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# Pneumonia in Diabetics: Clinico-Bacteriological Profile and Outcome

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## Abstract

**Introduction:** The present study was thus planned to study and compare pneumonia in diabetics and non-diabetics with respect to clinical presentation, bacteriological profile, laboratory parameters, complications and prognosis.

**Materials & Methods:** A total of 50 consecutive diabetic subjects with confirmed pneumonia were included in the study after informed consent (Study Group- SG). A similar number of non-diabetic controls were also taken (Control Group – CG). Detailed clinical history, general examination and relevant investigations were carried out for all patients and noted down in a pre-designed pro-forma. Relevant investigations were carried out in all patients including sputum gram staining, Chest X-ray and sputum and blood culture. Patients were treated as per standard hospital protocol and were followed up after 2 weeks to assess symptomatic improvement and for repeating chest radiograph.

**Results:** The average age in SG was 57.93±9.71 yrs and in CG were 56.90±11.83 yrs (p-0.613). Most of the patients in both groups were males (78% in CG and 60% in SG; p-0.39). Multilobe involvement (> 2 zones involvement in chest x- ray) was more common in SG (40% in CG vs. 70% in SG) which is statistically significant ($p<0.05$). On Gram staining, Gram positive cocci were significantly more ($p<0.05$) in CG in comparison with SG (48% vs. 16%) while a combination of GPC/GNB was significantly more in SG than CG (30% vs. 6%). More number of mortalities were seen in diabetics (24%) in comparison with non-diabetics (10%). Patients in diabetic group were significantly more among PSI class IV and V (60% vs 34%) in comparison with non-diabetics, who were predominantly among PSI class I ($P < 0.05$).

**Conclusion**: In patients with pneumonia, Diabetes Mellitus is associated with polymicrobial etiology, multilobe involvement, increased ICU admissions, increased severity in the form of high PSI score and mortality.

**Keywords:** diabetes mellitus, gram positive cocci, multi-lobar involvement, pneumonia, psi score

## Introduction

Diabetes is the leading cause of morbidity and mortality in both developed and developing countries. Pneumonia, urinary tract infection & skin & soft tissue infection are all more common in diabetic population. In general, the organisms that cause pulmonary infection are similar to those found in the non-diabetic population; however, gram negative organisms, S. aureus and mycobacterium tuberculosis are more frequent organisms [1].

For patients with community acquired pneumonia, diabetes mellitus is one of the most common underlying disease [2]. The magnitude & duration of hyperglycemia is strongly associated with the severity of micro vascular and neurologic complication [3]. The presence of these complications adds to risk of infection. The predisposition for infection may also be based on conditions that interfere with normal clearance mechanisms and on disturbance of pulmonary immune cell function [4]. Hyperglycemia impairs a wide range of functions in neutrophils & monocytes (macrophages) [3] this is particularly important in limiting invasion by pyogenic and other bacterial infections. Adherence and phagocytosis depend on recognition of specific molecule on bacterial surface including bacterial glycoproteins as well as attached complement and Ig G produced as a result of the immune response to the infection. The movement of phagocytic cells to the sites of infection is generally impaired in diabetics but improves with glycemic control [5].

Mortality among adults hospitalized with community-acquired pneumonia (CAP) ranges from 6 to 14% [6]. Advanced age and comorbidities such as diabetes are associated with increased mortality in these patients [7-9]. Given the hyperglycemia, decreased immunity, impaired lung function, and chronic complications, such as renal failure, heart disease, and pulmonary microangiopathy, associated with diabetes [10], it is plausible that diabetes may predict increased severity of pneumonia. However, results of recent observational studies and a meta-analysis of pneumonia-related mortality, were inconsistent [11-15]. Most studies lack data on pneumonia severity at hospitalization in diabetic versus non-diabetic patients [11, 13, 15].

As prevalence of diabetes [16] and pneumonia-related hospitalizations increase in the aging populations [11, 17], accurate data is required to understand the clinical course and to potentially prevent pneumonia-related deaths in diabetics. The present study was thus planned to study and compare pneumonia in diabetics and non-diabetics with respect to clinical presentation, bacteriological profile, laboratory parameters, complications and prognosis.

