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CORRELATION BETWEEN HEMOGLOBIN A1C IN DIABETIC PATIENTS WITH RATE OF INFECTION AND WOUND COMPLICATIONS FOLLOWING DECOMPRESSIVE SPINE SURGERY

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Abstract

Diabetes mellitus (DM) is known as an important risk factor for surgical site infection (SSI) in spine surgery. A chronic state of impaired glucose metabolism affects multiple components of the immune system, possibly leading to an increased incidence of post-operative infection. Such infection increases morbidity, length of stay, and overall cost. The present study was designed to assess the correlation between pre-operative hemoglobin A1c (HbA1c) and the incidence of post-operative infection in surgical patients undergoing decomperssive spine operations.

Forty diabetic patients who underwent decompressive spine surgery at different levels of spine were included in this retrospective study. These include 23 females and 17 males with mean age of 57.5 years. The patients data were collected from hospitals and private clinics archives including value of preoperative hemoglobin A1c, random blood sugar, postoperative C-reactive protein (CRP) and white blood cells count (WBC) as a diagnostic laboratory tests for identification of postoperative infection in follow-up periods.

The overall rate of infection in our study was 12.5%, which was categorized into 2 groups (Uncontrolled diabetes hemoglobin A1c >7 and controlled hemoglobin A1C ≤7), so the rate of infection was 19.2% among patients with uncontrolled diabetes compared with 0% among patients with controlled diabetes (p=0.143). The mean hemoglobin A1c among patients with uncontrolled diabetes who developed infection was 9.72% compared with 7.34% among those with no infection (p <0.001)

In conclusion, diabetic patients whose blood glucose levels were poorly controlled before surgery as indicated by high hemoglobin A1c were at high risk for postoperative wound infection. Preoperative hemoglobin A1c above 7.34% could serve as a threshold value for significant increased risk of postoperative surgical site infection.

Key words: Diabetes Mellitus, HbA1C, decompressive spine surgery, infection, complications.

Introduction

Diabetes mellitus is a disease of blood glucose dysregulation that is known to cause complications of the microvasculature often leading to cardiovascular, ophthalmic, renal and peripheral vascular disease[1]. The Center for Disease Control and Prevention provides updated statistics about diabetes in United States for audience stated that 30.3 million people have diabetes (9.4% of the US population), 23.1 million people are diagnosed while 7.2 million peoples are undiagnosed[2].

Diabetes impairs wound healing and predispose to wound infection in spine and other surgical sites. Postoperative wound infection have been reported to occur up to 24% of diabetic patients undergoing spine surgery. The mechanism by which diabetes is thought to contribute to infection risk included; increased glucose concentration in wound

fluid, the presence of dysfunctional polymorphonuclear neutrophils & macrophages, impaired lymphocyte chemotaxis, and delayed wound re-epithelialization[3].

Surgical site infection (SSI) is a relatively common complication after spinal surgery. Surgical site infection increases the morbidity, mortality, length of hospital stay, re-admissions, and healthcare costs. Factors known to affect the risk of surgical site infection includes: age, ASA score, obesity, diabetes mellitus, smoking, previous surgeries, previous infections, previous radiation therapy, chronic skin conditions, and how closely the patient adheres to postoperative wound care instructions[4-9]. Surgery-related risk factors includes; the type of surgical approach, the use of instrumentation, bone graft harvesting, estimated blood loss, and time of surgery[10].

For patients with diabetes mellitus undergoing any surgical intervention, it is generally thought that maintaining tight glycemic control in the perioperative period might reduce the risk of complications. For instance, the association between tightly controlled perioperative various glycemic markers, such as the glycated hemoglobin A1c level, has been associated with decreased infectious complications following total joint arthroplasty in the broader orthopedic literature. The hemoglobin A1c level represents an easily obtainable and objective lab value that reflects a patient's glycemic status over a 2-3 month period[11].

The present study was designed to assess the correlation between pre-operative hemoglobin A1c and the incidence of post-operative infection in surgical patients undergoing decomperssive spine surgery. All our patients have diabetes and were diagnosed by internist. Our hypotheses was to good managing diabetics as close to a normal blood glucose level safely, this means levels between 70 to 130 mg/dl before meals and less than 180 mg/dl two hours after starting meal, with an HbA1c less than 7%. Another aim of the current study is to calculate a threshold level of hemoglobin A1c above which the risk of postoperative infection after decompressive spine surgery that increases significantly in patients with diabetes.

Patients and Methods

In the present retrospective study, a total of 40 diabetic patients were selected from both Erbil West Emergency Hospital and Sardam Private Hospital, who underwent decompressive spine surgeries which included various surgical procedures like laminectomies, laminotomies, foraminotomies, and falavectomies for different pathologies like disc herniation, spinal stenosis and etc. These techniques were performed in different regions of the spine like lumber, dorsal and cervical. Reviews of our cases started from January 2017 to November 2018 with different follow-up time.

