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Emergence of Multidrug Resistance Acinetobacter baumannii at tertiary care hospital in South Gujarat: A Real Challenge in New Era

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Abstract

Background: Acinetobacter baumannii has become a major threat to public health worldwide. Emergence and spread of resistance to most of the available antimicrobial agents, due to its ability to easily acquire resistant genes, is an area of great concern. Infections by Acinetobacter baumanniii poses serious risk of healthcare-associated infections [HAIs] and the incidence is increasing, with many strains now being multidrug resistant [MDR].

Methods: A Prospective Cross-sectional study was conducted on samples received atMicrobiology Department, Tertiary Care Hospital, Surat between June 2021 to November 2021.Isolation and Identification of A.baumannii were performed by culture and biochemicaltesting followed by Drug susceptibility testing as per Clinical and Laboratory Standards Institute (CLSI) guideline.

Results: Multidrug Resistance to A. baumannii was 62% out of total A.baumannii isolates.Highest resistance is seen in Ceftazidime (30µl) 92% followed by Cefepime (30µl) 89%,Cefotaxime (30µl), Trimethoprim-sulfamethoxazole (1.25/25.75µl) & Ticarcilline / clavulanicacid (75/10µl) 88%, Ceftriaxone (30µl), Piperacillin (100µl)& Ciprofloxacin (5µl) 87%,Imipenem(10µl) &Meropenem(10µl)86%.

Conclusion: A very high rate of multidrug resistant A.baumannii has emerged in the clinical setting including invasiveinstrumentation and surgical procedures. Therefore, it is now a new threat in hospital, which requires tremendous effort to stop its spread and need of adherence to antibiogram and infection control practices.

Keywords: Acinetobacter Baumanni, Multidrug Resistance, Infection Control.

Introduction

Acinetobacter has emerged as one of the most virulent, multidrug-resistant no socomialpathogen worldwide in the past two or three decades.[1] Multidrugresistance (MDR)Acinetobacter baumannii has now emerged as a leading cause of hospital andcommunity acquired infections[2] among hospitalized older adults in long-term caresettings, especially in those with invasive devices and/or underlyingcomorbidities.[3-7]

World Health Organization has recently published a list of antibiotic resistant "priority pathogens" to guide research and development of newantibiotics, among which A. baumannii was being selected as priority-1 (critical),with its serious threats to public health.[8,9]

The exact definitions of multidrug-resistant Acinetobacter baumannii differwhen referring to an extensive range of genotypes and phenotypes. However, till date, unlike Mycobacterium tuberculosis, there is no accepted definitionfor the degree of resistance in the bacteria, internationally. Arbitrarily used terms have thus causedgreat confusion making it difficult for the available literature to be analyzed. In thecurrent article 'MDR Acinetobacter baumannii' shall be defined as the isolateresistant to at least three classes of antimicrobial agents — all penicillin's and cephalosporin's (including inhibitor combinations), fluroquinolones, and aminoglycosides. 'Extensively drug-resistance (XDR) A.baumannii' shall be the isolate that is resistant to the threeclasses of antimicrobials described for MDR A.baumannii with resistant tocarbapenems. 'Pan drug-resistance (PDR) A.baumannii' is defined as XDR A.baumannii that is resistant topolymyxinsand tigecycline.[10]

Acinetobacter baumannii colonizes on the warm and moist skin of axilla, groin, between toes, throat, nares, respiratory tract, urinary and gastrointestinal tract of healthy individual transiently at a low density but it generally does not cause infection. Itcan cause infections in burn, trauma, mechanically ventilated and immunecompromised patients. [5,11]

Risk factors that may contribute to colonization or infection with Acinetobacter baumannii includes, [3,5,12-14]

- **Chronic obstructive pulmonary disorder**
- Cardiac and Renal failure
- Diabetes mellitus
- Dementia
- Presence of wounds, burn, trauma.
- Mechanically ventilated.
- Immune compromised
- Use of antibiotics and/or invasive devices such as urinary catheters.

