) was the most predominant pathogen, followed by *Pseudomonas aeruginosa* (n=30, 12%) and *Escherichia coli* (n=35, 14%). We found amoxicillin the most susceptible drug against all the isolated bacterial

strains. Similar results reported by Gebre et al¹¹ in which *S. aureus* 14.8%, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *E. coli* 25.4% *Pseudomonas aeruginosa* 17.6% and *E. coli* 15.5% respectively. Also reported *S. aureus* and gram negative isolates were mostly susceptible on ampicillin drug 77.8% and 100% respectively. The current study provides microbiological evidence and should support primary care clinicians.

CONCLUSION

This comparative study results showed that amoxicillin is found more susceptible drug than doxycycline and cephalosporin against human lower respiratory tract pathogens.

Author's Contribution:

Concept & Design of Study: M Abbas Naqvi
 Drafting: Arifa Hashmi, Shehzeen Fatima
 Data Analysis: Aneeqa Naz, Rizwana Kousar, Muhammad Ibrahim
 Revisiting Critically: M Abbas Naqvi, Arifa Hashmi
 Final Approval of version: M Abbas Naqvi

Conflict of Interest: The study has no conflict of interest to declare by any author.

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