CLINICAL ARTICLE

Comparison between Drainage and Non-drainage after Total Hip Arthroplasty in Chinese Subjects

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Objective: To assess the difference between drainage and non-drainage after total hip arthroplasty (THA) in Chinese subjects by evaluating post-operative complications and joint function.

Methods: One hundred and sixty-eight patients undergoing THA were randomly allocated into drainage (83 patients) and non-drainage groups (85 patients). All surgeries were performed by one surgical team using the same pre-, intra-, and postoperative techniques. Measured items included: hemoglobin (Hb), superficial and deep wound infection, volume of blood transfusion, wound hematoma thickness, range of motion (ROM) of the hip, wound healing time, ecchymosis and tension vesicles around the wound.

Results: Early after THA, the Hb decreased significantly in the drainage group. There was no significant difference between non-drainage and drainage groups in need for or volume of blood transfusions (9.6% vs 8.2%, $P = 0.100$; 3.8 units vs 2.9 units, $P = 0.089$, respectively). In the non-drainage group, the incidence of superficial infection, ecchymosis and tension vesicles was significantly higher than in the drainage group (10.6% vs 2.4%, $P = 0.031$; 12.9% vs 3.6%, $P = 0.026$; 16.5% vs 4.8%, $P = 0.013$, respectively). In addition, the non-drainage group had a greater volume of hematomas ($P = 0.000$). Patients in the non-drainage group had smaller ROMs early after surgery but the final ROMs did not differ significantly between groups. No deep infection occurred in either group.

Conclusion: Non-drainage may reduce postoperative blood loss but has no benefits regarding blood transfusion or deep infection. It may cause more post-operative complications because of restriction of early postoperative exercise by pain and swelling. Therefore we suggest routine use of drainage after THA.

Key words: Drainage; Non-drainage; Total hip replacement

Introduction

In China, drainage is frequently used routinely after total hip arthroplasty (THA). Because this procedure involves the medulla, THA wounds are prone to formation of hematomas. Hematomas may increase incision tension, leading to wound discharge and providing a good medium for bacteria. It is thought that drainage reduces the incidence of postoperative hematomas, thus preventing infection^{1,2}. Nevertheless, some recent studies have claimed that drainage can cause other problems and does not reduce hematoma formation and risk

of infection. Furthermore, some studies have shown that drainage increases blood loss after THA, which may both lead to increased transfusion requirements and provide an entry point for skin micro-organisms^{3,4}. Several studies have found no significant differences between drainage and non-drainage in hematoma formation, rehabilitation time and post-operative complications^{5,6}. Thus, whether drainage should be used after THA is still controversial.

In China, because of a shortage of blood, high-risk of disease transmission by transfusions and very high patient

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Disclosure: The authors declare that they have no competing interests.

Received 16 November 2013; accepted 16 December 2013

expectations for this operation, we pay considerable attention to blood loss, transfusion and complications after THA.

Our hypothesis was that non-drainage may have no benefits regarding blood transfusion and may cause other postoperative problems. We therefore undertook this prospective, randomized study to compare drainage and non-drainage after THA.

Materials and Methods

This study included 168 patients who underwent primary unilateral THA in West China Hospital of Sichuan University between June 2011 and January 2012. Inclusion criteria were primary unilateral THA due to osteoarthritis or osteonecrosis of the femoral head. Exclusion criteria were revision cases, blood coagulation disorders, corticosteroid treatment and concomitant medical problems such as uncontrolled hypertension, chronic obstructive pulmonary disease, heart failure, severe cardiovascular disease, recent myocardial infarction, recent stroke, liver failure, renal failure and history of deep vein thrombosis. In addition, three patients had had intermittently used nonsteroidal anti-inflammatory drugs (trifloxystrobin) for 3 years pre-operation were excluded. This study was approved by our institutional review board and all patients gave their written informed consent.

All operations were performed by one surgical team under general anesthesia using biological fixation prostheses with Pinnacle cup and Corail stem (DePuy, Warsaw, IN, USA). A standard posterolateral approach and minimally invasive techniques were used. Before closure, a nurse opened a sealed, opaque envelope, in which was an instruction on whether to employ drainage. These instructions were allocated randomly by another person who was not involved in this research. In the drainage group, a silicone tube was inserted (removed 24 hours later^{4,7}), then the wound closed. In the non-drainage group direct closure was performed. All wounds were covered with ordinary dressing without any compression. Fraxiparine (GlaxoSmithKline, Bondeville, France) was injected s.c. once a day from the first postoperative day until discharge for thrombosis prophylaxis (dosage as follows: weight >60 kg, 0.4 mL; 50–60 kg, 0.3 mL; <50 kg, 0.2 mL)⁸ in both groups and celebrex (Pfizer, Caguas, Puerto Rico) was used as required. Drains were removed 24 hours post-operation. All patients were asked to perform ankle flexion and extension exercises in bed immediately after the procedure, then progressive ambulation exercises with partial weight bearing on the second postoperative day with the assistance of a walker or crutches.