## Materials and Methods

**Type of Study:** Randomized control study.

**Study Area:** Department of Chest Medicine of a Medical college and tertiary health care Institute.

**Study Population:** Patients of Pneumonia coming to OPD/ IPD of our department during the study period.
**Study Duration:** August 2014 to December 2016
**Inclusion Criteria:** All diabetic patients with age more than 14 years with confirmed bacterial pneumonia on clinical and radiological examination.

**Exclusion Criteria**
1. Patients with age less than 14 years
2. Patient not willing to give written informed consent
3. Diabetic patients having pneumonia other than bacterial etiology

**Sample Size**
A total of 50 consecutive diabetic subjects with confirmed pneumonia were included in the study after informed consent (Study Group – SG). A similar number of non-diabetic controls were also taken (Control Group – CG). So, final sample size of the study was 100 patients.

**Methodology**
A written and informed consent was taken from all 100 patients. Detailed clinical history and examination findings were entered in pre-designed pro-forma. Relevant investigations were carried out in all patients including sputum gram staining, Chest X-ray and sputum and blood culture. Patients were treated as per standard hospital protocol and were followed up after 2 weeks to assess symptomatic improvement and for repeating chest radiograph.

**Operational Definitions**
**Community-acquired pneumonia**
It was defined as the presence of an acute illness with features of lower respiratory tract infection (with two or more of the following signs and symptoms: fever; new or increasing cough or sputum production; dyspnea, chest pain and new focal signs on chest examination) and the presence of a consolidation in the chest radiograph that was consistent with acute infection.

**Diabetes Mellitus**
Its diagnosis was based on a previous clinical and/or biochemical diagnosis of diabetes mellitus and/or treatment with oral antidiabetic agents or insulin. Alternatively, diagnosis could be established during this episode of pneumonia when the fasting plasma glucose concentration was >/= 126 mg/dL (7.0 mmol/L), and/or after ingestion it was >/= 200 mg/dL (11.1 mmol/L) on two or more separate occasions [12].

**Statistical Analysis**
All the data was entered in Microsoft Excel sheet and then transferred to SPSS software ver. 21 for statistical analysis. Appropriate tests were applied according to type and distribution of data. A 'p' value <0. 05 was considered as statistically significant.

**Results**
The average age in SG was 57.93±9.71 yrs and in CG were 56.90±11.83 yrs (p-0.613). Most of the patients in both groups were males (78% in CG and 60% in SG; p-0.39). Consolidation was seen in 44% cases in CG as compared to 36% in SG (p-0.59). There was raise in total count in both the groups with no statistically significant difference. The average Hb% in CG was 10.7± 3.2 and in SG 9.6 ±2.44 gm% ($p$<0.05), which shows that anemia is more common in diabetics. Multilobe involvement (>2 zones involvement in chest x- ray) was more common in SG (40% in CG vs. 70% in SG) which is statistically significant ($p$<0.05). On Gram staining, Gram positive cocci (GPC) were significantly more ($p$<0.05) in CG in comparison with SG (48% vs. 16%) while a combination of Gram positive cocci and Gram negative bacilli (GPC/GNB) was significantly more in SG than CG (30% vs. 6%) (Table 1 & 2). There was no difference between two groups with respect to rate of ICU admission (or) complications ($p$>0.05). The common complications in both SG and CG groups were: pleural effusion (6% vs 6%) and septic shock (20% vs 14%). However more no. of mortalities were seen in diabetics (24%) in comparison with non-diabetics (10%) (Table 3 & 4). The duration of hospital stay was significantly more in SG (12.30±4.98 days) as compared to CG (9.10±5.24 days; $p$<0.05). Patients in diabetic group were significantly more among Pneumonia severity Index (PSI) class IV and V (60% vs 34%) in comparison with non-diabetics, who were predominantly among PSI class I (P < 0.05) (Table 5).

**Table 1:** Distribution of patients according to sputum Gram's stain Reports

| Gram's Stain | Group | | Total | p-value |
|---|---|---|---|---|
| | Non Diabetics | Diabetics | | |
| GNB | 9 | 13 | 22 | 0.47 |
| | 18.0% | 26.0% | 22.0% | |
| GPC | 24 | 8 | 32 | <0.05 |
| | 48.0% | 16.0% | 32.0% | |
| GNC | 5 | 0 | 5 | 0.06 |
| | 10.0% | 0.0% | 5.0% | |
| GNC/GNB | 2 | 0 | 2 | 0.49 |
| | 4.0% | 0.0% | 2.0% | |
| GPC/ GNB | 3 | 15 | 18 | <0.05 |
| | 6.0% | 30.0% | 18.0% | |
| GPC/ GPB | 2 | 5 | 7 | 0.44 |
| | 4.0% | 10.0% | 7.0% | |

