Annals of Clinical Case Reports

Research Article
Published: 25 Sep, 2023

What Can this Effort Bring to Diabetic Post-Menopausal Women Who Insist on Managing Blood Sugar on a Daily Basis During Total Hip Arthroplasty?

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Abstract

Objective: To explore whether diabetic patients with ideal daily blood glucose management can get unexpected benefits during total hip arthroplasty compared with diabetic patients with poor daily blood glucose management.

Method: 184 postmenopausal women with type 2 diabetes mellitus who underwent total hip arthroplasty in our hospital from January 1st, 2020, to April 30th, 2023, were analyzed retrospectively. The postmenopausal women with ideal daily blood glucose management were taken as the study group, and the postmenopausal women with poor daily blood glucose management as the control group. There were 109 cases in the study group and 75 cases in the control group. The differences in perioperative indexes such as Operation Time (OT), intraoperative Blood Loss (IBL), Postoperative Drainage (PD), Days of Antibiotic Use (DAU), Reaching the Time of VAS 3 score (RTVAS 3), Length of Stay (LOS) and Hospitalization Cost (HC) were compared between the two groups.

Results: The PD, the RTVAS 3, and the LOS in the study group were significantly lower than those in the control group ($P<0.05$). There was no significant difference in OT, IBL, DAU, and HC between the study group and the control group ($P>0.05$).

Conclusion: With the help of the comparison of the event of total hip arthroplasty, we found that postmenopausal women who adhere to the daily management of blood glucose and whose blood glucose level is at an ideal level have less blood loss, faster pain relief, and earlier discharge than those with poor daily blood glucose management.

Keywords: Type 2 diabetes; Postmenopausal women; Blood glucose management; Total hip arthroplasty

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Received Date: *05 Sep 2023*
Accepted Date: *20 Sep 2023*
Published Date: *25 Sep 2023*

Citation:
Zhiping C, Weimin C, Guoyang Z. What Can this Effort Bring to Diabetic Post-Menopausal Women Who Insist on Managing Blood Sugar on a Daily Basis During Total Hip Arthroplasty?. Ann Clin Case Rep. 2023; 8: 2477.
ISSN: 2474-1655.

Introduction

Studies have shown that the incidence of diabetes is highest in the 65 to 79 age group, and slows down after 80, suggesting that old age is a high-risk period for diabetes [1]. During the epidemic of COVID-19 in 2020, the mortality rate of patients with advanced age, diabetes, and poor blood glucose control increased significantly [2,3]. The average HbA1c of elderly patients with diabetes in the American Joslin Diabetes Center was controlled at 6.6%, of which 20% of the patients with diabetes whose course of diabetes was more than 50 years had no diabetic complications [4]. It is proven that good self-management levels and healthcare conditions can actively improve the blood glucose control of elderly patients with diabetes. Scientific prevention and treatment of diabetes can not only improve the survival years of patients, but also greatly reduce their blindness, disability, mental retardation, other complications, and improve the quality of life of patients.

HbA1c is an important biomarker for the detection of diabetes, and its level is not affected by short-term fluctuation of blood glucose [5]. In China, HbA1c ≤ 7.0% is used as the blood glucose control standard for elderly diabetic patients who are mainly treated with drugs, have the good self-care ability, or have good auxiliary living conditions [6]. A study revealed that the outcome of patients with early initial treatment of diabetes (i.e., the course of the disease is less than 5 years), blood glucose control levels close to normal (i.e., HbA1c between 6.5% and 7.0%) and full-day blood glucose control within the target range (3.9~10.0 mmol/L) is better than those with late initial treatment and poor long-term blood glucose control [7]. For every percentage increase in

HbA1c, the risk of death from all causes increased by 8% over 5 years [8]. Therefore, HbA1c is not only an important means to monitor the change of blood glucose level, but also an important reference to control the target blood glucose level.

Middle-aged and elderly women are at high risk of osteoporosis, and about 1/3 of postmenopausal women suffer from osteoporosis. The brittle fracture of the hip caused by osteoporosis is the most serious of all brittle fractures. The mortality rate of hip fracture in the elderly is as high as 27% in one year, and the overall risk of death is 3 times that of the general population [9]. The incidence of hip fractures increases with age, especially in women. More than 3 million osteoporotic fractures are expected to occur by 2025, increasing the total cost to $25.3 billion [10].

