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A Report of 14,195 Applications of Anesthetics to Oral and Maxillofacial Surgery at One Teaching Dental Hospital (1971–2000) Centering Around Airway Problems

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Study Objectives: *To examine the validity of our methods of anesthesia, i.e., awake intubation and assisted manual ventilation, in coping with the anesthetic problems particular to oral and maxillofacial surgery (OMF surgery).*
Design: *Prospective study.*
Setting: *Operating room and ward of a dental teaching hospital.*
Patients: *14,195 patients undergoing OMF surgery during the period from January 1971 to March 2000.*
Measurements and Main Results: *The kinds of anesthetic difficulties centering around airway problems and their frequency in OMF surgery were determined. In 2,401 patients (16.9%), awake intubation was employed because of definite or possible airway problems. No untoward effects due to awake intubation were noted. Volatile anesthetics were used with nitrous oxide (N2O) in 13,959 patients (98.3%), and their spontaneous respiration were assisted manually for the purpose of early detection of airway troubles such as accidental extubation, dislocation, kinking, and/or damage to the endotracheal tubes. Few accidents or complications were noted in relation to airway issues, and neither cardiac arrest nor death was experienced in these 14,195 patients.*
Conclusions: *Based on a sufficient number of anesthetic applications, awake intubation*

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and assisted manual ventilation were proved to be useful in coping with the anesthetic difficulties particular to OMF surgery.

Keywords: Anesthesia; oral surgery; awake intubation.

Introduction

General anesthesia for oral and maxillofacial (OMF) surgery can involve various airway problems; many patients have deformities of the face and/or abnormal airways. In addition, the airways are always included in the surgical fields, so that intraoperative dislocations and other troubles with endotracheal tubes, as well as postoperative airway complications, may arise at any moment. Meanwhile, the anesthesiologist, surgeons, nurses, and various equipment are crowded around the narrow surgical field, interfering with the anesthesiologist's movements. The anesthetic difficulties particular to OMF surgery may be responsible for the unexpectedly higher morbidity and mortality rates of such anesthesia.[1]

Therefore, anesthesiologists engaged in this kind of work should be well prepared for the above-mentioned problems, as well as for other commonly reported causes of serious complications during ordinary anesthesia, such as inadequate ventilation, drug overdose, and deep anesthesia.[2–6] A number of papers have discussed ways to cope with "difficult airways,"[7–9] or with other anesthetic problems particular to the surgery of the head and neck.[10] However, only a few papers have actually reported the results of large numbers of anesthesia cases for OMF surgery. We have employed awake intubation for patients with difficult airways[11] and manual ventilation for most of our patients. The purpose of our present study was to examine the results of our general anesthesia for OMF surgery in both the intraoperative and postoperative periods, centering around the airway problems at a single dental hospital during a period of about 29 years.

Materials and Methods

We retrospectively studied 14,195 patients undergoing OMF surgeries under general anesthesia in Osaka University Dental Hospital from January 1971 to March 2000. Osaka University Dental Hospital has had 40 beds, which have been used mainly by OMF surgery patients. Each patient's preoperative data, and intraoperative and postoperative course were evaluated by using the anesthetic record.

Preoperative Evaluation

In preanesthetic examinations, we carefully studied the anatomy of the oral and facial regions, including micrognathia, mandibular hypoplasia or hyperplasia, protruding teeth, opening of the mouth, and conditions of the teeth, especially those of the upper incisors, and head-tilt, in addition to other ordinary examinations. In patients with possible sleep apnea, respiration was checked previously during sleep by an anesthesiologist on night duty. Premedications and methods of induction and endotracheal intubation were chosen according to the evaluation of the patients thus obtained.

Induction of Anesthesia

In cases in which there was technical difficulty with mask fit, airway maintenance in mask anesthesia, the laryngoscope, and/or endotracheal intubation as a result of anatomical or functional abnormalities, endotracheal intubation was performed with intravenous (IV) sedation and topical anesthesia rather than face-mask induction. Even in other patients with seemingly few or no problems in either induction by face-mask or intubation, we nevertheless confirmed the condition of the airway. After test fitting of the face-mask and gentle application of the laryngoscope, the final decision was made as to which method to use: ordinary induction with a face-mask or awake intubation before induction of anesthesia. For patients in whom awake intubation was thought to be indicated, topical anesthesia of the trachea was achieved by intratracheal injection of 4% lidocaine *via* the cricothyroid membrane. Topical anesthesia of the larynx and deep pharynx was accomplished with a 4% lidocaine spray and gentle and careful application of the Mackintosh laryngoscope, while trying to minimize gag reflex and resistance as much as possible. In cases of difficult mouth-opening or trismus, the lidocaine solution was sprayed *via* the nostrils and choana during each deep inspiration. When the effect of this anesthesia was adequate, the endotracheal tube was placed as gently as possible.