Acinetobacter baumannii is one of the most challenging pathogens among thembecause of its particular antibiotic resistance characteristics. A recent high profile reportestimates that, by2050, 10million peoplewilldiefrom Antimicrobial resistance (AMR) every year if the current situation continues to be uncontrolled.[8,15]

Acinetobacter baumannii has developed both intrinsic and acquired resistance againstmanycommon antibiotics, suchaspenicillin's, cephalosporins and aminoglycosides. Therefore, carbapenems have become important treatment options for A. baumannii infection. [16]

The aim of this study is to determine Multidrug Acinetobacter baumanni infection inhospitalized patients. Lack of information of Sensitivity pattern and

Multidrug resistances train may cause MDR Acinetobacter baumannii infection outbreak. Acinetobacter baumannii has ability to survive on inanimate surface and hospital environment for prolonged period of time.

Materials and Method

This Observational Prospective Cross-sectional study was carried out from June 2021 to November 2021 for six- month period in the Microbiology Department, Tertiary care Hospital, Surat after obtaining the Institute Ethical Committee clearance. Total 162 Acinetobacter Baumannii were isolated from which 100 were Multidrug resistance Acinetobacter baumannii

Inclusion Criteria

Include all age group patients with suspected sepsis with or without open wound injuryfollowingaccidents.

ExclusionCriteria

Excludethe isolates other than A.baumannii and confounding factorassociated with it.

A.baumannii isolates collection

All samples like wound swab, endotracheal aspirates and tip, pus, urine, blood, and sputum etc. were collected under aseptic condition and sent to the Microbiology Department. Important demographic clinical & laboratory data were recorded and samples are further processed with the help of culture, biochemical test & antimicrobial susceptible test.

A. baumannii Identification

All samples were inoculated onto Nutrient agar, Mac-Conkey agar, Blood agar, Chocolate agar and direct Gram's staining was performed for all thesamples.Under microscope it appears as Gram-negative coccobacillus in pairs ranging from 1 to 1.5 µm. [11]

Acinetobacter baumannii is the only bacterium in the genus that can grow at 44°C.[6] Itgrows well on routinely used laboratory media such as Nutrient Aga, Mac-Conkey agar,Blood agar and Chocolate agar.[11] Colonies on Nutrient agar are 0.5-2mm in diameter,generally non – pigmented and opaque to translucent, whitish cream in colored.[18] On bloodagar, it forms colorless, non- haemolytic, shiny mucoid colonies, smooth in contexture witha diameter of 1–2 mm after 18–24 hours of incubationat 37°C. It produces colorlesscolonies on MacConkey agar which are shiny mucoid and tomb shaped, indicating its non-lactose fermenting ability [11,6] after 18–24 hours of incubation at 37°C. Biochemical reaction test is performed from growth of A. baumannii on culture media (Table 1).

Sn.	Biochemical tests	Results
1	Indole test	Negative(-ve)
2	Oxidase	Negative(-ve)
3	Catalase	Positive(+ve)
4	Growth at 420 C	Present
5	Glucose fermentation test	Glucose ferment
6	Simmon's citrate Test	Positive(+ve)
7	Christensen's Urease Test	Negative(-ve)
8	Triple Sugar Iron Agar	Alkaline slant/ No change

Table 1: A. baumannii Biochemical Reaction

Antibiotic Susceptibility Testing

The antimicrobial susceptibility testing was done by using the Kirby-Bauer disc diffusion method using commercially available discs. The result was interpreted following the Clinical and Laboratory Standards Institute (CLSI) guidelines.[19]

The antibiotic was selected as per CLSI guidelines. Antibiotics Like, Ampicillin - Sulbactum (10/10µg), Piperacillin–Tazobactum (100/10µg), Ticarcillin-

clavulanate (75µg), Gentamicin (10µg), Ciprofloxacin (5µg), Doxycycline (30µg),Imipenem (10µg), Cefepime (30µg), Ceftriaxone (30µg), Meropenem (10µg),Levofloxacine (5µg), Cefotaxime (30µg), Amikacin (30µg), Minocycline (30µg),Tobramycin (10µg), Piperacillin (100 µg), Tetracycline (30µg), Trimethoprim-sulfamethoxazole(1.25/23.75µg).

Results

Out of Total 162 A.baumannii isolates 100 were MDR A.baumannii which is 62% of all the isolates. InvasiveProcedure (83%)is the most likelyrisk factorassociated with the MDRA.baumannii. Majority of MDR A.baumannii were isolated from Pus/Wound Swab (69%) followed byEndotracheal Tip & Aspiration (15%), Blood (4%), Urine (4%), CSF & Plural Fluid (2%)other isolates like Sputum, Darin, Tissue, Peritoneal Fluid were 1%. Most of the MDR A.baumannii were isolated from Surgery ward (47%) followed by Intensive care units (ICU_s) (26%). This may be due to the use of invasive procedure such as, endotracheal intubation, Mechanical ventilation and Catheterization (both IV and Urinary catheter) in chronicallydebilitatedpatients.