It is not an easy task to adhere to the daily monitoring and regulation of chronic diseases, which involves regular follow-up and guidance by doctors, the convenience of drugs or treatments, and patients' attention to health. The purpose of our study is to explore whether diabetic patients who adhere to the daily management of blood sugar and whose blood sugar is at an ideal level can reap unexpected benefits in some events, such as full joint replacement, compared with those with poor daily blood glucose management.

Methods

The subjects of this study were postmenopausal women who underwent total hip arthroplasty in Taizhou second people's Hospital from January 1st, 2020, to April 30th, 2023, for a brittle fracture of the femoral neck.

Inclusion criteria

Postmenopausal women; new brittle femoral neck fracture; previous diagnosis of type 2 diabetes; voluntary choice of total hip arthroplasty; the same perioperative analgesia model; the same perioperative anti-infection model.

Exclusion criteria

Type 2 diabetes diagnosis time less than 3 months; with other parts of injury; with other chronic diseases; with severe diabetic complications; with respiratory, digestive or genitourinary system infection; postoperative transfer failed to complete the diagnosis and treatment process.

Grouping criteria

1. The patient's admission history was collected by answers about whether she had diabetes in the past, how to treat diabetes, and whether her blood sugar was tested regularly. 2. The results of HbA1c test on admission of 7% HbA1c was taken as the dividing line for diagnosis; 3. Combination of the results of 1 and 2. Thus, patients with previous diagnoses of diabetes, regular drug treatment, regular detection of blood glucose, and HbA1c less than 7% were included in the study group. Those who were previously diagnosed with diabetes, daily irregular drug treatment, irregular blood glucose detection, and HbA1c greater than 7% were included in the control group. Those whose previous information were not in accordance with HbA1c were excluded.

Anesthesia

Anesthesia is mainly divided into General Anesthesia (GA) and Intraspinal Anesthesia (IA). The specific choice of anesthesia was determined by the wishes of the patients and the evaluation results of the anesthesiologist.

Total hip arthroplasty

The operation was performed by the same group of experienced doctors. In the healthy lateral position, the skin was cut open by the posterolateral approach of the hip joint and separated layer by layer. After dislocation of the hip joint, the femoral head was removed by osteotomy through the femoral neck. Acetabular file grinding, shaping, mold testing, implantation of the acetabular prosthesis, and fixation. After the opening of the proximal femur, the medulla was reamed step by step and implanted into the biological femoral stem prosthesis. The hip joint was reduced and the range of motion and tightness of the joint were tested. Next, bleeding was stopped, wound rinsed, and then the joint capsule and external rotators reconstructed. the drainage tube was placed and the incision sutured layer by layer.

Postoperative drainage

The inner orifice of the drainage tube was placed in the hip joint cavity, and the external orifice was pierced and connected to the drainage bag at 2 cm under the lower edge of the incision. The drainage tube was fixed with silk thread. The volume of drainage was measured by the responsible nurse at 24 h and 48 h after the operation. The responsible doctor removed the drainage tube under the following conditions: If the drainage volume is less than 100 ml at 48 h, and if the drainage volume is greater than 100 ml at 48 h, after clamping for 8 h.

Analgesia model: 0.2 g celecoxib was taken orally one day before the operation, once in the morning and evening. After the operation, a self-controlled intravenous analgesia pump combined with non-steroidal anti-inflammatory analgesics was used to relieve pain, and the drugs were given as needed.

Anti-infective model: The first and second-generation cephalosporins are preferred drugs for anti-infective whereas levofloxacin or clindamycin was used for those who are allergic to cephalosporins. An adequate intravenous drip of a single antibiotic was routinely used half an hour before the operation and 48 h after the operation. Consequently, based on the condition of the incision, the index of inflammation, and the results of bacterial culture of incision secretion, we decided whether to change antibiotic infection prevention treatment to anti-infection treatment.

VAS score: The postoperative pain was evaluated by Visual Analogue Scale (Visual Analogue Scale, VAS). **Evaluation score range:** 0-10 points, the higher the score, the more severe the pain, with 0 points as painless, and 10 points as unbearable severe pain. The demarcation points of pain degree that does not affect sleep was divided into 3 points. The Reaching Time of VAS 3 score (RTVAS 3) was taken as the number of days required for postoperative pain relief so that sleep was not affected.

