# Relationship between Preoperative Diabetes and Delirium in Patients Undergoing Neurosurgery

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## ARTICLE INFO

## ABSTRACT

**Background:** One of the surgeries that led to the hospitalization of the patient in the ICU and the creation of postoperative delirium (POD) is neurosurgery. We conducted this study to investigate the relationship between preoperative diabetes and delirium in patients undergoing neurosurgery in the ICU.

**Methods:** In this study, before performing the surgery, the checklist designed by the researchers was completed by interviewing the patients, and the necessary information was completed through clinical examination, interviewing the patient, and studying the documents in the patient's file. Then, the research tool to identify POD was reviewed and completed on a daily basis from the time the patient entered the ICU until the time the patient was discharged. In order to investigate delirium, the researchers conducted a clinical examination, observed the patient's clinical record, and completed the CAM-ICU-7 questionnaire. After completing the research tools, the data were entered into SPSS software, and their analysis was done using version 18 data analysis.

**Results:** Results showed, in patients with diabetes, the prevalence of POD in patients with a history of smoking, high creatinine, agitation, and intubation was higher than in other patients (P value < 0.05). Also, the prevalence of POD diabetic patients was 54 (38.57%), which is 38 (54.28%) in diabetic patients and 16 (22.85%) in non-diabetic patients.

**Conclusion:** Considering that a significant relationship was observed between diabetes and the prevalence of POD, it is important to carry out the necessary prevention in this field.

## Introduction

The increase in the mental and economic burden of chronic diseases is one of the biggest challenges faced by the health and treatment system around the world in recent years [1-3]. Diabetes is a global epidemic and is the most common metabolic disorder caused by impaired insulin secretion and glucose metabolism. Diabetes causes disruption of glucose homeostasis in the body. This disease damages various organs of the body, including the liver, and increases the risk of chronic liver diseases [4-5].

Diabetes is a complex and multifactorial abnormality; in addition to metabolic and environmental factors, genetics also have an effect on its occurrence [6-8]. Considering that diabetes is an incurable disease, it

requires symptom control and continuous medical care. Diabetes leads to the development of micro- and macrovascular complications, primarily due to hyperglycemia and disruptions in metabolic pathways. These patients have a wide range of complications that lead to higher care and treatment costs, reduced quality of life, and increased mortality [9-10].

One of the most important factors in increasing mortality and causing diabetes complications in these patients is non-adherence to diabetes treatment. In fact, controlling diabetes requires frequent and continuous follow-up by the patient, which, if it is not properly managed, leads to hospitalization of the patient [11-12]. Having diabetes makes a person vulnerable and increases the risk of hospitalization. So that if the patient is admitted to the hospital, complications such as bedsores, infections, and psychological problems may occur. One of the psychological problems caused in patients is delirium [13-16].

Delirium is a well-known psycho-neurological syndrome that is characterized by disturbances in the patient's alertness and attention. Delirium is one of the main causes of confusion in hospitalized patients, which can cause states of inactivity, hyperactivity, or a combination of both in patients [17-18]. Factors affecting delirium include drug use, drug poisoning, trauma, infection, cardiovascular disorders, metabolic disorders, electrolyte disorders, pain, reduction of environmental stimuli, being away from family, and hospitalization in the ICU. Hospitalization of the patient in the ICU causes the patient to experience delirium due to the consumption of drugs prescribed in ICU, in addition to reducing environmental stimuli [19-22].

Neurosurgery can cause ICU hospitalization and postoperative delirium (POD). Diseases related to the brain and nervous system have a special sensitivity, and the treatment management of these diseases is one of the priorities of the healthcare system [23-24]. Surgeries related to the brain and nervous system are among the sensitive surgeries; due to the prevention of complications caused by these surgeries, it is necessary that the operated patients be hospitalized in the ICU [25–28].

Considering the prevalence of diabetes as well as surgical complications in patients with it, that is why this study was conducted.

## Methods

We conducted this study in a group of neurosurgery patients, including those who had diabetes prior to surgery. At first, the objectives of the research were explained to the patients, and written informed consent was obtained from all the patients participating in the study.

