Original Article

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Clinical and economic outcomes of *Acinetobacter* vis a vis non-*Acinetobacter* infections in an Indian teaching hospital

Abstract

Context: *Acinetobacter* infections are a major nosocomial infection causing epidemics of infection in the Intensive Care Units (ICU). **Aims:** This study estimates the clinical and economic outcomes of *Acinetobacter* infections and compares them with those of non-*Acinetobacter* bacterial infections. **Settings and Design:** Prospective cross-sectional observational study carried out for 6 months in the medicine ICU of a tertiary care hospital. **Materials and Methods:** Patients were divided in two groups, one group with *Acinetobacter* infections and the other with non-*Acinetobacter* infections. The data was collected for infection, length of stay (LOS), mortality and cost along with patient demographics from the hospital records for analysis. **Statistical Analysis Used:** The data was analyzed using Statistical Package for the Social Sciences Version 15.0. The LOS and cost of treatment (COT) for the two groups were compared using the nonparametric Mann–Whitney U-test. **Results:** A total of 220 patients were studied out of which 91 had *Acinetobacter* infections. The median LOS was 20 days in Group-A and 12 days in Group-B ($P < 0.0001$). The median COT was INR 125,862 in Group-A and INR 68,228 in the Group-B ($P < 0.0001$). Mortality in Group-A and Group-B was 32.97 and 32.56 ($P = 0.949$) respectively. **Conclusion:** The burden of *Acinetobacter* infections in ICUs is increasing with the increase in LOS and COT for the patients. The infection control team has to play a major role in reducing the rate of nosocomial infections.

Key words: *Acinetobacter species,* direct cost, length of stay, mortality

INTRODUCTION

Nosocomial infections (NI) have repeatedly been associated with an increased length of hospital stay and resulting increased cost in hospitalized patients. One of the recurrent causative agents of NI is *Acinetobacter* species.[1,2]

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Acinetobacter infections are common in hospitalized patients. The additional cost of treatment (COT) of infections can be directly related to the increased length of stay (LOS) in critically ill patients.[3] The commonly caused infections by *Acinetobacter* species are pneumonia (community acquired and ventilator-associated), meningitis, catheter-related bloodstream infections, skin and soft tissue infections.[4] *Acinetobacter* infections in Intensive Care Unit (ICU) are posing high risk due to the emergence of progressive resistance to carbapenems.[2,5] Infections with *Acinetobacter* have been associated with mortality rates as high as 43%.[6] The growing antimicrobial resistance among *Acinetobacter* with strains emerging resistant to carbapenem antibiotics adds to the seriousness of the issue.[7] In the event of a carbapenem resistant *Acinetobacter* infection, colistin is the available option despite being expensive and having a higher risk of toxicity.[8,9] The assessment of the burden of *Acinetobacter* and non-*Acinetobacter* infections in terms of LOS, COT and mortality is vital for policy makers and physicians in making decisions related to *Acinetobacter* infections.

This study calculates the burden of *Acinetobacter* infections in terms of LOS, COT and mortality in an ICU of a teaching hospital from South India. There are very few studies on burden of *Acinetobacter* infections from India. The study on burden of this infection is useful in formulating policy for budget allocation and to form appropriate strategy for planning the treatment options in terms of LOS and COT. The economic impact of *Acinetobacter* infections would indicate the need of interventions from policy makers to make necessary changes to control the LOS, COT and mortality.

MATERIALS AND METHODS

This study was carried out prospectively in medical ICU of Kasturba Hospital (KH), Manipal, Karnataka, India. The duration of the study was 6 months. All patients diagnosed with bacterial infections confirmed with culture report were included in the study. Patients <18 years of age and patients with sterile culture reports were excluded from the study. Patients were divided into two groups, Group-A and Group-B. Group-A consisted of patients with *Acinetobacter* infections while Group-B consisted of patients infected with bacterial infections other than *Acinetobacter* species. The study protocol was approved by the Institutional Ethics Committee of KH.

Data was collected prospectively on the clinical parameters along with patient demographics, site of infection, LOS in the hospital, mortality, hospitalization cost for patients in both groups. Patients were monitored on a day to day basis and the data was documented from the patients' files. The status of nosocomial infection was established according to the Center for Disease Control and Prevention definition of NI.[10] Charlson co-morbidity index was calculated for individual patients in both the groups. Bacterial infections were classified on the basis of site of infection, such as respiratory infections, blood and body fluid infections, urinary tract infections, catheter related infections and skin and soft-tissue infections.

The direct costs included the cost of hospitalization, cost of investigations, cost of consultation and cost of medication. The cost data was obtained from the Finance Department of KH and grouped under the above mentioned four categories.

The data was analyzed using Statistical Package for the Social Sciences version 15.0. The LOS and COT for the two groups were compared using the nonparametric Mann–Whitney U-test and significance was calculated for 95% confidence interval. The mortality data was compared using the Chi-square test for the two groups.

RESULTS

A total of 220 patients with confirmed bacterial infections were included in the study out of which 91 (41.36%) had *Acinetobacter* infection during their stay in the ICU. The remaining 129 (58.64%) patients with non-*Acinetobacter* bacterial infections were used as control.

The mean age of the subjects was 54 ± 16.24 years with 66.8% males and 33.2% females. The demographics of the patients are given in Table 1.

Respiratory tract infections were commonly associated with *Acinetobacter* species (81.31% in Group-A whereas 38.75% in Group-B) among all infections. Details of site of infection are given in Table 2.

The median LOS was 20 days in the Group-A as compared to 12 days in the Group-B ($P < 0.0001$).

Median COT for the Group-A was 125,862 INR whereas that for the Group-B was 68,228 INR ($P < 0.0001$).

