Use of Redon Drains in Primary Total Hip Arthroplasty Has No Clinically Relevant Benefits

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abstract

Although no proven evidence exists for the use of drainage in primary total hip arthroplasty, such drainage is routinely used.

This prospective, randomized study comprised 80 patients who underwent a non-cemented total hip arthroplasty using a minimally invasive anterolateral approach. Patients were divided into 2 groups of 40: group 1 underwent drainage treatment and group 2 underwent no drainage treatment. No selection of patients occurred by age, sex, or body mass index. Blood loss was not significantly different between groups 1 (mean blood loss, 0.9 L [range, 0.3-2.1 L]) and 2 (mean blood loss, 0.9 L [range, 0.3-2.4 L]) (P<.7). On postoperative day 1, patients who underwent drainage treatment reported significantly more pain at rest (P<.01) and under stress (P<.03). The same finding was observed on postoperative day 4 (at rest, P=.04; under stress, P=.02). The nonuse of drainage significantly reduced operative time by 72 seconds (P<.01). Patients without drainage treatment had significantly larger hematomas than patients with drainage (mean, 43.7 cm² [range, 0-343 cm²] vs mean, 40.1 cm² [range, 0-514 cm²], respectively) (P<.03).

No clinically relevant benefits associated with the use of drainage were identified. The increased size of the hematoma was not reflected in patient comfort. The authors consider the use of drainage in primary total hip arthroplasty unnecessary.

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Endoprosthetic hip replacement is one of the most successful operations in terms of improved quality of life and is performed approximately 160,000 times per year in Germany.\(^1\) Wound drainage can be used to reduce the size of the wound cavity and to minimize hematoma development following total hip arthroplasty (THA). The first drains, described by Redon et al\(^2\) in 1954, were used to treat extensive wound cavities.\(^2\) The routine use of Redon drains in primary THA remains widespread despite a lack of supporting scientific evidence.\(^3-5\)

Redon drainage is based on the hypothesis of stopping potential hematoma development, which is associated with delayed wound healing, increased pain, and increased deep infection risk. However, as a foreign body, the drain provides a lead structure for bacteria and increases the infection risk.\(^6-9\) A 2001 Cochrane study in 2007 on this topic was unable to give a final recommendation.\(^10-11\)

No clear recommendations exist concerning the extent to which Redon drainage leads to better outcomes and fewer complications. This is may be due to weaknesses in previous studies’ designs. The influence of postoperative blood transfusions has not been considered, which suggests that the calculated blood loss has no meaning. The influence of Redon drainage on blood loss in some patients was examined following different surgical procedures in 1 clinical study.\(^4,5\)

The purpose of the current study was to investigate whether the use of wound drainage for 24 hours following a highly standardized procedure, such as primary THA, compared with the use of no drainage, had benefits in terms of blood loss, cutaneous hematoma size, mobilization, operative time, and postoperative pain. To get statistically reliable results, blood loss was calculated using the well-established method of Nadler et al\(^2\) under the consideration of blood transfusion.

**Materials and Methods**

**Study Design**

This study was approved by the Ethics Commission of Berlin, Germany. Eighty patients were included consecutively in a prospective, randomized study (group 1 underwent drainage and group 2 underwent no drainage) between December 2011 and March 2012. All patients undergoing primary THA in the authors’ institution were included. No selection of patients occurred by age, sex, or body mass index. Patients with a known coagulopathy were excluded. Table 1 contains an overview of the patient cohort.

All patients underwent a noncemented THA using a minimally invasive anterolateral approach with Allofit cup and Femfit stem (Zimmer, Warsaw, Indiana). All implantsations were performed by the same surgeon (R.H.). The decision of whether to use drainage was made at the end of surgery before wound closure by opening a sealed envelope. The drain was placed intra-articularly and removed 24 hours postoperatively. The parameters recorded preoperatively and on days 1 and 4 postoperatively included hematocrit, pain (visual analog pain scale [VAS]), area of ecchymosis, and thigh circumference 10 and 20 cm below the surgical wound. Blood loss in the suction drainage device, operative time, drain content, and transfusion requirements (eg, colloid or crystalloid solutions and blood products) were investigated intra- or postoperatively or both. In both groups, mobilization began the morning of postoperative day 1 according to the clinic’s standard regimen. Patients were followed until discharge.

**Postoperative Procedure**

Postoperative treatment was standardized by the use of a hip rehabilitation procedure. Mobilization physiotherapy occurred twice daily starting on postoperative day 1. All patients were treated postoperatively with 90 mg of etoricoxib once daily orally and metamizole drops, up to 4×40 drops as required, as basic pain therapy for 7 days. Prophylaxis for thromboembolism was performed once daily with 4000 IU of low-molecular-weight heparin (enoxaparin sodium).