The inclusion criteria included being over 40 years old, having diabetes according to the opinion of a specialist doctor, and being on the list of neurosurgeries (elective and emergency). Exclusion criteria included severe complications of diabetes, neurological or psychological disorders (such as depression, Parkinson's, and schizophrenia), preoperative cognitive dysfunction, and visual or hearing disorders. The difference in confounding factors such as age, gender, type of anesthetic, duration of diabetes, and hemoglobin A1C (HbA1c) between the case group and the control group reached the minimum possible level in order not to affect the delirium rate. Then the patients were divided into two groups: case (diabetic patients) and control (non-diabetic patients). Before performing the surgery, the checklist designed by the researchers was completed by interviewing the patients, and the necessary information was completed through clinical examination, interviewing the patient, and studying the documents in the patient's file. Then, the research tool to identify POD was reviewed and completed on a daily basis from the time the patient entered the ICU until the time the patient was discharged. The method of completing the tool was that the researchers reported the presence or absence of POD by studying the clinical documentation in the file.

In order to investigate delirium, the researchers conducted a clinical examination, observed the patient's clinical record, and completed the CAM-ICU-7 questionnaire. The CAM-ICU-7 tool comprises seven questions, each with a score ranging from 0 to 7 [29-31].

The data were put into SPSS software after the research tools were finished. Version 16 of the software and descriptive and analytical tests, such as regression, ANOVA, independent t, and paired t, were used to analyze the data.

## Results

The findings of (Table 1) showed the comparison of the demographic characteristics of patients with and without diabetes. The results showed that there was a significant difference between the two groups of patients in every way that was looked at. The only things that did not show a difference were gender, emergency or non-emergency situation, BMI (kg/m²), and history of hospitalization in ICU. The findings of (Table 2) showed the comparison of demographic characteristics of patients according to delirium. and the type of surgery (emergency or elective), sedation, serum creatinine, agitation, intubation, and history of being hospitalized in the ICU. The findings of (Table 3 and 4) showed the relationship between the studied variables and the state of delirium. According to the findings, in patients with diabetes, the prevalence of delirium in patients with a history of smoking, high creatinine, agitation, and intubation was higher than in other patients (P value < 0.05).

**Table 1- Comparison of investigated variables in patients with and without diabetes undergoing surgery**

| Variable | | Total N (140) | Diabetes N (=70) | Nondiabetic N (=70) | P value |
|---|---|---|---|---|---|
| Gender | Male | 73(52.1) | 36(51.4) | 37(52.9) | 0.86 |
| | Female | 67(47.9) | 34(48.6) | 33(47.1) | |
| Surgery Type | Emergency | 70(50) | 37(52.9) | 33(47.1) | 0.50 |
| | Elective | 70(50) | 33(47.1) | 37(52.9) | |
| Current smoking | Yes | 79(56.4) | 37(52.9) | 42(60) | 0.39 |
| | No | 61(43.6) | 33(47.1) | 28(40) | |
| BMI (kg/m2) | ≥25 | 93(66.4) | 38(54.3) | 55(78.6) | 0.002 |
| | <25 | 47(33.6) | 32(45.7) | 15(21.4) | |
| Infection | Yes | 1(0.7) | 1(1.4) | 0(0) | 0.31 |
| | No | 139(99.3) | 69(98.6) | 70(100) | |
| Serum creatinine ≥1.2 | Yes | 58(41.4) | 41(58.6) | 17(24.3) | 0.000 |
| | No | 82(58.6) | 29(41.4) | 53(75.7) | |
| Sedation | Yes | 47(33.6) | 16(22.9) | 31(44.3) | 0.007 |
| | No | 93(66.4) | 54(77.1) | 39(55.7) | |
| Agitation | Yes | 64(45.7) | 48(68.6) | 16(22.9) | 0.000 |
| | No | 76(54.3) | 22(31.4) | 54(77.1) | |
| Intubation | Yes | 43(30.7) | 30(42.9) | 13(18.6) | 0.002 |
| | No | 97(69.3) | 40(57.1) | 57(81.4) | |
| Delirium | Yes | 54(38.6) | 38(54.3) | 16(22.9) | 0.000 |
| | No | 86(61.4) | 32(45.7) | 54(77.1) | |
| History of hospitalization in ICU | Yes | 12(8.6) | 8(11.4) | 4(5.7) | 0.23 |
| | No | 128(91.4) | 62(88.6) | 66(94.3) | |

