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Research Article

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An Evaluation of Anti-Microbial Pattern of *Escherichia coli* Isolated from Clinical Samples at a Tertiary Care Hospital

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ABSTRACT

Antibiogram is the periodic evaluation of antimicrobial susceptibility pattern of bacterial isolates in a local area. It helps clinicians in selecting antimicrobials for empirical therapy and monitors the development of resistance. This study is a move to determine the antimicrobial susceptibility pattern of E. coli from urine, exudate and blood samples. It is a retrospective review of in-patient culture results of urine, exudate and blood samples were investigated from January 2015 to December 2015. A total of 254 reports were obtained for analysis of antimicrobial susceptibility for 19 antibiotics. Out of the total 254 E. coli isolates, the highest number of positive E. coli isolates were found among urine samples (74%) followed by exudates (21%) and blood (5%). The 254 E. coli isolates studied were found to be highly sensitive to Meropenem (86%), Imipenem (86%), Amikacin (91%), Ertapenem (92%), Tigecycline (94%) and Colistin (98%), whereas they showed higher resistance rates to Ciprofloxacin (76%), Ceftriaxone (82%), Cefuroxime axetil (84%), Cefuroxime (85%), Ampicillin (89%) and Nalidixic acid (89%). E. coli isolates showed high rates of resistance to Ciprofloxacin, Ceftriaxone, Cefuroxime axetil, Cefuroxime, Ampicillin and Nalidixic acid and thus are inappropriate for in-patient treatment of E. coli in the study area. From this study it is suggested that Amikacin can be used as the drug of choice for empirical therapy and Cefaperazone/Sulbactam can be used as an alternative drug.

Keywords: *Escherichia coli*; Antibiogram; Resistance; Susceptibility pattern; Urinary tract infections

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INTRODUCTION

Antibiogram is necessary to make an antibiotic policy. It helps clinicians in selecting antimicrobials for empirical therapy and monitors the development of resistance if any in the given period. Guidelines have been formulated by the Clinical and Laboratory Standards Institute to regulate measures used in forming antibiograms [1]. Theodor Escherich in 1850 identified the common colon bacillus as *Escherichia coli* [2]. They are gram-negative, rod shaped and facultative anaerobic bacteria that belong to the family of *Enterobacteriaceae* [3]. *Escherichia coli* (*E. coli*) are found commonly in the intestinal flora of humans and animals as commensals. These commensal *E. coli* strains can become pathogenic and cause intestinal and extra intestinal diseases in case of immunocompromised hosts or where the normal gastrointestinal barriers are broken. Commensal E. coli is present in the mucous layer of the colon comprising the most abundant facultative anaerobe of the human intestinal micro flora. There are many highly adapted *E. coli* clones that have obtained virulence attributes which are well known to cause urinary tract infections, however they can also cause diarrhoea, pneumonia etc. [2,4]. Pathogenic *E. coli* has been broadly classified into two major categories: the Diarrheagenic *E. coli* and the Extraintestinal pathogenic *E. coli*. Among the diarrheagenic *E. coli*, there are currently six categories: enteropathogenic *E. coli* (EPEC), enterohemorrhagic *E. coli* (EHEC)/Shiga toxin-producing *E. coli* (STEC),

enterotoxigenic *E. coli* (ETEC), enteroinvasive *E. coli* (EIEC), enteroaggregative *E. coli* (EAEC), and diffusively adherent *E. coli* (DAEC) [4]. Extraintestinal pathogenic *E. coli* can colonize a variety of anatomical locations and cause various infections outside the gastrointestinal tract, among which urinary tract infections are the most common [5]. Diarrhea caused by different Diarrheagenic *E. coli* is usually self-limiting. In case of dehydration caused due to fluid loss, fluid replacement can be given. Antibiotics can also be given to people suffering from severe diarrhea to reduce the duration of the symptoms [6]. The extraintestinal infections caused are usually treated with antibiotics like Trimethoprim-Sulfamethoxazole, Fluoroquinolones and Cephalosporins but, the rise in antibiotic resistance in *E. coli* makes treatment complex [7]. For instance, the appearance of Fluoroquinolones resistant and extended-spectrum beta-lactamase producing strains has affected the therapeutic options for infections with those *E. coli* strains [8]. This work is a small step in generating Antibiogram in our area.

