North Bengal Medical College Journal
Vol 2 No 2 July 2016

Original Article

Comparison between Antibiotic Sensitivity of Community and Hospital Acquired Infections Caused by *Escherichia coli*

Taslima Yasmin,[1] Ummul Wara Khan Chowdhury,[2] Golam Mowla,[3] Shamima Akhter[4]

Revised : May 15, 2016 Accepted : May 29, 2016

Abstract

Introduction: *Escherichia coli is the most common Gram Negative Bacillus (GNB) causing various types of infection in both hospital and community. The purpose of the present study was to see the status of sensitivity of E. coli infection among hospital and community.*

Methods: *This cross sectional study was conducted in the Department of Microbiology at Mymensingh Medical College, Bangladesh from January 2011 to June 2011 for a period of 6 months. All the patients, at any age of both sexes, presented with wound infection and UTI were taken as study population. Specimens were taken aseptically. Specimens were processed and bacteria were isolated and identified according to standard procedure. Antimicrobial sensitivity test was done by disc diffusion method.*

Results: *A total number of 300 GNB were taken from various clinical specimens, among them majority was E. coli (52.0%), followed by Proteus (18.3%) and Klebsiella species (15%). All the isolates were sensitive to imipenem and nitrofurantoin followed by amikacin (92.9%).*

Conclusion: *In conclusion, E. coli is the most common bacteria causing wound infection, and UTI with a reduced sensitivity towards antibiotics both in hospital and community.*

Key words: *Escherichia coli, Gram Negative Bacilli, Antibiotic sensitivity*

North Bengal Med. Coll.J. 2016; 2 (2) : 42-49

1. *Associate Professor, Department of Microbiology, North Bengal Medical College, Sirajganj*
2. *Residential surgeon, Department of Gynae and Obstretics, Mymensingh Medical College, Mymensingh*
3. *Lecturer, Department of Community Medicine, Mymensingh Medical College, Mymensingh*
4. *Assistant Professor, Department of Pathology, TMSS Medical College, Bogra*

Correspondence *TaslimaYasmin, Email: taslimasanta@yahoo.com*

Introduction

Escheraichia coli, the most common Gram negative bacilli causing various types of infection in human. *E. coli* and related bacteria possess the ability to transfer DNA via bacterial conjugation, transduction or transformation, which allows genetic material to spread horizontally through an existing population.[1] This process led to the spread of various types of gene carried by a bacteriophage.[2] *E. coli* normally colonizes gastrointestinal tract in the bowel, it adheres to the mucus of the large intestine. It is the primary facultative anaerobe of the human gastrointestinal tract.[3] As long as these bacteria do not acquire genetic elements encoding for virulence factors, they remain benign commensals.[4] *E. coli*, when enters into unnatural sites, can cause variety of infectious diseases such as urinary tract infections, wound infections, bacteraemia, meningitis and other soft tissue infections.[5] The ability of *E. coli* to cause extra intestinal infections depends largely on several virulence factors, which help in the survival of *E. coli* under adverse conditions present in those sites, virulence factors such as haemolysin, surface hydrophobicity, serum resistance and protease.[6] In rarer cases, virulent strains are also responsible for haemolytic-uremic syndrome, peritonitis, mastitis, septicaemia and Gram-negative pneumonia.[7]

The treatment of *E. coli* infections is increasingly becoming difficult because of the multidrug resistance exhibited by the organism.[8] With the emergence and dissemination of antimicrobial resistance in bacteria which is well documented worldwide.[9] *E. coli*, an important gastrointestinal flora, known to be capable of accepting and transferring plasmids and which under stress readily transfers those plasmids to other species, is therefore considered an important reservoir of transferable antibiotic resistance.[10] Infection by *E. coli* occurs not only in hospital but also in community.[11] So it is important to find out the antibiotic sensitivity pattern of *E. coli* among hospital and community.

