Influence of Fasting Duration on Body Fluid and Hemodynamics

Masanori Tsukamoto, DDS, PhD,* Takashi Hitosugi, DDS, PhD,† and Takeshi Yokoyama, DDS, PhD†

*Department of Dental Anesthesiology, Kyushu University Hospital, Fukuoka, Japan, and †Department of Dental Anesthesiology, Faculty of Dental Science, Kyushu University, Fukuoka, Japan

Fasting before general anesthesia aims to reduce the volume and acidity of stomach contents, which reduces the risk of regurgitation and aspiration. Prolonged fasting for many hours prior to surgery could lead to unstable hemodynamics, however. Therefore, preoperative oral intake of clear fluids 2 hours prior to surgery is recommended to decrease dehydration without an increase in aspiration risk. In this study, we investigated the body fluid composition and hemodynamics of patients undergoing general anesthesia as the first case of the day versus the second subsequent case. We retrospectively reviewed the general anesthesia records of patients over 20 years old who underwent oral maxillofacial surgery. We investigated patient demographics, preoperative fasting time, anesthetic time, urine output, infusion volume, and opioid and vasopressor use. With respect to body fluid and hemodynamics, we extracted the data from the induction of anesthesia through 2 hours of anesthesia time. Thirty patients were suitable for this study. Patients were divided into 2 groups: patients who underwent surgery as the first case of the day (AM group: $n = 15$) and patients who underwent surgery as the second case (PM group: $n = 15$). There were no significant differences between the 2 groups in patient demographics. In the PM group, fasting time for a light meal (832 minutes) was significantly longer than for the AM group (685 minutes), $p = .005$. In the PM group, fasting time for clear fluids (216 minutes) was also significantly longer than for the AM group (194 minutes), $p = .005$. Body fluid composition was not significantly different between the 2 groups. In addition, cardiac parameters intraoperatively were stable. In the PM group, vasopressors were used in 4 patients at the induction of anesthesia ($p = .01$). There were not statistically significant changes in cardiac function or body fluid composition between patients treated as the first case of the day vs patients who underwent surgery with general anesthesia as the second case of the day.

Key Words: Fasting duration; General anesthesia; Body fluid; Hemodynamics.

Fasting before general anesthesia aims to reduce the volume and acidity of stomach contents, which reduces the risk of regurgitation and aspiration.^{1,2} The introduction of the concept of enhanced recovery after surgery has altered preoperative and postoperative care, particularly for major surgery.^{3,4} Preoperative carbohydrate loading and shortening of the fasting time potentially reduces surgical stress, and has been considered useful for perioperative management of patients. Now these concepts have been applied to a

broader range of surgical cases.^{3,4} However, in Japan, most institutions have not yet established enhanced recovery after surgery protocols. According to current guidelines, preoperative oral intake of clear fluids can be safely consumed up to 2 hours before surgery, and a light meal, such as toast and tea, may be consumed up to 6 hours preoperatively.^{1–4} However, conventional fasting times are frequently longer than the expected 6–8 hours.⁵ Overnight fasting may result in hunger, thirst, and anxiety. In addition, it enhances gluconeogenesis as well as insulin resistance.^{4–8} A prolonged fasting duration prior to surgery might lead to unstable hemodynamics, and might have a potentially harmful influence on cardiac preload.⁹ However, there are few reports about the perioperative relationships of body fluid parameters and cardiovascular parameters.

Perioperative fluid management is an important consideration during surgery. Assessment tools, such as bioelectrical impedance analysis, are currently avail-

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Address correspondence to Dr Masanori Tsukamoto, Department of Dental Anesthesiology, Kyushu University Hospital, 3-1-1 Maidashi, Higashi-ku, Fukuoka 812-8582, Japan; tsukamoto@dent.kyushu-u.ac.jp.

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Table 1. Patient Characteristics*

	<i>AM Group</i> (<i>n</i> = 15)	<i>PM Group</i> (<i>n</i> = 15)	<i>p</i>
Age, y	46.6 ± 16.2	38.1 ± 17.6	.06
Height, cm	162.4 ± 7.4	163.9 ± 8.1	.60
Weight, kg	64.4 ± 17.4	58.1 ± 10.5	.25
BMI, kg/m ²	24.1 ± 4.7	21.0 ± 2.1	.06
Gender, male/female	8/7	9/6	.76

* There was no significant difference in patients' characteristics. Values are means ± SD or number of patients. BMI indicates body mass index.

able for determining body fluid parameters.^{10–12} Bioelectrical impedance analysis is a simple and noninvasive method that has been used for evaluating parameters such as body composition and cardiac function in patients during general anesthesia.^{10–12}

In this study, we retrospectively investigated body fluid parameters and hemodynamics of patients scheduled for surgery as the first case of the day versus those scheduled as the second case from charts of patients undergoing oral and maxillofacial surgery under general anesthesia.

