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RESEARCH ARTICLE

RISK PROFILE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF *ACINETOBACTER BAUMANNII*CLINICAL ISOLATES IN A TEACHING HOSPITAL IN HYDERABAD

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Abstract

Introduction:*Acinetobacter baumannii* is a frequent cause of healthcare associated infections, has the ability to develop resistance to antibiotics quickly and survive in the hospital environment over a long period, posing a challenge in treatment and infection control. Risk profile and antimicrobial susceptibility of *Acinetobacter baumannii* varies from place to place.

Materials and methods: This study was conducted at a teaching hospital from January to December 2021. Relevant patient history regarding risk factors was taken. *Acinetobacter baumannii* identification and antimicrobial susceptibility testing from clinical samples was performed using the VITEK 2 system.

Results: Out of a total of 3000 clinical samples processed, *Acinetobacter baumannii* was isolated in 114 (3.8%) of them. 61% were from males and 39% from females.62.3% isolates were from medicine department and 23.5% from general surgery.66.6% of the samples were from ICUs. Isolation was highest from respiratory samples followed by blood. Resistance was highest to cephalosporins followed by quinolones. The associated risk factors were age >50 years, co-morbidities, mechanical ventilation, prior antibiotic usage, invasive medical and surgical procedures and ICU stay.

Conclusion: 74.5% of the isolates were resistant to carbapenems, which combined with risk factors noted in the study, narrows the choice of antibiotics. Varied antimicrobial susceptibility pattens across regions due to multiple reasons suggests the need for knowing local resistance rates to antibiotics. Timely and stringent infection control practices and appropriate use of antibiotics can play a vital role in reducing the burden of resistant strains while conserving and limiting antibiotic use.

Introduction:-

Acinetobacter baumannii is a gram negative, aerobic, non-fermenting coccobacillus. It is not fastidious in growth requirements. It can cause infections such as pneumonia,bacteremia, meningitis, urinary tract infection, and wound infection. It can survive over a long period of time on surfaces under varied environmental conditions leading to it being a frequent cause of outbreaks of infection and healthcare-associated infections.(1)

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Prolongedhospitalisation, Intensive care unit (ICU) stay, mechanical ventilation, colonization pressure, exposure to antimicrobial agents, recent surgery, invasive proceduresand severity of illness are some of the risk factors promoting colonization or infection with multidrug-resistant Acinetobacter species[2, 3, 4].

It is one of the six ESKAPE pathogens:*Enterococcus faecium, Staphylococcusaureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and*Enterobacter species.Resistance genes acquisition by ESKAPE pathogens has reducedtreatment options for serious infections, increased disease burden and mortality due to treatment failure (5)

Porin mutations, efflux pumps, acquired class A,B, C and D beta lactamases are the resistance mechanisms seen. Plasmid mediated carbapenem resistance due to metallo-beta-lactamases promotes rapid spread of carbapenem resistant strains in hospitals and requires stringent infection control practices.(6) The above pose a challenge in both treatment and infection control.

Owing to variations in the susceptibility of isolates among different hospitals of the country, different cities or even among countries, knowledge of the local resistance rates are of importance and can guide timely treatment. Hence this study was carried out to further information on the risk factors and the antimicrobial susceptibility rates in our hospital patients.

Materials and Methods:-

The study was conducted in the Department of Microbiology, Apollo Institute of Medical Sciences and Research, Hyderabad, Telanganafrom January 2021 to December 2021. Various clinical specimens (Blood, catheter tips, ET secretions, sputum, BAL fluid, pus, wound swabs, tissue and urine samples) were processed from both in-patients and out-patients. Isolation of *Acinetobacter baumannii* was done by inoculating on 5 % sheep blood agar and MacConkey agar and incubation for 18-24 hours at 37C.

