Bacterial Involvement in Causing Lower Respiratory Tract Infection in Adults Visiting Tribhuvan University Teaching Hospital and their Antibiotic Susceptibility Pattern

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Abstract

Introduction Respiratory conditions impose enormous burden on society. Reports indicated that the top five respiratory diseases accounted for 17.4 percent of all deaths and 13.3 percent of all Disability-Adjusted Life Years (DALYs). Also, out of total acute respiratory disease, 20-24 percent of deaths are accounted for by Lower Respiratory Tract Infection (LRTI). In developing countries like Nepal the need for timely diagnosis of the cases and the administration of appropriate therapy based on the antibiotic susceptibility test of the causative agents is critical. However, emergence of resistant strains may occur during antibiotic therapy, which is one of the contributing factors for the increase in the frequency of LRTI in recent years in the adult population of Nepal as well.

Objectives The study was undertaken to have a better understanding on the current trend of microbial involvement in causing LRTI in adults and to determine the efficacy of antimicrobial agents in-use in treating the infections.

Method A hospital based cross-sectional study was carried out from March 2002 to February 2003. Total 181 adults presenting with LRTI defined by a new or increasing cough, productive sputum, chest pain, fever, anorexia, haemoptysis, headaches and throat ache were enrolled with their consent. This is a prospective study which included bacteriological culture, microscopic examination and sensitivity testing of bacterial isolates *in vitro* in Health Research laboratory following Standard Operating Procedures (SOPs).

Results Lower Respiratory Infection was established in 75 cases (41.4%). Males (61.3%) were found more at risk to LRTI than females (38.7%). LRTI was found most prevalent in 50-59 year age groups (21.3%). Altogether 15 different types of bacteria were identified majority of which were Gram-negative bacteria (72.4%). *Haemophilus influenzae* was the commonest isolate at 23.0 percent followed by *Klebsiella pneumoniae* (18.3%). Among Gram- positive isolates *Streptococcs pneumoniae* was predominant (12.7%) followed by *Staphylococcus aureus*(9.3%).The *in vitro* antibiotic susceptibility test of the isolates showed that Chloramphenicol(100%) was the most effective antibiotic against Gram-negative bacteria followed by Amikacin (79.1%) and Ciprofloxaxin (66.7%), and the least effective was Co-trimoxazole (20.6%). Similarly, for the Gram-positive bacteria Ciprofloxacin (79.2%) was the most effective antibiotic and the least effective was Co-trimoxazole.

Conclusion The study shows increasing number of respiratory pathogens resistant to antimicrobials in-use to treat the infection.

Key words LRTI, Antibiotic susceptibility pattern.

Introduction

Respiratory diseases were responsible for 1/5 of youth and adult deaths in 1998. These deaths were mainly caused by Chronic Obstructive Pulmonary Disease (COPD), Tuberculosis (TB), and Acute Respiratory Infections (ARI; mostly pneumonia). Among infectious diseases, ARI and Tuberculosis were two of the six leading causes of death across all ages[1].

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The causes of the community-acquired Lower Respiratory Tract Infection (LRTI) are not well recognized, although it is traditionally taught that most are caused by viruses and atypical pathogens. There is a growing need for the better understanding of the pathogens that cause these infections which should allow a logical approach to treatment. The aetiology and the symptomatology of respiratory diseases vary with age, season, the type of population at risk, and other factors[2]. The need for the timely diagnosis of the cases and the administration of appropriate therapy based on the antibiotic susceptibility test of the causative agent is critical for blocking further spread of the pathogen which might otherwise lead to complications. Still, resistant strains may emerge during antibiotic therapy[3] which is one of the contributing factors for the increase in the frequency of LRTI in recent years in the adult population of Nepal as well.

In view to obtain information regarding aetiology of LRTI as well as to have knowledge in the current susceptibility pattern of antimicrobials, this study was undertaken.