**Blood Loss**

Blood volume was calculated using the following formula\(^2\):

\[
EBV = A\frac{\rho_3}{\rho_5} \times H^{0.725} \times W^{0.425} - B_2\frac{\rho_3}{\rho_5}
\]

where $EBV$ is estimated blood volume (EBV) in L, $A_2$ is 0.0236, $A_3$ is 0.0248, $H$ is height in cm, $W$ is weight in kg, $B_0$ is 1.229, and $B_2$ is 1.954.

Perioperative blood loss was calculated on the basis of height, weight, and hematocrit pre- and postoperatively\(^2\):

\[
V = EBV \times \ln \left(\frac{H_{\text{preop}}}{H_{\text{postop}}}\right)
\]

where $V$ is blood loss in L, $EBV$ is blood volume in L, $H_{\text{preop}}$ is preoperative hematocrit, and $H_{\text{postop}}$ is hematocrit on postoperative day 1.

**Statistical Analysis**

Statistical analysis was performed using SPSS version 20 for Mac (SPSS, Inc., Chicago, Illinois). Continuously distributed variables between the 2 groups were studied using the nonparametric Mann-Whitney U test. A power analysis was performed using PASS version 2008 (NCSS, Kaysville, Utah). The level of significance was set at a $P$ value less than .05 and a power of 80%.

**Results**

Statistical analysis showed a significant difference in operative time between

![Table 1: Patient Demographics](image-url)

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Drainage Group</th>
<th>No Drainage Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>No. M/F</td>
<td>14:26</td>
<td>19:21</td>
</tr>
<tr>
<td>Mean age (range), y</td>
<td>64.11 (30-81)</td>
<td>63.73 (29-79)</td>
</tr>
</tbody>
</table>


groups ($P = .01$) (Table 2). No significant difference existed in intraoperative suction volume ($P = .07$). Mean drain content for group 1 was 123.6 mL (range, 10-300 mL). Mean calculated perioperative blood loss following endoprosthetic hip replacement with drainage was 0.9 L (range, 0.3-2.4 L). Patients in group 2 lost a mean of 0.9 L (range, 0.3-2.1 L) of blood ($P = .02$). Because no patient received a blood transfusion, no need existed to correct the calculation of perioperative blood loss based on pre- and postoperative hematocrit. The extent of ecchymosis was significantly smaller in the patients undergoing drainage ($P = .03$). The measurement of thigh circumference 10 and 20 cm below the surgical area was not significant between groups ($P = .54$ and $P = .09$, respectively).

Although the groups’ subjective perception of preoperative pain, measured using a 10-cm VAS, showed no significant difference (at rest, $P = .8$; under stress, $P = .2$), the patients who underwent drainage reported significantly more pain at rest ($P = .01$) and under stress ($P = .03$) on postoperative day 1. The same finding was observed on postoperative day 4 (at rest, $P = .04$; under stress, $P = .02$) (Table 3).

**DISCUSSION**

Although no evidence exists for the use of drainage in orthopedic endoprosthetics, such drainage is routinely used in clinical practice. The current study suggests that the use of drainage in primary THA is unnecessary. The authors found no statistically significant benefits associated with the use of drainage.

No statistically significant difference existed in the suction fluid volume drained from the surgical area intraoperatively ($P = .07$). The drains contained a mean of 123.6 mL of blood. No significant difference existed in mean blood loss between groups 1 (0.9 L [range, 0.3-2.4 L]) and 2 (0.9 L [range, 0.3-2.1 L]) ($P = .7$). Previous studies reported no significant decrease in blood levels in patients with vs patients without drainage following knee and hip arthroplasty.\textsuperscript{4,5,13,14} Tjeenk et al\textsuperscript{15} reported no significant decrease in hemoglobin after treating patients with proximal femoral fractures with vs without drainage. After total knee arthroplasty, Crevoisier et al\textsuperscript{1} reported a greater decrease in hemoglobin level without drainage, although the difference was not significant.

Kumar et al\textsuperscript{4} reported that 62 of 126 patients in a drainage study following joint replacement received blood transfusions. No significant difference existed in blood loss in patients with vs without drainage was demonstrated. However, the influence of the blood transfusions was considered in the analysis of hemoglobin levels. In their studies of the influence of drainage on primary total knee arthroplasty, Elser et al\textsuperscript{16} and Holt et al\textsuperscript{17} reported no significantly increased blood loss in patients with drainage. Elser et al\textsuperscript{16} reported that 31 of 50 patients with and 19 of 50 patients without drainage received blood transfusions. The hemoglobin level calculations were not corrected, which was a weakness of the study.