**Table 2:** Distribution of patients according to sputum culture Reports

| Sputum Culture | Group | | Total | Total |
|---|---|---|---|---|
| | Non Diabetics | Diabetics | | |
| E. Coli | 2 | 3 | 5 | 1.00 |
| | 4.0% | 6.0% | 5.0% | |
| S. Pneumoniae | 20 | 11 | 31 | 0.59 |
| | 40.0% | 22.0% | 31.0% | |
| Klebsiella | 3 | 8 | 11 | 0.42 |
| | 6.0% | 16.0% | 11.0% | |
| S. Aureus | 10 | 3 | 13 | 0.07 |
| | 20.0% | 6.0% | 13.0% | |
| H. Influenza | 1 | 0 | 1 | 1.00 |
| | 2.0% | 0.0% | 1.0% | |
| Acinetobacter | 0 | 5 | 5 | 0.06 |
| | 0.0% | 10.0% | 5.0% | |
| P. Aeruginosa | 3 | 5 | 8 | 0.71 |
| | 6.0% | 10.0% | 8.0% | |
| P. mirabilis | 2 | 0 | 2 | 0.49 |
| | 4.0% | 0.0% | 2.0% | |
| Enterobacter | 1 | 3 | 4 | 0.62 |
| | 2.0% | 6.0% | 4.0% | |
| Poly-microbial | 3 | 10 | 13 | 0.07 |
| | 6.0% | 20.0% | 13.0% | |
| Enterococcus | 3 | 0 | 3 | 0.24 |
| | 6.0% | 0.0% | 3.0% | |

**Table 3:** Distribution of patients according to associated complications

| Complications | Group | | Total |
|---|---|---|---|
| | Non Diabetics | Diabetics | |
| Pleural effusion | 3 | 3 | 6 |
| | 6.0% | 6.0% | 6.0% |
| Septic Shock | 7 | 10 | 17 |
| | 14.0% | 20.0% | 17.0% |
| Renal Failure | 0 | 1 | 1 |
| | 0.0% | 2.0% | 1.0% |
| MODS | 0 | 1 | 1 |
| | 0.0% | 2.0% | 1.0% |
| VF | 0 | 1 | 1 |
| | 0.0% | 2.0% | 1.0% |
| Cardiac Arrest | 0 | 2 | 2 |
| | 0.0% | 4.0% | 2.0% |
| p- value - 0.12 | | | |

**Table 4:** Distribution of patients according to Outcome of the cases

| Outcome | Group | | Total | Total |
|---|---|---|---|---|
| | Non Diabetics | Diabetics | | |
| ICU Admission | 8 | 15 | 23 | 0.15 |
| | 16.0% | 30.0% | 23.0% | |
| Complications | 10 | 18 | 28 | 0.12 |
| | 20.0% | 36.0% | 28.0% | |
| Mortality | 5 | 12 | 17 | <0.05 |
| | 10.0% | 24.0% | 17.0% | |
| Recovered | 40 | 32 | 72 | 0.12 |
| | 80.0% | 64.0% | 72.0% | |

**Table 5:** Distribution of patients according to Pneumonia Severity Index (PSI)

| PSI | Group | | Total |
|---|---|---|---|
| | Non Diabetics | Diabetics | |
| Class I-III | 33 | 20 | 53 |
| | 66.0% | 40.0% | 53.0% |
| Class IV-V | 17 | 30 | 47 |
| | 34.0% | 60.0% | 47.0% |
| Total | 50 | 50 | 100 |
| | 100.0% | 100.0% | 100.0% |
| p- value < 0.05 | | | |

## Discussion

Miquel *et al*. has reported that patients with diabetes were significantly older with average age of 62.0 years [18]. Akbar DH *et al*. reported the mean age incidence of 58.9 years [11]. Viral N. Shah *et al*. [19] in their study shows that 61.41% of the patients were in age group between 40 to 60 years. In the present study, the average age in diabetics was 57.93±9.71 years and majority of them were between 40-60 years of age. Studies have reported male predominance in diabetics [11, 18], which is in accordance with our findings (M:F-1.5:1).