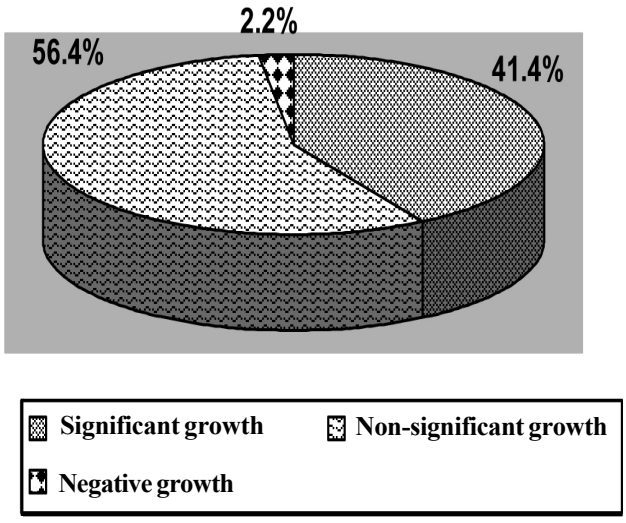
Methods

This was a hospital based prospective study done on 181 patients visiting medical out patient department of Tribhuvan University Teaching Hospital. Sputum for bacteriological culture and parasitological and fungal examination were collected after informed consent from patients presenting with LRTI as defined by a new or increasing cough, productive sputum, chest pain, fever, anorexia, haemoptysis, headache and weight loss. Before culture Gram-stained smear of every specimen was first examined microscopically. In microscopic examination sputum smear containing less than 10 squamous epithelial cells and more than 25 leucocytes or pus cells per low power field confirmed the reliability of the specimen indicating that it was not contaminated with saliva. Pathogens were isolated using Mac Conkey Agar, Blood Agar and Chocolate Agar media[4] supplemented with 7 percent sheep blood. Isolates obtained in significant numbers i.e., 10^5 cfu/ml of specimen were then identified following Bergey's Manual of Systematic Bacteriology. β-haemolytic Streptococci were grouped using commercially available Oxoid Streptococcal Grouping kit. *In vitro* antimicrobial susceptibility tests of the isolates were performed using modified Kirby-Bauer[5] Disc Diffusion Technique and zone size was interpreted following NCCLS[6] standard. All the plates were incubated at 37^0C and read after 24hours incubation. Also, Giemsa staining was done for *Pneumocystis carinii* and for fungi KOH preparation was performed. Likewise, saline preparation was performed for *Paragonimus westermanii*[7].

Results

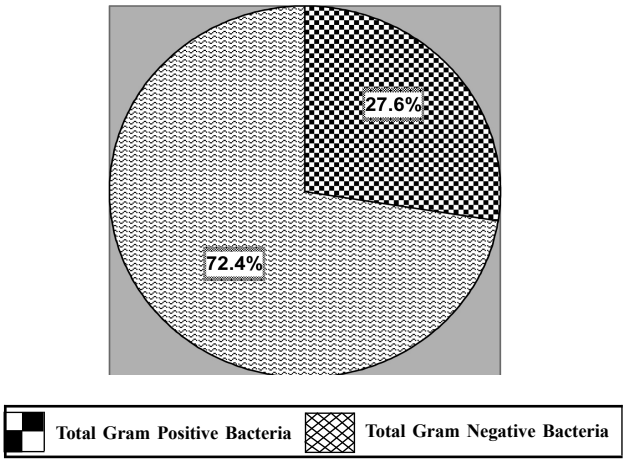
Out of total 181 samples processed only 75 (41.4%) had had microbiological diagnosis, 102 (56.4%) gave non-significant growth and remaining 4(2.2%) gave no growth (Fig. 1)

Figure 1: Pattern of Result



Out of total 87 bacterial isolates, 63 (72.4%) were Gram-negative and 24(27.6%) Gram-positive as depicted in Fig.2.

Figure 2: Distribution of Bacterial Isolates



Among the isolates *H. inflluenzae* was most frequently encountered at 20(23.0%).*S pneumoniae* was most common Gram-positive isolates accounting for 11(12.7%) (table 1).