Insurance coverage was present in only 28.2% of all patients. In Group-A, the percentage of people having insurance was much lesser (15.38%) as compared to the other group where 29.45% patients were having insurance coverage.

Table 1: Patient demographics, LOS and mortality

	Total patients	*Acinetobacter* group	Non-*Acinetobacter* group	*P*
Number of patients	220	91	129	NA
Mean age (years)	54.24±16.28	53.80±17.30	54.55±15.57	NA
Male *n* (%)	147 (66.8)	64 (70.33)	83 (64.35)	NA
Female *n* (%)	73 (33.2)	27 (29.67)	46 (35.65)	NA
Median CCI (IQR)	3 (5-1)	3 (5-0)	4 (5-2)	NA
Median LOS in days (IQR)	15 (20)	20 (21)	12 (17)	<0.0001
Mortality *n* (%)	72 (32.73)	30 (32.97)	42 (32.56)	0.949

IQR=Interquartile range, LOS=Length of stay, CCI= Charlson's Co-morbidity Index

Table 2: Site of infection for *Acinetobacter* with non-*Acinetobacter* infections

Site of infection	*Acinetobacter* group (*n*=91) *n* (%)	Non-*Acinetobacter* group (*n*=129) *n* (%)	χ^2	*P*
Respiratory	74 (81.31)	50 (38.75)	39.2956	<0.0001
Blood	7 (7.69)	49 (37.95)	25.8038	<0.0001
Skin and soft tissues	2 (2.19)	3 (2.32)	0.0039	0.950
Central line related	2 (2.19)	10 (7.75)	3.1918	0.074
Urine	6 (6.5)	20 (15.5)	4.0652	0.043

DISCUSSION

Acinetobacter infections are a major nosocomial infection causing epidemics of infection in the ICUs. *Acinetobacter* commonly causes infections in the hospital settings but there are significant cases from the community as well.[11] In our study, the LOS was significantly higher for the patients in *Acinetobacter* group as compared to the patients with non-*Acinetobacter* infections [Table 1]. The LOS increases the COT of the patient by increasing the hospitalization cost. The LOS data for *Acinetobacter* infections is in line with the data reported in the literature from USA.[12] The high LOS in case of patients with *Acinetobacter* infections may be due to the reason that *Acinetobacter* needs prolonged therapy and is a difficult organism to eradicate.[7] It tends to cause recurrent infections and the complications and morbidities associated with *Acinetobacter* infections are high.[13,14]

The COT and mortality are important concerns for developing countries as they pose an additional burden on the economy. NI worsen the scenario by increasing the COT and mortality.[15] In this study, we observed that the COT was substantially higher in case of patients with *Acinetobacter* infections as compared to the patients with non-*Acinetobacter* infections. The incremental costs of treatment in case of the *Acinetobacter* infections is due to the increased LOS and higher morbidities associated with the *Acinetobacter* infections.[12,14] The high hospitalization cost in *Acinetobacter* patients can directly be related to the high LOS in that group. The significantly higher investigation costs are suggestive of the recurrent infections occurring in case of *Acinetobacter* infections [Table 3]. Medication costs increase with the increase in the resistance of the organism to be eradicated.[16,17] The rise of multi-drug resistant strains in case of *Acinetobacter* infections will also lead to the use of high-end antibiotics such as colistin leading to the increased medication cost. More than 80% of the population in India does not avail any health insurance and pay for the treatment out-of-pocket.[18] The burden caused by the *Acinetobacter* infections have significant socioeconomic impact on families of such patients. The cost categories in COT indicate a towering cost for medicines in *Acinetobacter* infections. The burden of COT due to the *Acinetobacter* infections can be tackled with the help of effective screening programs for *Acinetobacter*.[19]

The major sites of infection in case of *Acinetobacter* infections are respiratory, bloodstream, skin and soft tissue, central line related and urinary tract.[20] The main site of infection was respiratory in *Acinetobacter* infections while patients in non-*Acinetobacter* group had almost equal blood stream infections and respiratory infections [Table 2]. Similar observation was made in the study by Jang *et al.* 2009 in Taiwan.[21] This observation can be supported by the fact that most of the patients in the first group were on ventilators and humidifiers were used which leads to higher respiratory infections in those patients.[22]

The mortality in the two groups showed no significant difference in contrast to the results in literature.[6] This might be attributed to the heterogeneous nature of the patients in the two groups. The situation is alarming for *Acinetobacter* infections which needs immediate attention. Infection control strategies could play an important role in the prevention of such infections as antibiotics have a little role to play due to the growing resistance.[23] Combination therapy with two synergistic antibiotics can be another option to look for in case of resistant infections like these.[24]

A high burden of cost and LOS of *Acinetobacter* infections in the ICU was established in this study. There is a need to control *Acinetobacter* infections and to decrease their resulting expenditure and morbidity for the patients.

Table 3: Cost of treatment for *Acinetobacter* versus non-*Acinetobacter* infections

Costs (INR)	Overall median (IQR)	*Acinetobacter* group median (IQR)	Non-*Acinetobacte* group median (IQR)	*P*
Total direct cost	95,440 (96,050)	125,862 (113,503) (2316.62$)	68,228 (82,780) (1255.80$)	<0.0001
Hospitalization cost	8912.5	13,660	6410	<0.0001
Investigation cost	17,640	23,685	14,690	<0.0001
Consultation cost	11,770	15,580	9135	<0.0001
Medication cost	52,309	67,865	37622.5	<0.0001

IQR=Interquartile range, INR=International normalized ratio

Effective implementations of the infection control policies would bring down episodes of *Acinetobacter* infections.

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Conflicts of interest

There are no conflicts of interest.

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