Blood culture was done in the BacT/Alert 3D.Broth from flagged bottles was subcultured onto 5% sheep blood agar and MacConkey agar plates. In case of urine samples, the sample was inoculated onto CLED agar. Standard microbiological techniques were used. Acinetobacter was identified as non-motile, Gram-negative coccobacilli, non-lactose fermenting and oxidase negative.Identification was done using Gram staining, colony morphology and biochemical tests.Identificationand Antimicrobial susceptibility testing (N281) were done using theVitek 2 Compact system. The risk factors such as age, co-morbidities, mechanical ventilation, invasive medical procedures, surgical procedures and prior antibiotic usage were made note of.

Results:-

Among the 3000 clinical samples processed, *Acinetobacter baumannii* was isolated in 114(3.8%) of them. 70(61%) were from males and 44 (39%) were from females. 32 (28%) of the samples were blood, 30 (26.3%) were endotracheal secretions, 15 (13.4%) were sputum samples, 11(9.6%) wound swabs, 10 (8.7%) pus samples, 7 (6.2%) catheter tip samples and 3 (2.6%) samples of BAL fluid, tissue and urine. 71(62.3%) of the isolates were from the medicine department, 27(23.5%) from general surgery, 8 (7.2%) from orthopaedics, 5(4.4%) from paediatrics and 3(2.6%) were from obstetrics and gynaecology. The majority were from in-patients (89.4%). 76 (66.6%)of the isolates were from the ICUs, 26 (22.8%) were from the wards and 12 (10.7%) were from the out-patient clinic. Resistance rates to the antibiotics are given in Table 1. Maximum resistance was seen against cephalosporins followed by quinolones. 64% of the isolates were from those aged 50 years or above.

Table 1:- Antimicrobial susceptibility.

Antibiotic	Susceptible	Intermediate	Resistant
Gentamicin	35 (30.8%)	3 (2.6%)	76 (66.6%)
Ceftazidime	23 (20.3%)	2 (1.7%)	89 (78%)
Quinolones	26 (22.8%)	2 (1.7%)	86 (75.5%)
Piperacillin-tazobactam	30 (26.4%)	-	84 (73.6%)
Cefoperazone-sulbactam	28 (24.6%)	4 (3.5%)	82 (71.9%)
Imipenem	30 (26.4%)	2 (1.7%)	82 (71.9%)
Meropenem	29 (25.5%)		85 (74.5%)
Trimethoprim/sulfamethoxazole	43 (37.8%)		71 (62.2%)

Colistin	-	114 (100%)	-
Tigecycline	111 (97.5%)	2 (1.7%)	1 (0.8%)
Minocycline	108 (94.8%)	4 (3.5%)	2 (1.7%)