Table 1: Bacterial involvement in LRTI

Types of isolates	No (%)	Total %
Streptococcus pneumoniae	11 (45.8%)	12.7
Staphylococcus aureus	8 (33.3%)	9.3
α Haemolytic Streptococcus Group A	1 (4.2%)	1.1
α Haemolytic Streptococcus Group C	2 (8.3%)	2.4
α Haemolytic Streptococcus Group D	1 (4.2%)	1.1
α Haemolytic Streptococcus Group G	1 (4.2%)	1.1
Total Gram Positive Bacteria	24 (100%)	27.6
Haemophilus influenzae	20 (31.7%)	23.0
Klebsiella pneumoniae	16 (25.4%)	18.3
Pseudomonas aeruginosa	12 (19.0%)	14.0
Escherichia coli	9 (14.3%)	10.3
Citrobacter freundii	2 (3.2%)	2.4
Morganella morganii	1 (1.6%)	1.1
Acinetobacter calcoaceticus	1 (1.6%)	1.1
Pseudomonas vulgaris	1 (1.6%)	1.1
Klebsiella oxytoca	1 (1.6%)	1.1
Total Gram Negative Bacteria	63 (100%)	72.4
Total no. of bacterial isolates		87 (100%)

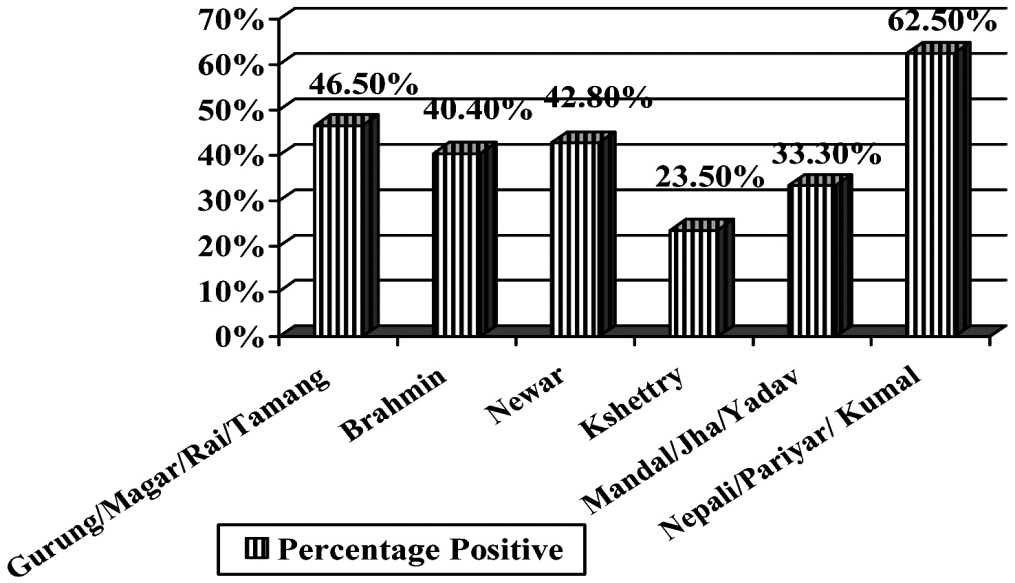
LRTI was found to be more prevalent in males than females. Of the total 102 males and 79 females enrolled for the study, LRTI was established in 61.3 percent and 38.7 percent respectively. Among the LRT infected cases, highest prevalence was as depicted in Table 2.

Table 2: Prevalence of LRTI by age and gender

Age groups(Years)	Male		Female		Total positive
	No. ofcases studied	Positive cases	No. ofcases studied	Positive cases	No.%
>14-19	7	5-55.5%	9	4-44.5%	9-12.0%
20-29	22	9-75%	16	3-25%	12-16%
30-39	13	8-57.1%	10	6-42.9%	14-18.7%
40-49	10	5-55.5 %	8	4-44.5%	9-12.0%
50-59	24	10-62.5%	18	6-37.5%	16-21.3%
60-69	19	8-80%	12	2-20%	10-13.3%
70-79	5	1-33.3%	4	2-66.7%	3-4.0%
80-89	2	0-0%	2	2-100%	2-2.7%
Total	102	46-61.3%	79	29-38.7%	75-41.4%

Among the different ethnic groups, LRTI was found highly prevalent in Nepali/Pariyar/Kumal (62.5%) followed by Gurung/Magar/Rai/Tamang(46.5%)and least prevalent in Kshettrys (23.5%)as shown in Figure 3.

