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Original Research

Acinetobacter Meningitis: A Retrospective Study on its outcome and Antimicrobial resistance pattern in Post neurosurgical meningitis Patients at a Tertiary Care Centre

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Abstract
Introduction and Aim: *Acinetobacter baumannii* (*A. baumannii*) is a gram negative bacillus and mortality rate due to Acinetobacter baumannii nosocomial meningitis (ANM) is high. The increasing antimicrobial resistance makes the treatment options available very limited necessitating the need for a continuous Antimicrobial Resistance surveillance that would aid in the proper implementation of the empirical therapy while taking into consideration its extensive antibiotic resistance spectrum. This study aims to determine the prevalence & antibiotic resistance pattern of *A. baumannii* isolated from the CSF samples from the post neurosurgical cases.
Material and methods: A cross-sectional study was conducted over two years, from December 2021 to November 2023, at the Department of Microbiology, Sher-i-Kashmir Institute of Medical Sciences, Srinagar. Data from 28 patients with positive CSF samples for *A. Baumannii* were collected, including age, gender, antimicrobial susceptibility, and mortality. CSF samples were received in culture bottles and incubated in the BacT/ALERT system. Positive bottles underwent gram staining and subcultures on blood, MacConkey agar, and Chocolate agar. Non-lactose fermenter colonies were identified using VITEK Densichek, and antimicrobial susceptibility testing was conducted using the using the VITEK 2 ID-GNB card and AST-NO09 card respectively in VITEK 2 system with software release 2.01.
Results: Mean age of the patients with Acinetobacter meningitis included in this study was 32.2 years. 16/28 (57.1%) were male. All cases were associated with previous neurosurgical procedures. Of the total number of patients enrolled in the study, 11 patients had MDR isolates whereas 2 patients had XDR Acinetobacter. 25 (89.2%) and 19 (67.8%) of the isolates were resistant to Imipenem and Meropenem respectively. Mortality rate of the patients was 57.14%.
Conclusion: In critically ill patients post-neurosurgery, *A. baumannii* infection poses a significant challenge. Understanding the pattern and antibiotic susceptibility of Acinetobacter meningitis is crucial for effective antimicrobial strategies, reducing mortality and morbidity. Continued efforts are required to develop improved antimicrobial policies and implement effective infection control practices. Given the high mortality rates observed, aggressive empirical treatment, including intrathecal therapy, is necessary in regions with endemic meningitis.

Introduction*:* *Acinetobacter baumannii* (*A. Baumannii*) is a pleomorphic, non-motile gram negative bacillus that belongs to the genus Acinetobacter, which inturn has as many as 30 species. Most of these species are found in the environment and are not pathogenic to human beings. The most commonly reported species are termed as A. calcoaceticus–A. Baumannii (ACB) complex which includes Acinetobacter calcoaceticus and A.baumannii. Among these, A.baumannii is clinically the most significant. It is an opportunistic pathogen owing to its ability to cause higher rate of infection in immunocompromised individuals. In the recent past, it has been termed as a “red alert” human pathogen.[1,2] It is known to cause a large number of infections including infections involving the respiratory tract, bacteremia, meningitis, and wound infection. [3] Patients undergoing neurosurgical procedures are very much prone to develop Hospital-acquired meningitis caused by a wide range of Gram negative and Gram positive microorganisms among which the majority of nosocomial meningitis is caused by A. baumannii. [4] Craniocerebral operations put the patients at a higher risk of suffering from bacterial meningitis caused by A. Baumannii with extremely fatal consequences. A. baumannii meningitis has been seen to be associated with external ventricular drainage (EVD), cerebrospinal fluid (CSF) leaking, or head trauma, Ventriculo-Peritonial (VP) shunt and is the most common pathogen isolated in this subset of patients[4,5].About 4% of all meningitis and shunt-related infections are caused by A. baumannii and these are known to show mortality rates nearing to 70%. The transmission of this pathogen occurs through the vicinity of affected patients or colonizers such as linens fomites, curtains, bed rails, tables, doors, feeding tubes, and even medical equipment and it is able to survive desiccation and remain viable for months which again is an important factor that facilitates its spread in the hospital. In addition to this, contaminated respiratory support equipment, suction devices, and devices used for intravascular access also serve as an important source of infection. [6] Also, age over 40,raised cerebrospinal fluid white blood cell count, and diabetic and hypertensive patients are at a higher risk for mortality due to A. baumannii in the neurosurgical ICU.[7] The A. Baumannii infections are usually treated with antibiotics like Carbapenems, Aminoglycosides, Polymyxins, Tigecycline, Tetracyclines and Combination Therapy.[8] At the same time, there has been a significant increase in the Multidrug-resistance of these isolates which is being recognized as a growing concern since resistance to all commercially available antimicrobials (aminoglycosides, cephalosporins, quinolones and imipenem) raises an important therapeutic issue.[9] In addition to all this, the penetration of antibiotic agents through the blood–brain barrier into the cerebrospinal fluid (CSF) is variable and further limits the therapeutic choices for these infections. [10]