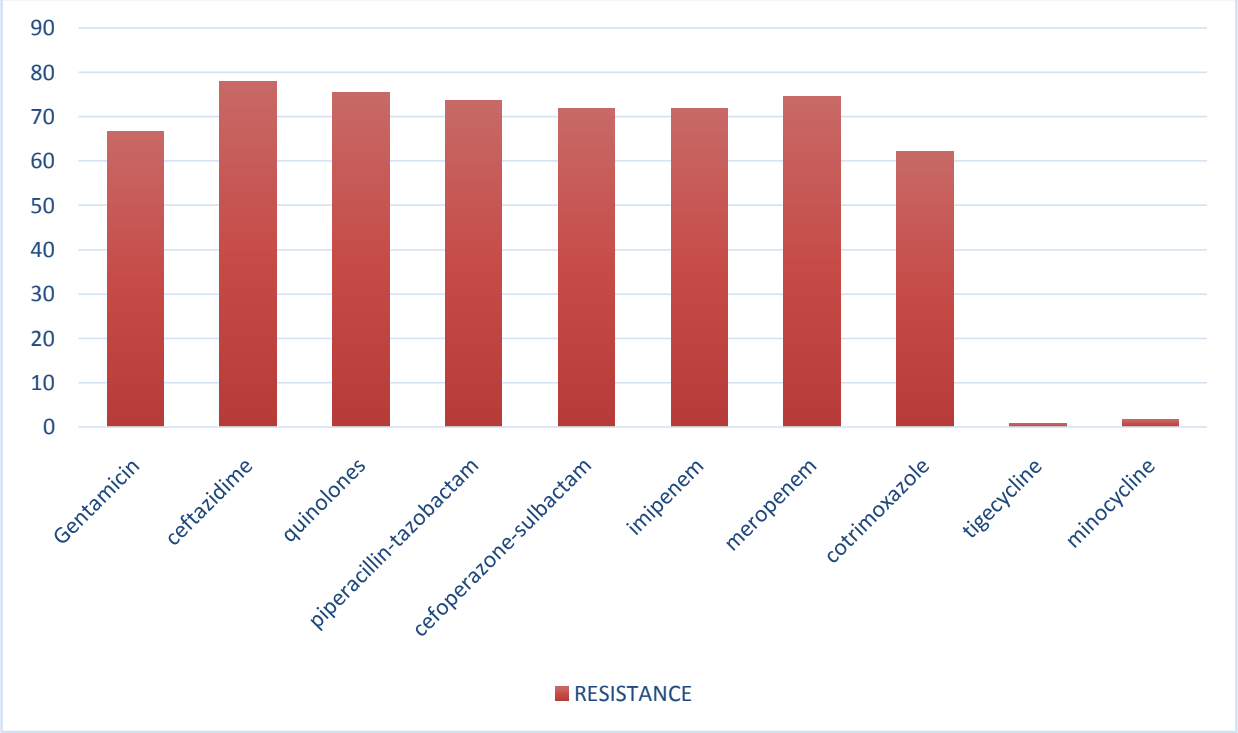

Fig 1:- Resistance pattern.

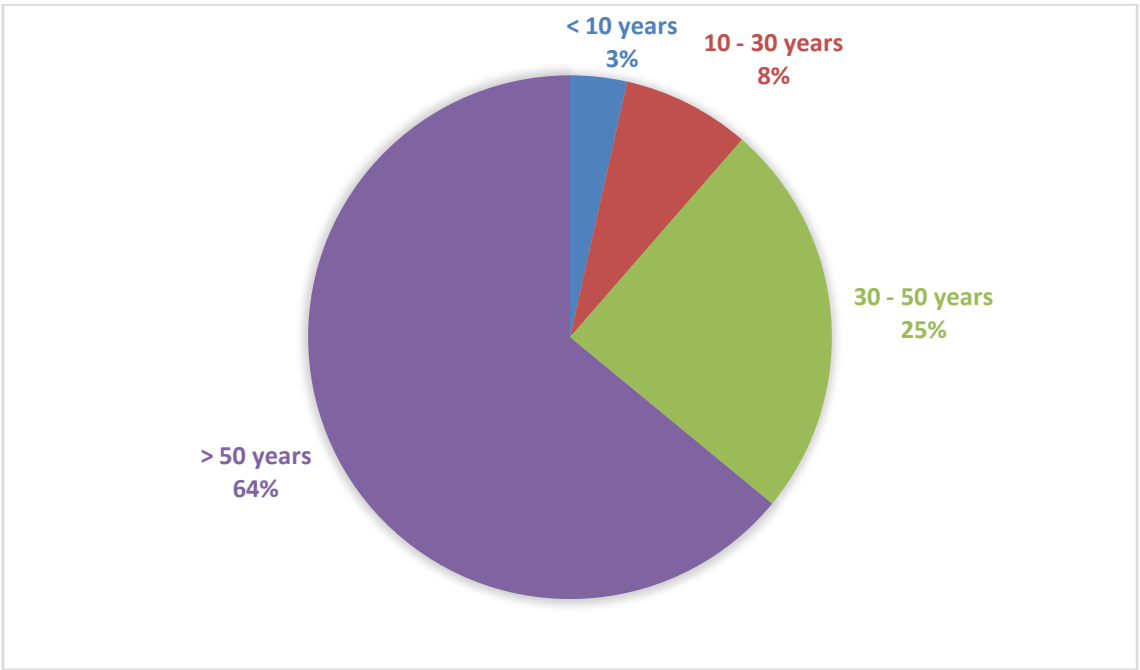

Fig 2:- Age distribution.