Multidrug resistant A. baumannii is distributed in almost all wards and ICUs. Highest MDR A. baumannii is isolated from surgical ward followed by ICUs (Table B) Acinetobacter baumannii sensitivity pattern is given in (Figure 1), which show highest resistance of92% in Ceftazidime (30µl).

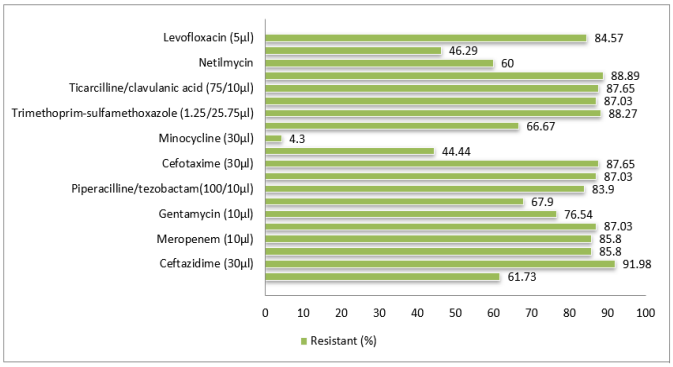

Figure 1: Antibiotic Sensitivity pattern of A.baumannii

Discussion

Acinetobacter baumannii is an emerging nosocomial pathogen and has been progressively associated with a wide variety of illnesses and drug resistant strain in hospitalized patient's especially in surgical ward, Intensive Care Units.

Total 162 A.baumannii was isolated from which 100 was MDR Acinetobacterbaumannii. In present study shows 62% of MDR A.baumannii compare to A studyconducted by Zeleke Ayenew et al. "showed prevalence of MDR among the isolateswas 71.6%".[20] In present study most of the A.baumannii isolates from the surgicalward (47%) and followed by ICUs (26%).More prevalence in surgical wardmay bedue to use of invasive procedure/ devices such as surgical procedure, intravenouscatheter, endotracheal intubation, urinary catheter, tracheotomy and central venous lines etc, use of broad spectrum antibiotic. Lack of awareness and not following the standard precaution for infection prevention and control policy by health care worker facilitatesurvivalandcolonisationoforganisminhospitalenvironment.Incontrast to other studies which show high prevalence of MDR A.baumannii in ICUS. Anandhalakshmi Subramaniyan et al. "study show 72.5% prevalence."[21] Sudhaharan Sukanya et al., Tuhina Banerjee et al. Study showing high prevalence of MDR A.baumannii about 77%" [22,23] In present

study most of the MDR A.baumannii isolatedfrom Pus/wound swab 69% compared to Anandha lakshmi Subramaniyan et al. “study showing isolates from wound swab were 58.3%.”[21]

In our study Minocycline has highest sensitivity of 94%followed by Doxycycline (54%). Lowest sensitivity is for Cefotaxime (3.7%). The sensitivity pattern of other antibiotics is as follows: Tetracycline (52%), Meropenem (14%), Levofloxacin (14%), Netilimicin (40%), Tobramycin (31%), Ampicillin - Sulbactum (23%), Piperacillin - Tazobactum (14%), Ciprofloxacin (12%), Ticarcilline / clavulanic acid (11%), Amikacin (29%), Imipenem (13%), Gentamicin (8%), Ceftazidime (6%) and Cefepime (10%), Ceftriaxone (5%),Cefotaxime (4%), Piperacillin(10%). In present study multidrug resistant (MDR) A. baumannii are 62%. A study by Zeleke Ayenew et al. “shows about 71.6% of A. baumannii isolates were multidrug resistant.”[20]A study by Dipak M. Panjwani et al. “shown sensitivity to isolates as follow Imipenem (63%), Amikacin (6.2%),Gentamycin (22%), Ciprofloxacin (9.3%), Cefuroxime (3%), Cefepime (9%), Co-trimaxazole (9%).”[24] A study by Assiya El Kettani et al. “shown highest resistant in Cefotaxim(99%), Piperacillin / Tazobactam (96%),Ciprofloxacin(88%), Ceftazidim (85%), Gentamycin (78%),Trimethoprim / Sulfametoxazol (77%), Imipenem (76%), Ampicillin / sulbactam (72%), Amikacin (66%),Tetracyclin(64%), Tobramycin (44%), Netilmycin (14%).”[17]

