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Original Article

Renal Function Status in Patients with Diabetes Mellitus Having Diabetic Foot Infection and Role of Antibiotics

Shabab Hussain[1], Arrham[2], Syeda Javeriya Saeed[3*], Ahmad Murtaza Anwar[4], Asif Khan[5] and Saifullah Brohi[6]

[1]Khyber Medical University Institute of Medical Sciences, Kohat, Pakistan
[2]Department of General surgery, Dr Akbar Niazi Teaching Hospital, Islamabad, Pakistan
[3]Bacha Khan Medical Complex, Sawabi, Pakistan
[4]Divisional Headquarters Teaching Hospital Mirpur, AJK, Pakistan
[5]Jinnah Teaching Hospital, Peshawar, Pakistan
[6]Bilawal Medical College for Boys LUMHS, Jamshoro, Pakistan

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***Corresponding Author:**

Syeda Javeriya Saeed
Bacha Khan Medical Complex, Sawabi, Pakistan
Drsyedajaveriya@hotmail.com

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ABSTRACT

It has been shown that antibiotic therapy in diabetic foot ulcers has a toxic effect on renal function. **Objective:** To assess the renal function among patients with diabetes mellitus having diabetic foot infection. **Methods:** It was a cross-sectional retrospective study in the surgical Unit of DHQ Teaching Hospital KDA Kohat for six-month duration from January 2022 to June 2022. 130 patients with diabetic foot ulcers were selected for this study. The patients receiving antibiotic with a low renal toxicity risk were included in Group-A and patients receiving antibiotics with an increased renal toxicity risk were included in group B. GFR was calculated and measured from Cockcroft-Gault equation and serum creatinine levels. SPSS 20.0 was applied for data analysis with paired t-tests, t-test and chi-square tests. **Results:** In group A there were 65 (50%) participants and 65 (50%) in group B. GFR after and before antibiotic therapy was 58.30±31.13 cm^3 / min and 65.98±35.76 cm^3 / min ($p = 0.004$), correspondingly. The GFR in group B was reduced significantly after antibiotic therapy ($p = 0.003$). **Conclusions:** Conferring to this study, renal function decreased and nephrotoxicity was noted after antibiotic treatment, the percentage of decline in GFR being greater in patients who received higher nephrotoxic antibiotics.

INTRODUCTION

Type-II diabetes is the common chronic ailment that results in heavy load on the healthcare system because of its increasing vascular complications and prevalence [1, 2]. 2.85 billion people are affected worldwide [3, 4]. Diabetic foot followed by infection is a common diabetic complication in both developing and under-developed states and is the communal reason of premature death and morbidity in diabetic patients [5, 6]. It is also high-cost treatment and is predictable to affect 26% of all diabetics in their life because of neuropathy and possible concomitant vascular disease. The process of diabetic foot begins with an often-unrecognized traumatic ulcer, often instigated by diabetic arteriopathy and neuropathy. Lacking quick and accurate valuation, it often results in ulcer formation and amputation of the lower limbs [7]. Antibiotic therapy has a vital part in the treatment of these diabetic foot infection. Wounds deprived of bone or soft tissue infection usually do not need antibiotic management [8]. Empirical treatment with gram-positive cocci cover is used to treat mild to moderate infections, while infections in severe form require broad-spectrum treatment with antibiotics covering both obligate anaerobes and aerobic

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gram-negative bacteria [9, 10]. The nephrotoxicity is the main side effect of aminoglycosides seen in about 21% of cases [11]. Also, in the early stages of DM, the kidneys enlarge and the GFR exceeds the predictable range. The significant factor in major amputation up to 2.5 to 3 times and ulceration is End stage renal disease (ESRD) [12]. The objective of this analysis was to assess the renal function among patients with diabetes mellitus having diabetic foot infection.