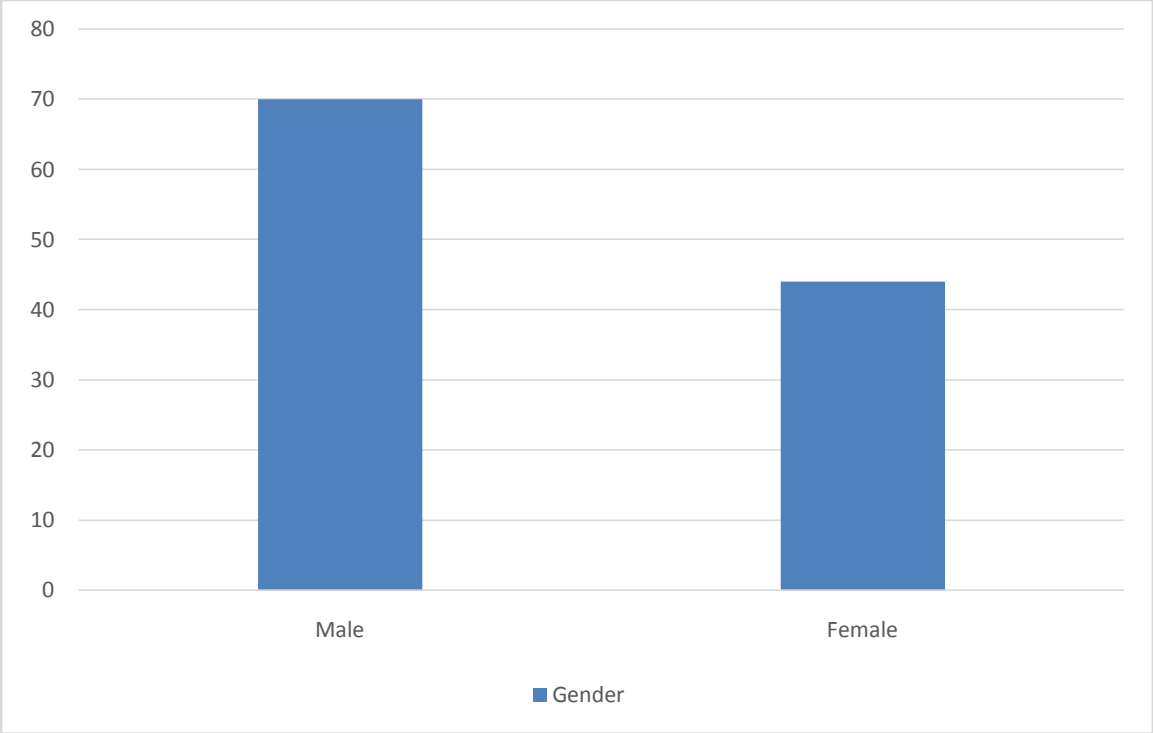

Fig 3:- Gender distribution.

