Multidrug Resistant Bacteria Causing Nosocomial Urinary Tract Infection in Neurology/Neurosurgical Unit of a Tertiary Care Hospital

Sarita Mohapatra¹, Reshu Agarwal¹, Prathyusha Kokkayil², Girija Prasad Rath³, Arti Kapil¹, Bimal Kumar Das¹, Benu Dhawan¹, Seema Sood¹

From ¹Department of Microbiology, All India Institute of Medical Sciences, New Delhi, India, ²Department of Microbiology, Government Medical College, Palakkad, India, ³Department of Neuroanaesthesiology, All India Institute of Medical Sciences, New Delhi, India

Correspondence to: Dr. Sarita Mohapatra, Department of Microbiology, All India Institute of Medical Sciences, New Delhi-110029, India, Email: saritarath2005@yahoo.co.in

Received - 25 January 2018 Initial Review – 16 February 2018 Accepted – 27 February 2018

**ABSTRACT**

**Introduction**: Nosocomial infections with the multidrug resistant microorganisms remain the major concern in the hospitalized patients. Due to the underlying illness, trauma, various neurosurgeries, patients admitted to neurology/neurosurgery units become more vulnerable to acquire device associated infections during their hospital stay. **Objectives**: To study the spectrum of uropathogens and their antimicrobial susceptibility pattern among patients admitted to the neurology/neurosurgery unit. **Material and methods**: A prospective study was conducted in the bacteriology laboratory, Department of Microbiology over a period of 4 months. Urine samples from the patients admitted to neurology and neurosurgical unit (ward and ICU) were processed and identified as per the standard protocol. The antimicrobial susceptibility testing was done using Kirby- Bauer method as per CLSI 2014 guideline. **Results**: Majority of the urinary isolates belonged to Enterobacteriaceae family in both ward and ICU patients. Among these, 91 out of 106 (86%) isolates in the ward and 43 out of 51 (84%) isolates in ICU were found to be multi drug resistant. Nitrofurantoin was observed to be resistant in more than 75% of both ward and ICU isolates. **Conclusion**: Majority of nosocomial uropathogens were found to be multidrug resistant. This study emphasizes the emergence of MDR isolates and nitrofurantoin resistance among the nosocomial uropathogens.

**Key words**: neurology, neurosurgery, MDR pathogen, Enterobacteriaceae

Patients admitted to neurology/neurosurgical unit remain in compromised condition because of their underlying diseases and associated comorbidities. Hence, these patients are more vulnerable to health-care associated infections during their hospital stay. Urinary catheters are commonly used after neurosurgical procedures to measure the urine output or relieve the incontinence. Likewise, patients who are bed-ridden for a prolonged duration and on ventilatory support owing to respiratory difficulty also require urinary catheterization. Moreover, among the various device associated infections, catheter associated urinary tract infection (CA-UTI) is the most common infection in these patients [1]. Approximately 12-25% of the total hospitalized patients are catheterized [2]. Urinary tract infection (UTI) alone accounts for 40% of total hospital acquired infections and 80% of UTI occurred due to indwelling urinary catheter [2]. The gram-negative bacteria (GNB) are the important causes of CA-UTI [3]. When infection occurs with antibiotic resistant pathogens, it leads to increase morbidity, mortality and
hospital cost. Multidrug resistant (MDR) pathogens are currently an emerging problem in many of the hospital-acquired infection [4]. These pathogens are resistant to most of antibiotics leaving very few therapeutic options for the physicians. Hence, we carried out this study to find out the incidence of MDR bacteria causing nosocomial UTI in patients admitted to neurology and neurosurgery unit of our hospital.

