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## Original Research Article

Prevalence of multidrug-resistant *Acinetobacter baumannii* in endotracheal aspirate samples: Experience at a tertiary hospitalDharnish Kumar Jha<sup>1,\*</sup>, Basudha Khanal<sup>2</sup>, Ratna Baral<sup>2</sup><sup>1</sup>Dept. of Microbiology, Koshi Hospital, Biratnagar, Nepal<sup>2</sup>Dept. of Microbiology, B. P. Koirala Institute of Health Sciences, Dharan, Nepal

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## ABSTRACT

**Introduction:** The emergence of resistance to multiple antimicrobial agents in pathogenic bacteria poses a significant public health threat because few or no effective antimicrobials are available for infectious diseases. *Acinetobacter baumannii* is a major cause of device-associated infections that pose a serious threat to critically ill patients. Resistance patterns are thought to result in very limited treatment options and high mortality. We examined the prevalence of *Acinetobacter baumannii* in endotracheal aspirates samples and explored their antibiotics susceptibility.

**Objective:** To determine the value of routine endotracheal aspirate cultures performed prior to the onset of the likely onset of ventilator-associated pneumonia (PVAP) in predicting pathogenic microorganisms and susceptibility to their antibiotics.

**Materials and Methods:** Patients admitted to the ventilatory intensive care unit were tested daily, and endotracheal aspirated (ET) specimens from suspected patients were sent to a microbiology laboratory for culture and sensitivity measurements.

**Results:** Of the 52 patients, only twenty five (48%) developed PVAP. Endotracheal aspirate cultures were positive in all PVAP cases. The most commonly isolated bacteria was *Acinetobacter baumannii* 14 (56%), followed by *Pseudomonas aeruginosa* 6 (24%) and *Klebsiella pneumoniae* 4 (16%). Almost all isolates of *Acinetobacter baumannii* are multidrug resistant (MDR). ICU stays greater than 16 days were observed for the pathogen *Acinetobacter baumannii*.

**Conclusion:** We believe that multidrug-resistant *Acinetobacter baumannii* is a widespread epidemic, leading to high mortality, long ICU stays, and a difficult case for ICU physicians. Further prospective studies are needed to tackle this threat.

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## 1. Introduction

*Acinetobacter baumannii* (*A. baumannii*) is a Gram-negative, non-fermentative bacterium and an important opportunistic pathogen in the hospital setting. *A. baumannii* can cause a wide range of serious nosocomial infections, including ventilator-associated pneumonia, bloodstream infections, skin and soft tissue infections, wound infections, and urinary tract infections.<sup>1</sup> Hard to eradicate. this is A's

fault *A. baumannii* has the ability to form strong biofilms on both biotic and abiotic surfaces.<sup>2-4</sup> *A. baumannii* can survive for 3 days-5 months on dry, inanimate objects and is hydrophobic to help bind to foreign materials such as plastics used in endovascular devices, catheters and ventilators.<sup>5-7</sup> *A. baumannii* are resistant to multiple antimicrobial agents, including carbapenems, and multidrug resistance (MDR) is very common.<sup>8</sup> Recently, they have become mostly drug-resistant (XDR) and pan-drug Resistance (PDR). Virtually drug-resistant *A. baumannii*

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isolates are increasing rapidly.<sup>9</sup> As a result, the World Health Organization (WHO) has declared that *A. baumannii* poses a serious public health threat and new antibiotics are urgently needed and classified as an important priority pathogen. Therefore, this study was conducted to determine the prevalence of *A. baumannii* and its resistance pattern in endotracheal aspirate isolates from ventilator (MV) patients with suspected of developing PVAP in critically ill patients.

