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A Study on the Effectiveness of Emperical Therapy of Antibiotics in Infective Diabetic Patient

Resmi Rajan[1]*, Pooja Darsan[1], C.T. Sophy[1], Muhammad Ameen[1], S. Thangamani[2] and D.R. Kiran[3]

[1]Department of Pharmacy Practice, Grace College of Pharmacy, Palakkad, Kerala, India.
[2]Karuna Medical College Hospital, Palakkad, Kerala, India.

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Diabetes mellitus is a known risk factor for certain infectious diseases such as skin, mucus membrane, soft tissue, urinary tract, respiratory tract and surgical or hospital associated infections. In elderly patients initial antibiotic therapy for diabetic infection is empirical. To study the efficacy of empirical antibiotic therapy is significant to ensure the potency of the given therapy. The study was aimed to determine the effectiveness of empirical antibiotic therapy in infective Diabetes Mellitus patients. A Prospective observational study, conducted in inpatients who were admitted in General medicine and surgery Department. The effectiveness of antibiotics was evaluated by parameters like the length of stay, adjustment, discontinued, modified, antibiotic days, antibiotic course and treatment period. There is no significant differences between sex and occurrence of infections showed sex is an independent factor for infection and age, co-morbidities, uncontrolled diabetes had the statistically significant ($p<0.01$) association with occurrence of infections. The empirical therapy was found to be effective choice of treatment in GI tract infections patients and taking empirical therapy showed effective outcome without adjustment and modification and the 65% patients had < 5 days of length of stay who were treated for diabetic foot ulcer followed by GI infections, UTIs and RTIs. The efficacy of the empirical antibiotic therapy was more effective in patients with GI infections as per modified and discontinuation and as per the < 5 days of length of hospital stay empirical antibiotics are effective in patients with Diabetic foot infections.

Keywords: Diabetes Mellitus; Efficacy; Empirical therapy; Infections.

Clinically, the relationship between diabetes and infection is well established, and a number of causal pathways have been identified, including impaired immune responses in a hyperglycemic environment, as well as possibly other abnormalities related to diabetes, such as neuropathy and altered lipid metabolism.[1] Other studies and populations have documented it, but not all of them systematically controlled for confounding variables like smoking, which is more prevalent in diabetics and linked to infection.[2] In the beginning, studies largely focused on primarily common diseases, with few able to incorporate significant but uncommon infections, such as endocarditis, or evaluated the full range of infection outcomes, from the use of health services to hospitalization and mortality.[3]

*Corresponding author E-mail: reshmi12rajan@gmail.com

People with diabetes are more vulnerable to developing new infections and returning infections of the urinary tract infection (UTI), periodontitis, pneumonia, skin and soft tissue infections (including the diabetic foot), osteomyelitis, and peritonitis due to weakened immune systems and disease complications[4]. Those with diabetes are more likely than non-diabetics to develop rare, life-threatening infections. Diabetes makes people more vulnerable to many respiratory diseases.[5] While infections owing to Streptococcus pneumonia or influenza virus may be associated with higher morbidity and mortality, pulmonary infections caused by Mycobacterium tuberculosis, Staphylococcus aureus, gram-negative bacteria, and fungi may occur more frequently[6].

Antibiotic therapy is used to treat infections that have known or presumed causes. It is applied when an individual receives antibiotics before the precise bacterium or fungus responsible for an infection is identified. The urgency of the condition should determine when to begin beginning therapy.[7] The selection of an antibiotic is also influenced by the host's underlying illnesses, such as HIV-related immunosuppression, cancer chemotherapy, steroid transplantation, severe trauma, organ failure, and allergies, genetic component.[8] Early, broad-spectrum, and widely dispersed empirical therapy is essential, quickly bactericidal and long-lasting.[9]

Critically ill patients, such as those with septic shock, febrile neutropenia, and bacterial meningitis, should begin empiric therapy immediately or concurrently with the collection of diagnostic specimens.[10] More stable clinical conditions require intentional interruption of antibiotic therapy until a suitable specimen has been collected and sent to a microbiology laboratory.[11] Initial treatment of infection is often empirical and clinically based, as microbiological results are available only after 24 to 72 hours.[12] Inadequate treatment of infections in critically ill hospitalized patients has been shown to be associated with poor outcomes, including increased morbidity and mortality and longer hospital stays.[13] Therefore, a common approach is to use broad-spectrum antimicrobial agents as initial empiric therapy (sometimes with a combination of antibiotics).In selecting empiric antimicrobial therapy for such infections, clinicians should consider the following: (1) the site of infection (2) prior knowledge of bacteria known to colonize and (3) the local bacterial resistance patterns or antibiotics that are available for important pathogens at most hospitals.[14]

Aim

The study was aimed to determine the effectiveness of empirical antibiotic therapy in infective Diabetes Mellitus patients.

METHOD

The study was designed as a Prospective Observational study was conducted in the Department of General Medicine and Surgery at Karuna Medical College Hospital in Palakkad, Kerala, from October 2021 to March 2022.A total of 104 patients were included in the study. A predesigned data entry form used to collect the patient information like demographics like age, sex, co-morbidities, social habits, lab investigations, culture and sensitivity reports and treatment chart.