**Table 2- Comparison of investigated variables in patients with and without Delirium undergoing surgery**

| Variable | | Total N (140) | With Delirium N (=54) | Without Delirium N (= 86) | P value |
|---|---|---|---|---|---|
| Gender | Male | 73(52.1) | 26(48.1) | 47(54.7) | 0.45 |
| | Female | 67(47.9) | 28(51.9) | 39(45.3) | |
| Surgery Type | Emergency | 70(50) | 36(66.7) | 34(39.5) | 0.002 |
| | Elective | 70(50) | 18(33.3) | 52(60.5) | |
| Current smoking | Yes | 79(56.4) | 34(63) | 45(52.3) | 0.22 |
| | No | 61(43.6) | 20(37) | 41(47.7) | |
| BMI (kg/m2) | ≥25 | 93(66.4) | 31(57.4) | 62(72.1) | 0.074 |
| | <25 | 47(33.6) | 23(42.6) | 24(27.9) | |
| Infection | Yes | 1(0.7) | 1(1.9) | 0(0) | 0.20 |
| | No | 139(99.3) | 53(98.1) | 86(100) | |
| Serum creatinine ≥1.2 | Yes | 58(41.4) | 49(90.7) | 9(10.5) | 0.000 |
| | No | 82(58.6) | 5(9.3) | 77(89.5) | |
| Sedation | Yes | 47(33.6) | 8(14.8) | 39(45.3) | 0.000 |
| | No | 93(66.4) | 46(85.2) | 47(54.7) | |
| Agitation | Yes | 64(45.7) | 46(85.2) | 18(20.9) | 0.000 |
| | No | 76(54.3) | 8(14.8) | 68(79.1) | |
| Intubation | Yes | 43(30.7) | 30(55.6) | 13(15.1) | 0.000 |
| | No | 97(69.3) | 24(44.4) | 73(84.9) | |
| History of hospitalization in ICU | Yes | 12(8.6) | 9(16.7) | 3(3.5) | 0.006 |
| | No | 128(91.4) | 45(83.3) | 83(96.5) | |

**Table 3- Comparison of the prevalence of delirium according to the with and without diabetes**

| Variable | | With Delirium, N 54 | | Without Delirium, N 86 | |
|---|---|---|---|---|---|
| | | Diabetes, N (38) | Non diabetic N (16) | Diabetes N (32) | Non diabetic N (54) |
| Gender | Male | 19(50) | 7(43.8) | 17(53.1) | 30(55.6) |
| | Female | 19(50) | 9(56.3) | 15(46.9) | 24(44.4) |
| Surgery Type | Emergency | 34(89.5) | 2(12.5) | 3(46.9) | 31(57.4) |
| | Elective | 4(10.5) | 14(87.5) | 29(90.6) | 23(42.6) |

| | | | | | |
|---|---|---|---|---|---|
| Current smoking | Yes | 22(57.9) | 12(75) | 15(46.9) | 30(55.6) |
| | No | 16(42.1) | 4(25) | 17(53.1) | 24(44.4) |
| BMI (kg/m2) | ≥25 | 24(63.2) | 7(43.8) | 14(43.8) | 48(88.9) |
| | <25 | 14(36.8) | 9(56.3) | 18(56.3) | 6(11.1) |
| Infection | Yes | 1(2.6) | 0(0) | 0(0) | 0(0) |
| | No | 37(97.4) | 16(100) | 32(100) | 54(100) |
| Serum creatinine ≥1.2 | Yes | 35(92.1) | 14(87.5) | 6(18.8) | 3(5.6) |
| | No | 3(7.9) | 2(12.5) | 26(81.3) | 51(94.4) |
| Sedation | Yes | 7(18.4) | 1(6.3) | 9(28.1) | 30(55.6) |
| | No | 31(81.6) | 15(93.8) | 23(71.9) | 24(44.4) |
| Agitation | Yes | 35(92.1) | 11(68.8) | 13(40.6) | 5(9.3) |
| | No | 3(7.9) | 5(31.3) | 19(59.4) | 49(90.7) |
| Intubation | Yes | 27(71.1) | 3(18.8) | 3(9.4) | 10(18.5) |
| | No | 11(28.9) | 13(81.3) | 29(90.6) | 44(81.5) |
| History of hospitalization in ICU | Yes | 7(18.4) | 2(12.5) | 1(3.1) | 2(3.7) |
| | No | 31(81.6) | 14(87.5) | 31(96.9) | 52(96.3) |

