Closed suction drains do not increase the blood transfusion rates in patients undergoing total knee arthroplasty

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Abstract We aim to determine whether the presence of a drain increases the actual blood transfusion rates in patients undergoing primary total knee arthroplasty (TKA). A retrospective review was performed on two consecutive groups of patients who underwent primary TKA: group 1 including 100 patients who underwent TKA and had one deep closed suction drain; group 2 including 100 patients who underwent TKA and had no drain. Blood transfusions were given post-operatively on the basis of clinical need without a pre-determined haemoglobin trigger factor. Group 1 drained a mean of 692 ml (range 150–1500) of blood in 48 h. The mean fall in haemoglobin at 48 h post-operatively was 3.26 g/dl in group 1 and 3.33 g/dl in group 2. Nine patients in group 1 and seven patients in group 2 required a blood transfusion; this was not statistically significant ($P=0.79$). Transfusion of primary TKA patients on the basis of clinical need can result in post-operative transfusion rates of 8%. The presence of a drain does not increase the transfusion rates of patients undergoing primary TKA.

Résumé Le but de cette étude est de déterminer si la mise en place d'un drain entraîne une augmentation du taux de transfusion chez les patients qui ont bénéficié d'une prothèse totale du genou. Une étude rétrospective a été réalisée à partir d'un groupe de patients ayant bénéficié d'une prothèse totale du genou de première intention. Dans

le premier groupe 5 patients ont bénéficié d'une prothèse totale avec un drainage, dans le deuxième groupe, 100 patients ont bénéficié de la même prothèse sans drain. Dans le premier groupe le drainage a permis de récolter 692 ml de sang (150 à 1.500) en 48 heures. Le taux moyen d'hémoglobine post-opératoire à 48 heures était de 3.26 g/dl dans le groupe 1 et de 3.33 g/dl dans le groupe 2. 9 patients du groupe 1 et 7 patients du groupe 2 ont nécessité une transfusion. La différence n'est pas significative. Le taux de patients nécessitant une transfusion post-opératoire est de 8%, l'indication étant posée sur l'état clinique du patient, la présence d'un drain n'augmente pas le taux de transfusion après une prothèse totale du genou de première intention.

Introduction

Post-operative blood transfusion rates following total knee arthroplasty (TKA), in the current medical literature, are between 11–70%. These studies report that patients following TKA are transfused if they are symptomatic, or are automatically transfused if their post-operative haemoglobin has fallen below a trigger value, which is commonly between 8–10 g/dl [5, 10, 12, 16, 22, 24, 25]. Hamer et al. recommends that patients with a haemoglobin count between 8–10 g/dl should only be transfused if symptomatic [11]. In two recent surveys performed in the United Kingdom regarding TKA, the majority of knee arthroplasty surgeons still use closed-suction drains [3, 4]. A large meta-analysis of 237 patients by who underwent TKA, showed that closed-suction drains may actually increase the risk of blood transfusion rates [19]. In these studies, patients were transfused if their haemoglobin fell below a certain trigger value; therefore, some patients may have been transfused when clinically not indicated [1, 8, 14, 18]. The many

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potential complications following blood transfusion are well documented, hence unnecessary transfusions should be avoided [25].

We are unaware of any study that compares the actual transfusion rates where a haemoglobin trigger factor was not used to initiate transfusion post-operatively in patients undergoing primary TKA; both those patients who had a closed suction drain and those who did not. We aim to determine whether the presence of a drain increases the actual blood transfusion requirement in patients undergoing primary TKA for primary osteoarthritis (OA).

Methods

The senior author's (RWP) routine policy of blood transfusion following primary TKA is to transfuse according to clinical need alone, which is not set by a pre-determined haemoglobin trigger factor to initiate transfusion. We retrospectively reviewed 200 consecutive patients who underwent primary TKA for primary osteoarthritis (OA) over a 2.5-year period with the senior author RWP at our institution. The first 100 consecutive patients (group 1) all had one deep Redivac closed-suction drain inserted at the time of closure which was removed 48 h after surgery. The next 100 consecutive patients (group 2) did not have a closed suction drain. In both groups, patients were transfused according to clinical need alone (if they were short of breath, tachycardic, had low blood pressure and found mobilisation difficult); a haemoglobin trigger factor was not used to influence post-operative transfusion. To determine a *P*-value of <0.05 to be significant and give this study a power of 80%, we needed to review a minimum of 87 patients in each group [18]. We reviewed the pre-operative (pre-op) and 48 h post-operative (post-op) haemoglobin values and the transfusion rates according to the clinical need of the two groups. We also determined the number of patients that would have been transfused in each group if various haemoglobin trigger factors were used.

Patients undergoing primary TKA were seen pre-operatively within 6 weeks of surgery and had routine blood samples taken which were 'group and saved'. Patients on Aspirin were asked to stop taking it 10 days before surgery. All the primary TKAs in this study were performed by or were directly supervised by the senior author RWP. The preparation

and surgery in all the patients was identical. All patients underwent a general anaesthetic with femoral and sciatic nerve blocks. An above-knee tourniquet was used and the patient's knee was double prepped with aqueous providone-iodine solution. A medial parapatellar skin incision and trivector arthrotomy was used. The prosthesis used was the Anatomic Modular Knee (AMK, Depuy, Warsaw, Indiana). The femoral, tibial and patella components were fixed with cement. The knee was closed using Vicryl for all the layers including the skin. Steristrips were applied to the incision; the incision was then covered with Melolin, and two layers of wool and crepe bandage were applied. The tourniquet was deflated immediately after the crepe bandage was applied. Patients were allowed to mobilise on the first post-operative day and the dressings were removed. The single closed suction drain in group 1 was removed at 48 hours.

