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AUTOLOGOUS BLOOD TRANSFUSION AND HYPOTENSIVE ANESTHESIA FOR ROTATIONAL ACETABULAR OSTEOTOMY

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ABSTRACT

We employed hypotensive anesthesia with prostaglandin E_1 (PGE_1) and transfused 400 ml of autologous whole blood on the first postoperative day to avoid homologous blood transfusion in 137 patients undergoing rotational acetabular osteotomy (RAO) and RAO combined with intertrochanteric valgus osteotomy. Four hundred ml of whole blood were donated 1 week before the surgery, and transfused on the first postoperative day after hematological examination. We employed induced hypotension with PGE_1 under general anesthesia with enflurane or isoflurane. Intraoperative systolic blood pressure was maintained at approximately 70–80 mmHg. The mean operation time was 139 ± 32 minutes. The mean intraoperative and the postoperative estimated blood loss was 286 ± 152 g and 259 ± 122 g, respectively. The mean hemoglobin content was 13.3 ± 1.1 g/dl before the operation. It showed the lowest value of 9.4 ± 1.0 g/dl on the first postoperative day but it returned to 10.4 ± 1.0 g/dl in the second postoperative week. There was no use of homologous blood transfusion. We consider that the concomitant use of autologous blood donation and hypotensive anesthesia is an extremely useful method to avoid homologous blood transfusion.

Key Words: autologous blood donation, hypotensive anesthesia, osteotomy/rotation

INTRODUCTION

Recently, adverse effects accompanying homologous blood transfusion have become a serious problem because of virus infections and graft versus host disease (GVHD).[1-3] Autologous blood donation is a useful method of avoiding homologous blood transfusions, and hypotensive anesthesia can reduce the intraoperative blood loss. We have performed rotational acetabular osteotomy (RAO)[4] with concomitant use of an autologous blood donation of 400 ml of whole blood and hypotensive anesthesia with prostaglandin E_1 (PGE_1). We examined the operation time, intra- and postoperative estimated blood loss, and the change in hematological parameters. The purpose of our study is to elucidate the usefulness of autologous blood donation and hypotensive anesthesia.

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MATERIALS AND METHODS

At the Aichi-ken Saiseikai Hospital, we performed RAO and RAO combined with intertrochanteric vulgus osteotomy consecutively in 143 patients. Among them 6 patients were excluded from this study for the following reasons: 4 patients refused autologous blood transfusion for religious reasons, 1 patient showed signs of anemia, and for 1 patient, predonated autologous blood was not transfused for coagulation of blood. The remainder of the patients were included in this study. We performed RAO and RAO combined with intertrochanteric vulgus osteotomy in 157 dysplastic hips of 137 patients with autologous blood donation and hypotensive anesthesia. We performed RAO in 119 hips and RAO combined with valgus osteotomy in 38 hips. There were 130 females and 7 males. The mean age was 41 years old (range: 14–60). The criteria for collecting blood were a hemoglobin content of more than 11 g/dl, a body weight exceeding 40 kg, and no serious complications. Four hundred ml of whole blood was donated one week before the operation and transfused on the first postoperative day after hematological examination. Premedication consisted of 0.5 mg of atropine sulfate and 10 mg of diazepam. After arrival in the operating room, an ECG was monitored continuously and heart rate and noninvasive blood pressure were measured. Anesthesia was induced after preoxygenation. Anesthesia was maintained with 1–2 vol% of enflurane or 0.5–1.5 vol% of isoflurane concentration in 67% of nitrous oxide and 33% of oxygen. We employed induced hypotension with PGE_1, when we osteotomied, and measured blood pressure every minute. We administered 0.1 to 0.2 μg/kg/min of PGE_1 to maintain systolic blood pressure between 70 and 80 mmHg. Fluid was administered at the rate of 5 to 20 ml/kg/h to keep urine volume above 0.5 ml/kg/h.

In the present study, we examined operative time, intra- and postoperative estimated blood loss, and hematological parameters. The hematological parameters were hemoglobin content, platelet count, total protein and albumin content, glutamic oxaloacetate transaminase (GOT), and glutamic pyruvic transaminase (GPT). We examined these parameters in the first week before the operation, on the fifth day before the operation (after autologous blood donation), and after the operation on the first and third days, in the first and second weeks, and in the first, second and third months.

All data were given in the form of mean and standard deviation. Statistical analyses were performed using the Wilcoxon test compared with the data in the first week before the operation. Statistical significance is indicated at $p < 0.05$.

RESULTS

We performed RAO in 157 hips without homologous blood transfusion. The mean operation time was 139 ± 32 minutes (range: 89–256). The mean intraoperative estimated blood loss was 286 ± 152 g (range: 86–915). The mean postoperative estimated blood loss was 259 ± 122 g (range: 81–654).