The criteria for post-operative blood transfusion were hemoglobin (Hb) <8 g/dL or Hb <10 g/dL with clinical signs of hypovolemia (drop in blood pressure below 100 mm Hg, tachycardia >100 beats/min, urine output <30 mL/h)⁹. The wounds were assessed for leakage and soaked dressings requiring reinforcement postoperatively. Pre-operation and on the first, third and seventh post-operative days the following data were collected: Hb, evidence of superficial (redness, swelling of wound and presence of discharge) and deep wound infection, presence of ecchymoses and tension vesicles, volume of any

blood transfusion, volume of drainage and dressing times. Wound hematoma thickness was assessed by ultrasonography on the third postoperative day¹⁰). The duration of hospitalization was recorded and range of motion (ROM) of the hip assessed pre-operation and on leaving the hospital. Blood loss was calculated based on the Hb balance method¹¹; evidence of deep vein thrombosis (DVT) and pulmonary embolism (PE) was also looked for and recorded. All patients were followed up in a joint replacement clinic 1 and 2 weeks then 1, 2 and 3 months after discharge from hospital, when the ROM, presence of infection and other complication such as dislocation and pain were recorded.

Statistical analysis was performed using SPSS 13.0 (SPSS, Chicago, IL, USA) computer software. Student's *t*-test and Pearson χ^2 test were used. *P* < 0.05 was considered significant.

Results

Relevant patient characteristics are shown in Table 1; there were 83 patients in the drainage and 85 in the non-drainage group. All patients tolerated the operation well and there were no intra-operative complications. The mean calculated intra-operative blood loss in the drainage and non-drainage groups was 271.2 mL and 254.4 mL, respectively (*P* = 0.323). The non-drainage group had higher Hb levels than the drainage group on the first and third postoperative days, whereas on the 7th day the difference was not significant. However, there was no significant difference between the drainage and non-drainage groups in terms of transfusion rate (9.6% vs 8.2%, respectively, *P* = 0.100) and average blood transfusion volume (3.8 units vs 2.9 units, respectively; *P* = 0.089, Table 2).

The incidence of superficial infection, ecchymoses and tension vesicles was significantly higher in the non-drainage than the drainage group (10.6% vs 2.4%, respectively, *P* = 0.031; 12.9% vs 3.6%, respectively, *P* = 0.026; 16.5% vs 4.8%, respectively, *P* = 0.013). There was no secondary vesicle infection. In addition, the non-drainage group had larger hematomas than the drainage group (*P* = 0.000) and their dressings required more reinforcement. However, there was no significant difference in length of hospital stay (10.5 d vs 10.2 d,

TABLE 1 Characteristics of drainage and non-drainage patients

Index	Drainage	Non-drainage	<i>P</i>
Number of patients	83	85	—
Male : female	41:42	40:45	0.441*
Age (mean ± SD, years)	60.2 ± 11.3	59.8 ± 6.4	0.215†
Diagnosis (OA : ONFH)	41:42	38:47	0.512*
BMI [mean ± SD, kg/m ²]	23.5 ± 1.9	23.7 ± 1.6	0.409†

*, based on Pearson χ^2 test; †, based on Student's *t*-test; OA, osteoarthritis; BMI, body mass index; ONFH, osteonecrosis of the femoral head.

TABLE 2 Comparison of blood loss, Hb levels and blood transfusions between drainage and non-drainage groups

Index	Drainage	Non-drainage	P
Blood loss intra-operation (mean $\pm$ SD, mL)	271.2 $\pm$ 68.6	254.4 $\pm$ 71.1	0.323†
Volume of drainage (mean $\pm$ SD, mL)	359.2 $\pm$ 216.2	0	0.000†
Hb (mean $\pm$ SD, g/L)			
Pre-operation	121.2 $\pm$ 17.1	120.9 $\pm$ 15.5	0.939†
Post-operation (first day)	97.3 $\pm$ 14.3	108.4 $\pm$ 13.2	0.001†
Post-operation (third day)	94.7 $\pm$ 20.0	106.7 $\pm$ 13.3	0.003†
Post-operation (seventh day)	113.9 $\pm$ 13.9	112.3 $\pm$ 13.6	0.615†
Blood transfusion cases (cases [%])	8 (9.6)	7 (8.2)	0.100*
Blood transfusion volume (mean $\pm$ SD, units)	3.8 $\pm$ 0.7	2.9 $\pm$ 1.1	0.089†

*Based on Pearson χ^2 test; †, based on Student's t-test.

respectively, $P = 0.478$, Table 3). The ROM values pre-operation, on discharge, 1 and 2 weeks and 1, 2 and 3 months after operation are shown in Figure 1. Superficial infections of surgical wounds were successfully treated with oral antibiotics. No deep infections or dislocations occurred in either group. Two patients complained of mild hip pain 3 and 4 weeks after surgery in the drainage group. No clinically evident DVTs or PE occurred in either group.