Materials and Methods

This cross sectional study was carried out in the Department of Microbiology at Mymensingh Medical College, Mymen-singh, from January 2011 to June 2011. Patients presented with UTI or wound infection, at any age with both sexes, were taken as study population. Non-repetitive clinical isolates were collected from MMCH both the outpatients and inpatients Departments of Sugery, Medicine and Gynae over a period of 6 months. Urine, pus and wound swab were used as specimens. Laboratory work was carried out in the department of Microbiology in Mymensingh Medical College. Specimens were collected aseptically. All samples were routinely cultured on MacConkey and blood agar plates at 37^0C aerobically for 18 hours. Gram negative isolates were further characterized by standard biochemical tests.

The susceptibility to antibiotics was determined by modified Kirby Bauer method according to CLSI 2010 protocols for Gram negative panels. *Esch. coli*ATCC 25922 was used as control strains.

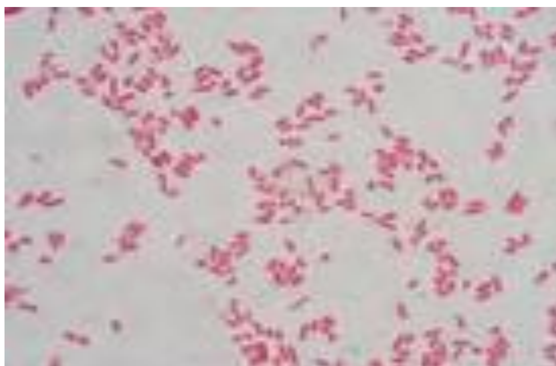

Figure 1: ***Esch. coli***

Results

During 6 months period, a total of 300 Gram negative isolates from various clinical specimens were included in the study. The distribution of various specimens were shown in Table I. The specimens were as follows as urine 216 (72%), wound swab 45 (15 %) and pus 39 (13%).

Table I: Distribution of sample from various specimens

Type of specimen	Total no. (%)
Urine	216 (72%)
Wound swab	45 (15%)
Pus	39 (13%)
Total	**300 (100%)**

Out of 300 Gram negative isolates in this study majority were *Esch. coli* 156 (52%), followed by *Proteus* spp. 55 (18.3%), *Klebsiella*spp. 45 (15%), *Pseudomonas* spp. 9 (3%) and others (*Enterobacter spp., Citrobacter spp.*) 35 (11.7%). (Table II).

Table II: Detection rate of different isolates in the study Population

Name of the organisms	Total No.	Percent (%)
Esch. coli	156	52.0
Proteus spp.	55	18.3
Klebsiella spp.	45	15.0
Pseudomonas spp.	9	3.0
**Others*	35	11.7
Total	**300**	**100.0**

* Others -*Enterobacter spp., Citrobacterspp*

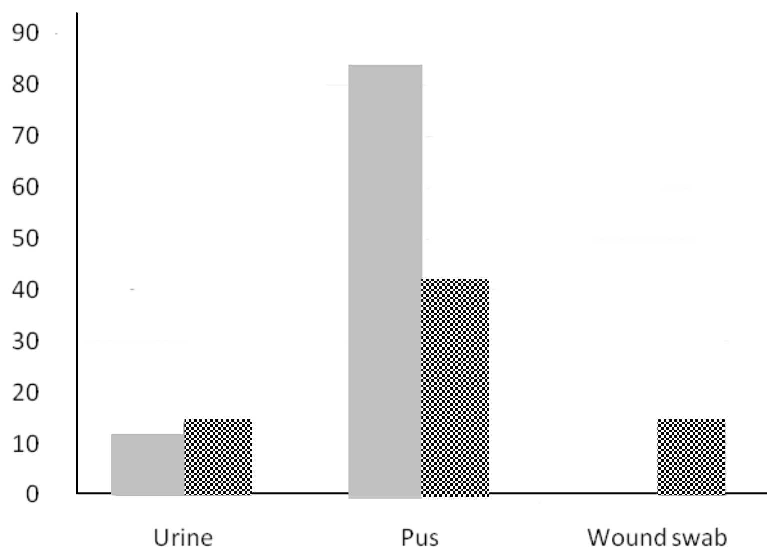

Figure 2: Distribution of *E. coli* in different specimens both from Hospital and Community