The mean hemoglobin content before the operation was 13.3 ± 1.1 g/dl, and after autologous blood donation it was 11.9 ± 1.2 g/dl ($p < 0.05$). It became the lowest at 9.4 ± 1.0 g/dl ($p < 0.05$) on the first postoperative day, rose to 9.9 ± 1.3 g/dl ($p < 0.05$) on the third postoperative day, and to 10.4 ± 1.0 g/dl ($p < 0.05$) in the second postoperative week (Fig. 1). Only three cases showed a hemoglobin content below 7 g/dl (6.5, 6.7, and 6.9 g/dl).

The mean platelet count was $23.6 \times 10^4 \pm 5.7 \times 10^4$ before the operation, reacting a maximum of $44.2 \times 10^4 \pm 11.3 \times 10^4$ ($p < 0.05$) in the second postoperative week. It returned to $26.0 \times 10^4 \pm 7.7 \times 10^4$ ($p < 0.05$) in the first postoperative month, and $24.1 \times 10^4 \pm 5.8 \times 10^4$

($p > 0.05$) in the second postoperative month (Fig. 2).

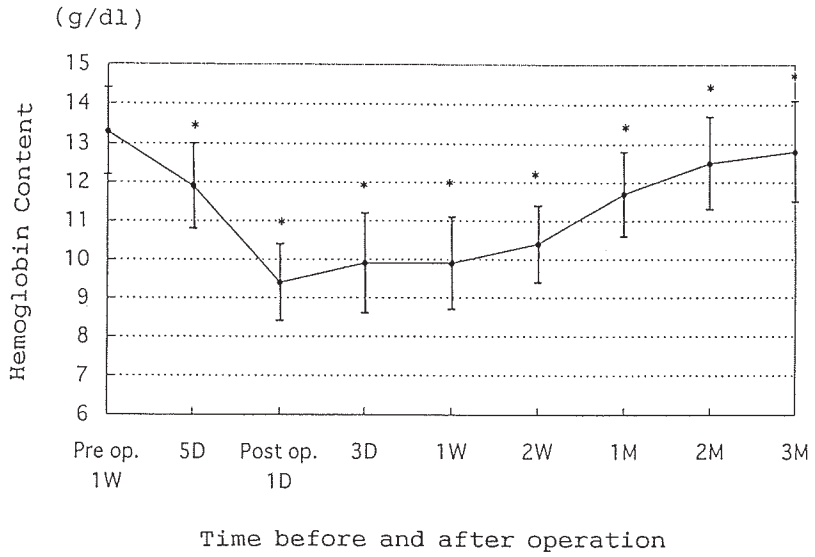

Fig. 1 Change of the mean of hemoglobin content
The mean hemoglobin content became the lowest at 9.4 g/dl on the first postoperative day. *=$p < 0.05$ compared with the data in the first week before the operation.

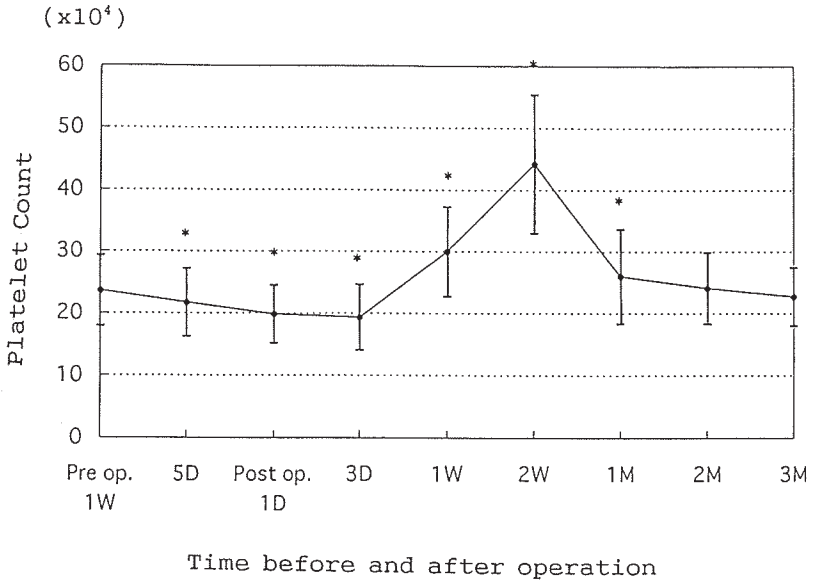

Fig. 2 Change of the mean of platelet count
The mean platelet count showed a maximum of 44.6×10^4 in the second postoperative week. *=$p < 0.05$ compared with the data in the first week before the operation.

The means of the other hematological parameters were within normal ranges before and after the operation.