In pediatric anesthesia, a venous route was established after premedication with intramuscular (IM) scopolamine. In infants in whom there was little or no problem with mask fit, airway, or laryngoscopy, anesthesia was induced by IV thiopental or ketamine, and the endotracheal intubation was facilitated by succinylcholine chloride or vecuronium bromide. In patients with the aforementioned airway problems, or intraoral bleeding after palatoplasty or pharyngeal flap operation, for example, direct laryngoscopy after IV diazepam and endotracheal intubation were carried out under direct vision or by referring to the patient's respiratory sounds when no part of the vocal cords or epiglottis was visible. Successful awake endotracheal intubation was immediately followed by IV thiopental administration.

In March of 1983, a fiberscope became available in our hospital and was used for difficult airway situations.

Maintenance of Anesthesia

As a rule, anesthesia was maintained with volatile anesthetics supplemented by nitrous oxide (N_2O), and the respiration was elaborately assisted manually after the effect of the initial muscle relaxant used in intubation subsided, no matter how lengthy was the duration of the operation. In cases of weak or absent spontaneous respiration, with the use of morphine or fentanyl for example, manually controlled ventilation was employed regardless of the length

Table 1. Distribution of Patients by Age

Age	Cases (%)
3 months–2 years old	5,583 (39.3)
2 years–5 years old	1,302 (9.2)
6 years–12 years old	1,143 (8.1)
13 years–19 years old	1,571 (11.1)
20 years–64 years old	3,914 (27.6)
older than 65 years old	682 (4.8)
Total	14,195

of the operation. We have never needed to use ventilators in anesthesia for OMF surgery.

Extubation

The timing of extubation and/or tracheostomy was determined by taking the following postoperative conditions into consideration: 1) maxillectomy, mandibulectomy or both and their degrees; 2) presence or absence of the structures keeping the tongue, larynx, hyoid, and lingual bones in position anteriorly; 3) possibility of edematous swelling or intraoral bleeding; and the 4) possibility of successful laryngoscopy and re-intubation in case of emergency.

In cases in which a postoperative airway problem was obvious after extubation, a tracheostomy was done just after the operation. Depending on the postoperative conditions, such decisions were postponed to the following day. Before the trachea was extubated, adequate recovery of patient's consciousness and capability for spontaneous respiration were confirmed.

Postoperative Management

Patients were followed by dental anesthesiologists at least until the morning after the operation. Depending on their condition, patients continued to be monitored by the staff anesthesiologists.

Results

Table 1 lists the distribution of the patients by age. *Table 2* denotes the kinds of operations performed. Nearly 50% of the patients were younger than 5 years old; they were usually treated for cleft lip and palate, including secondary repair. Of the 6,885 pediatric patients younger than 5 years of age, 6,870 patients underwent venipuncture successfully while conscious, and the remaining 15 patients, after the induction of anesthesia by face-mask. Operations for oral malignancy comprised 11.7% of all cases and included mandibulectomy and maxillectomy with or without neck dissection followed by reconstruction.

The numbers for each route of intubation are shown in *Table 3*. Oral intubation comprised about 70% of the three possible routes. This course was taken because of the large number of cleft lip and palate surgeries in which the tube was placed po. On the other hand, nasal intubation

Table 2. Breakdown of Operation

Operation	Cases (%)
Plastic surgery for cleft lip	3,054 (21.5)
Plastic surgery for cleft palate	2,941 (20.7)
Secondary repair of cleft lip and palate	2,491 (17.5)
Pharyngeal flap operation	381 (2.7)
Plastic surgery for other abnormalities	181 (1.3)
Extirpation of cyst	467 (3.3)
Operation for benign tumor	788 (5.6)
Orthodontic operation	1,118 (7.9)
Extirpation of salivary gland	113 (0.8)
Operation for oral malignancy	1,667 (11.7)
Operation for oral maxillofacial trauma	363 (2.6)
Operation for inflammation	173 (1.2)
Dental treatment	196 (1.4)
Operation for temporomandibular joint	179 (1.3)
Other	83 (0.6)
Total	14,195

comprised 26.0% of all intubations; this route was chosen for surgical convenience. Nasal intubation was also used in difficult airway situations when laryngoscopy was impossible.

