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New strategy of closed suction drainage after primary total hip arthroplasty

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ABSTRACT

Objective: The purpose of this study was to evaluate the effect of late applied negative pressure on postoperative drain output after primary total hip arthroplasty (THA).

Patients and methods: 100 patients (100 hips) were treated by closed suction drainage applying negative pressure immediately after THA (group I). The remaining 100 patients (100 hips) were treated by the same drainage system, but the negative pressure was not applied in the first 24 h after THA and then negative pressure was applied (group II).

Results: The mean total drain output was different between the two groups (group I: 597 ± 200.1 mL, group II: 403 ± 204.1 mL; $p < 0.05$). Reported drain output from immediate postoperative to postoperative day one was 369 ± 125.5 ml in group I and 221 ± 141.3 ml in group II ($p < 0.05$). The change of hemoglobin from immediate postoperative to 24 h after THA was lower in group II (group I: 1.5 ± 0.62 g/dL, group II: 1.1 ± 0.73 g/dL; $p = 0.004$). The mean unit number of blood transfusions was 1.0 (range, 0.0–5.0) in group I and 0.3 (range, 0.0–2.0) in group II ($p < 0.05$). There was no difference in Harris hip score between the two groups at postoperative 1 year or last follow-up ($p = 0.073$).

Conclusion: The minor change in drain system management can reduce postoperative blood loss after primary THA and the need for transfusion.

Level of evidence: Level III, Therapeutic study

Total hip arthroplasty (THA) procedures continue to grow in popularity. Efforts have focused on reducing associated problems, the most common of which is postoperative infection. Infections develop due to diverse factors, such as the general condition of the patient, intraoperative contamination or postoperative wound problem. Foremost, postoperative hematoma formation often heralds infection.[1]

Closed suction drainage is widely used after THA to reduce the chance of hematoma formation and eliminate this potential risk of infection.[2] Nevertheless, the routine use of drainage is contentious. Drainage may not be necessary after primary THA, with no reported difference in incidence of wound hematoma formation and wound infection. Additionally, drainage may increase the need for transfusion because of increased blood loss after THA.[3,4]

Although suction drains for wounds after primary THA can be questioned, many surgeons insert drainage system before wound closure to prevent oozing, ecchymosis and erythema around the wound.[5] The exposed bone surface could be a major source of postoperative bleeding. So, to some extent, a hematoma would act as a tamponade to slow the bleeding postoperatively. But, eliminating the tamponade effect by closed suction drainage could lead to increased blood loss.[6] From our previous experiences, more than half of the blood drainage takes place immediately after surgery to postoperative day one.

We hypothesized that gravity-dependent draining system in which negative pressure is not applied could maintain some resistance and act as a tamponade to the operative wound. This tamponade effect could reduce the drain output postoperatively, especially in the first 24 h after THA. In this respect, we conducted

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this prospective, randomized study to evaluate the effect of change in the management of drainage.

Patients and methods

This study included 200 patients who underwent unilateral primary THA from February 2010 to May 2012 at our hospital. Inclusion criteria were THA due to the osteonecrosis of femoral head (ONFH) or osteoarthritis of hip joint (OA), and age under 60 years. Exclusion criteria were hematologic disorder, essential use of anticoagulant agent for cardiovascular disease postoperatively, liver disease and renal failure. This study was approved by our institutional review board.

All primary THA procedures were performed using the modified minimally invasive two-incision method.[7] The Delta-PF acetabular cup (Lima LTO, Udine, Italy) and M/L Taper stem (Zimmer, Warsaw, IN, USA) were used in all patients. Before the subcutaneous layer was closed, the drain tube was not connected to the suction system. After assembly, patients were randomly allocated into two groups whether negative pressure was applied or not (Fig. 1).

Accordingly, one-hundred patients were treated by applying negative pressure just after skin closure (group I) and the other patients were managed to be drained by gravity for 24 h postoperatively (group II). The patient characteristics are outlined in Table 1.