METHODS

The Ethic Review Board of Kyushu University Hospital approved this retrospective study (Approval No. 26-252). The study period was from February 2013 until November 2014. The subjects were patients over 20 years old, American Society of Anesthesiologists (ASA) physical status I or II, who underwent oral and maxillofacial surgery under general anesthesia in Kyushu University Hospital. Patients with metabolic, cardiovascular, respiratory, or neurological abnormalities, as well as those with renal disease requiring dialysis, were excluded from the study. No patients could receive intravenous fluids in the hospital ward before general anesthesia.

We reviewed the anesthesia records and investigated patients' demographics (age, gender, height, weight, body mass index), preoperative fasting time, anesthesia start time, total anesthetic time, urine output, infusion volume, vasopressor and opioid use, and ASA physical status.

For preoperative fasting, oral intake of a light meal was permissible up to 6 hours, and clear fluid up to 2 hours, before estimated time to surgery. The patients received no premedication. In the operating room, patients were continuously monitored with standard ASA monitors and a bispectral index monitor. General anesthesia was induced with either midazolam (0.1 mg/kg) or propofol (1–2 mg/kg) in addition to atropine

(0.05 µg/kg) and fentanyl (2 µg/kg). Intubation was facilitated with rocuronium (0.6 mg/kg). Anesthesia was maintained with sevoflurane in air and oxygen (fraction of inspired oxygen: 0.4) titrated to a bispectral index value between 40 and 60. Continuous administration of remifentanyl and/or intermittently administered fentanyl was provided for additional analgesia. Patients were administered crystalloid loading at 10 mL/kg/h from induction of anesthesia until starting the surgical procedure, and 4–6 mL/kg/h during surgery. In addition, crystalloid boluses would be administered at approximately 3 times the estimated blood loss. If excessive hypotension (systolic blood pressure <80 mm Hg) during general anesthesia occurred, fluid therapy was first utilized. If needed, ephedrine and/or phenylephrine were then intravenously administered.

With respect to total body water (TBW), extracellular water (ECW), intracellular water (ICW), cardiac index (CI), cardiac output (CO), stroke volume, and stroke volume variation, we extracted the data from the induction of anesthesia through 2 hours of anesthesia time. TBW, ECW, and ICW were measured using an impedance device (BioScan 920-II, MP Japan Co, Ltd, Japan),¹⁰ and CO, CI, stroke volume, and stroke volume variation were measured using a different impedance device (Aescuron mini, Heiwa Bussan Co, Ltd, Japan).^{11,12}

For statistical analysis, the demographic data were compared using the unpaired *t* test, with a *p* value of .05 regarded as significant. Body fluid and hemodynamics changes of patients were compared using the Bonferroni correction, with a *p* value of .0125 regarded as significant. All values are expressed as mean ± SD or number of patients.

RESULTS

Thirty patients were suitable for this study. Patients were divided into 2 groups: patients who underwent surgery as the first case of the day (AM group: *n* = 15) and patients who underwent surgery as the second case of the day (PM group: *n* = 15). The surgical procedures in this study were intraoral tumor removal, cyst removal, or extraction of teeth. Operative time was within 3 hours for all cases. There were no significant differences between the 2 groups with regard to patient characteristics (Table 1). However, there was a trend toward younger patients in the PM group and patients with higher body mass index in the AM group.

In the PM group, fasting time for solids (832.1 ± 84.3 minutes) was longer than in the AM group (685.0 ± 107.0 minutes), *p* = .005. In the PM group, fasting time for clear fluids (216.5 ± 64.9 minutes) was longer than

Body fluid change in the 2 groups. ◇ indicates AM group; □, PM group; TBW, total body water, ICW, intercellular water; ECW, extracellular water. There was no significant difference in patients' characteristics. Values are means $\pm$ SD or number of patients.

in the AM group (194.5 ± 63.6 minutes), $p = .005$ (Table 2). In the AM group, average anesthesia start time was 0825 hours, whereas in the PM group, average anesthesia start time was 1305 hours. The other studied parameters, including urine output, transfusion volume, vasopressor use, opioid administration, and ASA physical status, were not significantly different between the 2 groups (Table 2).