The numbers of cases of endotracheal intubation before or after the induction of anesthesia are summarized in *Table 4*. In 2,401 cases (16.9%), anesthesia was induced after the trachea was intubated, because a difficult airway was recognized during the preanesthetic examination. The most difficult intubations were mainly experienced with such patients. However, despite our careful preanesthetic examination and evaluation of airways, in some patients for whom intubation was chosen after induction of anesthesia, endotracheal intubation was narrowly achieved after repeated difficult ventilation by face-mask and difficult laryngoscopy. As a result, the most difficult intubations were experienced in a total of 1,361 patients (9.6%) (*Table 5*). Fiberoptic intubation was performed in 120 cases in 17 years, and its frequency has recently increased. The 254 cases of intubation *via* tracheostomy, which was required by the surgeons, were also performed with IV sedation.

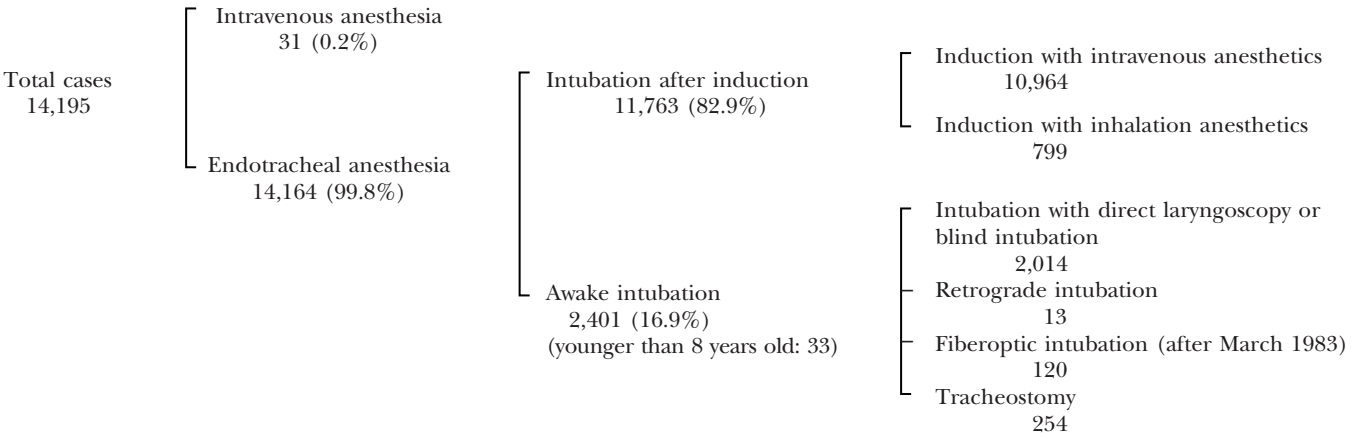
Table 6 shows the methods of maintenance of anesthesia. Volatile anesthetics were used with N_2O in 13,958 cases (98.3%), and the patients' spontaneous respirations were assisted manually for the purpose of early detection of airway troubles such as accidental extubation, dislocation, kinking, and/or damage to the endotracheal tubes.

The main troubles with airways encountered during

Table 3. Route of Endotracheal Intubation

	Cases (%)
Oral intubation	10,225 (72.2)
Nasal intubation	3,685 (26.0)
Tracheostomy	254 (1.8)
Total	14,164

Table 4. Methods of Anesthesia



anesthesia are summarized in *Table 5*. "Troubles with tube" includes displacement of tube, kinking of tube, injury to the tracheal wall, and damage to the tube by operative procedures. The number of such accidents was 38, or 0.27% of the 14,195 cases. However, there were no cases of accidental extubations during anesthesia.

There were two cases of pneumothorax, which occurred in small children 1 year and 4 months of age undergoing cleft palate surgery. Pneumothorax took place about ten minutes after the application of Digman's mouth gag and wide mouth opening compressing the tongue and supporting the endotracheal tube. Sudden spontaneous deflation of the reservoir bag was reported by the trainee after mouth gag application. The situations were remedied immediately, with no further serious complications.

There were no intraoperative deaths or cardiac arrests in relation to anesthesia or surgery in the operation room (OR) among our 14,195 patients.