Table III: Antibiotic Resistance Pattern of *E. coli* isolated from Hospital and Community by disc diffusion method

Antimicrobials *E. coli*	Hospital isolates n - 67		Community isolates n - 89	
	Resistance	**Sensitive**	**Resistance**	**Sensitive**
Aztreonam	67 (100%)	0 (0%)	89 (100%)	0 (0%)
Piperacillin	62 (92.5%)	5 (7.5%)	85 (95.5%)	4 (4.5%)
Amoxiclav	63 (94.0%)	4 (6.0%)	83 (93.2%)	6 (6.8%)
Ampicillin	64 (95.5%)	3 (4.5%)	80 (89.8%)	9 (10.2%)
Ceftriaxone	57 (85.0%)	10 (15%)	70 (78.6%)	19 (21.4%)
Ciprofloxacin	56 (83.5%)	11 (16.5%)	64 (71.9%)	25 (28.1%)
Cefotaxime	53 (79.1%)	14 (20.9%)	63 (70.7%)	26 (29.3%)
Ceftazidime	41 (61.1%)	26 (38.9%)	63 (70.7%)	26 (29.3%)
Azithromycin	54 (80.5%)	28 (19.5%)	52 (58.4%)	37 (41.6%)
Gentamicin	39 (58.2%)	28 (41.8%)	42 (47.1%)	47 (52.9%)
Amikacin	12 (17.9%)	55 (82.1%)	11 (16.4%)	78 (83.6%)
Nitrofurantoin	2 (2.9%)	65 (97.1%)	3 (3.3%)	86 (96.7%)
Imipenem	0 (0%)	67 (100%)	0 (0%)	67 (100%)

Discussion

In the last few decades, the frequency and spectrum of antimicrobial resistant infections have increased in both the hospital and the community. Certain infections that are essentially untreatable have begun to occur as epidemics both in the developing world and in institutional developed regions.[15] Proper use of antibiotics is very important for various reasons. Development of bacterial resistance against newer antibiotics makes the main focus of research.

In the present study, a total of 300 Gram negative strains were isolated from various clinical specimens of which majority of the organisms were isolated from urine 72% followed by wound swab 15%, pus 13%. Among the isolated organisms *E. coli* was the most prevalent 52%, followed by *Proteus spp*. 18.3%, *Klebsiella spp*. 15% and *Pseudomonas spp*. 3% . In the present study isolation of *E. coli* was 55.6% and 61.2% from both urine and pus respectively, which were in agreement with the findings done by Haque et al.[13] and Parveen et al.[14] in the same institute. In India Marcus[15] and associates found the same figure.

In Bangladesh, it has been reported that 65-92% of commensal *Enterobacteriaceae* and other organisms isolated from urine is resistant to commonly used antibiotics like ampicillin, tetracycline, co-trimoxazoleetc.[16] Now-a-day's organism encoding multiple antibiotic resistance genes are becoming increasingly prevalent.[17] In this study, aztreonam, ampicillin, amoxyclave were found 95-100% resistant (Table III), this was in agreement with other studies.[18,19] Cephalosporins especially third generation have been used for Gram negative bacterial treatment.[20] In the present study ceftri-axone, ceftazidime and cefotaxime were found 85%, 61%, 79% from hospital acquired and 78.6%, 70.7%, 70.7% resistant among community acquired *E. coli* respectively. It correlates with the study done by Sasirekha et al.and Singh and Goyal (2003) in India[18,21,] where they found 84% resistance to cefotaxime and 75%, 85% resistant for ceftriaxone and ceftazidime respectively. Hospital acquired isolates were more resistant than the community acquired isolates, it may be due to lack of antibiotic policy, irrational use of 3GCs mainly ceftriaxone in the hospital Shova[22] and the emergence of antibiotic-resistant organisms in hospitals in concert with the use of high levels of antibiotics use caused the emergence of resistant organisms and they might be inherently more virulent than the organisms are sensitive (CDC 2002).