The increasing antimicrobial resistance makes the treatment options available very limited necessitating the need for a continuous AMR surveillance that would in turn aid in the proper implementation of the empirical theory while taking into consideration its extensive antibiotic resistance spectrum. This study aims to determine the prevalence & antibiotic resistance pattern of A. baumannii isolated from the CSF samples from the post neurosurgical cases.

Material and methods

Study period

This cross-sectional study was conducted for a period of 2 years from December 2021toNovember2023 in Department of Microbiology at the Sher-i-Kashmir institute of medical sciences, Srinagar.

Methodology

Data of 28 patients whose CSF samples were positive for *A.Baumannii* were obtained with respect to age, gender, investigations done, and antimicrobial susceptibility pattern and mortality. Post-neurosurgical Meningitis was defined as meningitis developing within 3 months after neurosurgery and was diagnosed based on specific criteria: (1) Isolation of A. baumannii from cerebrospinal fluid (CSF); (2) Presence of at least one symptom or sign without alternative explanations, including fever (≥38°C), headache, vomiting, confusion, irritability, or meningeal irritation; (3) History of neurosurgical intervention within the preceding 3 months. [11,12] A patient was considered cured upon disappearance of symptoms and signs along with sterile CSF. [13]

CSF samples were received in the CSF culture bottles which were incubated at 35 ± 2°C in the BacT/ALERT blood culture System and the bottles that showed a positive signal were subjected to microscopic examination of gram-stained smears of their contents. At the same time, Subcultures were performed from these bottles on blood, MacConkey agar plates and Chocolate agar which were incubated aerobically at 37°C overnight. A suspension was prepared from the plates that showed growth as Non lactose fermenter on Maconkey agar and the turbidity of the bacterial suspension was adjusted with VITEK Densichek (bioMérieux) to match the McFarland 0.5 standard in 0.45% sodium chloride. Afterward, the VITEK 2 ID-GNB card, the AST-NO09 card, and the bacterial suspension were manually loaded into the VITEK 2 system. The VITEK 2 system reported the results automatically with software release 2.01. Standard strains including *Escherichia coli* ATCC 25922 and Pseudomonas aeruginosa ATCC 27853 were used as controls.

Statistical analysis: All the statistical analysis was done using SPSS software.V.23. All categorical variables were shown in the form of frequency and percentage. All variables were discussed at 5% level of significance i.e. value of P<0.05.

Results: Mean age of the patients with Acinetobacter meningitis included in this study was 32.2 years. 16 were male. Multi drug resistant *Acinetobacter spp.* was defined as the isolates resistant to at least three classes of antimicrobial agents. Extensively Drug Resistant *Acinetobacter* spp. was defined as the isolate that is resistant to the three classes of antimicrobials and also resistant to carbapenems. Finally, ‘Pan drug resistant *Acinetobacter* spp. was defined as the XDR *Acinetobacter* spp. that is resistant to polymyxins and tigecycline.[14]Of the total number of patients enrolled, 11 patients had MDR isolates whereas 2 patients had XDR Acinetobacter. Mortality rate was found to be 57.14%. There was no significant association observed between gender, length of hospital stay, and the mortality rate of the patients.