Postoperative troubles and airway complications that needed treatment are summarized in *Table 7*. Postoperative airway complications were seen in 215 cases, or 1.5% of 14,195 cases. Among these, one case of laryngeal edema in a 4 month-old infant was the result of anesthesia; it was treated with IM betamethasone (Predonine) without reintubation. The other complications were all caused by the oral surgery itself. Reintubations were done in 18 patients because of postoperative intraoral bleeding in 12 and airway obstruction due to swelling in 6. Emergency tracheostomies were done in 35 patients with or without prior oral or nasal awake intubation. The airway became patent by placing an oral or nasal airway in 128 patients. In the other 34, the conditions were treated with suctioning of secretions and blood clots and/or drug therapy. We noted 102 cases of postanesthetic hoarseness, most of which arose in adult patients, but still quite a few seen in the pediatric population also.

Finally, there were no postoperative deaths or cardiac arrests in the ward among the 14,195 patients.

Table 5. Intraoperative Problems and Airway Complications

	Cases
Difficult intubation	1,361
Increased secretion	125
Laryngospasm	15
Bronchospasm	38
Trouble with tube	38
Vomiting	34

Discussion

In the induction of general anesthesia for OMF surgery patients, deformities or other anatomical abnormalities existing in the oro-facial region and the upper respiratory tract may often make it difficult to perform an ordinary induction using a face-mask followed by intubation. Such conditions can be classified as follows. In the first group, a closed system cannot be prepared because of difficult face mask-fitting as a result of deformities in the orofacial region (*Figure 1*). In the second group, incurable airway obstruction is the result of the induction of anesthesia (*Figure 2*). In the third group, difficult intubation is expected due to difficult or impossible laryngoscopy (*Figure 3*). In the fourth group, awake endotracheal intubation is mandatory because of intraoral bleeding. In the last group, two or more of the aforementioned conditions are present in one patient. Interestingly, most of our cases were of the last category. In any of these cases, a grave catastrophe might have arisen during ordinary induction methods and a face-mask. As the alternative method of anesthesia of choice, blind nasal intubation with or without retrograde thread-guidance or tracheostomy was employed before anesthesia induction, until the introduction of the fiberscope. However, the former method is not always successful, and the tracheostomy should be the last method for airway establishment. Safe and practical methods include endotracheal intubation while the patient is conscious, with or without sedation and using a laryngo-

Table 6. Maintenance of Anesthesia

Methods		Cases
N_2O and volatile anesthetics in oxygen	N_2O and diethyl ether in oxygen	281
	N_2O and methoxyflurane in oxygen	1,846
	N_2O and halothane in oxygen	3,714
	N_2O and enflurane in oxygen	2,347
	N_2O and isoflurane in oxygen	2,466
	N_2O and sevoflurane in oxygen	3,231
	N_2O and two alternate volatile anesthetics in oxygen	74
N_2O in oxygen with supplementary drugs	Neurolept anesthesia	71
	N_2O in oxygen with intravenous ketamine	54
	N_2O in oxygen with muscle relaxant	41
Morphine or fentanyl and enflurane in air and oxygen		39
Intravenous ketamine without intubation		31

N_2O = nitrous oxide.

scope if possible, and awake blind nasal intubation in trismus. This means of airway establishment should be followed by the induction of anesthesia either with IV or inhalation anesthetics.[11] We still employed this method for patients of any age, including small infants,[12] even after the fiberscope became available. As shown in *Table 4*, the endotracheal tube was placed before the induction of anesthesia *via* oral, nasal, and tracheal stoma in 2,401 cases, based on preanesthetic examinations regarding possible airway problems in each patient.[7,8,13]

Recently, the fiberscope has been used frequently for difficult airway cases. However, we believe that all anesthesiologists should develop skill with awake endotracheal intubation. Such skill can truly only be achieved after extensive practice with laryngoscopy and under close supervision, the objective being to cause as little gagging and resistance as possible. We prefer endotracheal intubation without a fiberscope to that with the apparatus. This convenient apparatus is not always available during emergencies in the ward, for example, and the fiberscope is useless in patients with intraoral bleeding or airway edema.