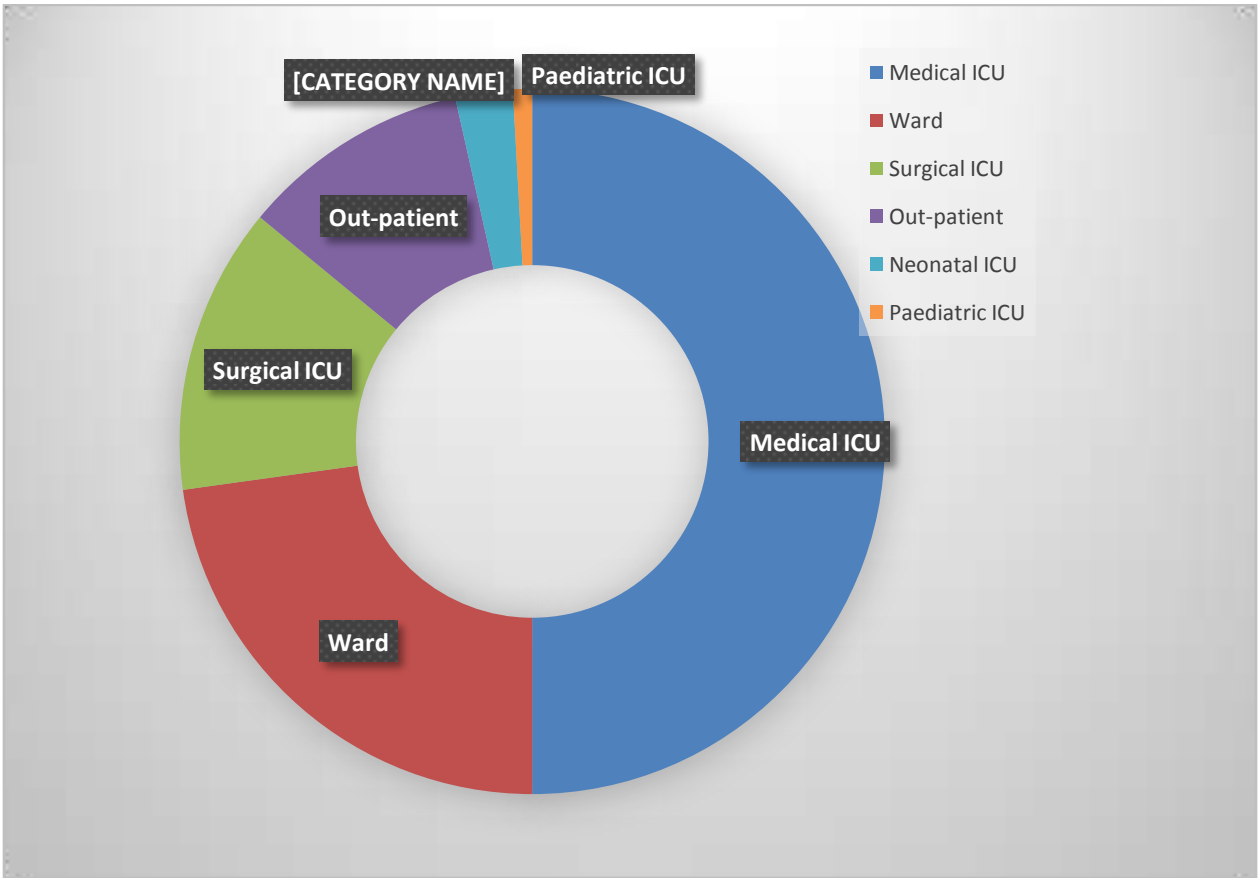

Fig 4:- Location.

