A Clinical Study of Diabetes Mellitus Type II and its Association with Bacterial Infections

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Abstract

This study was carried out at the Al-Nasiriyah Centre for Endocrinology and Diabetes for the period from 10th October 2013 to 3rd September 2014. It was conducted to determine the causal factors of diabetes mellitus type II at Thi-Qar province south of Iraq. The results showed that the incidence of diabetes was high among females (54%). The results also showed that the highest rate (30%) of the diabetes among age group 49-59 years that they have symptoms of diabetes but they have not a history of diabetes (51%). The highest incidence of diabetes was among smoker patients (64%), that the distribution of diabetes among urban was high (62%) than rural (38%). In addition, pathogenic bacteria were isolated from diabetic patients from different infectious sites such as urinary tract, wound and respiratory tract infections. *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella pneumoniae* were isolated at high percentage respectively, while the most bacterial isolates showed resistance to Ampicillin and Amoxycillin, but other isolates showed sensitive to Amikacin, Cefotaxime, Azithromycin and Cefixime. The results from published reports as well as our data suggest that good control of blood sugar in diabetic patients is a necessary aim to prevent of certain infections and to ensure maintenance of normal host defence.

Key words: Diabetes, bacterial infections, antibiogram.

A Clinical Study of Diabetes Mellitus Type II and its Association with Bacterial Infections

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دراسة سريرية لمرض السكري النوع الثاني وارتباطه بالاخماج البكتيرية

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الخلاصة

أجريت هذه الدراسة في المركز التخصصي للغدد الصماء وداء السكري في الناصرية للفترة من العاشر من تشرين الاول 2013 ولغاية الثالث من ايلول 2014. اذ تضمنت الدراسة معرفة العوامل المسببة لمرض السكري النوع الثاني في محافظة ذي قار جنوب العراق. اظهرت النتائج ان انتشار المرض بين الاناث اعلى من الذكور بنسبة (54%). كما اظهرت النتائج ان اعلى نسبة للإصابة كانت بعمر 49-59 سنة بنسبة 30%. كما أشارت الدراسة إن الذين لم يكن لديهم تاريخ مرضي كانت نسبة الإصابة لديهم أعلى بنسبة 51%. كما أشارت الإحصائيات إلى أن ارتفاع نسبة المرض بين المدخنين (64%). وان انتشار المرض في الحضر (62%) اعلى مما سجل عند الريف (38%). بالإضافة الى ذلك تم عزل وتشخيص البكتيريا المصاحبة لمرضى السكري حيث كانوا مصابين بالتهاب المجاري البولية واصابات الجروح واصابات الجهاز التنفسي. اذ تم عزل العصيات القولونية والمكورات العنقودية والكليبسلا الرئوية بنسب عالية واظهرت جميع العزلات مقاومتها لمضادات الـAmoxycillin ، Ampicillin ،وابدت بعض العزلات حساسيتها للمضادات Azithromycin ، Cefixime ، Cefotaxime، Amikacin. تشير نتائج البحوث المنشورة وكذلك بيانات الدراسة الحالية إلى أن المراقبة الجيدة لنسبة السكر في الدم لدى مرضى السكري هو الهدف الاساسي للوقاية من بعض الأخماج البكتيرية وضمان تعزيز آليات دفاع الجسم للعدوى.

الكلمات المفتاحية: مرض السكري – الاخماج البكتيرية- اختبار حساسية المضادات الحياتية

Introduction

Diabetes mellitus is a complex metabolic disease caused by a variable interaction between hereditary and environmental factors (1). Diabetes is a chronic disease that may be the range of the patient's life, which leads to abnormally high level of glucose in the blood, to the inability of the body to use and the conversion of glucose into energy. Diabetes occurs as a result of the defect in the metabolism of carbohydrates, the lack of secretion of the pancreas to the hormone insulin, which leads to high blood sugar in both blood and urine (2). The disease is also accompanied by a disorder of the metabolism of both proteins and fats. According to the World Health Organization (WHO), the incidence of diabetes is worldwide prevalence, with double the overall rate of diabetes patients in all continents of the world, and the infection is three times in each of India, the Arab countries and some other countries in the African continent in 2030. Also, according to statistics mention that about 20% of people infected with or at risk of diabetes. This has become an epidemic of diabetes globally, not only in developing countries but also in developed countries (3). Health map for the WHO indicate that one person out of every six people with diabetes (4). Diabetes is one of the most common diseases in the world, which requires first and foremost a physician experienced and familiar with the practical details of the treatment and the reasons for the emergence of the disease, and the odds of genetic influence, and type of diabetes, and the dimensions of the disease and its complications (5,6). Mechanism of the onset of diabetes is not confined only to the lack of insulin secretion in blood or deficiencies in the secretion of the pancreas, but also depends on lifestyle regulator for each individual, based on three basic pillars, namely physical exercise, balanced nutrition and proper medical treatment. All these three pivot points, the triangle in the middle embodied health diabetics (7,8).