## 2. Materials and Methods

This prospective study was conducted from January 2020 to December 2020 at the Department of Microbiology, B P Koirala Institute of Health Sciences (BPKIHS), Dharan, Nepal. Ethical approval for this study was obtained from the Microbiology and Institutional Review Board of BPKIHS in Dharan. Patients admitted to the ICU with MV were evaluated daily using the ventilator-related event surveillance criteria established by the Centers for Disease Control and Prevention/ National Healthcare Safety Network in 2013. A four-quadrant method followed by a semi-quantitative culture method was used.<sup>10</sup> Gram-screened endotracheal aspirates were plated on blood agar, MacConkey agar, cultured aerobically at 35 °C, and growth was recorded as no growth, +1, +2, +3, +4. Bacterial isolates were identified by colony morphology, Gram stain results, and the results of various biochemical assays using standard microbiological techniques.<sup>11</sup> Determining of Antibiotic Susceptibility using Mueller Hinton Agar culture plates according to Institutional Guidelines (CLSI-2019) . Susceptibility to colistin was determined using the colistin broth disc (CBDE) elution method recommended by CLSI.<sup>12</sup>

### 2.1. Data analysis

Of the 52 patients who gotten MV for  $\geq 2$  days, as it were 25 met criteria for PVAP. Result of ET suction and pooled information from all 25 patients sent for microbiology were entered into a database utilizing MS Excel expectations 2007. SPSS adaptation 20 was utilized for measurable investigation. Categorical factors were compared utilizing the chi-square test. For cells with an anticipated number less than 5, Fisher’s correct test was utilized. A t-test was utilized to compare the implies of two autonomous tests. P-values less than 0.05 were measurably critical.

## 3. Results

Endotracheal aspirate cultures resulted in bacterial growth in all cases of PVAP. A total of 25 (48%) patients developed PVAP. A total of 9 (36%) patients had early-onset PVAP and 16 (64%) patients had late-onset PVAP (P<0.001). *Acinetobacter baumannii* is associated with both early and late PVAP, but is mainly associated with late onset. All isolated organisms were Gram-negative

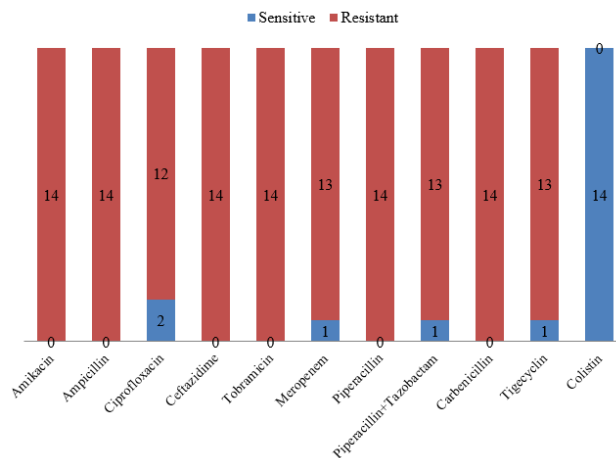
bacilli (GNB) , most commonly *Acinetobacter baumannii* 14(56%) followed by *Pseudomonas aeruginosa* 6(24%) and *Klebsiella pneumonia* 4(16%). *Acinetobacter baumannii* was the major pathogen isolated accounting for 56% of culture positive cases. All of the strains were resistant to amikacin, ampicillin, ceftazidime, tobramycin, piperacillin and carbenicillin whereas all were susceptible to colistin.

**Table 1:** Microorganisms isolated from ETA cultures in patients with PVAP (n=25).

Organism	Number of patients (%)
<i>Acinetobacter baumannii</i>	14(56)
<i>Pseudomonas aeruginosa</i>	6(24)
<i>Klebsiella pneumoniae</i>	4(16)
<i>Escherichia coli</i>	1(4)
Total	25(100)

**Table 2:** Number of organism isolated from early and late onset of PVAP

Onset of PVAP	Isolated organism	Number
Early-onset PVAP	<i>Acinetobacter baumannii</i>	6
	<i>Pseudomonas aeruginosa</i>	2
	<i>Escherichia coli</i>	1
Late-onset PVAP	<i>Acinetobacter baumannii</i>	8
	<i>Pseudomonas aeruginosa</i>	4
	<i>Klebsiella pneumoniae</i>	4



**Fig. 1:** Antibiotic susceptibility patterns of *Acinetobacter baumannii* to multiple antibiotics (n=14)

ICU length of stay ranged from 8 to 18 days, with a mean total length of stay of 11.2 days, although ICU length of stay was greater than 16 days observed for the pathogens *Acinetobacter baumannii* and *Pseudomonas aeruginosa*.

