Knee flexion significantly reduces blood loss and transfusion rate after uncemented total knee arthroplasty

S Jain, A Dinah, S Palmer

Citation

S Jain, A Dinah, S Palmer. *Knee flexion significantly reduces blood loss and transfusion rate after uncemented total knee arthroplasty*. The Internet Journal of Orthopedic Surgery. 2008 Volume 11 Number 1.

Abstract

Our aim was to evaluate post-operative knee flexion at 90° on a CPM machine as an effective, reliable and easily accessible means of reducing blood loss after knee arthroplasty. We performed a case-control study on 100 patients undergoing uncemented posterior cruciate retaining total knee arthroplasty. Two groups of 50 patients each were treated in a standard fashion, except for the use of the CPM machine to flex the knee at 90° and without using suction drains in one group. This set up was arranged in theatre and was in situ for 24 hours after surgery. For first two hours the knee was maintained at 90° flexion on a static CPM machine followed by dynamic CPM to allow 30° to 60° flexion for next 22 hours. We measured postoperative change in haemoglobin, haematocrit, and blood drained in first 24 hours. Range of motion was assessed, as were any complications. We found a statistically significant reduction in blood loss without compromising range of motion and without an increase in complications. We recommend the use of CPM machine as a safe and reliable means of significantly reducing blood loss by flexing the knee after total knee arthroplasties.

INTRODUCTION

Blood loss following total knee replacement (TKR) can be substantial. The total mean blood loss has been described in the literature to be up to 1474ml, of which up to 735ml can be hidden loss into the tissues [4].

Since knee arthroplasties are generally performed under tourniquet control, most blood loss occurs in the postoperative period. There are increased concerns regarding transfusion-associated infections and reactions and the cost of blood transfusions. A review of literature demonstrates a wide range of transfusion requirement in up to 45% to 80% of patients undergoing TKR [1]. Problems with suction drains include blood loss, obstruction and increased infection [10,11].

A variety of strategies to reduce blood loss following TKR have been described in the literature. These include the use of procoagulant drugs [7], clamping the suction drains, elevating the leg at 35 degree without flexing the knee [5] or flexing the knee on a special 90/90 pillow [9]. Flexing the knee at after 90 ° TKR significantly reduces blood loss probably by increasing the tension of the soft tissues and thereby decreasing the dead space available for bleeding [8]. The most probable reason for lack of popularity of pillows appears to be practical difficulties in finding and using these specially designed pillows. There is also a theoretical risk of compression of the popliteal vein, leading to an increased risk of DVT with this method[5].

We devised a novel method of maintaining the knee at 90 ° flexion after the operation by using the familiar and readily available CPM machine. The aim of our study was to evaluate the effectiveness of the CPM machine in substantially reducing blood loss after knee arthroplasty and thereby reducing the requirement for allogenic blood transfusion.

MATERIAL AND METHODS

A retrospective case-control study was performed over 6 months (May 2004 to October 2004). Inclusion criteria were patients admitted in the department undergoing elective uncemented TKR for painful osteoarthritis of the knee. Patients with bleeding disorders, peripheral vascular disease, or anticoagulant medications were excluded from the study.

A total of one hundred patients identified for the study were split into a control group (knee in extension with post-operative suction drain) and the treatment group (knee at 90 ° flexion after the operation on the CPM machine). There were fifty patients in each group.

All patients underwent standard surgery performed with a

tourniquet using a medial parapatellar approach. All the patients had standard uncemented TKR (Profix Total Knee System, Smith & Nephew). The knees were all closed in flexion with two layers of continuous vicryl and clips to skin. The tourniquet was released after the wound closure, over a suction drain with the knee in extension in the control group and knee flexed at 90 ° on a static CPM machine in the treatment group. Wool and crepe bandages were applied as a compressive dressing in both the groups, with the knee flexed at 90 ° in the CPM group. For the first two hours the knee was maintained at 90 ° flexion on a static CPM machine followed by dynamic CPM to allow 30 ° to 60 ° flexion for next 22 hours (Fig. 1).

Figure 1

Figure 1: Post-operative picture of use of CPM machine to maintain 90 ° flexed position.

Patients in the two groups underwent standardized postoperative regimen. A standard DVT prophylaxis protocol was used in all patients, which comprised of intra-operative intermittent calf compression pumps followed by TED stockings and Aspirin 150mg for 6 weeks in the post-operative period. Measurable blood loss was recorded from the drains on the ward after 24 hours and the suction drains were removed after 24 hours if there was no further drainage. The haemoglobin level and haematocrit were checked at 24 hours in both the groups after the operation. Physiotherapists performed routine active and passive range of motion (ROM) exercises with the patients, from the first post-operative day. The post-operative ROM was also recorded at 24 hours in both the groups.