Table 1: Gender and outcome of 28 patients with Acinetobacter meningitis

No	Gender	Outcome
1.	Female	Survival
2.	Female	Death
3.	Male	Survival
4.	Female	Survival
5.	Male	Survival
6.	Female	Death
7.	Male	Death
8.	Male	Survival
9.	Female	Death
10.	Male	Death
11.	Male	Survival
12.	Female	Death
13.	Male	Survival
14.	Male	Survival
15.	Male	Death
16.	Male	Survival
17.	Female	Death
18.	Male	Survival
19.	Male	Death
20.	Female	Survival
21.	Male	Survival
22.	Female	Death
23.	Male	Death
24.	Female	Death
25.	Female	Death
26.	Male	Death
27.	Female	Death
28.	Male	Death

Table 2: Resistance profile of Acinetobacter isolates

Antibiotic	N (%)
Amikacin	23(83.9%)
Gentamicin	26 (92.8)
Ampicillin	4(!4.2)
Cefepime	26 (92.8)
Ampicillin+Sulbactam	1(3.57)
Ceftriaxone	23(82.1)
Imipenem	25(89.2)
Meropenem	19(67.8)
Piperacillin+Tazobactam	19(67.8)
Colistin	0

Table 3: Distribution of isolates on the basis of gender and length of stay in the hospital.

Variable	Alive N(%)	Dead N(%)	P-value
Gender			
Male	9 (75)	7 (43.5)	0.184
Female	3 (25)	9(56.5)	
Length of hospitalization (days) median			
28 days	8(66.6)	6(37.5)	0.196
17 days	4(33.4)	10(62.5)	

Discussion: Meningitis is diagnosed on the basis of clinical symptoms and/or positive cerebrospinal fluid (CSF) cultures .Various gram positive and gram negative bacteria are responsible for causing meningitis in patients who have underwent neurosurgical intervention and this life-threatening condition is associated with a large number of severe complications necessitating the need for prompt and appropriate medical treatment and *A.* baumannii is considered to be a serious public health problem owing to their prevalence and mortality in developing countries.**[**15,16] Among the gram negatives, *A.*baumannii is known to be the most common pathogen causing post neurosurgical procedures.[4]After craniocerebral operations in neurosurgery the patients are at a high risk to suffer from bacterial meningitis caused by *A.* baumannii. *A.* baumannii meningitis is well recognized and has been described by many doctors worldwide.[13] *Acinetobacter* spp. is able to survive in a hospital milieu and can persist for a large period of time on surfaces.[17]A great challenge for physicians and clinical microbiologists is the management of multidrug-resistant *Acinetobacter* spp. infections. Carbapenems such as meropenem or imipenem are considered first-line, however carbapenem-resistant species have emerged recently. [18]

In this study, there was no major difference between the number of patients from each gender with 42.9% patients being female and 57.1% being male. Similar findings were discovered in a study conducted by Metan et al.[19] Length of stay was 17-28days. Comparable results were uncovered in research conducted by Metan and colleagues.[19]

Majority of the isolates were resistant to imipenem (89.2%), meropenem (67.8%), gentamicin (92.8%), amikacin (83.9%), ampicillin (14.2%), Ampicillin plus sulbactam (3.57%), ceftriaxone (82.1%), Piperacillin-Tazobactam (67.8%) and none of the isolates were found to be resistant to tigecycline or colistin. Similar pattern of resistance was seen in a study conducted by Kar et al . (4) Contrary to this, a study conducted by Tuon FF et al revealed a low resistance. [20]. The mortality rate in the present study was 57.14%. A by Tuon FF et al., [20] reported a mortality rate of 72.7% and by Sharma R et al., [6] who reported about 40% mortality. Contrary to these results, a mortality rate of 28.57%, 30% and 20%, respectively was seen in a study conducted by Sipahi OR et al.[21] The high mortality rate in our setting could be attributed to lack of strict infection control measures at our institution.

Considering the high prevalence and mortality rates of Acineto-bactermeningitis, steps need to be taken to reduce the post-surgery or shunt infection which include following strict infection control measures.

CONCLUSION: In critically ill people who have underwent neurosurgical intervention, a formidable challenge to proper management is infection with Acinetobacter *baumanii*. Information on the pattern and antibiotic susceptibility of Acinetobacter meningitis is important in modulating antimicrobial policy that would in turn help in reducing the mortality and morbidity related to infections. Hence, continued efforts are needed to develop better antimicrobial policies against this pathogen that will in turn help in implementation of appropriate infection control practices.

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