#### 4. Discussion

Multidrug-resistant (MDR) pathogens are defined as resistant to three or more antibiotics.<sup>13</sup> In addition, antibiotic-resistant infections are associated with longer hospital stays and higher medical costs than infections caused by antibiotic-sensitive strains (Cohen 1992). Polymyxin is the remaining antibiotic with relatively stable activity against MDR strains of *Acinetobacter* spp, *P. aeruginosa*, (McGowan 2006). All microorganisms isolated in our study were Gram-negative bacteria (GNB), *Acinetobacter baumannii* 14 (56%), *Pseudomonas aeruginosa* 6 (24%), *Klebsiella pneumoniae* 4 (16%) and *Escherichia coli* 1 (4%) in descending order in regularity. A study by John et al.<sup>14</sup> found that gram-negative bacteria were the most common pathogen associated with his PVAP in which, *Acinetobacter* species predominated (48.21%), followed by *Klebsiella* (19.64%). Pooling data from 24 published studies, Chastre and Fagon<sup>15–18</sup> found that 58% of the isolates were Gram-negative bacteria, with the most common being *Pseudomonas* spp. followed by *Acinetobacter* and *Proteus* species. I found that *Acinetobacter baumannii* was the primary pathogen isolate accounting for 56% of culture-positive cases. All strains were multidrug-resistant. Similar results have been reported by John et al.,<sup>14</sup> The highest number of MDR isolates was *Acinetobacter* species (51.85%). A prospective study performed in a tertiary care hospital reported that *Acinetobacter* was the most common multidrug-resistant pathogen (47.9%), followed by *Pseudomonas* (27%).<sup>19,20</sup> A study in India showed that 98.3% of *A. baumannii* causing ventilator-associated pneumonia was MDR-*A. baumannii*.<sup>21</sup> Similarly, A 100% isolated *A. baumannii* was also the MDR in this study. In this study, the duration of ICU stay was > 16 days compared with *A. baumannii* infection and mostly associated with late-onset of PVAP. Similarly, in one study, the mean length of hospital stay for *A. baumannii* was approximately 24 days.<sup>22</sup> In another study, the mean hospital stay of patients with *A. baumannii* is 20.25 days.<sup>23</sup> 23 In our study, a total of 25 (48%) patients had PVAP. A total of 9 patients (36%) had early-onset PVAP and 16 (64%) had late-onset PVAP ( $P < 0.001$ ). A study conducted in India showed a total of 74 (27.71%) patients with PVAP. Of which, 13 (17.56%) patients had early-onset VAP and 61 (82.43%) had late-onset VAP.<sup>24</sup> In another study from India, 44.23% were classified as early VAP and 55.77% as late VAP, which is close to our finding.<sup>25</sup>

#### 5. Conclusion

In summary, the results of this study are: PVAP caused by MDR *A. baumannii* may be associated with longer hospital stays and intensive care days. Taken together, these results suggest that it is important to learn more about the behavior of MDR *A. baumannii* and try to prevent its spread. *A. baumannii* has become a hospital pathogen. The

treatment options available for MDR *A. baumannii* infection are limited and colistin is often reported as the only effective antibiotic, making the pathogen very difficult to treat. Despite many efforts to study the mechanism of antibiotic resistance and its epidemiology, to date our understanding of its pathology is still relatively limited. Infection control surveillance, preventive measures, rigorous antibiotic prescribing, antibiotic resistance monitoring programs, and antibiotic cycles are essential for infection control in humans. Infection Prevention and Control (IPC) is essential and of great value in preventing infection and controlling this pathogen.

#### 6. Source of Funding

None.

#### 7. Conflicts of Interest

None.

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