Conclusion

In present study Multidrug resistant A.baumannii is often isolated from surgical wards. This may be due to the cause that Infection Control Policies are not followed properly during oraftersurgicalprocedure, and also device care bundle approach is not followed properly on patients with invasive instruments. Multidrugresistant A.baumanniihasability tosurvivefor prolonged period on surface, bed, linen, hospital instrument and colonize onpatient surrounding, on invasive instrument. This infection is spread by health care workerand patient himself. Ultimately it increases the hospital stay and severity of disease. MDR A.baumannii also resistant to three important class ofdrug which cause spread of MDR A.baumannii if not treated and effective drug are verylimited. So, if not constrain the spread of infection it’ll be difficult to treat in future with noavailabledrug.Forthat we should makeproperInfectioncontrolpoliciesandfollowedit.Multi drug Resistance spread mainly by Health care worker, due to colonization of MDR strain ontheir hand. So, knowledge of MDR strain is necessary, to make infection control policiesandAntimicrobialstewardship programme tocontrolspread ofinfection.

Abbreviations

- MDR - Multidrug-resistant
- A. baumannii - Acinetobacter baumannii
- XDR - Extensively drug-resistance
- PDR - Pan drug-resistance
- AMR – Antimicrobial resistance
- CLSI - Clinical and Laboratory Standards Institute
- ICU_s - Intensive care units

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Ethical approval with letter number: This study was approved by the Ethics Committee of GMC, Surat.

Letter number: GMCS/STU/ETHICS/Approval/122/15

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References

1. Shah K, Paliwal M, Singh S, Pandya Y, Patel R, Modi C and Patel C. Prevalence and Antimicrobial Drug Resistance of Acinetobacter baumannii Infection in a Tertiary Care Teaching Hospital of Rural Gujarat, India. Int. J. Curr. Microbiol. App. Sci. 2017;6(11): 1769-74. doi: https://doi.org/10.20546/ 2017.611.213
2. Mahanthesh S, Manasa S. Prevalence and resistance pattern of Acinetobacter species inPICU and NICU in a tertiary care Paediatric hospital in Bangalore. Trop J Path Micro2017; 3(2):114-9.doi:10.17511/jopm.2017.i2.06.
3. Ibrahim ME. Prevalence of Acinetobacter baumannii in Saudi Arabia: risk factors,antimicrobial resistance patterns and mechanisms of carbapenem resistance. Ann ClinMicrobiolAntimicrob.2019;18(1):1.Published2019.doi:10.1186/s12941-018-0301-x
4. Said D, Willrich N, Ayobami O, Noll I, Eckmanns T, Markwart R. The epidemiology ofcarbapenem resistance in Acinetobacter baumannii complex in Germany (2014-2018): ananalysis of data from the national Antimicrobial Resistance Surveillance system. AntimicrobResist Infect Control. 2021; 10(1):45. Published 2021. doi:10.1186/s13756-021-00909-8
5. Maragakis LL, Perl TM. Acinetobacter baumannii: epidemiology, antimicrobial resistance, and treatment options. Clin Infect Dis. 2008; 46(8):1254-63. doi:10.1086/529198
6. Asif M, Alvi IA, Rehman SU. Insight into Acinetobacter baumannii: pathogenesis, global resistance, mechanisms of resistance, treatment options, and alternative modalities. Infect Drug Resist. 2018; 11:1249-60. Published 2018. doi:10.2147/IDR.S166750
7. Mody L, Gibson KE, Horcher A. Prevalence of and risk factors for multidrug-resistant Acinetobacter baumannii colonization among high-risk nursing home residents. Infect Control Hosp Epidemiol. 2015; 36(10):1155-62. doi:10.1017/ice.2015.143
8. Xie R, Zhang XD, Zhao Q, Peng B, Zheng J. Analysis of global prevalence of antibiotic resistance in Acinetobacter baumannii infections disclosed a faster increase in OECD countries. Emerg Microbes Infect. 2018; 7(1):31. Published 2018. doi:10.1038/s41426-018-0038-9.
9. Ayobami O, Willrich N, Harder T, Okeke IN, Eckmanns T, Markwart R. The incidence and prevalence of hospital-acquired (carbapenem-resistant) Acinetobacter baumannii in Europe, Eastern Mediterranean and Africa: a systematic review and meta-analysis. Emerg Microbes Infect. 2019;8(1):1747-59. doi:10.1080/22221751.2019.1698273.
10. Manchanda V, Sanchaita S, Singh N. Multidrug resistant acinetobacter. J Glob Infect Dis. 2010;2(3):291-304. doi: 10.4103/0974-777X.68538. PMID: 20927292; PMCID: PMC2946687.
11. Asif M, Alvi IA, Rehman SU. Insight into Acinetobacter baumannii: pathogenesis, global resistance, mechanisms of resistance, treatment options, and alternative modalities. Infect Drug Resist. 2018; 11:1249-60. Published 2018. doi:10.2147/IDR.S166750
12. http://repository-tnmgrmu.ac.in/id/eprint/4737