In pediatric anesthesia, although slow induction by face-mask followed by establishment of a venous route is the most common method of anesthesia, it is well accepted that a rapid induction by IV anesthetics, mostly thiopental, as is usually done in the adult patients, is the better choice for pediatric induction, provided that a vein is accessible while the patient is awake.[14] The anesthesia is much safer if a venous route is available,[15] an injection given while in a hospital is accepted as a matter of course by children,[16,17] and the unpleasant feeling of gradual loss of consciousness experienced in slow induction can cause emotional trauma in pediatric patients.[16,18,19] However, IV induction in pediatric anesthesia loses its value if multiple punctures are required.[14] In anesthesia for pediatric patients with possible or definite airway problems, preanesthetic establishment of a venous route is believed to be the best choice, especially for safety reasons. We were able to avoid accidents caused by airway problems in 33 cases by performing awake intubations followed by IV thiopental and muscle relaxant. Difficult intubations were not associated with postanesthetic airway complications such as laryngeal edema. No laryngeal edema or hoarseness arose in pediatric patients with awake intubation due to difficult airways. We did experience postanesthetic laryngeal edema in a 4-month-old infant in whom the endotracheal tube had been inserted easily after the administration of thiopental and succinylcholine.

Table 7. Postoperative Problems and Airway Complications

		Cases
Hoarseness		102
Airway problems that needed treatment	Tracheostomy	35
	Reintubation	18
	Insertion of oral or nasal airway	128
	Other	34
Vomiting		534

Postanesthetic hoarseness is often the result of positioning of head and neck. In the patient whose head and neck are slanted and rotated for an operative procedure, the vocal cords as well as the laryngeal walls opposite the direction of the slanting and rotation may be compressed by the endotracheal tube.[20] It is quite possible that the laryngeal structure can be damaged by compression, leading to hoarseness and edema.

Dislocation of the endotracheal tube during OMF surgery is so common that it is not possible to pay too much attention to determining depth and other conditions of the endotracheal tube. In our cases, after endotracheal intubation was complete, the depth of the tube was carefully determined according to our published standards,[21–23] as well as to the conventional method by auscultation.

Inadequate ventilation and deep anesthesia occur frequently in anesthesia.[1–4] Such problems are due mostly to the use of long-acting muscle relaxants and ventilators. Although convenient respiratory monitors of recent devel-

Figure 1. A. A 60-year-old female with a huge mandible due to fibrous dysplasia. **B.** The same patient just after awake nasal intubation before fixation of the tube with adhesive tape.

opment have contributed much to decreasing mortality due to inadequate ventilation,[24] human spontaneous respiration is still an important vital sign, and is well noted by the reservoir bag and felt by the anesthesiologist's hand.[25,26]

As shown in *Table 6*, anesthesia was maintained with volatile anesthetics and N2O in oxygen in 13,958 cases (98.3%). In most of those cases, which needed little or no muscle relaxation, respiration was manually assisted. During anesthesia for OMF surgery, accidental extubation, dislocation, kinking, and/or damage of the endotracheal tubes may well take place at any time. For the early detection of such untoward events, it is particularly useful to pay constant attention to the conditions of the reservoir bag with the position of pop-off valve fixed suitably. In the cases of pneumothorax noted earlier, the trainees reported to their instructors sudden deflation of the reservoir bag of unknown cause after mouth gag application. As

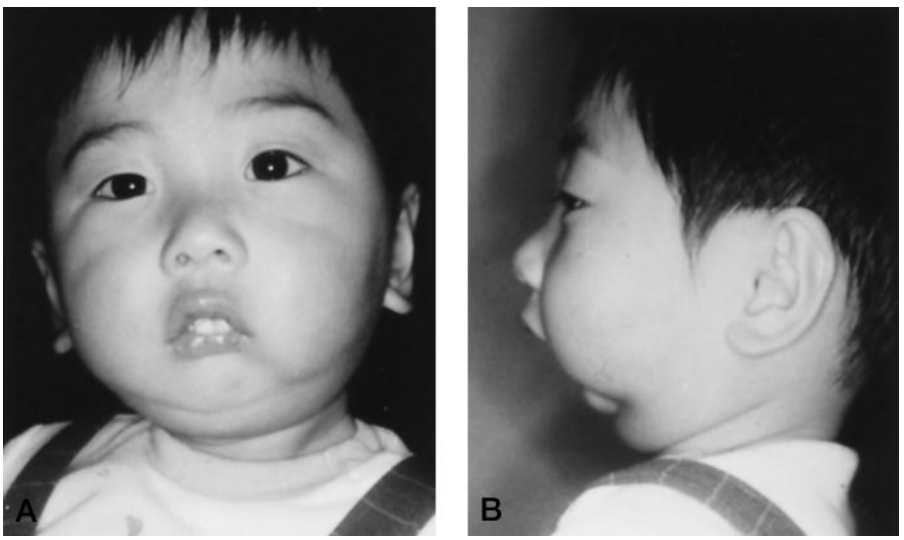


Figure 2. A. A 4-year-old male with micrognathia and trismus. **B.** Lateral view of the patient.