Statistical analysis of results in the two groups was performed, to compare the difference in the pre and post-operative haemoglobin (Hb) and haematocrit (Hct) levels, the need for blood transfusion, length of stay, post-operative ROM, and complications (Student's unpaired t-test).

RESULTS

The two groups were comparable pre-op, in terms of age/sex distribution as well as Hb/Hct levels (see Table 1).

Figure 2

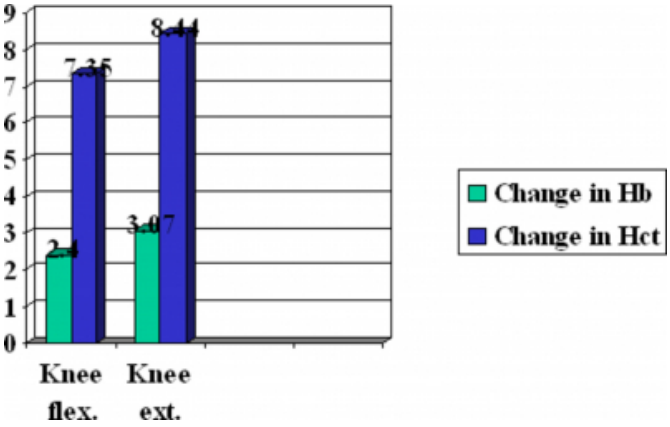
Table 1: Pre-op and post-op ROM in the two groups

	Knee extension group	Knee flexion group with CPM machine	p-value
Mean pre-op ROM	101.8 (20-120)	99.4 (70-120)	0.69
Mean post-op ROM	80.8 (30-100)	73.3 (25-95)	0.10

There was a significant difference in the postoperative haemoglobin and haematocrit levels in the two groups (Fig. 2). The average drop in haemoglobin level in the knee extension group was 3.07g/dl as compared to 2.41g/dl in the knee flexion group, which was found to be statistically significant (p=0.001). The corresponding drop in the haematocrit level was 8.44units, as compared to 7.35units in the knee flexion group (p <0.001).

Figure 3

Figure 2: Changes in haemoglobin (Hb) and haematocrit (Hct)



The average blood loss in the suction drains at 24 hours was 855mls. Fourteen patients in this group required average of 2.5 units blood transfusion (range 1-4 units). The mean transfusion cost in this group based on the number of units of blood required was £500 (£200 per unit). None of the patients in the knee flexion group required blood transfusion.

The ROM in both groups was similar (see Table 2). The average length of stay in the knee extension group was 6.6 days as compared to 5.9 days, in the knee flexion group

(p=0.44).

Figure 4

Table 2: Patient demographics in the two groups

	Knee extension group	Knee flexion group with CPM machine	p-value*
Number of patients	50	50	n/a
Average age (years)	75	70.5	n/a
Sex (M:F)	20:30	26:24	0.08
Average pre-op Hb (gm/dl)	13.44	13.98	0.87
Average pre-op Hct (units)	40.62	42.72	0.01

There were no major complications. There were two superficial infections, one in each group. Both of these cases were treated successfully with antibiotics. There was no case of DVT or haematoma formation in either group.

DISCUSSION

This case-controlled study showed that using a CPM machine to hold the knee flexed at 90 ° reduces post-operative blood loss after uncemented TKR with no drain, compared to keeping the knee fully extended with the use of suction drain.

A previous study documented similar results [5] but these authors used a cemented TKR, rather than the uncemented implants as in our study. Uncemented TKR has been shown to be associated with higher blood loss than cemented TKR [1]. Furthermore, the authors of the study investigating the 90 ° flexed position used a unique wedge to achieve this position [5]. However, this is subject to problems such as wedge availability, standardisation of wedges, deformation of wedges, instability of the leg on the wedge, as well as the need for special materials for health and safety standards. All these issues can be simply and effectively addressed by using a CPM that holds the knee in 90 ° of flexion and allows movement to be introduced early on in the post-operative period. The current study is therefore both conceptually distinct from previous ones, and clinically and practically relevant to the post-op management of TKR.