Miquel *et al* reported that typical clinical features like signs of consolidation were seen in 58% of the patients and other 42% of patients presented with signs other than consolidation in diabetics [18]. The present study reported 63.3% with signs of consolidation and 36.7% signs other than consolidation in diabetics.

Korum *et al*. [3] in their study observed that patients with diabetes had higher median levels of blood urea nitrogen, creatinine and lower Hb levels but nearly the same levels of C-reactive protein, leukocyte counts, and PaO2 at admission, compared with the nondiabetic patients. In present study there was raise in total count in both the groups with no statistically significant difference. There was significant difference between two groups with regard to Hb levels (Controls - 10.7± 3.2 vs Diabetics - 9.6 ±2.44 gm %). The difference can be attributed to the finding that most of the patients in diabetic group were anemic.

Miquel *et al* has reported that there was no significant difference in microbiological results in patients with diabetes and non-diabetes [18]. Present study has also shown that there is no significant difference in microbiological results in between both the groups. Spomenka *et al*. reported that Staph auerus and Gram negative organisms such as Klebsiell, E coli, Enterobacter, Pseudomonas and Acinectobacter are common organisms in diabetes [19]. Palmar DL reported that Gram positive cocci such as Strep pneumonia are responsible for majority of infections in diabetic patients, followed by agents such as H influenza [20]. The present study has shown that among diabetes the common organisms are Strep pneumonia (22%), polymicrobial (20%), Klebsiella (16%), Acinectobacter (10.0%). Miquel *et al*. reported 19% of patients had polymicrobial infections in comparison to 9% in non-diabetics [18]. Present study showed 20% patients had poly microbial in comparison to 6% in non-diabetics.

The present study also showed that there is no significant difference in no. of ICU admissions in between both the groups. Miquel et al. also reported that there was no significant difference in no. of ICU admissions in between the two groups [18]. Potgieter *et al*. reported that bacterial pneumonias in diabetic individuals, especially when caused by Klebsiella and Staphlococcus is associated with more severe course of disease and more frequently need mechanical ventilation [21]. Korum *et al*. [3] observed the median duration of hospital stay as 7 days and it did not differ by diabetes status. Miquel *et al*. reported that duration of stay was more in diabetics in comparison with non-diabetics [18]. Present study has also shown that duration of hospital stay was significantly more ($p$<0.05) in diabetics (12.30±4.98 days) in comparison with non-diabetics (9.10±5.24 days).

The common complications observed in our study (in both groups) were: pleural effusion (6% vs 6%) and septic shock (20% vs 14%). Koziel H *et al*. reported that the most common complications of pneumonia in diabetics were pleural effusion, empyema and bacteremia [10]. Miquel *et al*. reported that pleural effusion was more in diabetic patients and there was difference between other risk factors [18].

The present study reported that patients in diabetic group were significantly more among PSI class IV and V (60% vs 34%) in comparison with non-diabetics, who were predominantly among PSI class I (P < 0.05). Similarly, Miquel *et al*. reported that majority of non-diabetics presented with PSI class I in comparison with diabetics who in majority presented with class IV which was statistically significant ($p$<0.01) [18].

In present study, more no. of mortalities were observed in cases of diabetes (24%) as compared to non-diabetics (10%). Biological mechanisms underlying increased mortality among diabetic patients hospitalized for pneumonia may include decreased leukocyte function and harmful effects of hyperglycemia [22, 23]. Miquel *et al*. reported that mortality was more common in diabetic patients which was statistically significant [18]. Akbar DH also reported a significant difference in mortality between both the groups [11]. In another study by Korum *et al*. [3], mortality among diabetic patients was greater than that among other patients: 19.9% vs. 15.1% after 30 days and 27% vs. 21.6% after 90 days. A recent Spanish study of 660 patients by Falguera M *et al*. with CAP, found that diabetes was associated with markedly increased 30-day mortality (adjusted RR 2.14 [95% CI 1.09–4.19]) [24].

## Conclusion

In patients with pneumonia, diabetes mellitus is associated with polymicrobial etiology, multilobe involvement, increased ICU admissions, increased severity in the form of high PSI score and mortality. This study suggests that this adverse outcome is more attributable to the underlying circumstances of patients than to uncommon microbiological findings. Certainly, age, prior co morbidities, as well as multilobe infiltrates have already been related to poor prognosis; however, in this study, diabetes also remained a significant prognostic factor of mortality in patients with pneumonia.

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