13. Jiang M, Chen X, Liu S. Epidemiological Analysis of Multidrug-Resistant Acinetobacter baumannii isolates in a Tertiary Hospital Over a 12-Year Period in China. Front Public Health. 2021; 9:707435. Published 2021. doi:10.3389/fpubh.2021.707435.
14. Basatian-Tashkan B, Niakan M, Khaledi M. Antibiotic resistance assessment of Acinetobacter baumannii isolates from Tehran hospitals due to the presence of efflux pumps encoding genes (adeA and adeS genes) by molecular method. BMC Res Notes. 2020;13(1):543. Published 2020. doi:10.1186/s13104-020-05387-6
15. Vázquez-López R, Solano-Gálvez SG, Juárez Vignon-Whaley JJ. Acinetobacter baumannii Resistance: A Real Challenge for Clinicians. Antibiotics (Basel). 2020;9(4):205. Published 2020. doi:10.3390/antibiotics9040205.
16. Kyriakidis I, Vasileiou E, Pana ZD, Tragiannidis A. Acinetobacter baumannii Antibiotic Resistance Mechanisms. Pathogens. 2021;10(3):373. Published 2021. doi:10.3390/pathogens10030373.
17. El Kettani A, Maaloum F, Diawara I. Prevalence of Acinetobacter baumannii bacteremia in intensive care units of IbnRochd University Hospital, Casablanca. Iran J Microbiol. 2017;9(6):318-23.
18. Tille, Patricia M. Bailey & Scott's Diagnostic Microbiology. St. Louis, Missouri: Elsevier, 2014.
19. Performance Standards for Antimicrobial Susceptibility Testing. 32nd ed. CLSI Approved Standards M100. Clinical and Laboratory Standards Institute 2022.
20. Ayenew Z, Tigabu E, Syoum E, Ebrahim S, Assefa D, Tsige E. Multidrug resistance pattern of Acinetobacter species isolated from clinical specimens referred to the Ethiopian Public Health Institute: 2014 to 2018 trend anaylsis. PLoS One. 2021;16(4):e0250896. Published 2021. doi: 10.1371/journal.pone.0250896.
21. Subramaniyan A, Nair S, Noyal MJ, Kanungo R. Profile of Multidrug Resistant Acinetobacter Baumannii Infections among Hospitalized Patients. JMSCR. 2017; 5(06):23111-5.doi:https://dx.doi.org/10.18535/jmscr/v5i6.51.
22. Begum S, Hasan F, Hussain S, Alishah A. Prevalence of multi drug resistant Acinetobacter baumannii in the clinical samples from Tertiary Care Hospital in Islamabad, Pakistan. Pak J Med Sci. 2013;29(5):1253-8. doi: 10.12669/pjms.295.3695. PMID: 24353731; PMCID: PMC3858913.
23. Banerjee T, Mishra A, Das A, Sharma S, Barman H, Yadav G. High Prevalence and Endemicity of Multidrug Resistant Acinetobacter spp. in Intensive Care Unit of a Tertiary Care Hospital, Varanasi, India. J Pathog. 2018;2018:9129083. Published 2018. doi:10.1155/2018/9129083
24. Panjwani DM, Lakhani SJ, Lakhani JD, Khara R, Vasava S. Bacteriological profile and antimicrobial resistance pattern of Acinetobacter species isolated from patients of tertiary care hospital of Gujarat. IAIM, 2016; 3(7): 203-10.