Figure 3: Distribution of LRTI among various ethnic groups



In vitro antibiotic susceptibility test showed that for Gram-positive bacteria Ciprofloxacin at 79.2 percent was the most effective antibiotic and Cotrimoxazole least effective. Similarly, for Gram-negative isolates Chloramphenicol (100%), followed by Amikacin (79.1%) and Ciprofloxaxin (66.7%), was the most effective antibiotic and Cotrimoxazole was least effective (Figure 4 and Figure 5).

Figure 4: Antibiotics susceptibility Pattern of Gram Positive bacteria

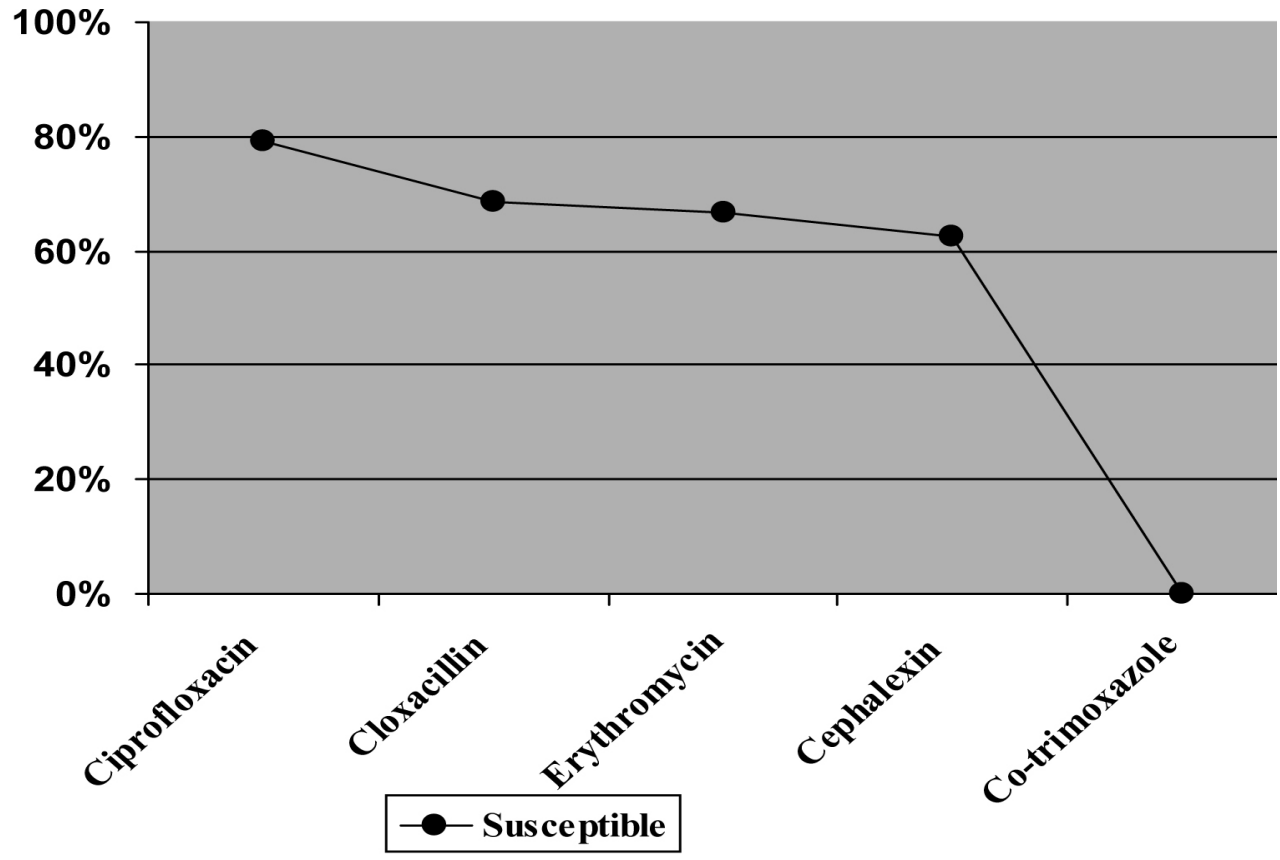
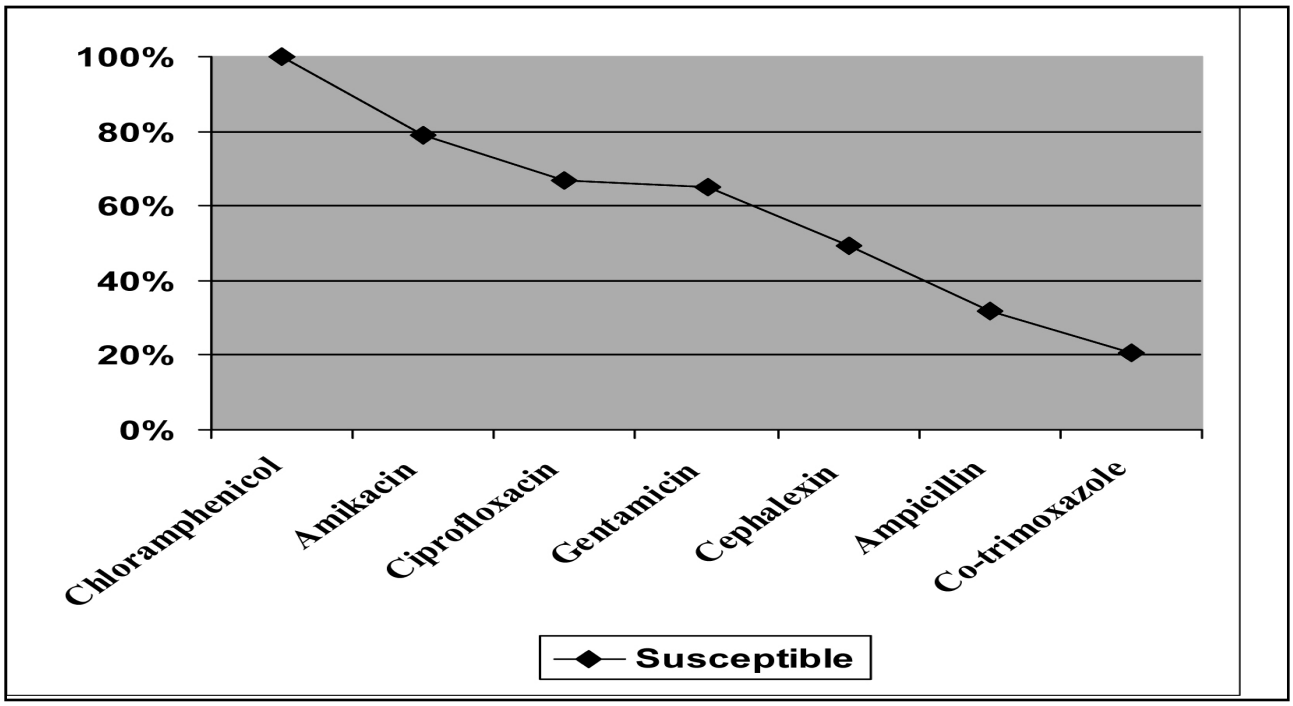


Figure 5: Antibiotics susceptibility Pattern of Gram Negative Bacteria



Discussion and Conclusion

Only 75(41.1%) sputum, of the total 181 specimen processed, was found to have significant growth in culture. In a similar study carried out by Hosker[8] (1994) significant growth was obtained in about 60 percentof the cases. The greater negative results in the current study may be attributed to viral and aetiological agents, apart from bacteria. Though the study also attempted to look for *Pneumocystis carinii* and *Paragonimus westermanii*; no such findings were obtained.

