
Diabetes Mellitus Related to Clinical Outcomes and Postoperative Bleeding of Total Knee Arthroplasty

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Abstract: To investigate the effect of diabetes mellitus (DM) on the postoperative clinical outcomes and perioperative bleeding volume in patients with primary total knee arthroplasty. Clinical data of 49 patients with osteoarthritis underwent primary total knee arthroplasty (TKA) were collected and retrospectively analyzed from October 2015 and September 2016. Patients were set to two groups with (A) or without DM (B). Data were compared between 2 groups, including postoperative hemoglobin, hematocrit (Hct), Hb, dominant blood loss, hidden blood loss, theoretical total blood loss, range of joint motion, VAS score, increasing rate of circumference length above 10 cm of the knee, HSS score, the operation time and hospitalization days. The results showed that the Hb and Hct of A group was significantly less than the B group ($P < 0.05$). The dominant blood loss, the hidden blood loss and theoretical total blood loss of A group was significantly higher than B group ($P < 0.05$). The hospitalization days of A group was significantly longer than B group ($P < 0.05$). The VAS score and the increasing rate of circumference length above 10 cm of the knee of A group was significantly higher than B group at 3 days ($P < 0.05$). The patients were all followed up 12 weeks. The HSS score of A group was significantly lower than B group at 4 weeks ($P < 0.05$). There was no significant difference in the HSS score between 2 groups at 12 weeks after operation ($P > 0.05$). The prosthesis was in good position, without loosening, subsidence, or osteolysis. In general, patients with DM got TKA have a higher bleeding and longer hospitalization days. DM acts as an adverse impact on recent functional recovery after TKA.

Keyword: Knee Osteoarthritis, Diabetes Mellitus, Total Knee Arthroplasty, Blood Loss

1. Introduction

With the arrival of the aging society, the incidence of osteoarthritis (OA) is increasing, which has become the second high incidence disease among the population over the age of 50, after the cardiovascular disease [1, 2]. OA usually involves the knee joint and other weight-bearing joint, making the degeneration of cartilage and subchondral bones, the contracture of capsule and the surrounding ligaments, finally leading to the joint deformity and activity disorders, greatly affecting patients' living quality of life. Total knee arthroplasty (TKA), as one of the most successful orthopedic surgeries in 20ths century, can effectively relieve the pain of OA patients in late stage and make end-stage OA patients return to normal life [3]. However, the outcome of TKA is affected by many factors, including diabetes mellitus (DM). With the

trend of becoming the largest DM country of China, diabetic osteoarthritis will receive its peak in the future, thus to elucidate the relationship of DM and OA on TRK is of special importance [4, 5]. The current study comparatively analyzed the affecting indexes of patient under TKA with or without DM, trying to provide evidences for the clinical treatment of diabetic osteoarthritis patients.

2. Materials and Methods

2.1. Study Design

Retrospective analysis was performed to the data of patients under unilateral TKA from Oct 2015 to Sep 2016 in the First Affiliated Hospital of Jinan University. Patients were divided

into two groups with or without DM. The inclusion criteria of OA: (1) according to the OA guideline by Chinese Medical Association Orthopedic Branch to diagnosis OA; (2) the first time for TKA; (3) post-operative fluid replacement less than 2000 ml. Exclusion criteria: (1)

2.2. Surgical Procedures

The pre-operation preparation and surgical procedures are the same between the two groups. Patients were given antibiotics and tranexamic acid intravenous infusion 30 min before the surgery and the posterior stabilizing platform knee prosthesis were applied (Biomet, Germany). Surgeries were done under combined spinal epidural anesthesia, supine position and balloon tourniquet, 100 mmHg systolic blood pressure. Front knee incision, medial patellofemoral ligament approach were applied with normal TKA procedure. Analgesic pumps were given post-surgery. Oral rivacipine was given for anticoagulant therapy from day 1. 48 h later patients were doing rehabilitation exercise. 2 week later, the stitches were discharged and patients were left hospital when joint activity > 95 °.

