A comparison of desflurane consumption according to fresh
gas flow

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The consumption of volatile agents during general anesthesia
can be altered by fresh gas flow (FGF), and it is known to be bet-
ter to maintain an anesthetic effect with a lesser amount of vola-
tile anesthetics because cost considerations, as long as it does
not present a safety problem. A previous study reported that the
consumption of sevoflurane and isoflurane was decreased in low
FGF anesthesia, and the decreased amount was proportional to
the FGF rate [1]. We hypothesized that desflurane consumption
would proportionally depend on the FGF rate during anesthetic
management in surgery.

After obtaining Institutional Review Board approval and
informed consent, 42 patients, age 20–60 years and scheduled
for oro-facial surgery, were randomly allocated to one of two
groups: Group F1 received an FGF 1 L/min and Group F3 re-
ceived an FGF 3 L/min. After arriving in the operating room, all
patients were monitored by non-invasive blood pressure, pulse
oximeter, electrocardiogram, Entropy, and Surgical Pleth Index
(SPI) (GE Healthcare, Helsinki, Finland). Anesthesia induction
was performed using propofol and rocuronium. After intuba-
tion, administration of 8% desflurane was initiated with an FGF
6 L/min for the first five minutes and then the FGF was switched
to 1 or 3 L/min according to the assigned group. Anesthesia was
maintained with only desflurane; no adjuvant drugs including
nitrous oxide, opioids, intravenous anesthetics, and anti-hyper-
tensive and vasoactive drugs. Blood pressure was maintained
within ± 20% from the baseline value, which was obtained be-
fore anesthesia induction, and Entropy and SPI were kept below
50. If blood pressure, Entropy, or SPI were out of the mainte-
nance range, the study was paused and the proper treatment
was conducted for the patient’s safety. Desflurane consumption
was measured using an anesthesia machine (Avance CS2™, GE
Healthcare, Helsinki, Finland) at 5, 15, 30, and 60 minutes after
intubation, when the administration of desflurane was initiated.
The analysis was performed using SigmatPlot 12.5 (Systat Soft-
ware Inc., San Jose, USA). Data were expressed as mean ± SD or
median (range; 25–75%). The differences between two groups
were analyzed by a t-test or Mann-Whitney rank sum test de-
pending on the results of the normality and equal variance test.
Statistical significance was considered at P < 0.05.

Five of 42 enrolled patients did not complete the study and
were excluded from the statistical results; 18 patients in group
F1 and 19 patients in group F3 completed as protocol. There
was no statistical difference between the two groups in age,
sex, height, weight, the time from intubation to skin incision,
the type of surgery, hemodynamic parameters, and anesthetic
depth. Desflurane consumption with a FGF 6 L/min for the first
five minutes after intubation was 15 (13–15) ml in the F1 group
and 14 (12–15) ml in the F3 group, which were not statistically
different (P = 0.189). The desflurane consumption for one hour
was 54 (49–56) ml in the F1 group and 94 (86–105) ml in the F3
group (P < 0.001, Fig. 1).

Although the FGF difference was three-fold (1 vs. 3 L/min)
in this study, the desflurane consumption during one hour was
less than twofold greater (54 vs. 94 ml). Weiskopf and Eger
[2] calculated the desflurane consumption with various FGFs
through simulation under the assumption that 1 MAC was kept
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constantly and found that desflurane consumption increased nearly twice — directly proportional to a twofold increase in FGF.

However, in our study, the desflurane consumption decreased less than a half with a threefold decrease in FGF. Several hypotheses to explain the cause can be postulated. First, a constant MAC was not maintained during anesthetic management in the present study. Proper anesthetic depth varies depending on the situation, and such factors including preparation for the operation after the anesthetic induction, a difference of surgical stimuli for the entire operation time, and individual variation can affect the depth. Second, relatively high concentrations of volatile anesthetics in low FGFs are required to reach the same anesthetic depth or MAC because the absolute amount of anesthetics to be delivered to the respiratory circuit of the anesthesia machine is decreased when FGF is decreased. In our study, a higher concentration of desflurane should be required in the F1 group compared to the F3 group, when the increasing of MAC was needed during the surgery. Third, although there was no statistically significant difference between 69 (61–78) kg in the F1 group and 63 (56–67) kg in the F3 group, the body weight in the F1 group was higher than that of the F3 group. Desflurane consumption may have increased more than expected due to the 10% body weight difference in the F1 group.

It is generally accepted that a low FGF is pharmacoeconomic due to the reduction in the consumption of volatile agents [1-3]. However, to reduce the FGF, a device that can monitor the respiratory gases is essential, but the monitoring device can increase the cost. When the FGF is low, the rebreathing fraction through the carbon dioxide absorbent is increased so that carbon monoxide production is increased by the degradation of anesthetics with the absorbent. The cost of carbon dioxide absorbent should also be considered.

There are some limitations to our study. Our study was conducted during anesthetic management for surgical stimuli, so it was difficult to maintain an equal anesthetic depth simultaneously in both groups. Second, because we did not record the dial setting of the vaporizer, there is no evidence that a higher dial setting was maintained in the F1 group compared to the F3 group. Third, there were no lower limits for Entropy and SPI, so there is a possibility of desflurane overdose. Fourth, the volatile agent consumption of Avance CS2TM was calculated by a formula [4], not measured by the actual consumption amount. These factors may be a possible source of bias.

In conclusion, the desflurane consumption measured by Avance CS2TM for one hour was less in the FGF 1 L/min than in the FGF 3 L/min, and the amount of desflurane saved was less than half during anesthetic management in surgery.

References

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