Statistical analysis

SPSS26.0 software (IBM, Armonk, USA) was used to analyzed the data. The data collected were tested by Shapiro-Wilks test and Levene's test for normal distribution and homogeneity of variance respectively. The test results in accordance with the normal distribution are expressed as ($x \pm s$), and the results that do not conform to the normal distribution are expressed as (M (P25, P75)). Bivariate normal distribution data were compared by single factor analysis of variance and non-bivariate normal distribution data by Kruskal Wallis test. The counting data were expressed by (n (%)), and the differences between groups were tested by the χ^2 test. $P<0.05$ indicates that the difference is statistically significant.

Results

Baseline data

A total of 184 subjects were enrolled, with an average age of 71.0 ± 6.9 years old, including 109 in the study group and 75 in the control group.

In the study group, the average age was 71.48 ± 7.14 years, and the average Course of Disease (COD) was 5.77 ± 2.46 years. In the control group, the average age was 69.85 ± 6.44 years, and the average COD was 6.00 (2.40, 10.50) years. There was a balance between the study group and the control group in terms of age and COD, and there was no significant difference between the two groups (P>0.05). The average HbA1c was 5.60 ± 0.70% in the study group and 8.50 ± 0.80% in the control group, which was significantly higher than that in the study group (P<0.001) (Table 1).

Perioperative indexes

In the study group, the average Postoperative Drainage (PD) was 154.52 ± 94.72 ml, the average RTVAS 3 was 5.90 ± 2.60 days, and the average Length of Stay (LOS) was 13.80 ± 3.20 days. In the control group, the average PD was 224.62 ± 95.36 ml, the average RTVAS 3 was 7.90 ± 2.00 days, and the average LOS was 16.20 ± 2.50 days. The PD, the RTVAS 3, and the LOS in the study group were significantly lower than those in the control group (P<0.05).

In the study group, the average Operation Time (OT) was 64.58 ± 10.48 min, the average Intraoperative Blood Loss (IBL) was 237.74 ± 64.95 ml, the average Days of Antibiotic Use (DAU) was 6.80 ± 3.10 days, and the average Hospitalization Cost (HC) was 37535.54 ± 10416.46 yuan. In the control group, the average OT was 65.15 ± 8.69 min, the average IBL was 276.46 ± 55.49 ml, the average DAU was 7.30 ± 2.20 days, and the average HC was 34802.11 ± 7950.89 yuan. There was no significant difference in OT, IBL, DAU and HC between the study group and the control group (P>0.05) (Table 2).

Discussion

This study analyzed the perioperative differences between diabetic postmenopausal women who adhere to daily blood glucose management and maintain an ideal level of blood glucose management and those with poor daily blood glucose management during the perioperative period of total hip arthroplasty. We found that the PD, RTVAS 3, and LOS in the study group were significantly lower than those in the control group.

In general, long-term hyperglycemia damages the structure and function of blood vessels and corresponding organs and tissues, and sometimes can even lead to organ failure, which is life-threatening. Among the elderly diabetic patients with renal injury caused by diabetic microangiopathy, 1/3 was caused by diabetes alone [11]. Notably, severe diabetic microangiopathy often lead to cardiomyopathy, cardiac autonomic neuropathy, arrhythmia, and lack of induction to myocardial ischemia [12]. However, elderly patients with long COD are often accompanied by multi-vessel coronary artery disease, and serious cardiovascular adverse events such as asymptomatic myocardial infarction and sudden cardiac death may occur in clinic. Thus, long-term poor management of blood glucose in patients with diabetes can cause serious damage to the cardiovascular system. In this regard, our results show that there is no significant difference in intraoperative blood loss between postmenopausal women who adhere to daily management and postmenopausal women who are not managed or not managed enough, but the postoperative drainage volume of the former is significantly lower than that of the latter. This implies that long-term and reasonable control of blood glucose can help reduce the damage to vascular structure and function caused by diabetes and reduce blood loss after operation.

Under a certain genetic background, long-term hyperglycemia and related oxidative stress can cause peripheral nerve ischemia, axonal injury or demyelinating changes in the donor area through microvascular damage, resulting in sensory, motor, and autonomic neuronal function weakening and decline. This eventually correspond to pain temperature tactile disappearance, muscle atrophy, and multi-system sympathetic/vagal nerve regulation abnormality [13]. As the most common chronic complication of diabetes, diabetic peripheral neuropathy mainly affects cranial nerve, spinal nerve, distal nerve, and autonomic nerve, among which Distal Symmetric

Table 1: Comparison of baseline data in diabetic postmenopausal women with ideal daily blood glucose management and those with poor daily blood glucose management.