2.3. Efficacy Evaluation Indexes

Perioperative blood loss related indicators: (1) hematocrit (Hct) and Hemoglobin (Hb): preoperative and 3 days postoperative; (2) Theoretical total blood loss = preoperative blood volume × (preoperative Hct- postoperative Hct); (3) Dominant blood loss = intraoperative blood loss +

postoperative blood loss; (4) Recessive blood loss = theory of total blood loss + blood transfusion - dominant blood loss.

Surgery efficacy evaluation indicators: operation time and hospitalization time; VAS pain score 3 days postoperative; joint activity 3 and 7 days postoperative; swelling degree 3 and 7 days postoperative; HSS score 4 and 12 weeks postoperative; postoperative complications, including incision healing, superficial blisters, superficial soft tissue infections, deep venous thrombosis and joint infection loosening.

2.4. Statistical Analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences, version 20.0 for Windows. A two-sided P-value <0.05 was considered statistically significant.

3. Results

3.1. Perioperative Blood Loss Related Indicators

The general data of the patients in the two groups (OA with DM, experimental group) and (OA without DM, control group) showed no significant differences. The 3d postoperative Hb and Hct values were significantly decreased in OA with DM group ($P < 0.05$, Table 1). The recessive blood loss, dominant blood loss and theoretical total blood loss were all significantly larger than the control group ($P < 0.05$, Table 1).

Table 1. Perioperative blood loss related indicators ($\bar{x} \pm s$).

| Groups | Hb (g/L) | | Hct (%) | | Recessive blood loss (mL) ^a | Dominant blood loss (mL) ^a | Theoretical total blood loss (mL) ^a |
|--------|----------------|-------------------------------|--------------|-------------------------------|--|---------------------------------------|--|
| | preoperative | 3d postoperative ^a | preoperative | 3d postoperative ^a | | | |
| OA+DM | 124.76 ± 10.92 | 76.39 ± 14.96 | 38.54 ± 3.64 | 19.92 ± 5.06 a | 526.86 ± 162.67 a | 558.17 ± 233.81 a | 1076.42 ± 321.37 a |
| OA | 128.90 ± 13.40 | 86.01 ± 17.68 | 39.65 ± 3.24 | 26.28 ± 4.16 | 411.36 ± 181.41 | 423.27 ± 207.46 | 826.32 ± 296.62 |

a, compare with control group (B group), with significant difference, $P < 0.05$.

3.2. Surgical Efficacy Evaluation

The operation time showed no significant difference between the two groups ($P > 0.05$, Table 2). The VAS score 3d postoperative decreased significantly than the OA group ($P < 0.05$, Table 2). The hospitalization time was longer, the 3d postoperative VAS score was increased, the 3d postoperative swelling degree was severer in OA+DM group than OA group ($P < 0.05$, Table 2).

Table 2. VAS score, operation and hospitalization time ($\bar{x} \pm s$).

| Groups | VAS | | Swelling degree | | Operation time (min) | Hospitalization (d) ^b |
|--------|--------------|---------------------------------|-------------------------------|------------------|----------------------|----------------------------------|
| | preoperative | 3d postoperative ^{a,b} | 3d postoperative ^b | 7d postoperative | | |
| OA+DM | 8.39±0.32 | 6.02±0.43 | 8.63 ± 0.72 | 5.33 ± 0.64 | 117.26±10.73 | 15.26±1.53 |
| OA | 7.92±0.27 | 4.29±0.31 | 5.96 ± 0.43 | 4.97 ± 0.53 | 101.33±10.82 | 10.13±1.67 |

a, compared with preoperative value, with significant differences ($P < 0.05$);

b, OA+DM group compared with OA group, with significant differences ($P < 0.05$).