Discussion

The most important reasons for the use of drainage are to reduce the formation of hematomas and infection rate^{1,10}. Hematomas increase the tension of incisions and decrease tissue perfusion, providing an ideal medium for bacterial culture; subsequent fibrosis may affect hip motion. According to Alexander *et al.*, wound fluids provide an ideal medium for bacterial culture because they are deficient in opsonic proteins and thus unable to opsonize bacteria for phagocytosis and kill bacteria by normal neutrophils². Whether drainage can prevent formation of hematomas is controversial¹²⁻¹⁴. In our study, we used ultrasound to measure the thickness of hematomas and found the mean thickness was greater in the

non-drainage than the drainage group (5.1 mm vs 3.0 mm, respectively, $P = 0.000$). Moreover, the non-drainage group had a higher incidence of ecchymoses, tension vesicles and superficial infection than the drainage group. This was probably because the hematomas caused high incision tension and wound discharge, increasing the need for change of dressings in the non-drainage group. However, there was no difference between groups in wound healing.

Prevention of the devastating complication of arthroplasty, deep infections, is the most important reason for using drainage. However, drainage may provide access for micro-organisms to migrate retrogradely into a wound along the drain or drain track, increasing the rate of wound infection⁷. Prolonged duration of drainage also increases the infection rate. Raves *et al.* have shown that retrograde migration of bacteria may occur in up to 20% of cases with closed suction drainage by 72 hours¹⁵. Drinkwater and Neil recommend routine culture if drainage is in place for more than 24 hours⁷. However, the sensitivity of routine drain tip culture for diagnosing postoperative infection after primary joint arthroplasty is reportedly 0% and the specificity 99.2%¹⁶. Being made of prosthetic materials, drainage tubes may affect the normal function of the immune system. In our study, no deep infections occurred in either group.

Some studies have shown that drainage can increase blood loss after THA¹⁷, increasing the need for blood transfusion³. Walmsley *et al.* reported that the postoperative transfusion rate in a drained group was significantly higher than in a non-drained group (33% vs 26.4%, $P = 0.042$)¹⁸, and Hallstrom and Steele reported transfusion rates in drainage and non-drainage groups of 57.3% and 43%, respectively¹⁹. In addition, among patients who require transfusion, those with wound drainage reportedly require significantly more blood than those without drainage (1.12 units vs 0.62 units per patient for men; 1.73 units vs 1.03 units per patient for women)¹⁹. Brueggemann *et al.* pointed out that intermittent clamping of suction drains may decrease blood loss after THA²⁰, whereas Tai *et al.* claimed that although drainage clamping does decrease the volume of drainage, only clamping for at least 4 hours reduces true blood loss; they found no

TABLE 3 Comparison of post-operative variables between drainage and non-drainage group

Variable	Drainage	Non-drainage	P
Volume of hematoma (mean $\pm$ SD, mm)	3.0 $\pm$ 1.3	5.1 $\pm$ 2.0	0.000†
Superficial infection (cases [%])	2 (2.4)	9 (10.6)	0.031*
Dressing change (mean $\pm$ SD, days)	3.2 $\pm$ 0.4	4.5 $\pm$ 0.4	<0.001†
Ecchymosis (cases [%])	3 (3.6)	11 (12.9)	0.026*
Tension vesicle (cases [%])	4 (4.8)	14 (16.5)	0.013*
Length of hospital stay [mean $\pm$ SD, d]	10.5 $\pm$ 1.5	10.2 $\pm$ 1.4	0.478†

*, based on Pearson χ^2 test; †, based on Student's t-test.

Fig. 1 The range of motion of the hip joint pre-operation, on discharge, 1 and 2 weeks and 1, 2 and 3 months after discharge from hospital. * indicates $P < 0.05$; 1W, one week after discharge; 2W, two weeks after discharge; 1M, one month after discharge; 2M, two months after discharge; 3M, three months after discharge.

significant difference regarding blood transfusion²¹. In our study, we assessed blood loss by comparing Hb levels pre- and post-operatively and found that the drainage group may have had more blood loss in the first few days after THA; however, 7 days postoperatively the difference was not significant. In our study, eight patients (9.6%) needed blood transfusion in the drainage group and seven (8.2%) in the non-drainage group; the mean volumes were 3.8 units versus 2.9 units, respectively, of erythrocyte suspension. However, this difference is not significant. These findings indicate that non-drainage may reduce blood loss post-operation, but has no benefits regarding reduction of blood transfusion.

Kim *et al.* found no significant difference between drainage and non-drainage groups in the ROM of the hip joint²². In our study, the drainage group had a better ROM of the hip joint on discharge and 1 and 2 weeks after discharge. This was probably attributable to limb pain and swelling restricting

early postoperative exercise in the non-drainage group. By 1 month later, this difference had gradually disappeared, indicating that there was not enough hematoma-related fibrosis to affect the ROM of the hip joint in the non-drainage group.

Thus, non-drainage may reduce blood loss after operation, but has no benefit regarding blood transfusion. In addition, non-drainage can cause more wound problems, such as ecchymoses, tension vesicles and superficial infection. It can also cause restriction of early postoperative exercise, though it makes no difference to the final ROM of the hip. Therefore we suggest using drainage routinely even though it has no documented benefits regarding reduction of deep infection after THA.

The limitations of this study include that we did not quantify the complications of ecchymoses and tension vesicles and did not use ultrasound or computed tomographic angiography to identify non-clinic DVT and PE.

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