MATERIAL AND METHODS

A prospective study was conducted on the patients admitted to neurology and neurosurgery ward and ICU over a period of 4 months. Urine samples from the patients with more than 48 hours of hospitalization were collected and processed in the bacteriology laboratory, Department of Microbiology. All the urine samples were processed within 2 hours of collection. The samples were cultured on Cysteine Lysine Electrolyte Deficient (CLED) media. The analysis of culture report was done by semi quantitative method. Samples with colony count ≥10⁵ CFU/ml with or without symptoms were considered having significant bacteriuria. The isolated organism was identified using conventional phenotypic methods as per standard protocols. Patients were categorized to have asymptomatic bacteriuria (ASB) or CA-UTI depending on the presence or absence of symptoms as per the CDC guidelines [5]. Growths with ≥3 types of organisms or gram-positive bacilli were considered as contaminants. Same species isolated from same patient with same antibiogram within 6 days duration were considered as single isolate and same species isolated from same patient in two different occasions with a gap of ≥6 days were considered as two different isolates. Antibiotic susceptibility testing was done on Mueller-Hinton agar using Kirby-Bauer disc diffusion method as per CLSI 2014 guideline [6]. MDR was defined as the species resistant to ≥3 different classes of antibiotics.

RESULT

A total 1515 urine samples were received for microbiological processing out of which 910 were collected from wards and 605 were from the ICU. Out of 910 samples, 159 (16.5%) were culture positive (≥10⁵ CFU/ml) with 106 different clinical isolates from the patients of neurosurgery ward. Similarly, among the ICU samples, 74 out of 605 (12%) samples were found culture positive (>10⁵ CFU/ml) with 51 different isolates. Gram-negative bacilli were the predominant isolate in both ward and ICU patients.

Antibiotic susceptibility pattern of GNB: Majority of the isolates belong to Enterobacteriaceae followed by Pseudomonas spp. and Acinetobacter spp. Among Enterobacteriaceae, Klebsiella pneumoniae, Escherichia coli, and Enterobacter spp. were the commonest isolates (Table 1). Antibiotic resistance pattern of both ward and ICU isolates remained similar. In total 85% of the isolates were MDR and 70-80% isolates were resistant to carbapenem, cefoperazone-sulbactam, and piperacillin-sulbactam (Table 2). Among Enterobacteriaceae, Klebsiella spp. and Enterobacter spp. were observed to be more resistant to different class of antibiotics in comparison to E. coli. More ever, K. oxytoca was more resistant than K. pneumoniae. 90% isolates were resistant to aminoglycosides, fluoroquinolones and third generation cephalosporins. Nitrofurantoin resistance was found in >75% of the isolates of different species except in E. coli where only 30% isolates were resistant.

Antimicrobial susceptibility pattern of GPC: Enterococcus faecium was the commonest isolate among followed by Staphylococcus aureus. None of the isolate found to be vancomycin resistant. However, >60% of E. faecium isolates were high level aminoglycoside resistant.

| Table1 – Microbiological profile of samples with significant bacteriuria |
|-----------------|---|---|
| **Organism**    | **Ward** | **ICU** | **Total** |
| Gram negative bacilli |     |     |     |
| Escherichia coli | 31 | 13 | 44 |
| Klebsiella spp. | 33 | 13 | 46 |
| Enterobacter spp. | 9 | 7 | 16 |
| Proteus vulgaris | 2 | 1 | 3 |
| Citrobacter spp. | 3 | 1 | 4 |
| Morganella spp. | 1 | 1 | 2 |
| Pseudomonas eruginosa | 13 | 5 | 18 |
| Acinetobacter spp. | 8 | 4 | 12 |
| Gram positive cocci |     |     |     |
| Staphylococcus aureus | 1 | - | 1 |
| Enterococcus faecium | 5 | 6 | 11 |
multidrug resistant uropathogens in neurosurgical unit

Mohapatra et al.

Table 2 - Distribution of uropathogens and antimicrobial resistance pattern (Resistance rate in %)