EXPERIMENTAL SECTION

Materials and Methods

A prospective interdepartmental study, involving departments of Pharmacology and Microbiology of K S Hegde Medical Academy was done on results of Escherichia positive cultures of different samples for a period of one year from January 2015 to December 2015. Institutional ethical committee approval was taken for conducting the study. Inpatients belonging to any age, sex, having any illnesses and under any medications and clinical samples like urine, blood and wound exudates were included in the study. Outpatients and clinical samples like stool and sputum were excluded from the study. Microbiology lab culture and sensitivity record book for blood, urine, and exudate were used to collect the relevant data from inpatient case sheets. Inpatient numbers of patients whose blood, urine and exudates were positive for *E. coli* were noted down from the record books maintained for the particular specimen in the microbiology lab at the K S Hegde Charitable Hospital. Further, above referred case sheets were obtained from the medical records department and the data was entered systematically in the proforma created in Microsoft excel sheet. The data was analysed for frequencies of sensitivity and resistance patterns expressed as percentage for each antimicrobial listed in the proforma. The frequencies were obtained for different Ages and sex. The incidence of *E. coli* infections in the samples analysed was determined as percentage positive for each sample. All the data were entered in the Microsoft excel sheet and processed for statistical analysis using SPSS Software version 21to calculate various percentages.

RESULTS

During the study period, a total of 254 *E. coli* isolates were obtained from Urine, Exudates and Blood and the data of *E. coli* infections based on sex, age was collected along with antibiotic susceptibility pattern using commonly used antibiotics. Out of 254 clinical isolates, majority of the isolates were from Urine (74%) followed by Exudate (21%) and Blood (5%) (Table 1). Sex wise distribution of patients with *E. coli* infection showed that males formed the majority (Table 2). The ages of patients with *E. coli* infection ranged from new born to 90 years. Majority of patients were in age group >50 years (55.5%) (Table 3).

The 254 *E.coli* isolates studied were found to be highly sensitive to Meropenem (86%), Imipenem (86%), Amikacin (91%), Ertapenem (92%), Tigecycline (94%) and Colistin (98%) (Figure 1), whereas they showed higher resistance rates to Ciprofloxacin (76%), Ceftriaxone (82%), Cefuroxime axetil (84%), Cefuroxime (85%), Ampicillin (89%) and Nalidixic acid (89%) (Figures 1 and 2).

Table 1: Overall incidence of *Escherichia coli* isolates from samples collected

Clinical Samples Collected	*Escherichia coli* Positive Isolates Numbers	Percentage (%)
Urine	187	74%
Exudate	54	21%
Blood	13	5%

Table 2: Distribution of all samples of *E. coli* positive isolates based on gender

Samples	Males (Numbers)	Females (Numbers)
Urine	96	91
Exudate	32	22
Blood	6	7
Total	134	120

Table 3: Age distribution among *E. coli* positive isolates

Age Distribution (Years)	*E. coli* Positive Isolates (Numbers)
0-10	8
11-20	7
21-30	31
31-40	32
41-50	35
51-60	55
61-70	61
71-80	22
81-90	3