### Table 2

<table>
<thead>
<tr>
<th>Item</th>
<th>Drainage</th>
<th>No Drainage</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time, min</td>
<td>33.0 (29-41)</td>
<td>30.8 (25-38)</td>
<td>.01*</td>
</tr>
<tr>
<td>Suction drainage device content, mL</td>
<td>216.0 (150 to 350)</td>
<td>238.9 (150 to 350)</td>
<td>.07</td>
</tr>
<tr>
<td>Drain content 48 h postop, mL</td>
<td>123.6 (10 to 300)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Blood loss (min-max), L</td>
<td>0.9 (0.3 to 2.4)</td>
<td>0.9 (0.3 to 2.1)</td>
<td>.71</td>
</tr>
<tr>
<td>Ecchymosis (min-max), cm$^2$</td>
<td>40.1 (0 to 514)</td>
<td>43.7 (0 to 343)</td>
<td>.03*</td>
</tr>
<tr>
<td>Thigh swelling below surgical area (Δ pre/ postop), cm</td>
<td>10</td>
<td>0.8 (−2 to 5)</td>
<td>1.2 (−2 to 9)</td>
</tr>
<tr>
<td>20</td>
<td>1.3 (−3 to 7)</td>
<td>2.1 (−1 to 10.5)</td>
<td>.09</td>
</tr>
</tbody>
</table>

*Abbreviations: postop, postoperative; preop, preoperative.*

*Significant difference.

### Table 3

<table>
<thead>
<tr>
<th>VAS Preoperatively- and on Days 1 and 4 Postoperatively</th>
<th>Mean (Range)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drainage</td>
<td>No Drainage</td>
</tr>
<tr>
<td>Preoperative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest</td>
<td>3.19 (0-7)</td>
<td>3.15 (0-7)</td>
</tr>
<tr>
<td>Stress</td>
<td>7 (3-10)</td>
<td>6.3 (1-10)</td>
</tr>
<tr>
<td>Postoperative day 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest</td>
<td>2.0 (10)</td>
<td>1.2 (0-6)</td>
</tr>
<tr>
<td>Stress</td>
<td>3.8 (0-10)</td>
<td>2.7 (0-10)</td>
</tr>
<tr>
<td>Postoperative day 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest</td>
<td>0.6 (0-4)</td>
<td>0.3 (0-3)</td>
</tr>
<tr>
<td>Stress</td>
<td>2.2 (0-6)</td>
<td>1.4 (0-7)</td>
</tr>
</tbody>
</table>

*Abbreviation: VAS, visual analog scale.*

*Significant difference.
No meaningful statement can be made about calculated blood loss without considering blood transfusions. No blood products were transfused in the current study. Compared with previous studies, it was not necessary to adjust the calculation of blood loss. The authors think that blood loss volume via drainage can only be assessed on this precondition. In addition, the referenced studies report an inhomogeneous patient population. In some studies, the use of drainage was studied in different surgical procedures.\textsuperscript{4,5} Al-Naser\textsuperscript{3} reported that the individual orthopedic interventions are studied separately to obtain reliable information regarding the use of drainage. The current study investigated a highly standardized procedure in a randomized, prospective setting.

In addition, the basis used previously for calculating blood loss was the hemoglobin or hematocrit level.\textsuperscript{4,5} Accordingly, no height, blood volume, and sex-specific differences could be considered. This study used the calculation of blood loss established by Nadler et al.,\textsuperscript{12} which includes these parameters.

Not using drainage significantly reduced operative time ($P = .01$). However, the reduction was 72 seconds. This time period approximately corresponds with the time required to insert and fixate the drain.

The current study showed a significant enlargement of the postoperative ecchymosis without drainage ($P = .03$). However, Elser et al\textsuperscript{16} reported no significant difference in the extent of ecchymosis in patients undergoing primary knee arthroplasty with vs without drainage. These conflicting results may be explained by the greater soft tissue involvement and reduced opportunity for the use of compression bandages in the hip area. However, this result was not reflected in patient comfort. Although the study groups reported similar preoperative pain levels, the pain levels of patients not undergoing drainage on postoperative days 1 and 4, at rest and under stress, were significantly lower (Table 3). However, the values showed a VAS difference of less than 1 point in both conditions. In their Cochrane analysis, Parker et al\textsuperscript{10} reported 2 studies\textsuperscript{18,19} that addressed pain as an outcome parameter; none of these found a significant difference in pain level. The current authors interpreted their findings as a consequence of soft tissue irritation: when the hip is flexed, drain entrapment in the soft tissue leads to an exacerbation of pain.

Thigh circumference was not significantly altered in this study by the nonuse of drainage (10 cm below the surgical area, $P = .54$; 20 cm below the surgical area, $P = .09$). The same conclusion was reached by Elser et al\textsuperscript{16} after primary knee arthroplasty and by Gonzalez Della Valle et al\textsuperscript{13} and Mengal et al\textsuperscript{20} after primary THA.

**Conclusion**

This study identified no clinically relevant benefits associated with the use of drainage after primary THA. The patients showed no significant difference in blood loss. No patients required a blood transfusion. Surgery was conducted using a minimally invasive anterolateral approach. This may lead to reduced blood loss due to less muscle trauma. Therefore, the authors consider the use of drainage in primary THA unnecessary.

**References**