We chose to limit the post-operative immobilisation to 24 hours for two reasons. A longer period of immobilisation would have interfered with the rehabilitation regime. Most drains are removed at 24 hours, and using this as the post-operative CPM immobilisation period allowed consistency between the two groups. A previous study has shown that most of the visible blood loss is drained from TKR in the first 8 hours [2,4].

Theoretical complications of maintaining the knee in 90 ° of flexion in the post-operative period include increased stiffness (especially lack of full extension), and increased incidence of DVT due to venous stasis. Use of a CPM can theoretically cause injury to patients or pressure sores, when compared to using a softer wedge as previously described [9,5]. We looked specifically for all these complications, and there was no statistically significant difference in the ROM or maximum extension between the two groups. There were no cases of symptomatic DVT or pressure sores. There was one case of superficial infection in each group, treated uneventfully with antibiotics.

A possible criticism of this study relates to the fact that the two groups differed not only by the position of immobilisation, but also by the presence or absence of a drain. Initially we tried withholding a drain in the group with knee in extension but haematoma formation in the post-operative period was a concern. This may introduce a confounding factor, but a previous study used a similar protocol in cemented knees [9]. Furthermore, the amount of blood drained from the group that held the leg in extension in the current study was more than that previously reported by over 200ml (1488ml vs. 1220ml) [4,3].

A further limitation may relate to the lack of power due to the relatively small numbers, when considering complications such as DVT and reduced ROM or stiffness. However, this still makes our study clinically relevant.

CONCLUSION

We have showed that a CPM machine that holds the knee flexed at 90 ° reduces post-operative blood loss after uncemented TKR with no drain, compared to keeping the knee fully extended with the use of suction drain. The CPM is a well-recognised and easily available piece of equipment that thus has another application in the post-operative management of TKR.

CORRESPONDENCE TO

1 St. Thomas Close Sutton Coldfield Birmingham B75 7QJ UK. E-mail address: shivajdoc@hotmail.com Tel. 01212402256

References

1. Porteous AJ, Bartlett RJ. Post-operative drainage after cemented, hybrid and uncemented total knee replacement. Knee. 2003 Dec;10(4):371-4.
2. Drinkwater CJ, Neil MJ. Optimal timing of wound drain removal following total joint arthroplasty. J Arthroplasty. 1995 Apr;10(2):185-9.

3. Kumar N, Saleh J, Gardiner E, Devadoss VG, Howell FR. Plugging the intramedullary canal of the femur in total knee arthroplasty: reduction in postoperative blood loss. J Arthroplasty. 2000 Oct;15(7):947-9.
4. Sehat KR, Evans R, Newman JH. How much blood is really lost in total knee arthroplasty? Correct blood loss management should take hidden loss into account. Knee. 2000 Jul 1;7(3):151-155.
5. Ong SM, Taylor GJ. Can knee position save blood following total knee replacement? Knee. 2003 Mar;10(1):81-5.
6. Jones HW, Savage L, White C, Goddard R, Lumley H, Kashif F, Gurusany K. Postoperative autologous blood salvage drains--are they useful in primary uncemented hip and knee arthroplasty? A prospective study of 186 cases. Acta Orthop Belg. 2004 Oct;70(5):466-73.
7. Levy O, Martinovitz U, Oran A, et al. The use of fibrin tissue adhesive to reduce blood loss and the need for blood transfusion after total knee arthroplasty: a prospective randomised multicentre study. J Bone Joint Surg Am 81:1580, 1999.
8. Abdel-Salam A, Eyres K. Effects of tourniquet during total knee arthroplasty: a prospective randomised study. J Bone Joint Surg Br 81:30, 1999.
9. Timlin M, Moroney P, Collins D, Toomey D, O'Byrne. The 90/90 pillow reduces blood loss after knee arthroplasty: a prospective randomised case control study. J. The Journal of Arthroplasty Vol.18 No. 6 2003.
10. Parker MJ, Roberts CP, Hay D. Closed suction drainage for hip and knee arthroplasty. A meta-analysis. J Bone Joint Surg Am. 2004 Jun;86- A(6):1146-52.
11. Mengal B, Aebi J, Rodriguez A, Lemaire R. A prospective randomized study of wound drainage versus non-drainage in primary total hip or knee arthroplasty. Rev Chir Orthop Reparatrice Appar Mot. 2001 Feb 1;87(1):29-39.

Author Information

S.A. Jain, Specialist Registrar
Department of Orthopaedics, Worthing & Southlands Hospital

A.F. Dinah
Department of Orthopaedics, Worthing & Southlands Hospital

S.H. Palmer
Department of Orthopaedics, Worthing & Southlands Hospital