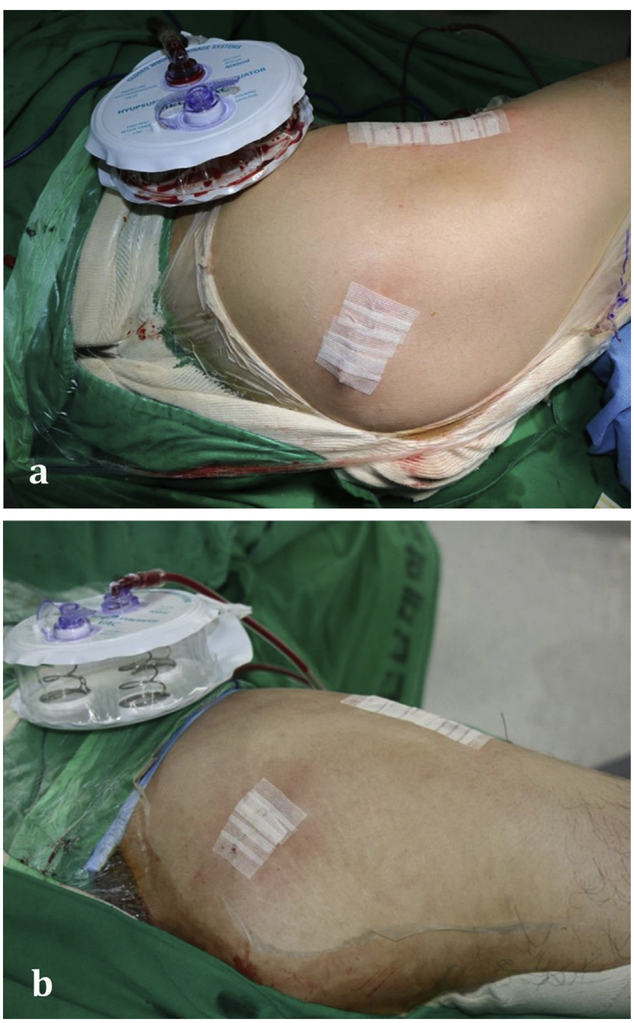

Fig. 1. Two different method for managing closed suction drainage **(a)** Negative pressure was applied for drainage system immediate after THA. **(b)** Drain relied on gravity to evacuate fluid for the first 24 h after THA.

Table 1
Demographic characteristics of the patients.

	Group I	Group II
Patients	100	100
Age (years)	45.0 (26–58)	46.0 (21–59)
Male/female	72/28	80/20
BMI (kg/m^2)	23.9 (18.4–32.8)	24.3 (19.5–30.5)
Operation time (min)	64.4 (50–95)	62.5 (50–100)
Follow-up (month)	46.2 (20–64)	42.8 (12–64)
Diagnosis		
ONFH	81	84
OA	19	16

BMI: body mass index; ONFH: osteonecrosis of femoral head; OA: osteoarthritis.

Postoperatively, all patients applied intermittent pneumatic compression (IPC) for the prevention of venous thromboembolism and were instructed to begin full-weight bearing ambulation three days after THA.

The amount of drained blood was checked daily and the drain tube was removed if the quantity of drained blood was less than 100 mL for a day. The blood hemoglobin level was checked at day 1, 2, 3, and 7 postoperatively. Patients received RBC transfusion if hemoglobin level was below 8.0 g/dL.

Clinical parameters that were assessed were the volume of total drain output, change of hemoglobin (Hg), volume of blood transfusion and occurrence of superficial or wound infection or hematoma formation during hospitalization period and deep infection during follow-up period. Clinical results were graded by Harris Hip Score (HHS) at postoperative 1 year or last follow-up.[8] Data were analyzed between the two groups using the Student's t-test and SPSS ver. 20.0 software (SPSS, Chicago, IL, USA). p-values < 0.05 were considered significant.

Results

The average total drain output was less in group II (403 ± 204.1 mL) than group I (597 ± 200.1 mL) ($p < 0.05$) (Table 2). Reported drain output from immediate postoperative to postoperative 24 h was 369 ± 125.5 mL in group I and 221 ± 141.3 mL in group II ($p < 0.05$). However, there was no difference in amount of drained blood from postoperative 24 h to 48 h (group I: 134 ± 69.4 mL, group II: 131 ± 85.0 mL; $p = 0.824$).

The change of Hg from preoperative to immediately postoperative reflecting intraoperative blood loss was not different between the two groups (group I: 1.8 ± 0.98 g/dL, group II: 1.9 ± 1.04 g/dL; $p = 0.815$). However, the change of Hg from immediate postoperative to 24 h after THA was lower in group II (group I: 1.5 ± 0.62 g/dL, group II: 1.1 ± 0.73 g/dL; $p = 0.004$). The change of Hg from preoperative to postoperative day seven was lower in group II than group I (group I: 3.8 ± 1.16 g/dL, group II: 3.1 ± 0.94 g/dL; $p < 0.05$). The mean unit number of blood transfusions was 1.0 (range, 0.0–5.0) in group I and 0.3 (range, 0.0–2.0) in group II ($p < 0.05$).

The mean period of drain removal after THA was 3.2 ± 1.05 days in group I and 3.0 ± 0.80 in group II. There was no incidence of superficial infection, wound dehiscence and hematoma formation during the hospitalization period. However, one case of deep infection by *Mycobacterium tuberculosis* was reported in group II. The patient had a past history of cured pulmonary tuberculosis and complained of persistent groin pain at 3 months after THA. Four months after the operation, fluid collection was detected by ultrasonography and laboratory results suggested

Table 2
Clinical outcomes between the two groups.