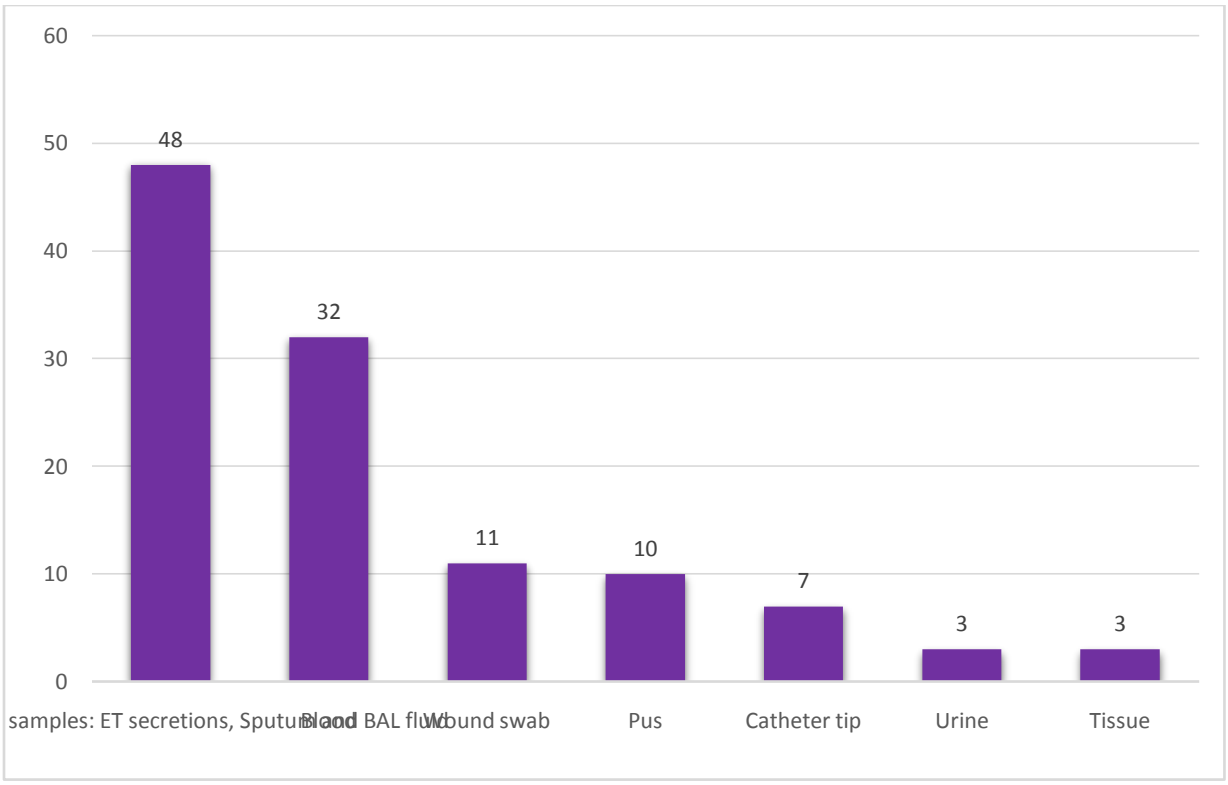

Fig 5:- Sample types.