Altogether 15 different types of bacteria were isolated and identified in sputum culture. Greater number of the isolates was GNB. The ratio of Gram-negative bacterial infection to Gram-positive bacterial infection was 2.6:1. These findings correlated well with that of similar study conducted in 1995[9].

The study showed males (61.3%) at more risk to LRTI than females (38.7%). Reason as such could be because females enrolled in the study comprised largely of housewives, who, being less mobile experienced less exposure to respiratory risk factors. It could also be attributed to predisposing factors in males like smoking and alcoholism[10]. Furthermore, in this study higher prevalence of LRTI was observed in elderly population (40 years and older) accounting for 53.3 percent of the total infected cases than younger lot (30 years and younger at 46.7%). In particular, patients in age groups 50-59 years were found more prone to LRTI (21.3%) and the prevalence decreased drastically in population 80 years and older (2.7%). Similar study showed that pneumococcal infection is common in patients over the age of 55, who also have an increasing incidence of LRTI as they get older[11], since immune system in older patients become less effective owing to either malnutrition or underlying degenerative diseases such as diabetes mellitus, emphysema, uraemia etc[12].

The current sudy also indicated plausible link between LRTI and ethnic group enrolled. Accordingly, Kumal/Nepali/ Pariyar (62.5%) was found more susceptible to LRTI and Kshettrys were least susceptible of all at 23.5 percent. This discrepancy in distribution of LRTI among various ethnic groups could be attributed to their social, cultural and religious background not mentioning the inequality in access to services and in the range of opportunities available; however, the study did not divulge the precise link between the prevalence of LRTI and ethnic groups.

Of the total bacterial isolates *Haemophilus influenzae* was the most common isolates (23%) followed by klebsiella(18.3%) and pseudomonas(14%). *Streptococcus pneumoniae* (12.3%) was the predominant pathogen among the Gram-positive isolates. Though earlier study had shown *S. pneumoniae* as a predominant isolate followed by *H. influenzae*[11], our findings correlates well with that of Sayami[9], 1994. It is also noteworthy that in the current study *H. influenzae* (and other GNB) were diagnosed predominantly in population with pre-existing chronic diseases[11].

In this study isolates resistant to one or more antibiotics commonly in use was observed to be higher than similar study conducted in 1999[13]. All Gram-positive isolates showed resistance to Cotrimoxazole whereas 79.4 percent of Gram-negative isolates were resistant to Cotrimoxazole. Similarly, higher percentage of both Gram-positive and Gram-negative isolates showed resistant to Ciprofloxacin, Cephalexin and Ampicillin compared to earlier study.

Pseudomonas and Klebsiella are among the bacteria manifesting high levels of resistance-most notably in developing nations. The increase in the antibiotic non-susceptible strains of pathogens in recent years could be attributed to their indiscriminate and promiscuous use. This alarming situation is due, in part, to widespread confusion over the difference between viral and bacterial respiratory infections which has also led to the emergence of resistant pneumococci[3] and staphylococci. Similarly, in case of GPB like *S. pneumoniae* the use of suboptimal and long duration regimens increase the opportunity for acquisition and/or amplification of resistant strains[15]. Formerly, first-line medications were both effective and affordable. With the onset of resistance however, newer treatments are proving too costly to the vast majority of those living in poor developing nations[3].

The study indicates that the there has not been any significant changes in the pattern of bacterial involvement in causing LRTI. Also, the population and the age groups at risk have remained more or less the same over the period of time. However, increasing number of drug resistant pathogens emphasizes the importance of judicious antibiotic use. Educational program in this respect for general public and clinicians as well could be useful in checking the emergence of drug resistant pathogens. Furthermore, including atypical pathogens like *Mycoplasma pneumonia* and other respiratory viruses in microbial investigation of LRTI could reduce the unnecessary antibiotic use in humans.

Acknowledgements

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