Body fluid changes such as TBW, ECW, and ICW were not significantly different between the 2 groups (Figure). Vomiting did not occur in any patients during induction of anesthesia. In the PM group, vasopressors due to hypotension at induction were used similarly as regards propofol (ephedrine: 2 cases) vs midazolam (ephedrine 1 case, phenylephrine 1 case) (Table 2) ($p = .01$). Blood loss was minimal (<25 mL) in all cases. Otherwise, cardiovascular parameters were stable throughout the surgery.

DISCUSSION

In this study, the distributions of body water and cardiovascular function, as measured by impedance

technology, were not significantly different between the AM group and the PM group. In addition, the difference in preoperative fasting time did not show significant body water imbalance or unstable hemodynamic change.

Over the last decade, guidelines regarding preoperative fasting before elective surgery have changed.^{1,3,5} A light meal up until 6 hours before the induction of anesthesia is recommended, and unrestricted clear fluids such as water, black coffee, or tea are recommended until 2 hours before the induction of anesthesia in patients without risk factors for pulmonary aspiration.^{1,2} Fasting time has decreased to attenuate preoperative discomfort without an increase in aspiration risk. In addition, preoperative fluid intake may relieve preoperative thirst, anxiety to some extent, and metabolic alterations.^{5,6,13}

In our operating rooms, each first general anesthesia case of the day starts at the same time. However, the subsequent second case of the day may be affected by the length and conduct of the first case of the day. In this study, vasopressor in the PM group was administered to maintain the hemodynamics at the induction of anesthesia because of temporary hypotension (systolic blood pressure <80 mm Hg), although hemodynamics and cardiac function were stable throughout the remainder of the procedure. Therefore, the additional 150 minutes of solid fasting (solid food can have a lot of water in it) and 22 minutes of liquid fasting might have contributed to lower afternoon volume status.

Bioelectrical impedance analysis for body fluid (TBW, ICW, ECW) analysis is a simple, noninvasive method of measuring body composition and fluid distribution in many clinical situations, such as anticipated cardiac diseases, hypovolemia, and renal failure.¹⁰ This device uses tetrapolar electrodes placed on hands and feet, including the extremity with the intravenous line placed, to obtain readings. It allows the calculation of body composition and volumes by means of an electric current passing through the body. Noninvasive cardiac

Table 2. Demographic Data of the 2 Groups*

	AM Group (n = 15)	PM Group (n = 15)	P
Preoperative fasting time (fluid), min	194.5 $\pm$ 63.6	216.5 $\pm$ 64.9	.005
Preoperative fasting time (solid), min	685.0 $\pm$ 107.0	832.1 $\pm$ 84.3	.005
Anesthesia time, min	229.6 $\pm$ 62.9	251.3 $\pm$ 82.4	.25
Urine volume, mL	568.6 $\pm$ 432.6	594.6 $\pm$ 369.4	.77
Transfusion, mL	1665.8 $\pm$ 448.0	1669.6 $\pm$ 439.0	.77
Vasopressor ephedrine/phenylephrine, No.	0/0	3/1	.01
Fentanyl, mcg	340.0 $\pm$ 84.0	390.0 $\pm$ 163.5	.45
Remifentanyl, mcg	1656.7 $\pm$ 668.2	1922.6 $\pm$ 808.2	.40
ASA-PS 1/2, No.	1/14	2/13	.46

* There was no significant difference in patients' demographic data, except in preoperative fasting time ($p = .005$; unpaired t test). Values are means $\pm$ SD or number of patients. ASA-PS indicates American Society of Anesthesiologists physical status.

functional monitoring (CO, CI, stroke volume, stroke volume variation) using impedance technology has been suggested as an alternative to the standard use of a pulmonary artery catheter and thermodilution.^{11,12} This device involves applying 2 electrodes at the neck and the inferior aspect of the thorax. The change in impedance across the thorax is measured as aortic blood volume increases and decreases with each cardiac cycle, which is then multiplied by heart rate to obtain CO and CI. It is not clear that this impedance technology can be considered as reliable as standard methods, although these monitors are often used to monitor cardiovascular trends.

The limitations of this study were the retrospective nature and small sample size. Different anesthesiologist preferences such as the selection of sedatives in propofol vs midazolam at induction of anesthesia were not standardized, and their experience levels were not noted. Further study with larger sample sizes, standardized selection of anesthetics and hemodynamic interventions, and study of more intraoperative hemodynamic parameters, such as blood pressure and heart rate change, is recommended.

CONCLUSION

There were no statistically significant changes in cardiovascular variables and body fluid parameters between patients undergoing oral and maxillofacial surgery under general anesthesia treated as the first case of the day versus those treated as the second case of the day.

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