All our patients had history of diabetes mellitus or were diagnosed by internist that carrying diabetes mellitus with variety of modalities of treatment either on oral hypoglycemic agents or insulin.

Patients age less than 18 years, or who had treated with spine fixation surgeries for different pathologies, or other immunosuppressant diseases were excluded from the study.

Third generation cephalosporin was administered intravenously 30 minutes before starting surgery, and postoperative intravenous antibiotics were orderd for five days. All patients with diabetes mellitus received subcutaneous insulin at postoperative period aiming to lower blood glucose to less than 200 mg/dl.

Our data were collected from hospital and clinic archives with different follow-up schedules, these data included; age, gender, approximate time for surgery which is divided into less than 2 hours or

more than 2 hours, region of spine surgery, and number of spine levels.

Regarding laboratories tests, we used the last hemoglobin A1c and random blood sugar at the day before surgery, although for evidence of infection we used C-reactive protein and white blood cells count as laboratory markers at postoperative follow-up period.

Surgical site infection was diagnosed using the Center for Disease Control and Prevention (CDC) definition and guidelines, Surgical site infection included superficial surgical site infections that occurred within 30 days and deep surgical site and organ space infections that occurred within 30-90 days postoperatively.

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 22). Chi square test of association was used to compare proportions. Fisher's exact test was used when the expected count of more than 20% of the cells of the table was less than 5. Student's t test of two independent samples was used to compare the two means. A p-value of ≤0.05 was considered as statistically significant.

The ethical approval of the present study was obtained from the Kurdistan Board for Medical Specialties. Informed consent was obtained from all the patients prior to study and they were asked to permit the review of their records.

Results

Forty diabetic patients underwent decompressive spine surgery. Fourteen patients had controlled diabetes (group I) and the rest (26) had uncontrolled diabetes (group II). Their mean age was 57.58±10.58 years, ranging from 38 to 78 years. The median was 59 years. The highest proportion (37.5%) of the patients aged 60-69 years, and only 12% aged ≥70 years. No significant difference in age distribution was found between patients with controlled diabetes and patients with uncontrolled diabetes (p=0.964). More than half (57.5%) of the patients were females. No significant differences were detected between the two groups regarding the gender distribution (p=0.169). The majority underwent the operation in Sardam Private Hospital as presented in Table I.

Table I. Basic characteristics of the studied sample.

	Controlled DM		Uncontrolled DM		Total		P value
	No.	(%)	No.	(%)	No.	(%)	
Age (years)							
< 50	4	(28.6)	7	(26.9)	11	(27.5)	
50-59	3	(21.4)	6	(23.1)	9	(22.5)	
60-69	6	(42.9)	9	(34.6)	15	(37.5)	
≥ 70	1	(7.1)	4	(15.4)	5	(12.5)	0.964*
Gender							
Male	8	(57.1)	9	(34.6)	17	(42.5)	
Female	6	(42.9)	17	(65.4)	23	(57.5)	0.169
Center							
West Erbil emergency hospital	2	(14.3)	6	(23.1)	8	(20.0)	
Sardam hospital	12	(85.7)	20	(76.9)	32	(80.0)	0.689*
Total	14	(100.0)	26	(100.0)	40	(100.0)	

*By Fisher's exact test.

Table II shows that the level of surgery was in the lumber region in 77.5%, 15% in the cervical region, and 7.5% in the dorsal region, with no significant difference between the two groups (p=0.836). The operation involved multiple levels in half of the patients (35.7% in controlled, and 57.7% in the uncontrolled diabetes, but the difference was not significant, p= 0.440). The length of surgery was ≥2 hours in 15.4% of patients with uncontrolled diabetes compared with 0% among patients with controlled diabetes (p=0.278).

Table II: Details of the operations

	Controlled DM		Uncontrolled DM		Total		P value
	No.	(%)	No.	(%)	No.	(%)	
Level of surgery							
Lumber	10	(71.4)	21	(80.8)	31	(77.5)	
Cervical	3	(21.4)	3	(11.5)	6	(15.0)	
Dorsal	1	(7.1)	2	(7.7)	3	(7.5)	0.836*
Number of levels							
Single	6	(42.9)	8	(30.8)	14	(35.0)	
Two levels	3	(21.4)	3	(11.5)	6	(15.0)	
Multiple	5	(35.7)	15	(57.7)	20	(50.0)	0.440*
Length of surgery							
< 2 hours	14	(100.0)	22	(84.6)	36	(90.0)	
≥ 2 hours	0	(0.0)	4	(15.4)	4	(10.0)	0.278*
Total	14	(100.0)	26	(100.0)	40	(100.0)	

*By Fisher's exact test.