All patients were followed up, of 13-15 weeks and average 14.7 weeks. The knee functions in both the two groups were improved, HSS score of postoperative 4 weeks and 12 weeks were both significantly improved ($P < 0.05$, Table 3) and HSS score of postoperative 4 weeks in OA+DM group showed significant difference than OA group ($P < 0.05$, Table 3). The

Joint function id 3d postoperative decreased significantly in OA+DM group ($P < 0.05$, Table 3). All the incisions were healed, no complications such as fat liquefaction, incision dehiscence and infection, occurred. There was no pulmonary embolism and deep vein thrombosis occurred.

Table 3. Joint function and HSS score in hospitalization ($\bar{x}\pm s$).

| Groups | Joint activity (°) | | | HSS Score | | |
|--------|--------------------|-------------------------------|------------------|--------------|---------------------------------|--------------------------------|
| | preoperative | 3d postoperative ^b | 7d postoperative | preoperative | 4w postoperative ^{a,b} | 12w postoperative ^a |
| OA+DM | 81.37 ± 12.57 | 55.93 ± 11.82 | 108.42 ± 12.63 | 49.83 ± 6.17 | 61.28 ± 6.95 | 82.73 ± 10.27 |
| OA | 82.68 ± 11.17 | 68.97 ± 10.81 | 110.81 ± 14.79 | 51.65 ± 8.63 | 72.28 ± 8.67 | 83.36 ± 9.21 |

a, compared with preoperative value, with significant differences ($P < 0.05$);

b, OA+DM group compared with OA group, with significant differences ($P < 0.05$).

4. Discussion

Although the incidence of OA is high, the mechanisms remain obscure. The understanding of OA is growing, from 'wear and tear' to 'whole joint disease'. Recently, more and more evidences suggest that metabolic syndromes are related with OA, inflammation, immune system, genetic factors and hormones are all involved in the development of OA, broking the balance between synthesis and degradation of articular chondrocytes, extracellular matrix and subchondral bones [1, 2]. OA has become a part of the metabolic syndromes. And DM, as one important part of metabolic syndromes, is attracting the attention of the function in OA development [5]. In 2003, Mariely and the colleagues compared the data of 100 DM and 102 non-DM patients from Puerto Rico, via the analysis of multivariate regression curve, they showed that 49% of DM patients accompanied with DM, and only 26.5% of non-DM patients showed no OA, suggesting that DM patients had high risk of OA [6]. Then, Georg and the colleagues, by the nearly 20 years' follow-up of 927 participator, showed for the first time that DM was an independent risk factor of OA, with the exclusion of sex, age, BMI and other risk factors [7]. These studies show that DM is closed related with the OA development, DM is the independent risk factor, and diabetic osteoarthritis is arising the attention.

DM is a common chronic disease worldwide, showing significant upward trend along with the growing aging population. Currently, China is becoming the largest DM country, with estimated 143 million people in 2035. Thus, there will be a treatment peak of diabetic osteoarthritis disease. According to the statistics, among the patients who received TKA, the ratio of DM is increasing from 8.3% to 25.7%, and the age is younger [8-12]. Also, among the DM patients, the rate of hip or knee replacement is increasing, nearly 52% [13, 14]. Thus, to elucidate the role of DM during TKA is also critical for the treatment of OA.

In general, this study indicates that DM would increase the blood loss during TKA perioperative period, impact the function recovery postoperatively and increase postoperative complications. Preoperative assessment should be applied for cardiopulmonary conditions, comprehensive control of blood sugar. Preoperative education should be given to prevent infection and DVT formation, thus to increase the surgical outcome and patients satisfaction rate.

5. Conclusion

We investigate the effect of diabetes mellitus on the

postoperative clinical outcomes and perioperative bleeding volume in patients with primary total knee arthroplasty. Clinical data of 49 patients with osteoarthritis underwent primary total knee arthroplasty were collected and retrospectively analyzed. The results suggest that DM increases the blood loss during TKA perioperative period, impacts the function recovery postoperatively and increases postoperative complications. Preoperative assessment should be applied for cardiopulmonary conditions, comprehensive control of blood sugar.

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