Balanced nutrition represents a pivotal point in human life, especially in patients with diabetes. Food regulation in patients with diabetes plays a key role in the increase or decrease the amount of sugar in the blood, and therefore the impacts on the amount of fat in the blood

have a positive or a negative effect (9-12). Appropriate treatment for each patient completed health triangle diabetics; this is the property of abuse, and the medical tests and diagnostic tests by the attending physician (13). The aims of the study were to identify the causes of diabetes mellitus type II, to determine the prevalence of the diabetes in Thi-Qar province and to study the bacteriological agents and their antibiotic sensitivity which may associate with diabetic patients.

Materials and Methods

This study was carried out at the Al-Nasiriyah Centre for Endocrinology and Diabetes for the period from 10th October 2013 to 3rd September 2014. It was conducted to determine the causal factors of diabetes mellitus type II at Thi-Qar province south of Iraq. A total number (7370, 54% female and 46% male) of patients were studied. The study was taken about the causal factors of the disease using a questionnaire and through the medical records in the centre of diabetes. The questioner included age, gender, smoking, residence, medical family history, medications and fasting blood sugar level. In addition, bacteriological study of this prospective study was conducted from infection sites such as pus, urine, sputum and blood samples that were obtained from consecutive diabetic patients. A loop full or swab from infection sites was inoculated onto MacConkey agar and blood agar (Oxoid, UK) and incubated in anaerobic candle jar to supply anaerobic condition; another loop full or swab was streaked onto the same media in aerobic condition and incubated for 24-48 hrs in 37°C. Classification and identification of aerobic and anaerobic bacterial types were performed according to standard routine techniques proposed by Mahon *et al.* (14). Antibiotic susceptibility test was done using disc diffusion method to determine of inhibition zones which measured in millimetre using Muller-Hinton agar (15).

Results and discussion

From the results, the number of diabetes incidence in females was 3979 (54%), while the number of diabetic males was 3391 (46%). Table 1 shows the incidence of diabetes according to age, with high occurrence (number 2211, 30%) in the age group 49-59, followed by the age group >60 years with number 1990 (27%). The lowest number of diabetic incidence among age group 1-18 years was 369 (5%). This refers to the diabetes mellitus type 2 as old age disease because some reason such as life style, obesity and smoking which they make high incidence at age group > 60 years. DM type 2 previously known as non-insulin-dependent diabetes mellitus is a serious, costly disease affecting approximately 8 % of adults in the USA (16).

The distribution of diabetes among people according to the family history of the disease, there were 49 % of patients with positive diabetic family history but 51 % of patients were negative family history. This may be due to that most of the patients in the urban came to the diabetes centre for this period do not have family history of the disease. However, because the family history reproduces genetic susceptibility in addition to other factors, it may be a useful public health tool for disease prevention (17).

Table 1: The distribution of diabetic patients according to the age groups

Age	Number	Percentage (%)
1-18	369	5
-2819	442	6
29-38	663	9
39-48	1695	23
-5949	2211	30
≤ 60	1990	27
Total	7370	100

Table 2: The number of smokers and non-smokers patients.

	No.	%
Non-Smoker	2653	36
Smoker	4717	64
Total	7370	100

Table 2 shows the relationship of smoking to diabetes where the percentage of smoker patients was 64% and the percentage of non-smokers was 36%. Smoking has been identified as a possible risk factor for insulin resistance an originator for diabetes. Smoking has also been shown to weaken glucose metabolism which may lead to the onset of type 2 diabetes. Researchers have known that diabetic patients who smoke have high blood sugar, making their sugar difficult to control and putting them at a great risk to develop several complications such as blindness, nerve damage, kidney failure and heart diseases (18).

Table 3: The distribution of diabetic patients according to the residence

Residence	Number	Percentage (%)
Urban	4569	62
Rural	2801	38

Table 3 shows that the prevalence of diabetes in urban (62%) was more than rural (38%). The total number of people with diabetes in the province was (7370), a very large proportion due to the reasons of the absence of a health-care and also because some diseases that will help to raise the incidence of diabetes as well as awareness among the people and their followers bad

diet. The prevalence diabetes is still about doubles in urban subjects when compared the rural and urban peoples after removing the differences in obesity and age (19).

Table 4: The types of infections which associated with diabetic patients

Type of infections	Infection rate (%)
Urinary tract infections	260 (38.80)
Wound infections	290 (43.28)
Respiratory tract infection	120 (17.91)
Total	670 (100)

Table 4 shows the total number (670) and percentage of infections which associated with diabetic patients, the highest incidence of infection is wound infections (43.27%) followed by UTI (38.79%). Diabetic patients develop a low efficiency of the immune system, the body defence system against infection. A high glucose level causes the immune cells to function ineffectively, which raises the risk of infection for the patient. Studies indicate that particular enzymes and hormones that the body produces in response to an elevated blood sugar are responsible for negatively impacting the immune system (20). Wound infections are commonly polymicrobial. Following surgery, patients with diabetes are at high risk of wound infections as their immune response may be compromised. However, the response to infection may be subdued in diabetic patients, due to the underlying pathophysiology (21).