| GNB              | AK  | Net | CAZ | Cef | AC | CFs | Imi/Mer | Cip | PT | FD | MDR |
|------------------|-----|-----|-----|-----|----|-----|---------|-----|----|----|-----|
| *E. coli*        | 84  | 80  | 95  | 95  | 93 | 75  | 64      | 91  | 77 | 30 | 89  |
| *K. pneumoniae*  | 98  | 98  | 98  | 95  | 90 | 76  | 71      | 93  | 83 | 83 | 98  |
| *K. oxytoca*     | 100 | 100 | 100 | 100 | 100| 50  | 50      | 100 | 83 | 75 | 100 |
| *Enterobacter*   | 88  | 88  | 94  | 94  | 94 | 88  | 69      | 88  | 88 | 75 | 87.5|
| *Citrobacter*    | 100 | 100 | 100 | 100 | 100| 75  | 100     | 100 | 75 | 100| 100 |
| *P. vulgaris*    | 67  | 67  | 100 | 100 | 100| 75  | -       | 33  | -  | 33 | 33  |
| *Morganella*     | 100 | 100 | 100 | 100 | 100| 50  | 100     | 100 | 100| 100| 100 |
| *P. aeruginosa*  | 89  | -   | 94  | -   | -  | 78  | 89      | 94  | 67 | 83 | 94  |
| *Acinetobacter*  | 92  | -   | 92  | 92  | 92 | 25  | 92      | 88  | 88 | 75 | 92  |
| **GPC**          |     |     |     |     |    |     |         |     |    |    |      |
| *S. aureus*      | 100 | 0   | 0   | 0   | -  | -   | 0       | 0   | 0  | 0  | 0   |
| *Enterococcus*   | -   | -   | 91  | 91  | 64 | -   | 0       | 0   | 0  | 0  | 0   |

*Ak: amikacin, Net: netilmicin, Caz: ceftazidime, Cef: cefotaxime, AC: amoxicillin-clavulanate, CFs: cefoperazone-sulbactam, Imi/Me: imipenem/meropenem, Cip: ciprofloxacin, PT: piperacillin-tazobactam, Fd: nitrofurantoin, Pen: penicillin, Cef: cefoxitin, Ery: erythromycin, HGen: high level gentamycin 120μg, Co-tri: co-trimoxazole, Van: vancomycin, Lin: linezolid

**DISCUSSION**

Catheter associated UTI is the commonest infection in neurosurgical patients because of prolonged catheterization during hospital stay. Detection of microbiological etiology along with its antimicrobial resistance gives an idea about the local epidemiological trend, and its antibiotic resistance pattern. This information can be utilized for decision making with regard to antibiotic prophylaxis, control of potential outbreaks, and treatment of unusual pathogen etc. It provides the knowledge on pathogens and their resistance patterns. The present study highlights the high prevalence of MDR strains causing nosocomial UTI or persistent colonizers in neurology or neurosurgery patients. It also gives us knowledge about the spectrum of pathogens and their resistance pattern.

Mohanty et al. (2003) carried out a similar study in our center and found that *E. coli* was the commonest nosocomial uropathogen followed by *K. pneumoniae* and other GNB [7]. However, the present study show increase in resistance rates for third generation cephalosporins, aminoglycoside, and fluoroquinolone group of antibiotics among the GNBs. The resistance in the present study was found to be 67%-100% for the above three group of antibiotics in comparison to earlier when it was reported as 75%. Increase in resistance to nitrofurantoin was observed (55.6% to ≥75%) (except *E. coli* and *Proteus spp.*). An increase in resistance to imipenem, meropenem, cefoperazone-sulbactam, piperacillin–sulbactam was also observed. This is worrisome as these were the most active drugs in hospitalized patients. Contrary to our finding, previous study have shown lower rates of antimicrobial resistance to cephalosporins, aminoglycoside, freshmaninoles [8]. It may be due to rapid emergence of carbapenem resistance in India due to frequent use of carbapenem group of drugs among the hospitalized patients. The prevalence of GPC, especially *Enterococcus spp.* and *Staphylococcus spp.* constitute a small subset (<1%) in causation of nosocomial UTI in this study.

Colonization with MDR organism is the major concern for the management. This group of organism is not only high risk for management of infection control but also disseminate the MDR genes in the hospital environment [9]. It is also accompanied with challenges in the implementation of antibiotic prevention strategies and antibiotic stewardship program. The study has certain limitation like risk factors analysis, correlation of MDR colonizers with subsequent infection. It is also important to
know how many among these patients are getting antibiotics for UTI without having actual disease. Further longitudinal studies can be conducted to evaluate the risk factors and to proof the above concept. The other limitation of our study was lack of complete clinical history of the patients. Hence, the exact number of patients having ASB or CA-UTI could not be analyzed. Several studies have proven that prolong use of multiple antibiotics is a prominent risk factor for antibiotic resistance [10-13]. These factors of MDR colonization should be analyzed to target the preventive strategies. Standard contact precaution, hand hygiene practice, and aseptic techniques should be implemented to prevent the transmission of these MDR genes from one to other.