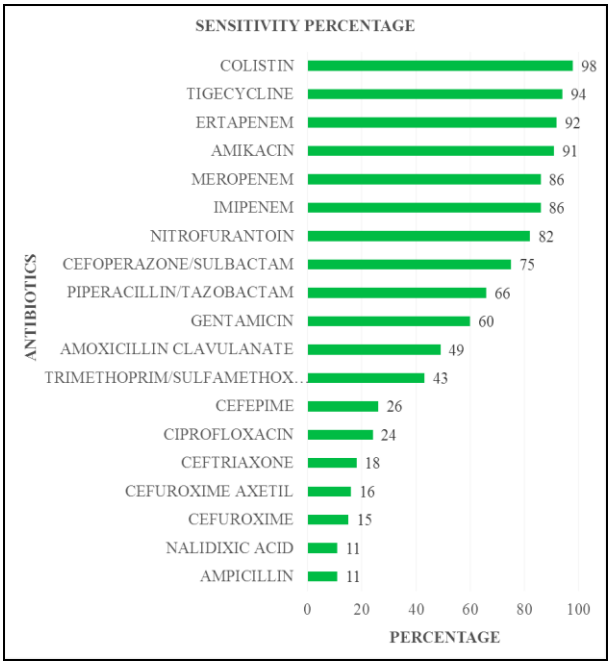

Figure 1: Frequency distribution of sensitivity pattern among all clinical samples

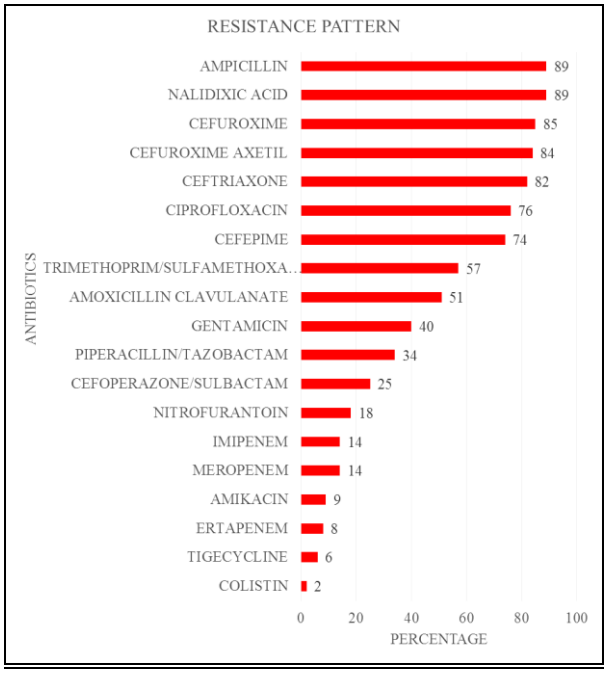

Figure 2: Frequency distribution of resistance pattern among all clinical samples