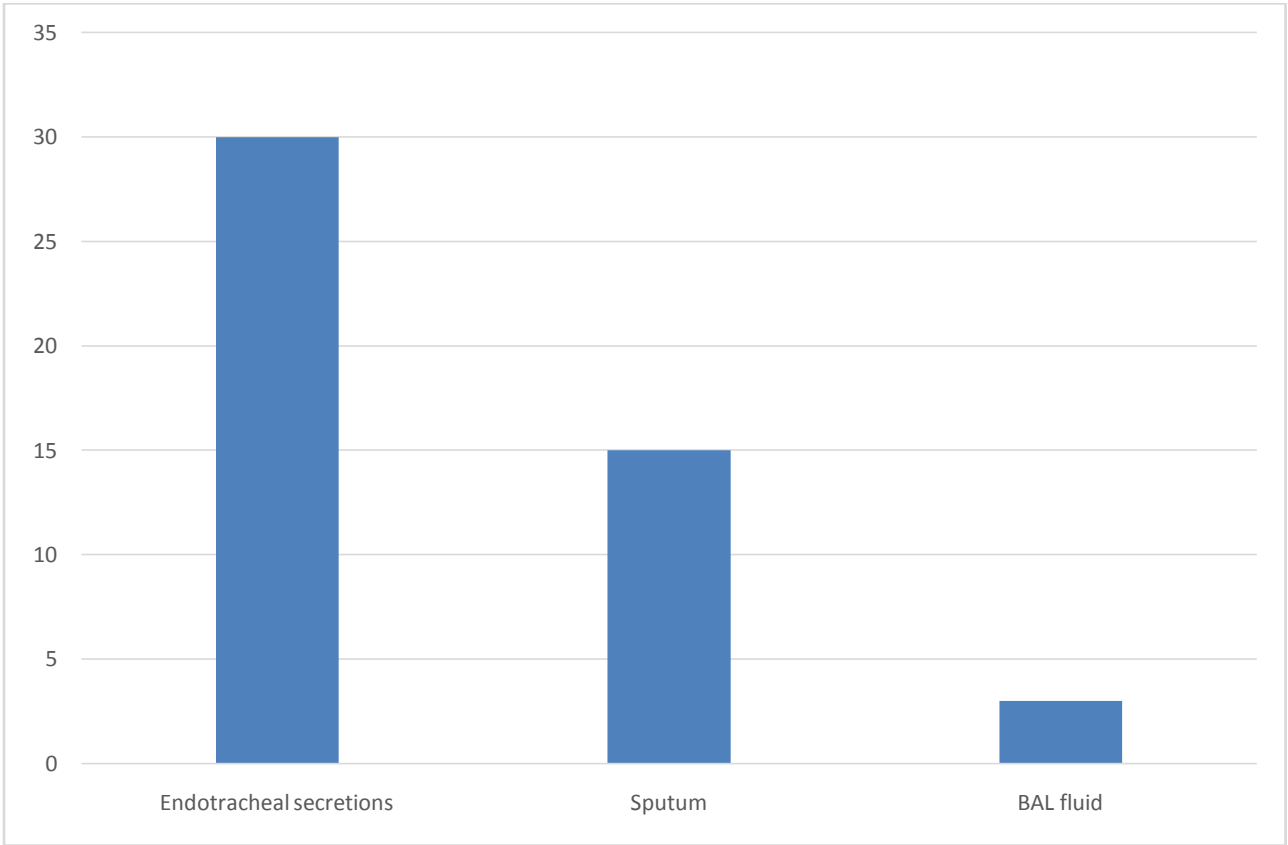

Fig 6:- Respiratory sample types.

Table 2:- Risk factors.

RISK FACTORS	No of patients with *Acinetobacter baumannii* isolated from various samples (n=114)
Mechanical ventilation	30 (26.3%)
Surgical intervention	37 (32.4%)
Prior antibiotic use*	103 (90.3%)
IV/Central Venous catheter	80 (70.17%)
ICU admission	76 (66.6%)
Co-morbidities**	83(72.8%)
Age > 50 years	73 (64%)

*3rd generation cephalosporins and fluoroquinolones (6)

**congestive heart failure, coronary artery disease, Chronic obstructive pulmonary disease, diabetes mellitus, renal disease, cancer and infection with HIV (7)

Discussion:-

Prevalence of *Acinetobacter baumannii* in our study was 3.8% of processed samples. It was found to be 3.2 % and 3.64 %in the studies of Swathi et al and Perween et al respectively. (7,8) Kaur et al reported a lower rate of 0.71%(9). Higher rates were found in the studies of Rajkumari et al(5.26% of total processed samples) and in a study by Kalpesh et al it was 7.7% of the total samples processed.(10, 11).

Majority of the samples were from male patients similar to the studies of Mahamad W et al and Ravan et al(12,13). Kaur et al's study showed higher isolation from female patients(9). Most of the isolates were from those aged 50 years and above similar the studies of Swathi et al and Ravan et al (7,13) in contrast to a study by Dimple et al where maximum isolation was seen in those aged <10 years. (14)

The highest number of isolates belonged to the ICUs (66.6%) similar to the studies of Ashutosh et al (72%) and Yadav et al (49.6%) (15,16). This is due to the fact that ICU patients are exposed to medical and surgical interventions and are generally immunocompromised making them susceptible to infection. (17)

Acinetobacter baumannii was isolated highest from respiratory samples (42%). This has been reported similarly in the studies of Yadav et al, Ingvild Odsbu et al and Panjwani et al (16,18,19). The studies of Rani Sahu et al, VL Nag et al and Apoorva et al revealed most of the isolates to be from pus / wound specimens.(20,21,22).

In our study, resistance was highest to cephalosporins (ceftazidime-78%). The studies of Yadav et al and Tripathi et al showed a resistance of 99.4% and 100% to ceftazidime (6,16). Slightly lower resistance rates to ceftazidime were observed in the studies of Sannathimmappa et al (75%) and Kusalkar et al (75%) (17,23). A resistance rate of 66.6% was seen against gentamicin in our study. Lower rates were noted in the study of Kaur et al (38.2%) and a similar rate was seen in the study of Sannathimmappa et al (67%) (9,17). The study of Mahamad W et al showed a resistance rate of 73.3% (12). The study of Yadav et al showed a high resistance rate of 93.8% to gentamicin (16). 75.5% of the isolates were resistant to quinolones in our study. Lower rates were seen in the study of Mahamad W et al (levofloxacin – 66.4% and ciprofloxacin – 57.9%) compared to our study (12). Higher rates were noted in the studies of John et al (96%-levofloxacin), Swathi et al (91.6%), Kumari et al (96%-ciprofloxacin) (24,7,25).

