

# Effect of drain pressure in total knee arthroplasty

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## ABSTRACT

**Purpose.** To study the effect of drain suction pressure on drainage volume, decrease in haemoglobin level, blood transfusion, and wound complications following total knee arthroplasty.

**Methods.** Primary total knee arthroplasty for degenerative osteoarthritis was performed in 60 (49 female and 11 male) patients. Patients were randomised for high-pressure (600 mm Hg) or low-pressure (350 mm Hg) postoperative suction drainage. Drain output was recorded daily and the drain removed after 48 hours. Postoperative haemoglobin level was measured on the evening of the operation day and on postoperative day 2.

**Results.** The high-pressure group had a significantly higher drainage volume and decrease in haemoglobin level than the low-pressure group. However, there was no significant difference between groups in the

transfusion rate, number of units of blood transfused, wound discharge, or Knee Society knee and function scores. No wound infection was detected in any patient.

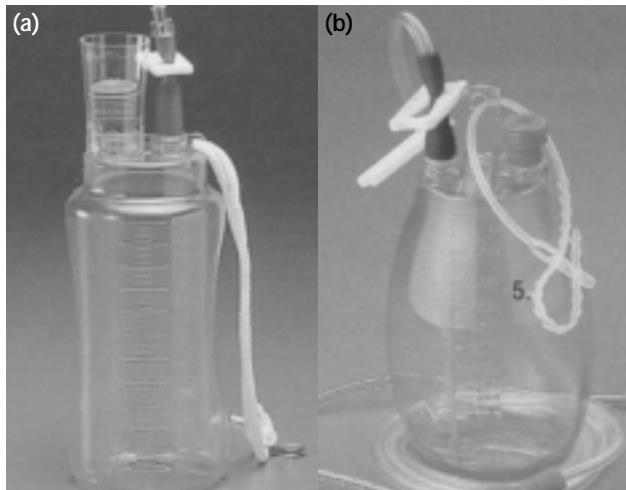
**Conclusion.** Low-pressure suction drainage results in less blood loss without a significant increase in wound complications.

**Key words:** arthroplasty, replacement, knee; drainage; pressure; suction

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## INTRODUCTION

In 1961, Waugh and Stinchfield<sup>1</sup> advocated the use of suction drainage in orthopaedic surgery. The aims of postoperative drainage were to prevent haematoma formation and subsequent wound complications.<sup>2</sup> Although the use of suction drains in total joint arthroplasty has been widely studied, most studies



**Figure** (a) High suction pressure drain bottle (Medinorm S-600), and (b) low suction pressure drain bottle (Survac).

have concentrated on drainage versus no drainage,<sup>3-9</sup> when to open the drain postoperatively,<sup>10</sup> and the optimal time for drain removal.<sup>11-13</sup> Only one study compared a high- and low-pressure suction drain in total hip arthroplasty.<sup>14</sup> In addition, most commercially available disposable drains do not indicate suction pressure. We aimed to study the effect of high- and low-pressure suction drainage in total knee arthroplasty (TKA).

## MATERIALS AND METHODS

From May to October 2001, 49 female and 11 male patients underwent primary TKA for degenerative osteoarthritis at the Prince of Wales Hospital, Hong Kong. Pharmacological prophylaxis for deep venous thrombosis was not prescribed. Patients were randomised to a high-pressure group with an initial suction pressure of 600 mm Hg (Medinorm S-600, Van Straten Medical, Nieuwegein, Netherlands; Fig. a) or a low-pressure group with an initial suction pressure of 350 mm Hg (Survac, Surimex, Nunawading, Australia; Fig. b). Each group had 30 patients. The initial suction pressures were preset by the manufacturers, and the capacity of the drain was 600 ml. The diameter of the drain catheter was 10 Ch, and 2 suction drains were inserted.

Posteriorly stabilised total knee prosthesis (Legacy PS, Zimmer, Warsaw [IN], USA) was used with cement in all patients. The tourniquet pressure was set at 300 mm Hg, and the tourniquet was released for haemostasis before wound closure.

