Propofol-remifentanil is More Effective than Propofol-fentanyl in Decreasing Intraoperative Blood Loss during Sagittal Split Ramus Osteotomy

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Received 10 February, 2016/Accepted for publication 17 March, 2016

Abstract

This study retrospectively compared blood loss during sagittal split ramus osteotomy in patients receiving propofol-remifentanil (R group) and those receiving propofol-fentanyl (F group). All patients underwent sagittal split ramus osteotomy under general anesthesia during the 3-year 4-month period between October 2007 and February 2011 in an operating room at Tokyo Dental College Suidobashi Hospital. Blood loss in the R group was significantly less than that in the F group. Mean arterial pressure and heart rate, measured at 20 and 15 min after tracheal intubation, respectively, were both lower in the R group. No marked change was observed in blood pressure in the R group under general anesthesia, however. Volume of urine was also larger in the R group. The results of this study suggest that remifentanil is effective in reducing intraoperative blood loss during sagittal split ramus osteotomy.

Key words: Propofol — Remifentanil — Sagittal split ramus osteotomy — Blood loss

Introduction

Clinically, this group has found that surgery for jaw deformities involves less blood loss when performed under anesthesia with propofol-remifentanil than with propofol-fentanyl. In addition, studies using Japan White rabbits have shown that continuous infusion

of remifentanil significantly decreased tissue blood flow in mandibular bone marrow^{3,4)}.

The purpose of the present study was to retrospectively compare the effects of various narcotic analgesics used in conjunction with propofol on intraoperative blood loss and hemodynamic variables to clinically verify findings reported in rabbit model studies.

Patients and Methods

This study was conducted with the approval of the Ethics Committee of Tokyo Dental College (Approval number: 399). All the patients included underwent sagittal split ramus osteotomy under general anesthesia during the 3-year 4-month period between October 2007 and February 2011 in an operating room at Tokyo Dental College Suidobashi Hospital. Patients with an American Society of Anesthesiologists Physical Status (PS) score of 2 or higher and those taking oral psychotropic agents or anticoagulants were excluded. Patients in whom nitrous oxide or an inhaled anesthetic was used were also excluded. Thus, only patients in whom fentanyl (F group) or remifentanyl (R group) were concomitantly used under air-oxygen and propofol anesthesia were extracted for the analysis.

Patient characteristics obtained from anesthesia records included age, sex, height, weight, duration of surgery, duration of anesthesia, total fluid infusion, total dose of fentanyl in the F group, total dose of remifentanyl in the R group, blood loss during surgery, urine output, and intraoperative mean blood pressure and heart rate. Mean arterial pressure was calculated as diastolic blood pressure plus one third of pulse pressure at each observation point in the anesthesia records. To compare intraoperative hemodynamic variables between the two groups, differences in mean arterial pressure and heart rate were monitored for 120 min after tracheal intubation. In the statistical analysis, the Student *t*-test was used for unpaired samples and the Mann-Whitney U test where appropriate. A *p*-value of less than 5% indicated a significant difference.

Results

A total of 262 patients underwent sagittal split ramus osteotomy under general anesthesia during the study period. Excluded patients included the following: 1 patient with a PS score of higher than 2; 4 patients who were

Table 1 Patient characteristics

	F group	R group
Age (yr)	26.9 ± 8.1	25.8 ± 8.4
Sex (M/F)	20/45	19/47
Height (cm)	164.1 ± 9.0	163.4 ± 8.2
Weight (kg)	55.9 ± 10.7	57.1 ± 9.0

taking oral psychotropic agents; and 126 patients given nitrous oxide or an inhaled anesthetic. As a result, a total of 131 patients were included in the analysis, comprising 65 in the F group and 66 in the R group.

All patients underwent target-controlled infusion at a predicted blood propofol concentration of 3.5 µg/ml during the induction of anesthesia. A bolus intravenous injection of 100 µg fentanyl was given in the F group before administration of propofol, whereas the R group was given continuous infusion of remifentanyl at 0.25 µg/kg/min. Anesthesia was maintained at a predicted blood propofol concentration of 3.0–4.0 µg/ml, with bolus injections of 1–2 µg/kg fentanyl in the F group or continuous infusion of remifentanyl at 0.25–0.4 µg/kg/min in the R group. Rocuronium was administered at a bolus dose of 0.6 mg/kg for tracheal intubation, and then by continuous intravenous injections at 7 µg/kg/min in all patients. A total of 16 ml of 2% lidocaine hydrochloride with 12.5 µg/ml epinephrine was administered to the surgical field in all patients together with a 50-mg diclofenac sodium suppository on completion of the surgical procedure. In addition, the R group received a bolus injection of fentanyl at 2.0 µg/kg approximately 20 min before the end of the surgical procedure.

No significant differences in patient backgrounds were observed between the two groups (Table 1). Moreover, no differences were revealed in duration of surgery, duration of anesthesia, or total volume of fluid infusion between the two groups. Patients in the F group received a total dose of fentanyl of 443.8 ± 92.4 µg, and those in the R group a

Table 2 Intraoperative data

	F group	R group	p-value
Duration of surgery (min)	112.0 ± 29.5	115.8 ± 16.4	p = 0.183
Duration of anesthesia (min)	179.4 ± 27.8	183.4 ± 20.3	p = 0.177
Total volume of fluid infusion (ml)	1,968.5 ± 502.1	1,830.8 ± 326.8	p = 0.164
Total dose of fentanyl (μg)	443.8 ± 92.4	—	
Total dose of remifentanyl (μg)	—	2,350.0 ± 631.5	
Volume of urine output (ml)	420.8 ± 293.0	567.5 ± 295.0	p = 0.005
Amount of blood loss (ml)	171.7 ± 130.2	118.4 ± 69.6	p = 0.004