Statistics Analysis was performed using the software Medcalc (Mariakerke, Belgium, Version 8.1.1.0). The mean and 95% confidence interval (CI) are given. The un-paired *t*-test was used to determine differences in haemoglobin between the two groups. The chi-squared test was used to determine if there was a significant difference in the number of patients being transfused in each group. The chi-squared test was used to determine if there was a significant difference in the number of patients being transfused if trigger values were used.

Results

Patients in group 1 and 2 were equally matched for age and weight. In both groups of patients, there were twice as many females as males (Table 1). There was no significant difference between the mean pre-op and 48-h post-op haemoglobin values (Table 2). Group 1 patients; a mean of 526 ml (range 50–1,500 ml) of blood drained at 24 h. A mean total of 692 ml (range 150–1,500 ml) of blood was drained at 48 h. A total of 1,500 ml of blood had been drained in 24 h from one patient who became clinically symptomatic; the patient was transfused with two units of blood before a check haemoglobin was obtained. This patient's pre-op Hb was 15.8 g/dl, and the post transfusion haemoglobin was 11.8 g/dl. As we were unable to obtain

Table 1 Demographic details of the patients

	Group 1 (100 patients)		Group 2 (100 patients)		<i>P</i> -value
	Mean	95% CI	Mean	95% CI	
Sex (male:female)	1:2	—	1:2	—	—
Age (years)	72.35	70.82–73.88	74.2	72.42–76.0	0.12
Weight (kg)	78.1	75.66–80.50	76.08	72.9–79.3	0.32

Table 2 Pre-op and post-op haemoglobin values of the two groups

	Group 1 (99 patients)		Group 2 (100 patients)		<i>P</i> -value
	Mean	95% CI	Mean	95% CI	
Pre-op Hbg/dl	13.33	13.06–13.61	13.42	13.18–13.68	0.63
Post-op Hbg/dl	10.07	9.81–10.33	10.09	9.79–10.39	0.93

the 48-h post-op haemoglobin for this patient, the patient's haematology data was removed from the calculations. A total of nine patients out of 100 in group 1, and seven patients out of 100 in group 2, were transfused post-operatively after 48 h according to clinical need. There was no statistical difference in the number of patients transfused between the groups (chi-squared; $P=0.79$). All these patients were clinically pale, short of breath and tachycardic and found mobilisation difficult as a result. None of the patients required an intra-operative blood transfusion. Patients who were transfused were given two units of blood. Table 3 shows the number of patients in each group that would have been transfused if trigger factors were used.

Discussion

In studies which investigated the use of closed suction drains in TKA, no significant difference in the fall in haemoglobin between patients who had a closed suction drain and those who did not has been reported [1, 2, 6–8, 13, 14, 17–19, 21]. These studies state that patients were transfused if their post-operative haemoglobin fell below a certain level, which is commonly between 8–10 g/dl; or if they were clinically symptomatic. Only four of these studies reported the number of patients that received a post-operative blood transfusion in each group [1, 8, 14, 18]. None of these studies distinguishes between which patients were transfused for clinical reasons and which were transfused when their haemoglobin fell below a certain trigger value. Therefore, it is not possible to conclude which patients actually needed a blood transfusion, and which patients were transfused arbitrarily. Using a pre-determined haemoglobin trigger factor to initiate transfusion can result in patients who are not clinically symptomatic being transfused. Our study shows that a closed suction drain does not significantly increase the transfusion rate of patients undergoing TKA if they are clinically assessed post operatively, which is contrary to the meta-analysis of Parker et al. [19].

Table 3 shows the number of patients in group 1 and group 2 that would have been transfused if arbitrary haemoglobin trigger values alone were used to initiate transfusion as in other studies. There is no significant

difference in the number of patients that would have been transfused if various haemoglobin trigger factors alone were used to initiate transfusion.

It is not clear why more patients with drains were transfused in the reported studies. One can only postulate that combining clinical assessment and visualising approximately 500–1,000 ml of blood in a drain may indicate significant blood loss, thereby allowing for a potential tendency by medical staff to initiate transfusion. There are very few studies in the medical literature where patients following TKA have been given a blood transfusion according to clinical need alone. Our mean transfusion rate of 8% is comparable to that of Gainor whose transfusion rate was 6% in 115 consecutive TKAs, and to that of Mehra et al., whose transfusion rate was 6% in 50 patients [9, 15]. Some surgeons use re-infusion drains in TKA. Re-infusion drains used in primary TKA have been reported to significantly reduce allogenic blood transfusion requirements. Peter et al. reported an allogenic blood transfusion rate of 19% in 160 patients who underwent primary TKA and had a re-infusion drain [20]. In a similar study, Sinha et al. reported an allogenic transfusion rate of 16% [23]. Both these studies used haemoglobin trigger factors to initiate allogenic blood transfusion, which may have resulted in patients who were not clinically symptomatic being transfused.

Conclusion

This study showed that closed-suction drains do not significantly increase the risk of a post-operative blood

Table 3 Number of patients that would have been transfused if haemoglobin trigger values were used solely

Hb g/dl	Group 1 (drain), 99 patients	Group 2 (no drain), 100 Patients	<i>P</i> -value
<10	50	51	1.0
<9.5	36	37	1.0
<9	23	25	0.87
<8.5	8	12	0.48
<8	3	6	0.49

transfusion in patients undergoing primary TKA for primary OA. To avoid unnecessary transfusion, patients should be assessed clinically, the post-operative haemoglobin value should be noted and blood transfusions should be given according to clinical need. It remains to be seen if re-infusion drains can significantly reduce post-operative blood transfusion, since studies which have reported that re-transfusion reduces allogenic blood-transfusion requirements, have also used haemoglobin trigger factors.

Conflict of interest statement There are no conflict of interest.

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