Resistance to piperacillin tazobactam was seen in 73.6% of the isolates in this study. Lesser degree of resistance was noted in the studies of Kaur et al (65.7%) and Mahamad W et al (52.8%) (9,12). Kusalkar et al's study revealed a rate of 75% and the study of Raina Dimple et al showed a rate of 83% (23,14). The resistance rate to cefoperazone - sulbactam in our study was 71.9%. Ravan et al and Rajkumari et al noted rates of 69% and 26.81 % respectively, in contrast the study of Sana Ali revealed a rate of 81.5%. (13,10,26). Imipenem resistance was found to be 71.9% in the present study. A similar rate was found in a study by Sannathimmappa et al (72%) and a higher rate in a study by Ravan et al(84%) (17,13). Lower resistance rates of 43% and 55% were seen in the studies of Tripathi et al and B Apoorva et al (6,22). The resistance rate to meropenem was found to be 74.5% in this study. A similar rate was seen in the study of Raina Dimple at al (74%) and a higher rate was seen in the study of Yadav et al (89.4%) (14,16). The studies of Kaur et al and Sannathimmappa et al in contrast only showed rates of 55.6% and 70% respectively (9,17). Resistance to cotrimoxazole was 62.2% in this study. 92.4% was seen in the study of John et al and 85.42% was seen in the study of Kusalkar et al (24,23). A lower rate was noted in the study of Sannathimmappa et al (58%) (17).

Tigecycline resistance was found to be only 0.8% in this study with higher values being found in the studies of Rajkumari et al, Kusalkar et al, Ravan et al, and Sana Ali et al (10,23,13,26). Resistance to colistin was not observed in this study.

The resistance observed in the isolates could be due to the fact our hospital receives patients with a history of previous admission and antibiotic administration from other hospitals, contributing to the transmission of resistant strains. Similar to other studies, risk factors noted in the patients with cultures positive for *Acinetobacter baumannii* were mechanical ventilation, presence of co-morbidities, prior antibiotic usage and ICU stay. (6,7,27).Acinetobacter is known to cause medical device associated infections due to its property of adherence to surfaces such as catheters, shunts etc(28).

Colistin is being increasingly used as the drug of choice for carbapenem resistant *Acinetobacter baumanii* (CRAB). Colistin is also highly nephrotoxic and hence not a good choice in patients admitted with renal issues. CLSI does not recommend colistin monotherapy and states that there is limited clinical efficacyeven if an intermediate result is obtained and hence should be clubbed with another antibiotic (s). It recommends use of non-polymyxin agents.(29) Combination therapy with colistin can include drugs such as carbapenems, glycopeptides, tigecycline or minocycline (7).

The drug cefepime-zidebactam,which is a beta-lactam – beta-lactamse enhancer, revealed good activity in in-vivo studies against *Acinetobacter baumannii*(30). Newer agents such as cefiderocol and eravacycline have shown good in vitro activity.Newer combination drugs such as aztreonam-avibactam,ceftazidime-avibactam,imipenem-relebactam and meropenem-vaborbactam do not have clinical activity (31,32).

Conclusion:-

In our study, 74.5% of the isolates were found to be carbapenem resistant, greatly lowering therapeutic options. Combined with the risk factors predominant in our study, which were found to be mechanical ventilation, co-morbidities, ICU stay, surgical and/or medical interventionsand prior antibiotic use, it poses a great challenge in successful patient treatment. The susceptibility pattern was also found to vary widely across hospitals in the country and within hospitals of the same state. This could be due to differences in prescription patterns, in-patient load and infection control practices. Due to the looming pressure of limited treatment options, quick de-escalation of broad-spectrum antibiotics once the susceptibility report is available, better infection control practices, emphasis on basics such as hand hygiene and an active antimicrobial stewardship program are some of the implementable measures to reduce the burden of resistant strains while conserving and limiting antibiotic use.

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