Inclusion Criteria

Type II Diabetes Mellitus inpatients with infections

Exclusion Criteria

Patients with Type I DM, gestational diabetes, CRF patients, cancer patients

Statistical Analysis

The data was entered and analysed by MS Excel. The additional factors such as age sex,co-morbidities reinfection and uncontrolled state of blood sugar on occurrence of infection were compared by using Chi-square test. The P value <0.05 was considered as significant.

The efficacy of empirical therapy of antibiotics in the study population were determined based on quality indicators.

Adjustment

Antibiotic/regimen change 48-72 hours after initial treatment related to any of the following:

Modified

Means either treatment withdrawal (narrowing by discontinuing any drug or using a narrower spectrum option) or treatment expansion (alternatively adding or using a broader spectrum).

Length of Stay

The efficacy was assessed by length of stay (<5days).

Antibiotic Days

Number of days the patient received systemic antibiotics during hospitalization.

RESULTS

A total of 104 patients with infective diabetic mellitus were included in the study. The efficacy of empirical therapy of antibiotics in the study population were determined based on quality indicators used as metrics. Based on different quality indicators (variables) such as antibiotic days, antibiotic course, treatment period, adjustment, modified and discontinuation the results of each category of infections was represented as below:

The baseline characteristics of the study population was found in table 1, such as gender, age, and number of complications, reinfection, and random blood sugar level. In this study, based on the parameter sex, there are 49 (47%) males and 55 (53%) females. The distribution of age was 15 (14.42) under 50 years and 89 (85.58) over 50 years. Hypertension is one of the most important comorbidities in DM patients with infections. Reinfection was one of the associated factors, with 56 (53.8%) patients becoming re-infected and 48 (46.15%) patients not re-infected which is not statistically significant. There were 29 (27.88%) patients with less than 140mg/dl and 75(72.11%) patients with greater than 140mg/dl. There is no significant differences between sex and occurrence of infections showed sex is an independent factor for infection. Whereas age, co-morbidities uncontrolled diabetes had the P value of <0.01 which indicates that there is statistically significant association between these factors and occurrence of infections.

The distribution of type of infection was showed in table 2 in which 32 patients (30.76%) having respiratory tract infection, 25(24.03%) patients having urinary tract infections, 23(22.11%) patients having foot infections,11(10.57%) patients having GI infections,13(12.50%) are on other miscellaneous group of infections were reported. Here the most frequent type of infections was respiratory tract infections in patients with Type II Diabetes Mellitus (30.47%).

The antibiotics use based on different metrics was showed in table 3. In urinary tract infection. Initially the antibiotic days for patient was 4.59±19.13, and antibiotic course was 5.25±3.13. The maximum number of antibiotics at a time for the urinary tract infection for a patient was 1.95±4.24, length of stay for patients less than 5 days were 15(60%) and more than 5 days were 10(40%). Changes made to the antibiotic regimen were assessed by adjustment 6(24%), modified 8(32%), and no change were 11(44%). In respiratory tract infection the antibiotic days for patient was 5.93±2.63, and antibiotic course was 7.4±6.69. The maximum number of antibiotics at a time for the respiratory tract infection for a patient was 1.75±0.91, length of stay for patients less than 5 days were 18(56.25%) and more than 5 days were 14(43.75%). Changes made to the antibiotic

Table 1. Baseline Characteristics among the Study Population

No	Parameters		No. of Patients (N=104)	Percentage of Patients (%)	P value
1	Sex	Male	49	47%	0.4053
		Female	55	53%	
2	Age	<50(years)	11	14.42%	<0.01
		>50(years)	89	85.59%	
3	Co-morbidities	Hypertension	55	52.88%	<0.01
		Others like Asthma, Hypothyroidism,COPD	49	47.11%	
4	Reinfections	Yes	56	53.8%	0.267
		No	48	46.15%	
5	RBS (mg/dl)	<140	29	27.88%	<0.01
		>140	75	72.11%	

P-value <0.05 considered as significant

regimen were assessed by adjustment 6(18.75%), modified 8(25%), and no change were 18(56.25%).

In GI infection the antibiotic days for patient was 5±1.89, and antibiotic course was 4.2±1.4. The maximum number of antibiotics at a time for the GI infection for a patient was 1.41±0.51, treatment period (length of stay) for patients less than 5 days were 7(63.6%) and more than 5 days were 4(36.3%). Changes made to the antibiotic regimen were assessed by adjustment 1(9.09%), modified 2(18.18%), and no change were 8(72.72%)**.** The antibiotics use based on different metrics in Diabetic foot ulcer in which the antibiotic days for patient was 5.55±1.96, and antibiotic course was 3.37±1.12. The maximum number of antibiotics at a time for the foot ulcer for a patient was 1.82±0.83; treatment period (length of stay) for patients less than 5 days were 15(65.21%) and more than 5 days were 8(34.8%). Changes made to the antibiotic regimen were assessed by adjustment 9(39.13%), modified 4(17.39%), and no change were 10(43.47%).