METHODS

This retrospective cross-sectional study was held in the surgical unit of DHQ Teaching hospital KDA Kohat for six-month duration from January 2022 to June 2022 for one-year duration from January 2021 to December 2021. The criteria of inclusion were the presence of infected lower limb ulcers and the diagnosis of diabetes mellitus. The criteria of exclusion were below-knee amputation and ESRD. The patients receiving antibiotics with a low renal toxicity risk were included in Group-A (clindamycin, ceftriaxone and ciprofloxacin) and patients receiving antibiotics with an increased renal toxicity risk were included in group B (imipenem, vancomycin and aminoglycosides. Patient data like gender, age, diabetes duration, location, body mass index (BMI), diabetes control method, creatinine after and before the antibiotic treatment, wound severity, Renal function and GFR after and before the antibiotic treatment was taken from the hospital record. The Wagner criteria was used to classify the diabetic foot ulcer. Grade-0 ulcers are pre- and post-ulcerative lesions, Grade-I ulcers are superficial with partial or full thickness involvement of skin, Grade-II ulcers penetrate the joint capsule and ligaments and are deeper and Grade-III ulcers are deeper lesions with osteomyelitis or abscesses. GFR was calculated and measured from Cockcroft-Gault equation and serum creatinine levels. SPSS 20.0 was applied for data analysis with paired t-tests, t-test and chi-square tests. The standard deviations, mean, relative and absolute frequencies were determined for descriptive statistical analysis. Statistical analysis was accomplished by means of t-test. X2 tests were executed for categorical data in command for comparison of the variables among the both groups. The association between Wagner stages and GFR were performed using the non-parametric Spearman coefficient test.

RESULTS

gram-negative bacteria [9, 10]. The nephrotoxicity is the main side effect of aminoglycosides seen in about 21% of cases [11]. Also, in the early stages of DM, the kidneys enlarge and the GFR exceeds the predictable range. The significant factor in major amputation up to 2.5 to 3 times and ulceration is End stage renal disease (ESRD) [12]. The objective of this analysis was to assess the renal function among patients with diabetes mellitus having diabetic foot infection.

Variable	Mean± SD	Minimum	Maximum
Age in years	59.06±11.12	30	90
Height (cm)	168.30±11.01	144	195
Diabetes duration (year)	15.12±6.87	9	42
BMI (kg/m2)	27.17±4.08	19.62	35.55
Weight (kg)	73.20±11.28	50	117
Serum creatinine after antibiotic therapy (mg/dL)	1.75±1.10	0.9	5.8
Serum creatinine before antibiotic therapy (mg/dL)	1.82±0.95	0.8	3.8
GFR after antibiotic therapy (cc/min)	58.30±31.13	14.00	123.00
GFR before antibiotic therapy (cc/min)	65.98±35.76	14.00	123.00

Table 1: Mean quantitative variables of the studied patients

There were 80 women (61.5%), 75 (57.7%) lived in the rural areas, 90 (69.2%) patients have glycemic control, 95 (73.1%) were on oral hypoglycaemic drugs, 72 (55.4%) patients were of Wagner's grade-II and 25 (19.2%) were of Wagner's grade-III. Table 2 shows the variables of decreased renal function. The studied variables were compared after and before antibiotic therapy. The GFR reduced in both sexes, but was substantial decrease was seen in women (64.92±31.48 vs. 57.51±32.45 cm3 / min, p = 0.004). Also, very high BMI patients (obese subjects) had a significant reduction in renal function (70.50±33.31 vs 57.49±23.69 cm3 / min, P = 0.005). The renal function was better in patients with glycemic control by insulin after antibiotic treatment (64.70±35.39 vs. 63.61±33.82 cm3 / min, p = 0.54).

Variable	Renal function before treatment Mean±SD	Renal function after treatment Mean±SD	P-value
Age group (years)			
Less than 30	110.10±0.02	105.30±00	-
31-55	68.14±34.19	65.15±30.29	<0.001
55-80	61.79±32.89	53.51±28.10	<0.001
Gender			
Male	67.51±32.67	65.38±28.15	0.42
Female	64.92±31.48	57.51±32.45	0.004
Drug regimen			
High risk	69.01±33.08	51.42±33.58	0.003
Low risk	71.52±30.42	61.79±29.73	0.03
Diabetes duration (years)			
Less than 10	67.54±31.23	62.89±30.50	0.33
11-25	62.50±36.90	56.32±32.67	0.05
25-35	59.91±30.81	53.67±24.27	0.15
35-45	73.49±40.15	59.28±30.82	0.08
Body mass index (kg/m2)			
Normal	56.71±31.90	58.20±28.30	0.60
Obese	70.50±33.31	57.49±23.69	0.005
Overweight	67.38±32.09	60.08±33.67	0.12

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Glycemic control			
Insulin	64.70±35.39	63.61±33.82	0.54
oral agent	66.15±33.78	52.06±31.48	0.004
Nothing	62.91±31.08	57.99±28.60	0.42
Wound severity			
I	68.21±39.10	54.79±32.48	0.02
II	65.71±39.90	55.22±30.59	0.04
III	62.02±31.59	60.79±28.29	0.03
IV	63.50±32.84	66.08±31.76	0.49

Table 2: Renal function after and before treatment with antibiotics

According to Wagner's category, renal function was significantly reduced in the 1st three stages, but not substantial in the final stage (p = 0.52). GFR after and before antibiotic therapy was 58.30±31.13 cm3 / min and 65.98±35.76 cm3 / min (p = 0.004), correspondingly. It was reduced significantly in the high-risk group (57.50 ± 36.90 vs 49.46 ± 33.59cm3 / min, p = 0.003). Although there was a decrease in the low-risk group but not substantial (71.25 ± 30.76 vs 64.54 ± 27.98 cm3 / min, P = 0.94; Table 3).

