Aim. The purpose of this study is to assess the effect of drainage systems with and without the use of vacuum and the time of withdrawal of tourniquets on perioperative blood loss in total knee replacement (TKR).

Materials and methods. This is a prospective randomized study of 60 patients who underwent total knee replacement who were randomly divided into 4 groups of 15 patients each in which different times of tourniquet withdrawal were used as well as different drainage systems with and without vacuum. The groups were: Group A, the incision was closed without withdrawing the tourniquet and, after compressive bandaging, open drainages with vacuum were left in place for 48 hours; Group B, after prosthesis placement the tourniquet was removed, hemostasis was applied and open drainages with vacuum were left in place for 48 hours; Group C, after prosthesis placement the tourniquet was removed, hemostasis was applied and open drainages without vacuum were left in place for 24 hours; Group D, the tourniquet was kept in place until compressive bandaging was completed and open drainages without vacuum were left in place for 24 hours, and then with vacuum for a further 24 hours.

Results. Less blood loss was seen in the groups with open drainages without vacuum for 24 hours; no related complications were seen (p = 0.0000) in these patients. Also, there hematocrit values were significantly lower (p = 0.0353).

Conclusion. We consider these issues of interest since they may help reduce the need of need of transfusions in TKR.

Key words: total knee replacement, bleeding, blood transfusions.

Comparative Study of Blood Loss in Primary Knee Replacement Using Different Drainage Procedures and Times of Compression

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Estudio comparativo de las pérdidas sanguíneas en cirugía protésica primaria de rodilla con diferentes pautas de drenaje y momentos de retirar la isquemia

Objetivo. El propósito de nuestro estudio es valorar el efecto de la utilización de sistemas de drenaje con o sin vacío y el momento de la retirada de la isquemia en las pérdidas sanguíneas perioratorias asociadas a las prótesis totales de rodilla (PTR).

Material y método. Planteamos un trabajo prospectivo y aleatorizado con 60 pacientes a los que se implantó una arthroplastia total de rodilla y que aleatoriamente incluimos en cuatro grupos de 15 pacientes cada uno, en los que se utilizaron diferentes momentos de retirar la isquemia combinados con sistemas de drenaje con y sin vacío. Los grupos fueron: grupo A, cierre de la incisión sin retirar la isquemia y tras el vendaje compresivo redones abiertos con vacío durante 48 horas; grupo B, tras el implante de la prótesis se retiró la isquemia y se realizó hemostasia, dejándose los redones abiertos y con vacío durante 48 horas; grupo C, tras colocar la prótesis se retiró la isquemia y se realizó hemostasia, los redones se mantienen abiertos y sin vacío las primeras 24 horas y con vacío las siguientes 24; grupo D, se mantiene el torniquete hasta haber realizado el vendaje compresivo y los drenajes abiertos y sin vacío las primeras 24 horas y con vacío las siguientes 24.

Resultados. Las menores pérdidas sanguíneas se encuentran en los grupos en los que se dejan los dos drenajes de redón abiertos sin vacío las primeras 24 horas; no observóse complicaciones relacionadas asociadas (p = 0,0000), siendo también significativas las diferencias en el descenso del hematocito (p = 0,0353).

Conclusión. Consideramos éste un punto de interés al planificar una cirugía protésica de rodilla con ahorro de transfusiones sanguíneas.

Palabras clave: arthroplasia total de rodilla, pérdidas sanguíneas, transfusiones sanguíneas.
Prosthetic knee surgery is associated to significant blood loss, estimated at between 0.8 and 1.5 liters. This means that between 33.3 and 100% of patients need to be transfused. We normally perform primary knee arthroplasty using a tourniquet, which permits preventive ischemia of the limb. We have reviewed the literature in search of data as to whether it is best to release the ischemia cuff before closing the incision, and therefore be able to identify and coagulate the bleeding vessels as far as it is possible, or to do so after closing the wound and placing a compressive bandage. On the other hand, we use drains in order to minimize the appearance of wound hematomas and potential prosthetic infections, although there are certain authors who do not follow this technique.

After reviewing the different ways of discontinuing ischemia and using redon drains, we decided to carry out a study that included variations of both parameters in order to assess the blood loss that occurred. The final goal was to determine the best way to reduce blood loss without any associated complications and hence reduce the incidence of transfusion.

MATERIALS AND METHODS

We prospectively reviewed blood loss in 60 patients, all of them diagnosed with gonarthrosis and operated consecutively between October 2003 and March 2004 by the same team of surgeons; the changes in blood loss values were not associated with any changes in the usual surgical technique. Patients were divided into four groups; inclusion into one group rather than another depended on when the ischemia was released and on how well the drainages worked. Patients in all four groups were comparable with respect to age, gender and pre-op hematological values. None of them had associated conditions that might modify he results; we included no patients with coagulation abnormalities or on long-term treatments that could alter coagulation (aspirin, salicylic acid, steroids, etc.). This was confirmed preoperatively with coagulation tests. Patients with a previous knee surgery were also excluded.

Antibiotics were administered (1 g of IV cephalin every 8 hours) half an hour before surgery. Twelve hours before surgery thromboembolic prophylaxis was begun with low molecular weight heparin. Surgery was performed through a longitudinal and medial parapallelar incision on the skin. Selection of the prosthesis type to be used was left to the surgeon in each case. The femoral cuts; a bone plug was placed in the distal femoral hole. Two kinds of redon drains were used in all cases: an intraarticular and a subcutaneous one. The capsule, the subcutaneous cellular tissue and the skin were independently sutured. All procedures were performed with preventive ischemia of the limb with a tourniquet at the muscle root, at a pressure of 300-350 mmHg.