In this study observed resistance to ciprofloxacin was 78% in *E. coli*. These findings were in accordance with the study by Haque and Salam[13] from Bangladesh and it was 90.9%. Another study by Sasirekha

from India where they found 68% resistant to ciprofloxacin.[18] Aminoglycosides have good activity against clinically important gram negative bacilli[23] In the present study 82.1% isolates were susceptible to amikacin, followed by 41.8% to gentamicin, it was similar to Sasirekha et al.[21] Several studies showed that amikacin was more sensitive than gentamicin but if it is over used than it may also become resistant. In 2010 gentamicin was 59% resistant in India and 55.5% in Bangladesh.[13,18,19] These variations may be due to increased use of gentamicin, caused by selection pressure of aminoglycosides in different region.[24] Carbapenems are the drugs of choice for many infections caused by Gram positive and Gram negative bacteria.[19] In this study imipenem was 100% sensitive. These findings were similar to study done by Haque and Salam[13] but one study showed 3.1% resistant to imipenem in Bangladesh.[25] Amikacin was the second most common sensitive drug after imipenem. So, these drug resistance organisms have limited theraputic options and necessitated the increased use of carbapenems.

Conclusion

Infection by *E. coli* increasing both in hospital and community with reduced sensitivity profiles. Indiscriminate use of antibiotics should be restricted and adequate laboratory facility for culture and sensitivity should be ensured. The infection control programs should be monitored continuously in hospital.

Contribution of the Authors

First author was the principal researcher. Others were responsible for data collection, statistical analysis and computer composing.

References

1. Feng P, Weagant S, Grant M. Enumeration of Escherichia coli and the Coliform Bacteria. Bacteriological Analytical Manual, 8th ed. FDA/Center for Food Safety & Applied Nutrition. Retrieved 2007-01-25.
2. Zwadyk P. Enterobacteriaceae: Salmonella and Shigella, Intestinal pathogens. In: Joklik, W.K. Willet, H.P. Amos, B. and Wilfert CM, eds. Zinsser Microbiology, 20th ed. USA: Appleton and Lange, 1992; 556-565.
3. Todar K. Pathogenic E. coli. Online Textbook of Bacteriology. University of Wisconsin–Madison Department of Bacteriology. Retrieved 2007-11-30.
4. Evans Jr, Doyle J, Dolores G. Evans. *Escherichia coli*. Medical Microbiology, 4th edition. The University of Texas Medical Branch at Galveston. Archived from the original on 2007-11-02.
5. Rendón MA, Saladana Z, Erdem AL, Monteiro-Neto V, Vazquez A, Kaper JB et al. Commensal and pathogenic *Escherichia coli* use a common pilus adherence factor for epithelial cell colonization. PNAS 104, 2007; 25: 10637–42.