DISCUSSION

The present study was undertaken to study the pattern of susceptibility of *Escherichia coli* in various clinical samples from K S Hegde Medical Hospital during a period of one year from January 2015 to December 2015. The patient records were obtained from the Microbiology laboratory and reviewed from the medical records department. Studying the susceptibility pattern for a particular organism helps to form a guideline to empirical treatment which reduces emergence of new pattern of resistance and also reserve the highly sensitive agents to be used when required. *Escherichia coli* is a common inhabitant of the human gut. It is the leading cause of urinary tract, ear, wound and other infections. It is also commonly associated with food and water-borne diarrhea in developing countries. *E. coli* infection has been enumerated as one of the leading causes of Antimicrobial resistance. Increasing occurrences of antimicrobial resistance among *Escherichia coli* is a growing concern worldwide, since it increases the cost of treatment, morbidity and mortality which are important factors in a developing country like ours [9,10]. In the current study the highest number of positive *E. coli* isolates was found among urine samples followed by exudates and blood which was similar to other studies [11]. 55.5% of positive isolates were in patients of above 50 years of age. It is observed that this age group constitutes only 20% of the total India's population according to the current census [12]. Rest of the positive isolates of 45.5% belonged to the age group of below 50 years which constitute 80% of the population. This shows the common incidence of *E. coli* infections in the former age group. Similar studies done in other regions also showed higher incidence in elderly age group [13]. Current study showed that out of the positive isolates 53% belonged to males and 47% to females. 74% of urinary tract infections in our study were due to *E. coli*. This shows higher association of Escherichia coli with urinary tract infections. In a study done in Delhi in the year 2005 involving collection of samples from 5 different hospitals, it was found that the most common organism causing UTI was *E. coli* (68%) followed by Klebsiella spp. (16.9%), Proteus spp. (5.5%), Enterobacter spp. (5.3%), *S. saprophyticu*s (2.8%), and Enterococcus spp. (1.5%) [14]. Susceptibility of *E. coli* in the current study isolated from various clinical samples like urine, exudate and blood was tested using a common panel of 19 antimicrobial agents. The antibiotics used were Ampicillin, Amoxicillin/Clavulanate, Piperacillin/Tazobactam, Cefuroxime, Cefuroxime axetil, Ceftriaxone, Cefoperazone/Sulbactam, Cefepime, Ertapenem, Imipenem, Meropenem, Amikacin, Gentamicin, Nalidixic acid, Ciprofloxacin, Tigecycline, Nitrofurantoin, Colistin and Trimethoprim/Sulfamethoxazole. *E. coli* isolates were highly sensitive to Gentamicin (60%), Piperacillin/Tazobactam (66%), Cefoperazone/Sulbactam (75%), Colistin (86%), Amikacin (86%), Ertapenem (92%), Meropenem (91%), Tigecycline (94%), and Imipenem (98%) which was similar to that seen in previous year data with Gentamicin (72%), Piperacillin/Tazobactam (75%), Amikacin (95%), Ertapenem (93%), Meropenem (93%), Tigecycline (95%) and Imipenem (98%). Another study done in Nepal showed similar sensitivity pattern with Amikacin (82.1%) and Imipenem (100%) [15]. In the current study higher resistance was seen towards Ampicillin (89%), Nalidixic acid (89%), Cefuroxime (85%), Cefuroxime axetil (84%), Ceftriaxone (82%) which was similar to previous data in the same hospital with, Ampicillin (80%), Nalidixic acid (85%), Cefuroxime (85%), Cefuroxime axetil (80%), Ceftriaxone (82%). It was also comparable with the study done by Gautham et al with Nalidixic acid (92.8%) followed by Ceftriaxone (65.7%) and Cotrimoxazole (64.6%) [15]. Based on the results of this study we suggest the use of Amikacin as the drug of choice for empirical therapy for *E. coli* infections. Being a drug to be used by parenteral route only it is less prone for misuse by public (self-medication) or by primary health care practitioners. It is less expensive than other drugs. Though there is a more probability of adverse effects, its use can be justified in a tertiary care hospital because of the facility available to monitor and treat those adverse effects. We suggest the use of Cefaperazone/Sulbactam as an alternative drug in case there is any contraindication for the use of Aminoglycosides. Production of new antibiotics seems to have hit a hurdle and currently there is no drug in the pipeline to combat carbapenem resistance which is considered a clinical nightmare. Hence studies like these should be done periodically to ensure conservative use of reserve drugs and also control the microbial resistance. These studies are also required because of the wide variations in the usage of antimicrobials as well as the susceptible pattern in different regions. Phenotypic studies were not performed to differentiate ESBL from non ESBL producers. Susceptibility patterns were not studied consistently for all the samples for each antimicrobial listed. These are the limitations of this study.

CONCLUSION

There is widespread occurrence of multi drug resistant organisms due to misuse/improper use of antimicrobial agents. There is a wide regional variation in the distribution of such patterns. To prevent such multi drug resistance it is made mandatory to make antibiograms which helps in the recognition of the problems of antimicrobial resistance and helps in the formulation of guidelines for the appropriate use of antimicrobials for empirical therapy. This study is a small step in that direction. Though small, it is highly focused.

It is suggested that Amikacin can be used as the drug of choice for empirical therapy and Cefaperazone/Sulbactam can be used as an alternative drug.

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