The four groups studied were the following:

- **Group A**, the surgical wound was closed without releasing the ischemia cuff and, after applying the compressive bandage, the redon drainage was opened and the vacuum maintained for 48 hours;
- **Group B**, the ischemia cuff was released after implanting the prosthesis and hemostasis was achieved; after applying the compressive bandage, the redons remained open, maintaining the vacuum for 48 hours;
- **Group C**, the ischemia cuff was released after implantation and hemostasis was carefully performed; after compressive bandage was applied, the patient left the OR with the redon drains open with no vacuum for 24 hours. Subsequently vacuum was created and maintained for the next 24 hours;
- **Group D**, the surgical wound was closed without releasing the ischemia cuff and, after the compression bandage was applied, open redons were put in without vacuum during the initial 24 hours; in the next 24 hours, vacuum was created.

The following parameters were assessed in all patients:

- Total blood loss visible (intraoperatively and in the drains up to their withdrawal)
- Hemoglobin and hematocrit levels; this data was recorded when the patients were put on the surgery program (approximately 45-90 days pre-op); at the time of anesthesia preparation (immediately before surgery) and during the post-op control, 24 hours after surgery when virtually all blood loss had subsided.

We used the chi square and Student’s t tests to conduct the statistical analysis of the data collected. Values of p < 0.05 were considered statistically significant.

RESULTS

In group A, the ischemia cuff was not released before wound closure; redons were open and with vacuum. In this group, made up of 15 patients (12 female, 3 male) of an average age of 72 ± 4 years (range: 63-80) no complications resulting from surgery were observed hospitalization; no instances of deep venous thrombosis or superficial skin infections were identified either. No patient had a degree of skin inflammation that imposed restrictions on rehabilitation. Average bleeding was 663 cc (Standard deviation [SD]: 191.70 cc) (range: 400 cc-965 cc). Drainage during the second 24-hour period post-op was scant, with an average 94.33 cc (SD: 104.58 cc) (range: 15 cc-480 cc). This made it possible to regard the hematologic level at 24 hours post-op as the post-surgical control value since the small blood losses that occurred did not influence the hematologic figures. Hematocrit levels decreased by an average 8.96 (SD: 3.00) (range: 5.2-15.2) between the pre-anesthesia and the
post-surgical control values. Hemoglobin levels decreased by 3.06 (SD: 0.89) (1.9-4.6).

Group B, contained 15 patients (12 female, 3 male) of a mean age of 72.4 years (SD: 6.52 years) (range: 61-84) and no complication was recorded during the patient’s hospitalization. Nor did we observe deep venous thrombosis or superficial skin infections; no patient showed a degree of knee inflammation that made it necessary to change their rehabilitation program.

The average bleeding measured was 934.6 cc (SD: 246.79 cc) (range: 663 cc-1.481 cc). Post-op drainage during the second 24-hour period post-op was minimal, with an average 91.67 cc (SD: 78.16 cc) (range: 20 cc-290 cc). Hematocrit figures decreased by an average 11.71 (SD: 2.60) (range: 7.4-15.1) between the pre-anesthesia and the post-surgical control values. Hemoglobin levels decreased by 3.77 (SD: 0.92) (range: 2.4-5.1).

In group C, which contained another 15 patients (12 female, 3 male) of an average age of 69 years (SD: 5.82 years) (range: 60-80) no surgical complication of note was observed during hospitalization; no patient showed deep venous thrombosis or a degree of knee inflammation that made it necessary to restrict their rehabilitation program. One patient presented with a mild superficial wound infection that healed without the need of additional surgical maneuvers.

The average bleeding measured was 383.2 cc (SD: 139.16 cc) (range: 199 cc-661 cc). Drainage during the second 24-hour period post-op was scant, with an average 62.66 cc (SD: 49.45 cc) (range: 199 cc-290 cc). Hematocrit levels decreased by an average 8.90 (SD: 5.98) (range: 1.6-15.7) between the pre-anesthesia and the post-surgical control values. Hemoglobin levels decreased by 2.97 (SD: 1.05) (range: 1.4-5.7).

In group D, made up of 15 patients (7 female, 8 male) with a mean age of 69 (SD: 9.10 years) (range: 55-84) no surgical complication of note was observed during hospitalization; no patient showed deep venous thrombosis or a degree of knee inflammation that made it necessary to change their rehabilitation program. One patient presented with a mild superficial wound necrosis that healed without the need for surgical treatment.

The average bleeding measured was 265 cc (SD: 89.70 cc) (range: 110 cc-420 cc). Drainage during the second 24-hour period post-op was scant, with an average 104.33 cc (SD: 38.45 cc) (range: 15 cc-300 cc). This made it possible to regard the hematologic level at 24 hours post-op as the post-surgical control value. Hematocrit figures decreased by an average 8.86 (SD: 2.89) (range: 2.9-13.6) between the pre-anesthesia and the post-surgical control values. Hemoglobin levels decreased by 2.9 (SD: 0.93) (range: 1.4-4.5).

The statistical comparison between the four groups revealed a significantly lower blood loss (p < 0.0000) in groups C and D in which the redon drains were kept open but without vacuum during the first 24 hours and with vacuum during the subsequent 24 hours; this always be preceded by the application of a compressive bandage. All the above applies both if preventive ischemia is discontinued and a careful hemostasis performed and if the wound is closed without releasing the ischemia cuff. No complications were observed that could be attributable to the method used. Therefore, these lower blood loss levels (Figs. 2 and 3) lead to fewer clinical repercussions and to a lesser need for blood replenishment.
We, the authors, have not received any commercial support to carry out this study. No authors have signed any agreement with any commercial firm to receive benefits or fees. On the other hand, no commercial firm has provided nor will provide economic support to non-profit foundations, educational institutions or any of the other non-profit organizations that we are members of.