CONCLUSION

In conclusion, antibiotic drug resistance is an alarming condition especially in developing countries. We found increased resistance to multiple antibiotics among the urinary isolates including both pathogen and colonizers. Hence, judicious use of antibiotics and implementation of antibiotic stewardship programme is highly essential to prevent the emergence and spread of MDR genes in these patients.

REFERENCES

1. Zolldann D, Spitzer C, Häfner H, Waitschies B, Klein W, Sohr D, et al. Surveillance of nosocomial infections in a neurologic intensive care unit. Infect Control HospEpidemiol2005; 26:726–73.
2. Tits worth WL, Hester J, Correia T, Reed R, William M, Guin P, et al. Reduction of catheter associated urinary tract infections among neurological intensive care unit: a single institution’s success. J Neurosurg 2012; 116:911-20.
3. Gaynes R, Edwards JR, National Nosocomial Infections Surveillance System. Overview of nosocomial infections caused by gram-negative bacilli. Clin Infect Dis 2005; 41:848-54.
4. O’Fallon E, Pop-Vicas A, D’Agata E. The emerging threat of multidrug resistant Gram-negative organisms in long-term care facilities. J Gerontol A Biol Sci Med Sci 2009; 64: 138–41.
5. Center for Disease Control and Prevention. 2014. Protocols and Definitions Device- associated module Catheter associated urinary tract infections.
6. Clinical Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing; Twenty- fourth Informational Supplement CLSI Document M100-S24. Vol.35. Wayne, PA: Clinical Laboratory Standards Institute; 2014.
7. Mohanty S, Kapil A, Das BK, Dhawan B. Antimicrobial profile of nosocomial uropathogen in a tertiary care health center. Indian J Med Sci 2003;57:148-54.
8. Sorlozano A, Jimenez-Pacheco A, Castillo JDL, Sampedro A, Martinez-Brocal, A, Miranda-Casas C, et al. Evolution of the resistance to antibiotics of bacteria involved in urinary tract infections: A 7-year surveillance study. AM J Inf Cont 2014;42:1033-8.
9. Lim CJ, Cheng AC, Kennon J, Spelman D, Hale D, Melican G, et al. Prevalence of multidrug-resistant organisms and risk factors for carriage in long-term care facilities: a nested case–control study. J Antimicrob Chemother 2014;69:72-80
10. Van der Mee-Marquet N, Savoyen P, Domelier-Valentin AS, Quentin R, Réseau des Hygiénistes du Centre Study Group CTX-M-type fluoroquinolone resistant Escherichia coli: analysis of the colonization of residents and inanimate surfaces 1 year after a first case of urinary tract infection at a nursing home in France. Infect Control. Hosp Epidemiol 2010; 31: 968–70
11. Brugnaro P. Clustering and risk factors of methicillin-resistant Staphylococcus aureus carriage in two Italian long-term care facilities. Infection 2009; 37: 216–21.
12. Eveillard M, Charru P, Rufat P, Hippeaux MC, Lancien E, Benselama F, et al. Methicillin-resistant Staphylococcus aureus carriage in a long-term care facility: hypothesis about selection and transmission. Age Ageing 2008; 37: 294–9.
13. Rooney PJ, O’Leary MC, Loughrey P, McCallmont M, Smyth B, Donaghy P, et al. Nursing homes as a reservoir of extended-spectrum b-lactamase (ESBL)-producing ciprofloxacin resistant Escherichia coli. J Antimicrob Chemother 2009; 64: 635–41.

How to cite this article: Mohapatra S, Agarwal R, Kokkayil P, Rath GP, Kapil A, Das BK, Dhawan B, Sood S. Multidrug Resistant Bacteria Causing Nosocomial Urinary Tract Infection in Neurology/Neurosurgical Unit of a Tertiary Care Hospital, Eastern J Med Sci. 2018; 3(1):2-5.

Funding: None; Conflict of Interest: None Stated.