Table III shows that the C-reactive protein was positive among 26.9% of patients with uncontrolled diabetes compared with 0% among patients with controlled diabetes, but the difference was not significant (p=0.075). The rate of infection was 19.2% among patients with uncontrolled diabetes compared with 0% among patients with controlled diabetes (p=0.143).

Table III: Post-operative outcome

	Controlled DM		Uncontrolled DM		Total		P value
	No.	(%)	No.	(%	No.	(%)	
CRP							
Negative	14	(100.0)	19	(73.1)	33	(82.5)	
Positive	0	(0.0)	7	(26.9)	7	(17.5)	0.075*
Infection							
No	14	(100.0)	21	(80.8)	35	(87.5)	
Yes	0	(0.0)	5	(19.2)	5	(12.5)	0.143*
Total	14	(100.0)	26	(100.0)	40	(100.0)	

*By Fisher's exact test.

The mean hemoglobin A1c among patients with uncontrolled diabetes who developed infection was 9.72% compared with 7.34% among those with no infection (p<0.001) as presented in figure 1.

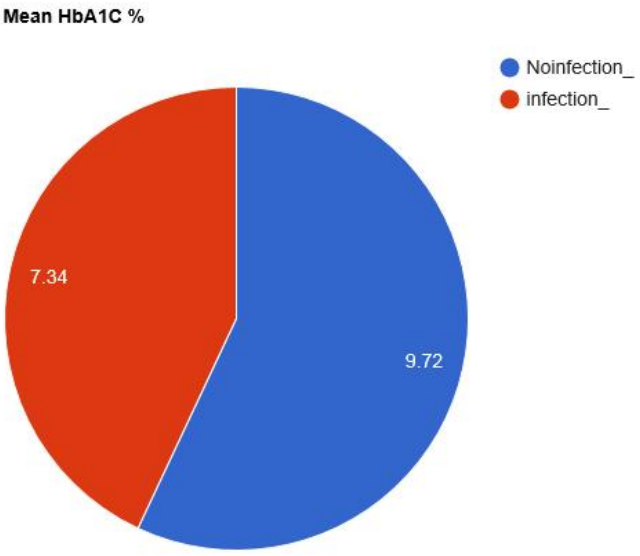

Figure 1: Mean of HbA1C by infection status among patients with uncontrolled diabetes. P<0.001

Discussion

Many studies reported that diabetes is a risk factor for development of wound infection after spinal surgery, although there are only few articles showed correlation between hemoglobin A1c and rate of infection in diabetic patients following spinal procedures.

In our study hemoglobin A1c >7% have been acceptable as a cutoff point for uncontrolled diabetes and value of ≤7% as controlled diabetic patients.

Reported surgical site infections rates ranged from less than 1% to more than 10%, depending on the diagnosis and surgery-related or patient factors[11]. In our study, the rate of infection was was 12.5% as compared with Hikata and colleagues[10] who investigated relationship between perioperative hemoglobin A1c levels and surgical site infection following posterior thoracic and lumbar spinal fusion (retrospective study of 435 patients and 36 of them had diabetes mellitus), their rate of infection was 16.7%. Another study by Jourdan and colleagues[11] which determine hemoglobinA1c level as a predictor of deep infection after single lumber level decompression surgery in diabetic patients, overall rate of postoperative infection ranged from 0.5% to 3.5%.

In our study preoperative hemoglobin A1c was above 7.34% that could be serve as threshold value in which the infection developed following decompressive spine surgery, while the threshold value for two above mentioned reports[10,11] were 7.5% and <7% respectively.

Klemencsic and colleagues[12] published a paper regarding risk factor for surgical site infection after elective lumber surgeries, they found aging could be a risk factor for SSI specially after age of 54 year and explained it by general health state and systemic immunoreactivity declining, in our study the median age was 59 year and no significant difference between age distribution and surgical site infections (p=0.964).

Kim and colleagues[13] found the association between prolonged surgery and postoperative surgical site infection, they analyzed 1831 patients who had posterior lumber interbody fusion, and found that surgical site infections patients had longer surgery than those in the non-

surgical site infections group (p=0.008), however in another case control study by Petilon[14] who found a negative relationship (p=0298), similarly our results was negative (p=0.278).

This study had some limitations regarding the sample size, a larger data should be conducted to confirm our finding.

Conclusion; Diabetic patients whose blood glucose levels were poorly controlled before surgery were at risk for postoperative wound infection. To prevent this complication in diabetic patients, we recommend lowering the Hemoglobin A1c to 7.34 % before performing spine surgery.

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