**Table 4- Comparison of the relationship between delirium and investigated variables in patients with and without diabetes**

| Variable | Diabetes N (=70) | | | Nondiabetic N (=70) | | |
|---|---|---|---|---|---|---|
| | 95.0% Confidence Interval for B | | P value | 95.0% Confidence Interval for B | | P value |
| | Lower Bound | Upper Bound | | Lower Bound | Upper Bound | |
| Gender | -0.993 | 0.712 | 0.744 | -0.947 | 0.342 | 0.351 |
| Surgery Type | -2.684 | 0.059 | 0.060 | -0.161 | 1.242 | 0.128 |
| Current smoking | 0.316 | 1.946 | 0.007 | -0.841 | 0.613 | 0.755 |
| BMI (kg/m2) | -1.345 | 0.280 | 0.195 | 0.212 | 1.959 | 0.016 |
| Infection | -1.944 | 4.498 | 0.431 | - | - | - |
| Serum creatinine ≥1.2 | -3.522 | -1.154 | 0.000 | -3.199 | -1.381 | 0.000 |
| Sedation | -1.474 | 0.525 | 0.347 | -0.047 | 1.440 | 0.066 |
| Agitation | -2.562 | -0.363 | 0.010 | -3.255 | -1.550 | 0.000 |
| Intubation | -3.141 | -0.697 | 0.003 | -1.769 | -0.083 | 0.032 |

## Discussion

The result showed that the prevalence of delirium in diabetic patients was 54 (38.57%), which is 38 (54.28%) in diabetic patients and 16 (22.85%) in non-diabetic patients. In Alvarez et al.'s study, which examined 99 patients admitted to the ICU, the prevalence of delirium was 57%, and the average time of delirium onset was one day. Moreover, 84% of the delirium-diagnosed patients experienced symptoms within the first 48 hours of admission [30]. In the study by Lee et al. (Korea) in the group of patients undergoing liver transplant surgery who were hospitalized in the ICU, the prevalence of delirium was 17%, of which 8% occurred on the first day after surgery. Also, a significant relationship was observed between the prevalence of delirium and hospital length of stay, mechanical ventilation duration, and ICU length of stay [31].

In Wang et al.'s study (China), which looked at 128 patients in the neurosurgery department, the rate of delirium was 42.2%. Fever, lack of sleep, and physical limitations were all linked to this rate [33]. In the case-control study conducted by Morshed et al. (USA), out of

235 patients who underwent skull surgery, 52 patients, equivalent to 22.1%, experienced delirium. Factors predicting delirium included older age, infection, emergency admission of the patient, and presence of neurological deficit [34]. In the study by Gao et al., with a (N=588,732), the prevalence of POD ranged from 0.83 to 0.88%. Also, Researchers reported factors like age, blood loss, and disorders in the central nervous system as effective factors in delirium [35]. In fact, after neurosurgery, patients hospitalized in the ICU experienced POD, which is consistent with the results of this study.

Regarding the relationship between diabetes and delirium, it was shown that the prevalence of POD was higher in patients with diabetes. In the study by Van et al. (Netherlands), a cohort study was done between 2011 and 2013 to compare delirium in diabetic and non-diabetic patients. They found a significant link between hypoglycemia and delirium [36]. Also, in the study of Shang et al. (China), in a cohort study of patients who underwent orthopedic surgery, the prevalence of POD was higher in diabetic patients [37]. This study confirmed that diabetic patients had a higher prevalence of POD than other patients. Given the complications caused by

diseases, it is essential to take the necessary preventive measures [38-40].

## Conclusion

Considering that a relationship was observed between diabetes and the prevalence of POD, it is important to carry out the necessary prevention in this field.

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