Table 5: Bacterial species associated with the diabetic patients

Bacterial species	Wound	urine	sputum	Total
Gram-negative bacteria:	N (%)	N (%)	N (%)	N (%)
Escherichia coli	60 (8.95)	160 (23.88)	0 (0)	220 (32.83)
Klebsiella pneumoniae	40 (5.97)	20 (2.98)	100 (14.92)	160 (23.88)
Pseudomonas aeruginosa	20 (2.98)	10 (1.49)	0 (0)	30 (4.47)
Bacteroides	30 (4.47)	0 (0)	0 (0)	30 (4.47)
Gram-positive bacteria :				
Staphylococcus aureus	90 (13.43)	70 (10.44)	20 (2.98)	180 (26.86)
Clostridium	50 (7.46)	0 (0)	0 (0)	50 (7.46)
Total	290 (43.28)	260 (38.80)	120 (17.91)	670 (100)

Table 5 shows infection with UTI was (38.80%), wound infection (43.28%) and respiratory tract which diagnosed as pneumonia (17.91%). The profile and frequency distribution of Gram-positive and Gram-negative bacteria isolated from various sites. The number of Gram-negative as compared with Gram-positive bacterial isolates was high in our study. *E. coli* among Gram-negative and *S. aureus* among Gram-positive cocci were the most common pathogens. Other studies from India have also reported Gram-negative bacilli as predominant pathogen in diabetic infections (22). Anaerobic bacteria also isolated as major pathogens of such infections but could not be assessed because of lack of facilities. On the other hand, Kranthi *et al.* (23) have concluded that the development of resistance by certain bacterial in

wound infections is due to improper antibiotic usage by patients which leads to sustained infection, delay in recovery and subsequent increased length of hospitality. Patients may overcome this problem by taking appropriate dosage of antibiotics and avoid irregular usage of drugs.

Table 7: Percentage of antimicrobial resistance among various bacteria isolates (total number: 670) obtained from diabetic patients.

Antibiotics	*E.coli* N=220 (%)	*K.pneumonia* N=160 (%)	*P.aeruginosa* N=30 (%)	*S.aureus* N=180 (%)	*Clostiridium* N=50(%)	*Bacteroides* N=30(%)
Amoxycillin	40(18.18)	60(37.50)	0(0)	60(33.33)	30(60.00)	12(40.00)
Ampicillin	30(13.63)	40(25.00)	7(23.33)	45(25.00)	40(80.00)	10(33.33)
Gentamicin	120(54.54)	140(87.50)	17(56.66)	25(13.88)	20(40.00)	14(64.66)
Amikacin	160(72.72)	130(81.25)	22(73.33)	155(86.11)	29(58.00)	22(73.33)
Ceftazidime	110(50.00)	135(84.37)	20(66.66)	120 (66.66)	0(0)	13(43.33)
Ciprofloxacin	120(54.54)	110(68.75)	16(53.33)	160(88.88)	30(60.00)	24(80.00)
Cefotaxime	130(59.09)	100(62.50)	14(46.66)	100(55.55)	10(20.00)	0(0)
Polymyxin	10(4.54)	40(25.00)	0(0)	0(0)	12(24.00)	0(0)
Azythromycin	0 (0)	0 (0)	0 (0)	60 (33.33)	45(90.00)	24(80.00)
Cefixime	120 (54.54)	110 (68.75)	20 (66.66)	95 (52.77)	35(70.00)	27(90.00)

Table 7 shows the overall susceptibility amoxycillin, third-generation cephalosporins, fluoroquinolone, tested among Gram-negative bacilli and macrolides, Amoxicillin first-

generation cephalosporins, fluoroquinolones among Gram-positive cocci were low. The other studies on infections among diabetic patient have also reported high resistance rates to various antibiotics among Gram-negative and Gram-positive bacteria. The most serious concern with antibiotic resistance is that some bacteria have become resistant to almost all of the easily available antibiotics. These bacteria are able to cause serious disease and this is a major public health problem (22,24). Antibiotic resistance rates are associated with prior use of antibiotics by patients. Due to frequent infections, diabetic patients have more exposure to antibacterial agents, which can lead to increase antibiotic resistance rates (25).

Conclusions

Diabetes is a complex disease that effects on acute and chronic wound management. Education of patients within primary care can play a role in preventing complications. Diabetic patients are at a high risk for lower respiratory tract infection, urinary tract infection, skin and mucous membrane infection. Studies were emphasized onto the health care of such infections in patients with diabetes. *E. coli, Staphylococcus aureus* and *Klebsiella pneumoniae* were isolated from different infectious sites. Most bacterial isolates show susceptibility for Amikacin, Azithromycin, Cefixime and Cefotaxime. The results from published reports as well as our data suggest that a good control of blood sugar in diabetic patients is a necessary aim in the prevention of certain infections and to ensure maintenance of normal host defence mechanisms that determine resistance and response to infection.

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