DISCUSSION

Infectious disease is more prevalent in individuals with diabetes. It is a condition that may potentiate infectious diseases and predispose patients to acquiring more severe disease. A recent matched cohort study analyzed the incidence infection rate from 306,011 patients and reported that patients with diabetes are more susceptible for developing severe infectious disease.[15]

The study showed that the majority of patients with diabetic infections were females but it is not statistically significant more in men. The age group >50years have shown higher susceptibility to the infection. Typically, patients between 50-60 years of age represents a serious risk factor for development of infections in type 2 DM patients with infections.[16] Hypertension is one of the major comorbidities seen in diabetic patients The prevalence of hypertension among type 2 diabetes mellitus (DM) patients is higher than that of age- and sex-matched patients without diabetes, ranging from 32% to 82%.[17] On the basis

Table 2. Types of Infections among DM Patients

No	Type of infection	Number of patients (N=104)	Percentage of patients (%)
1	Respiratory tract infection	32	30.76
2	Urinary tract infection	25	24.03
3	Foot ulcers	23	22.11
4	GI Infection	11	10.57
5	Miscellaneous	13	12.50

Table 3. Efficacy of empirical therapy of antibiotics in different infections

Variable		RTI (n=32)	UTI (n=25)	GI Infections (n=11)	Diabetic Foot Ulcer (n=23)
Antibiotic days(mean ± Standard Deviation)		5.93±2.63	4.59±2.13	5±1.89	5.55 ± 1.96
Antibiotic course(mean ± Standard Deviation)		7.4±6.69	5.25±3.13	4.2±1.14	3.37±1.12
Maximum number of antibiotics at a time (mean ± Standard Deviation)		1.75±0.91	1.95±4.24	1.41±0.51	1.82±0.83
Length of stay (%)	<5(days)	18(56.25%)	15(60%)	7(63.6%)	15(65.21%)
	>5(days)	14(43.75%)	10(40%)	4(36.3%)	8(34.8%)
AdjustmentN (%)		6(18.75%)	6(24%)	1(9.09%)	9(39.13%)
ModifiedN (%)		8(25%)	8(32%)	2(18.18%)	4(17.39%)
No changeN(%)		18(56.25%)	11(44%)	8(72.72%)	10(43.47%)

of reinfection 56 (53.8%) patients becoming re-infected. The greater frequency of infections in diabetic patients is caused by the hyperglycemic environment that favors immune dysfunction.[18] There were 29 (27.88%) patients with less than 140mg/dl and 75(72.11%) patients with greater than 140mg/dl.

The distribution of type of infection was showed in table 2 in which 32 patients (30.76%) having respiratory tract infection, 25(24.03%) patients having urinary tract infections, 23(22.11%) patients having foot infections,11(10.57%) patients having GI infections,13(12.50%) are on other miscellaneous group of infections were reported. Comparing to the previous studies patients with Respiratory tract infection is higher as compared to any other type of infections. Urinary tract infection precedes RTI, and is more common in women than in men.GI & Foot infections are most important chronic complication in DM.[19]

Different metrics were used to compare the effectiveness of empirical antibiotic therapy in infective DM patients.[20] LOS is a relevant outcome measure because it reflects the recovery time of patients and defines hospital costs.(21) Appropriate empirical antibiotic therapy (i.e. appropriate therapy) is defined as applying the antibiotic agent which matches in vitro susceptibility of the isolated bacteria, but was initially provided without evidence on the causative pathogen or its antibiogram.[22] Considering the quality indicators such as Length of stay (LOS), Antibiotic days, Antibiotic course, Maximum no. of antibiotics, the efficacy of empirical antibiotic therapy was more effective in patients with Length of stay of < 5 days[23]. In this present study showed that 65% patients had < 5 days of length of stay who were treated for diabetic foot ulcer followed by GI infections, UTIs and RTIs. Length of stay have significant association on the occurrence of infections in diabetic patients. Appropriate empirical therapy is effective for increasing coverage rates without prescribing unnecessarily broad regimens[24]

This study resulted that the empirical therapy was found to be effective choice of treatment in GI tract infections patients and taking empirical therapy showed effective outcome without adjustment and modification where as in diabetic foot infections empirical therapy was found to be least effective. The empirical therapy was found to be moderately effective in Respiratory tract and Urinary tract infections. Overall the empirical therapy was found to be effective in more than half of the study population. Therapy optimization initiates empirical coverage with minimal delay followed by discontinuation or streamlining to a regimen with the narrowest possible spectrum based on relevant diagnostic information.[25]

CONCLUSION

Diabetes represents an incredibly important risk factor for infection raising the likelihood of infection for both treated conditions and those which lead to hospitalization. The efficacy of the empirical antibiotic therapy was more effective in patients with GI infections as per quality indicators like modified and discontinuation and as per the < 5 days of length of hospital stay empirical antibiotics are effective in patients with Diabetic foot infections. As per the study conducted about half of the patients had effective empirical antibiotic therapy without adjustment or modifications.

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Conflict of Interest

Here we would like to declare that we don't have any conflict of interest.

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