	Group I (N = 100)	Group II (N = 100)	*p* value
Drain output (ml)			
Total (A)	597 ± 200.1	403 ± 204.1	0.000
To 24 h (B)	369 ± 125.5	221 ± 141.3	0.000
From 24 to 48 h	134 ± 69.4	131 ± 85.0	0.824
B/A (%)	65 ± 18.4	56 ± 20.5	
Change in Hg (g/dL)			
From pre to immediate post	1.8 ± 0.98	1.9 ± 1.04	0.815
To 24 h	1.5 ± 0.62	1.1 ± 0.73	0.004
From pre to post day 7	3.8 ± 1.16	3.1 ± 0.94	0.001
RBC transfusion (pack)	1.0 (0–4)	0.3 (0–2)	0.001
Drain removal (hours)	77 ± 25.5	72 ± 19.4	0.341
HHS (Pre)	57.1 ± 4.90	58.1 ± 6.45	0.361
HHS (Post)	95.9 ± 2.38	96.8 ± 2.53	0.073

Hg: hemoglobin; Pre: preoperative; Post: postoperative.

postoperative infection. The patient was treated with two-staged reconstruction.

There was no difference in HHS between the two groups at postoperative 1 year or last follow-up (group I: 95.9 ± 2.38, group II: 96.8 ± 2.5; $p = 0.073$).

Discussion

Routine use of closed suction drainage system after arthroplasty is contentious. Some recent studies have recommended no closed-suction drainage after THA, because the routine use of drainage may be of more harm than benefit.[9,10] So, several studies have evaluated the effectiveness of the drainage system, but they did not reach the same conclusion. Many surgeons still elect to use a drain tube to reduce potential complications. The most important reasons for inserting drain tube are to prevent hematoma formation and reduce chance of infection.[2] However, drainage may increase risk of retrograde infection through the drain tube and prolonged duration of drainage also may increase infection rate acting as foreign body. Some studies have reported that drainage can increase blood loss after THA,[11] eventually increasing the need for transfusion.[12,13] Patients can be concerned with the prospect of allogenic blood transfusion because of transfusion-related problems, religious beliefs and unfounded psychological factors. To decrease perioperative blood loss, several methods including preoperative autologous blood donation, erythropoietin injection, cell preservation and topical application of tranexamic acid in primary THA.[14–16] However, the cost-effectiveness or safety of these procedures is debatable. On the other hand, Brueggemann et al reported that intermittent clamping of drainage could reduce the need for blood transfusion.[17]

From our previous experiences, more than half of the blood drainage occurs in the first 24 h after THA. In the absence of violation of the intramuscular plane, as in our approach, we presume that the main source of bleeding is cut medulla. So, initial compression by accumulated blood to the exposed bony surface may decrease bone bleeding through the tamponade effect and finally reduce total drain output.

Based on this reasoning, we designed a new method to manage a closed suction drainage system. Since complete clamping of the drain tube in the first 24 h could increase hematoma formation and disturb wound healing, we elected gravity influenced drainage under the pressure created by itself. After the 24-h dependent drain, we altered drainage into negative pressure, with the aim of lessening further hematoma formation.

The amount of drained blood from immediate postoperative to postoperative 24 h was reduced in group II compared to group I. Accordingly, the change of Hg was also reduced in group II. The decreased blood drainage is thought to reflect an initial tamponade effect to exposed bony surface. Consistent with this assumption, approximately 60% of the total drain output occurred during the first 24 h. After applying negative pressure at 24 h postoperatively, both groups displayed similar blood drainage (Table 2).

Concerning the timing of drain tube removal, a formal removal time was not pre-set. Rather, removal was determined by the last output. If the amount of drained blood was less than 100 mL for a day, the drain tube was removed. After postoperative 24 h, drain output steadily decreased and results were similar for both groups. Therefore, there was no difference for the maintenance period of drainage in group I and II ($p = 0.341$). Despite one case of postoperative deep infection in group II, we effectively reduced drain output and change of Hg without increase of complications.

There are several limitations of the present study. Many variables influence Hg level and drain output. By conducting the same operative technique, we tried to minimize differences of intraoperative blood loss. But, several factors that still could affect clinical outcome included different fluid therapy. Furthermore, we tried to conduct blood sampling and checking drain output on time until postoperative 48 h. However, the accurate calculation of the time to remove the drain tube is difficult. This is why checking the last output was considered for drain removal instead of an actual time for the two groups.

As a blood-saving strategy, we can consider autologous blood reinfusion, fibrin sealant, pharmacologic intervention, or other additional management like intermittent clamping. But, these options are difficult to conduct or costly.

In conclusion, closed suction drainage under influence of gravity in the first 24 h after THA is a much easier way to treat and to reduce blood loss without additional device and cost.

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