DISCUSSION

Recently there has been an increasing interest in the use of autologous blood for support of elective surgery to prevent adverse effects of homologous blood transfusion. In the operation of total hip replacement, predonation autologous blood was useful to reduce exposure to homologous blood.[5,6] We performed RAO and RAO combined with intertrochanteric valgus osteotomy in 157 hips of 137 patients without homologous blood transfusion. After osteotomy bleeding generally continued for a few days. We transfused autologous blood on the first postoperative day after hematological examination. Mean hemoglobin content was 9.4 ± 1.0 g/dl on the first postoperative day, and this was the lowest after the operation. Hemoglobin content was below 7 g/dl in 3 patients. Since they showed no symptoms such as tachycardia, hypotension or a decrease in electrocardiographic ST, we did not administer homologous blood to all 137 patients in this study. The mean estimated intraoperative blood loss was 286 ± 152 g, though there was a case with 915 g of estimated blood loss during the operation. The mean estimated postoperative blood loss was 259 ± 122 g and the maximum estimated blood loss was 654 g. From these findings, we consider that predonation of autologous blood in the amount of 400 ml was useful to avoid the need for homologous blood transfusion.

Takeuchi et al. examined platelet counts in 39 patients after gastrointestinal surgery. At first the platelet counts decreased, and then the counts increased and reached their maximal values in the second week.[7] In our study, platelet counts reached a maximum of $44.2 \times 10^4 \pm 11.3 \times 10^4$ in the second week. The platelet count changes in our study were consistent with their study. We therefore consider the changes in platelet count in our study to be normal postoperative changes.

Many drugs are used to induce hypotension during surgery. Ganglion-blocking drugs, such as trimetaphan, is associated with undesirable side effects, such as reduced cardiac output and subsequent reduced blood supply to vital organs.[8] Nitroglycerin dilates both resistance and capacitance vessels, but the effect on the latter is predominant. Nitroglycerin often increases the heart rate, and occasionally, does not produce a dry operative field.[9] But PGE_1 decreases total peripheral resistance and arterial pressure. While PGE_1 reduces blood pressure, it increases heart rate, cardiac output and myocardial contractile force.[10] As 90% of the infused PGE_1 is removed in one circulation through the pulmonary vascular bed, the drug shows excellent regulation.[11] Renal blood flow and urine flow often decrease during and after hypotension with other hypotensive drugs. But PGE_1 increases renal blood flow, and does not cause kidney disorders.[12] Also, PGE_1 does not cause liver disorders.[13] For these reasons we used PGE_1 to induce hypotension. We maintained the systolic blood pressure at approximately 70–80 mmHg during induced hypotension with PGE_1. There was no drug toxicity related to PGE_1, such as tachycardia, decrease in electrocardiographic ST, and phlebitis.

We employed induced hypotension with PGE_1 under general anesthesia and transfused 400 ml of autologous blood on the first postoperative day. We did not transfuse homologous blood to 137 patients who underwent 157 hip surgeries. We consider that the concomitant use of autologous blood donation and hypotensive anesthesia is an extremely useful method to avoid homologous blood transfusions.

REFERENCES

1) Fernandez, M.C., Gottlieb, M. and Menitove, J.E.: Blood transfusion and postoperative infection in orthopedic patients. *Transfusion*, 32, 318–322 (1992).
2) Grody, G.F., et al.: Risk of posttransfusion hepatitis in the United States. *JAMA*, 220, 692–701 (1992).
3) Sazama, K.: Reports of 355 transfusion-associated deaths: 1976 through 1985. *Transfusion*, 30, 583–590 (1990).
4) Ninomiya, S. and Tagawa, H.: Rotational acetabular osteotomy for the dysplastic hip. *J. Bone Joint Surg. [Am]*, 66, 430–436 (1984).
5) Sharland, M.G. and Holmon, P.R.: Autologous blood donation in total hip replacement. *Aust. N. Z. J. Surg.*, 65, 17–19 (1995).
6) Woolson, S.T. and Watt, J.M.: Use of autologous blood in total hip replacement. *J. Bone Joint Surg. [Am]*, 74, 76–80 (1991).
7) Takeuchi, H., et al.: The changing pattern of platelet count after gastrointestinal surgery according to the healing stage. *Iryo*, 48, 483–487 (1994) (in Japanese).
8) Fahmy, N.R. and Laver, M.B.: Hemodynamic response to ganglionic blockade with pentolinium during N_2O-halothane anesthesia in man. *Anesthesiology*, 44, 6–15 (1976)
9) Goto, F., Otani, E., Kato, S. and Fujita, T.: Prostaglandin E_1 as a hypotensive drug during general anesthesia. *Anesth.*, 37, 530–535 (1982).
10) Nakano, J. and Richard, J.M.: Cardiovascular effects of prostaglandin E_1. *J. Pharmac. Exp. Ther.*, 156, 538–547 (1967).
11) Ferreira, S.H. and Vane, J.R.: Prostaglandins: Their disappearance from and release into the circulation. *Nature*, 216, 868–873 (1967).
12) Fukusaki, M., Shibata, O., Fujigaki, T., Makita, T. and Gotoh, Y.: The effect of prolonged controlled hypotension induced by prostaglandin E_1 on renal tubular function. *J. Anesth.*, 4, 197–205 (1990).
13) Iwatsuki, N., Yasuda, A., Tokutomi, S., Saishu, T., Koga, Y. and Hashimoto, Y.: Preventative effect of PGE_1 for postoperative liver damage. *J. Anesth.*, 6, 131–137 (1992).