Table 3 Intraoperative mean arterial pressure and heart rate

		Control	5 min	10 min	15 min	20 min	30 min	40 min	50 min	60 min	70 min	80 min	90 min	100 min	110 min	120 min
MAP (mmHg)	F group	86.6 ± 9.2	80.4 ± 9.7	80.3 ± 14.8	78.4 ± 13.0	77.5 ± 10.6	78.9 ± 10.0	77.4 ± 12.1	77.0 ± 11.0	80.2 ± 12.3	81.5 ± 10.2	83.6 ± 14.5	86.6 ± 14.7	85.5 ± 14.5	84.4 ± 14.0	84.0 ± 13.1
	R group	88.4 ± 10.0	80.4 ± 13.6	78.2 ± 11.9	75.7 ± 8.8	71.9 ± 8.3	72.5 ± 7.5	70.7 ± 9.0	71.3 ± 10.5	68.6 ± 8.3	71.4 ± 9.1	69.2 ± 8.7	66.9 ± 7.5	69.3 ± 7.3	67.6 ± 7.0	68.3 ± 7.5
	R vs F					*	*	*	*	*	*	*	*	*	*	*
HR (bpm)	F group	66.8 ± 11.0	62.9 ± 11.7	63.0 ± 11.8	65.0 ± 10.8	64.7 ± 11.3	65.3 ± 11.1	73.0 ± 13.7	74.4 ± 11.0	76.6 ± 12.0	79.3 ± 13.0	79.6 ± 11.3	78.4 ± 11.5	74.2 ± 11.9	72.1 ± 11.5	70.2 ± 11.2
	R group	70.3 ± 11.7	62.0 ± 10.7	60.8 ± 9.2	60.0 ± 9.0	59.5 ± 9.0	59.5 ± 9.1	64.9 ± 10.1	66.5 ± 9.0	66.5 ± 10.6	67.6 ± 7.2	67.2 ± 7.7	64.5 ± 7.7	62.4 ± 8.0	60.9 ± 6.8	59.6 ± 7.0
	R vs F				*	*	*	*	*	*	*	*	*	*	*	*

*: p < 0.05 between two groups

MAP: mean arterial pressure, HR: heart rate, F: fentanyl, R: remifentanyl, min: minutes

total dose of remifentanyl of 2,350.0 ± 631.5 μg (Table 2).

Mean blood loss in the R group was 118.4 ± 69.6 ml, which was smaller than that in the F group (171.7 ± 130.2 ml) (Table 2). Mean arterial pressure and heart rate, measured at 20 and 15 min after tracheal intubation, respectively, were lower in the R group (Table 3). A significant difference was also seen in the mean volume of urine output between the two groups (567.5 ± 295.0 ml in the R group vs. 420.8 ± 293.0 ml in the F group; Table 2).

Discussion

The results of this study revealed that blood loss was lower with administration of remifentanyl than with fentanyl during sagittal split ramus osteotomy.

It has been reported that blood loss during jaw deformity surgery showed a positive correlation with duration of surgery⁷⁾. In the present study, duration of surgery was similar between the two groups, and was therefore unlikely to have influenced the volume of blood loss observed.

Induced hypotension has been used to

decrease blood loss in highly invasive surgeries of the jaw bone such as sagittal split ramus osteotomy. In a previous study, it was reported that induced hypotension during jaw deformity surgery was effective in avoiding blood transfusion when the mean blood pressure was maintained at 50–60 mmHg⁶⁾. The results of the present study showed that the mean blood pressure was maintained at around 80 mmHg in the F group and 70 mmHg in the R group. Thus, while intraoperative blood pressure decreased to some extent in both groups, it did reach levels as low as those achieved with induced hypotension.

Remifentanyl can cause bradycardia and reduce blood pressure due to parasympathetic activation and sympatholytic effects¹⁾. A study in patients undergoing tympanoplasty compared the effects of induced hypotension under air-oxygen and propofol anesthesia with 0.25–0.5 µg/kg/min remifentanyl, 0.25 µg/kg/min sodium nitroprusside (SNP), or 100–300 µg/kg/min esmolol hydrochloride (ESMO) by measuring middle ear blood flow. Remifentanyl or SNP elicited a greater decrease in middle ear blood flow than ESMO²⁾. However, SNP decreased pH and increased PaCO₂. Based on these results, the authors concluded that remifentanyl reduced tissue blood flow in the middle ear and provided good surgical conditions for tympanoplasty. Another study using Japan White rabbits reported that remifentanyl reduced mandibular bone marrow blood flow when infused at a clinical dose of 0.25 µg/kg/min during 12 mg/kg/hr propofol anesthesia, although almost no change was observed in carotid artery blood flow³⁾. In the present study, remifentanyl reduced blood pressure and decreased blood loss. However, as this was a retrospective study, it was not possible to investigate whether there was any correlation between this observed reduction in blood loss and decrease in blood pressure. This indicates the need for further prospective study to clarify whether the observed reduction in blood loss with administration of remifentanyl is due to hypotension or a reduction in tissue blood flow.

The volume of urine was greater in the R group. This result is consistent with that of Myles *et al*⁵⁾. It has been suggested that this increase in the volume of urine with administration of remifentanyl is due to subsequent inhibition of excretion of catecholamine and cortisol, although this remains to be confirmed^{5,8)}. This increase in urine and concomitant decrease in blood pressure suggests that adequate renal blood flow was ensured during mild hypotension.

In conclusion, the results of this study revealed that continuous infusion of remifentanyl during sagittal split ramus osteotomy reduced blood loss without any excessive decrease in blood pressure.

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