6. Heaton JC, Jones K. Microbial contamination of fruit and vegetables and the behaviour of enteropathogens in the phyllosphere: a review. J Appl Microbiol. 2008; 3: 613–26.
7. Chalmers RMH, Aird FJ. Bolton Waterborne *Escherichia* Bitzan, M and Karch, H (1992).
8. Yasmin T, Hossain M, Paul SK, Sultana S, Kabir MR, Mawla G et al. Prevalence of ESBL producing isolates among skin wound infection in a Tertiary care Hospital In Bangladesh. Mymensingh Med J. 2013; 23 (3) : 23-27.
9. Sahm DF, Thornsberry C, Mayfield DC, Jones ME, Karlowsky JA. Multidrug-resistant urinary tract isolates of *Escherichia coli:* prevalence and patient demographics in the United States in 2000. Antimicrob agent Chemother 2001;45(5): 1402-1406.
10. Chapman PA, Siddons CA, GerdanMalo AT, Harkin MA. A 1-year study of *Escherichia coli* 0157 in cattle, sheep, pigs and poultry. Epidemiol Infect. 1997;119: 245-50.
11. Akram M, Shahid M. Etiology and antibiotic resistance patterns of community-acquired urinary tract infections in JNMC Hospital Aligarh, India. Ann Clin Microbiol Antimicrob, 2007; 6 (4).
12. Aibinu IE, Peters RF, Amisu KO, Adesida SA, Ojo MO, Tol Odugbemi. Multidrug Resistance in *E. coli* 0157 strains and the Public Health Implication. J Am Sc. 2007; 3(3): 25-33.
13. Haque R, Salam MA. Detection of ESBL producing nosocomial gram negative bacteria from a tertiary care hospital in Bangladesh. Pk J Med Sci. 2010; 26(4): 887-891.
14. Parveen US, Hossain MA, Musa AK, Mahmud C, Islam MT, Haque N et al. Pattern of Aerobic Bacteria with Antimicrobial Susceptibility Causing Community Acquired Urinary Tract Infection. Mymensingh Med J. 2009;18(2):148-153.
15. Marcus N, Ashkenazi S, Yaari A, Samra Z, Livni G. Non-*Escherichia coli* versus *Escherichia coli* community-acquired urinary tract infections in children hospitalized in a tertiary center: relative frequency, risk factors, antimicrobial resistance and outcome. Pediatr Infect Dis J. 2005; 24 (7): 581-585.
16. Chowdhury MA, Yamanaka H, Miyoshi S, Aziz KM, Shinoda S. Ecology of Vibrio mimicus in aquatic environments. Appl Environ Microbiol. 1989; 55 (8): 2073-2078.
17. Perez F, Endimiani A, Hujer KM, Bonomo RA. The continuing challenge of ESBLs. Curr Opin Pharmacol. 2007;7 (5): 459-469 .
18. Sasirekha B, Manasa R, Ramya P, Sneha R. Frequency and Antimicrobial Sensitivity Pattern of Extended Spectrum β- Lactamases Producing *E. coli* and KlebsiellaPneumoniae Isolated in a Tertiary Care Hospital. Al Ameen J Med Sc. 2010; 3(4): 265-271.

19. Ullah F, Malik SA, Ahmed J. Antimicrobial susceptibility pattern and ESBL prevalence in Klebsiell-apneumoniae from urinary tract infections in the North –West of Pakistan. African J Microbiol. 2009; 3 (11): 670-680.
20. Samaha-Kfoury JN, Araj GF. Recent developments in β lactamases and extended spectrum β lactamases. Bairut Med J.2003; 327 (22): 1209-1213.
21. Singh NP, Goyal R. Changing trends in bacteriology of burns in the burns unit, Delhi, India. Burns. 2003; 29 (2): 129-132.
22. Shobha KL, Gowrish RS, Sugandhi R, Sreeja CK. Prevalence of Extended Spectrum β Lactamases in Urinary Isolates of *Escherichia coli*, Klebsiella and Citrobacter Species and their Antimicrobial Susceptibility Pattern in tertiary care hospital. Indian J Practic Doctor. 2007; 3(6): 1 -2.
23. Gonzalez LS, Spencer JP. Aminoglycosides: a practical review. Am Fam Physician. 1998; 58 (8): 1811-1820.
24. Miller GH, Sabatelli FJ. The most frequent aminoglycoside resistance mechanisms--changes with time and geographic area: a reflection of aminoglycoside usage patterns? Aminoglycoside Resistance Study Groups. Clin Infect Dis.1997; 24 (1): 46-62.
25. Rashid A, Chowdhury A, Rahman SH, Begum SA, Muazzam N. Infections by Pseudomonas aeruginosa and Antibiotic Resistance Pattern of the Isolates from Dhaka Medical College Hospital. Bangladesh J Med Microbiol. 2007; 1(2): 48-51.