Drain output was recorded daily and the drain removed 48 hours postoperatively. Postoperative haemoglobin level was measured on the evening of the operation day and on postoperative day 2. Blood transfusion was initiated when haemoglobin level fell below 80 g/l or when the patient was haemodynamically unstable and the number of units transfused was charted. No autologous transfusion was performed. Using the criteria devised by Krackow,<sup>15</sup> wound drainage was defined as persistent if fluid drainage continued for 4 consecutive days beyond postoperative day 5, or if the drainage soaked at least a 2x2 cm area of gauze dressing, or if it emanated from the same specific site(s) along the wound. Knee Society knee and function scores were measured to compare the clinical results of both groups.<sup>16</sup> Patients were followed up for a mean period of 4.3 years.

Student's *t* test was used for statistical analysis and statistical significance was defined as  $p < 0.05$ .

## RESULTS

The results are summarised in the Table. The mean age of patients was 63.3 years in the high-pressure group and 65.8 years in the low-pressure group; the difference was not significant ( $p = 0.31$ ). The mean preoperative haemoglobin level was significantly lower in the low-pressure group (122 g/l) than the high-pressure group (132 g/l) [ $p = 0.003$ ]. The mean drain output was significantly higher in the high-pressure group (1227 ml; range, 280–930 ml) than the low-pressure group (918 ml; range, 540–1460 ml) [ $p = 0.035$ ].

The high-pressure group had a significantly larger fall in haemoglobin level (mean, 45 g/l; range, 14–64 g/l) than the low-pressure group (mean, 36 g/l; range 12–62 g/l) [ $p = 0.016$ ]. There was no difference in respective transfusion rates (71% versus 78%,  $p = 0.43$ ). The mean number of blood units transfused was the same in both groups (1.7 units,  $p = 0.96$ ).

In the high- and the low-pressure groups, respective mean Knee Society knee scores at 4.3 years follow-up were 90.8 (range, 74–99) and 90.5 (range, 70–100) [ $p = 0.87$ ], and mean function scores were 70.3 (range, 5–100) and 74.3 (range, 5–100) [ $p = 0.2$ ].

Persistent postoperative wound drainage was present in one patient in the high-pressure group who was treated with daily wound dressings and intravenous antibiotics; it resolved on postoperative day 10. Although persistent postoperative wound drainage increases the risk of wound infection, no wound infection was encountered.

Table  
Summary of results

	High suction pressure group Mean (SD)	Low suction pressure group Mean (SD)	p value
Age (years)	63 (9)	66 (10)	0.31
Preoperative haemoglobin level (g/l)	132 (12.4)	122 (11.7)	0.003
Drain output (ml)	1227 (764)	918 (290)	0.035
Postoperative haemoglobin drop (g/l)	45 (17.4)	36 (10.2)	0.016
Transfusion rate	71%	78%	0.43
Blood transfused (units)	1.7 (1.5)	1.7 (1.2)	0.96
Knee Society scores			
Knee score	90.8 (7.5)	90.5 (8.9)	0.87
Function score	70.3 (24.6)	74.3 (27.7)	0.2

## DISCUSSION

Postoperative suction drainage has been performed in orthopaedic surgery for more than 40 years.<sup>1,2,4,6,9</sup> The preset suction pressure of most drains varies, and surgeons may not know the clinical significance of different suction pressures. The higher the negative pressure, the greater the drain output, but whether this causes more complications following TKA has not been studied.

Benoni and Fredin<sup>14</sup> studied the difference between high- (600 mm Hg) and low- (65 mm Hg) pressure suction drainage in total hip arthroplasty and reported a significantly higher drain output and decrease in haemoglobin level in the high suction pressure group. Nonetheless, differences in blood transfusion rates and wound complication rates between the groups were not statistically significant.

In this study, although the high-pressure group had a significantly greater reduction in haemoglobin level than the low-pressure group (45 g/l versus 36 g/l), the transfusion rates and numbers of blood units transfused were not significantly different. The

higher preoperative haemoglobin level in the high-pressure group may have affected the transfusion rate, because patients with higher preoperative haemoglobin levels may be more able to withstand blood loss without transfusion.

This study measured the initial suction pressure instead of the constant suction pressure. According to Boyle's law (pressure/volume=constant), suction pressure decreases when residual drain bottle volume decreases (drain output increases). The percentage decrease in suction pressure in the 2 drains (with same volume) is proportional to the drain volume increase. The relation between the rate of change in drain volume and suction pressure is subject to further study.

## CONCLUSION

A low suction pressure drain (350 mm Hg) reduces drain output and the decrease in haemoglobin level, without a significant increase in wound complications. The optimal suction pressure to use following TKA requires further evaluation.

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