	Control group	Study group	Test value	*P* value
Age (year)	69.85 ± 6.44	71.48 ± 7.14	0.509	0.479
COD (year)	6.00 (2.40, 10.50)	5.77 ± 2.46	-0.061*	0.543
HbA1c (%)	8.50 ± 0.80	5.60 ± 0.70	169.157	<0.001

*Indicates that the statistical value of correlation analysis is the value of Kruskal Wallis test
COD: The Course of Disease

Table 2: Comparison of perioperative indexes of total hip arthroplasty in diabetic postmenopausal women with ideal daily blood glucose management and those with poor daily blood glucose management.

	Control group	Study group	Test value	*P* value
OT (min)	65.15 ± 8.69	64.58 ± 10.48	0.03	0.863
IBL (ml)	276.46 ± 55.49	237.74 ± 64.95	3.527	0.067
PD (ml)	224.62 ± 95.36	154.52 ± 94.72	4.997	0.031
DAU (day)	7.30 ± 2.20	6.80 ± 3.10	0.283	0.598
RTVAS3 (day)	7.90 ± 2.00	5.90 ± 2.60	5.708	0.021
LOS (day)	16.20 ± 2.50	13.80 ± 3.20	5.541	0.023
HC (yuan)	34802.11 ± 7950.89	37535.54 ± 10416.46	0.716	0.402

OT: The Operation Time; IBL: Intraoperative Blood Loss; PD: Postoperative Drainage; DAU: Days of Antibiotic Use; RTVAS3: Reaching Time of VAS 3 Score; LOS: Length of Stay; HC: Hospitalization Cost

Polyneuropathy (DSPN) is the most representative. More than half of the elderly patients with diabetes, especially those with a history of more than 10 years, are involved [14]. The main clinical manifestations of patients affected by DSPN are bilateral symmetrical distal limb pain, including spontaneous pain, and hyperalgesia [15]. Herein, our results indicate that pain relief is faster in the study group than in the control group, suggesting that diabetic patients with the same COD have less neurological damage from hyperglycemia if they maintain a reasonable blood glucose level. Meanwhile, it also suggests that for diabetic patients who fail to properly control their blood sugar for a long time, even in the absence of no typical symptoms of peripheral neuropathy, their ability to relieve pain after trauma or surgery may be declined.

Of note, diabetic patients are prone to a certain degree of heart, brain, kidney, and other important organ damage due to long-term endocrine and metabolic disorders, and inevitably cause drastic changes in blood sugar in the face of surgery, anesthesia, fasting, and other stimuli, thus aggravating the injury of important organs and increasing the incidence of infection, poor wound healing, and prolonged hospitalization. Evidence indicates that the postoperative mortality rate of diabetic patients is 5 times higher than that of non-diabetic patients [16,17]. Comparatively, we found that the LOS of the study group with good blood glucose control was significantly shorter than that of the control group with poor blood glucose control. This observation corroborated with previous research [18,19]. Therefore, patients with abnormal blood glucose inevitably need blood glucose adjustment and detection. In the case of patients whose blood sugar is significantly elevated and difficult to control, treatment may be executed through a more professional program given by the endocrinology department after consultation. The increased risk of postoperative infection caused by hyperglycemia [20] and prolonged postoperative pain relief are also factors affecting the length of stay.

Based on the comparison of the event of total hip arthroplasty, we found that the study group had less blood loss, faster pain relief, and earlier discharge than the control group. Of course, brittle fractures are something no one wants to experience, but when it's a foregone conclusion, this effort has reaped unexpected benefits for postmenopausal women with diabetes who insist on managing their blood sugar on a daily basis and maintaining ideal levels. Therefore, for people with diabetes, the benefits of long-term and reasonable control of blood sugar may go beyond the intuitive items on the health education list.

Limited to the singleness of the research center, our results have the following shortcomings. 1. China has the largest number of diabetic patients in the world [21], but the sample size in this study is small because of the patients with other chronic diseases, severe diabetic complications, respiratory, digestive or genitourinary system infections, and other site injuries. 2. Considering the traffic, medical convenience, and other reasons, although the wound healed well and the inflammatory index returned to normal after operation, local patients still tend to be discharged after removing stitches. As a result, the average LOS in both groups was about 2 weeks, and the difference in length of stay between the two groups was affected.

Funding

This study was funded by Young and middle-aged doctors training project of excellent talent for osteoporosis and bone mineral disease (G-X-2019-1107); Scientific Research Project of Jiangsu Provincial Health Committee (M2022119).

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