Variable	Renal function before treatment Mean±SD	Renal function after treatment Mean±SD	P-value
Group A (low risk regimen)	71.25 ± 30.76	64.54 ± 27.98	0.94
Group B (high risk regimen)	57.50 ± 36.90	49.46 ± 33.59	0.003

Table 3: Status of renal function in the studied groups

DISCUSSION

Foot infections and ulcers are the main reasons of disability in diabetic people. The foot ulcers are developed in about 15% of cases [13]. The infection in the foot ulcer caused by diabetes takes a long time to heal. Today, renal complications are usually caused by diabetes in both the developed and developing world [14]. In renal failure advanced stages, when GFR drops below 15-20 cm3 / mint, renal insulin clearance declines. This is of greater clinical value in diabetes mellitus treatment. In our analysis, GFR reduced later to antibiotic treatment in patients with diabetes [15]. Adeleye et al., stated that renal failure mostly developed in diabetic patients having foot ulcers [16]. Rubio et al., believed that loss of kidney function was recognized as an important factor in the formation of foot ulcers [17]. The uremic toxins accumulation and elevated levels of parathyroid hormone in chronic renal failure patients have been shown to result in resistance of insulin in tissues, especially in skeletal muscle, mostly because of insulin-binding receptor damage and impaired metabolism of glucose and glycogen formation [18]. A 2009 study by Barwell et al., showed a strong relationship between diabetic foot and renal function. Moreover, a substantial inverse association was found between the Wagner grades and GFR of the diabetic foot [19]. Kateel et al., determined that impaired renal function in patients with diabetes rises levels of creatinine and lowers GFR [20]. A drop in GFR above normal in diabetic patients leads to exacerbation of the infection in diabetic foot and eventually results in the amputation. This is possibly because of metabolic acidosis, increased parathyroid hormone levels and reduced secretion of insulin in patients with impaired renal function, which may be because of low vitamin D levels [21]. Hicks et al., showed that GFR is significantly related to diabetes and autonomously influence renal function. In our analysis, patients receiving antibiotics have deteriorated renal function [22]. Renal function deterioration was much greater in people taking antibiotics with increased nephrotoxicity. Antibiotics are widely used to treat infections [23]. Its use may damage the kidneys. In addition, kidneys are the main source of antibiotics clearance from the body. In Liu et al., study; it was noted that gentamicin has few side effects on the kidneys [24]. Though, irrespective of the mechanism and nature, the antibiotic toxicity be contingent on the concentration, dose, other underlying diseases and its duration. Antibiotic therapy in patients with diabetes must be carefully observed as these patients mostly have renal dysfunction and this tendency is enhanced by the usage of antibiotics [25]. In this analysis, all age group patients have significantly reduced renal function. Though, there was a severe decrease in older patients. This was apparent that the underlying disease worsens with age, organ function deteriorates, and the body's ability to tolerate and remove waste from the body decreases.

CONCLUSIONS

According to this study results, renal function deteriorated afterwards treatment with antibiotics. The antibiotics having greater nephrotoxicity causes a huge decrease in GFR in diabetic patients. This study outcomes may be cast-off to recognise aspects having effect on renal function in diabetic people having diabetic foot infection. The treatment with an antibiotic is not operative in preventing infection in diabetic foot and must be used in the event of an infection. When vancomycin is administered, creatinine and blood urea levels must be observed periodically and the concurrent nephrotoxic drugs must be avoided like aminoglycosides if possible. Treatment of aminoglycoside induced renal injury is mainly supportive, with drug discontinuation and replacement with another antibiotic drug which is non-nephrotoxic. If possible, the duration between dosages of aminoglycosides should be increased. In addition, the usage of various drugs causing nephrotoxicity must be evaded to maintain electrolyte and fluid balance.

Conflicts of Interest

The authors declare no conflict of interest

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