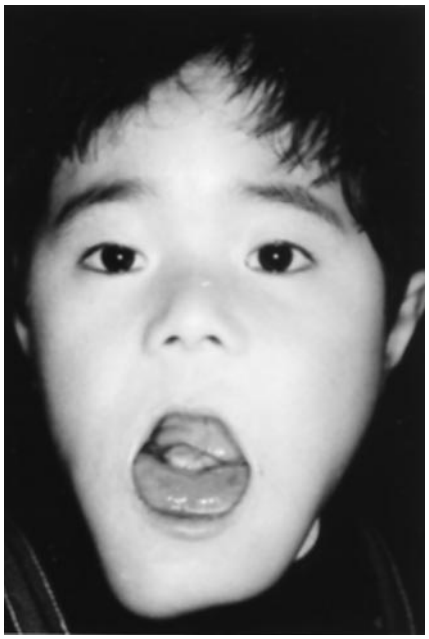


Figure 3. A 7-year-old male with a large mandible due to fibrous dysplasia. The oral cavity became narrower because of the enlarged mandible.

reported by Kubota et al.,[27] the angle of bifurcation between the right and left bronchi is larger in an infant than in an adult, so it is quite possible that the tip of the polyvinyl endotracheal tube, which hardens with repeated use, lacerated the trachea in our cases of pneumothorax, probably at the carina when it was depressed by the mouth gag. Since the time of those accidents, a soft spiral tube has been used with no further problems.

Although Steward[28] and Spear *et al.*[29] have partially disputed the usefulness of the anesthesiologist's "educated hand" in pediatric anesthesia, we were actually able to recognize our airway troubles sooner during manually assisted ventilation. This action resulted in avoiding further serious complications in both the intra-and postoperative periods, as seen in *Tables 5 and 7.*

The incidence or frequency of postanesthetic vomiting is very important in OMF surgery patients, because their oropharyngeal function is usually impaired and respiratory complications can easily ensue from vomiting. Thirty-four of our patients vomited during extubation. Even though a gastric tube was placed in these patients, vomiting occurred especially often in intraoral surgeries. It should be remembered that the gastric mucous membrane is particularly irritated by the iron contained in hemoglobin.[30] Postoperatively, 534 patients produced vomitus with which blood clots were commonly present. Cohen *et al.*[31] reported the frequency of postoperative nausea and vomiting in a general hospital to be more than five hundred per 10,000 anesthetics. Even though these researchers did not explain the number of such nausea and/or vomiting cases, we nevertheless believe that we should make more attempts to decrease vomiting.

Kubota *et al.*[32] reported four cardiac arrests in 85,708 anesthetics; three of those patients were resuscitated, for a mortality rate of 0.1 per 10,000 cases. According to other recent reports,[6,33] the rate of anesthetic cardiac arrest is about 1 per 10,000 cases, and mortality, 0.6 per 10,000 cases. Nishikawa *et al.*[1] reported seven cardiac arrests during anesthesia for OMF surgery among 36,159 anesthetics in a medical college hospital. Those cardiac arrests represented 9% of all the cardiac arrests at the hospital. Such a high frequency of cardiac arrests is thought to have much to do with the aforementioned anesthetic difficulties specific to anesthesia for OMF surgery. We are happy to report that we experienced no cardiac arrests or deaths in either the surgical suite or the ward in our hospital in 14,195 anesthetics applications for OMF surgery in the last 29 years.

Summary

For the purpose of evaluating the validity of our method of anesthesia, we retrospectively studied 14,195 patients undergoing OMF surgeries with general anesthesia at our dental teaching hospital from January 1971 to March 2000. Definite or possible airway problems, including difficult mask fit, airway obstruction after induction of anesthesia, difficult laryngoscopy, and postoperative intraoral bleeding, were noted in 2,401 patients (16.9%). For those cases, awake intubation was employed. In 98.3% of patients, anesthesia was maintained with volatile anesthetics, and spontaneous respiration was manually assisted regardless of the length of the operation.

We conclude that awake intubation and assisted manual ventilation are very useful in coping with the anesthetic difficulties particular to OMF surgery.

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References

1. Nishikawa K, Yamakage M, Fujita S, Kawamata M, Namiki A: Survey of cardiac arrests during anesthesia and surgery in the past ten years. *J Jpn Soc Clin Anesth* 1993;13:131–6.
2. Cooper JB, Newbower RS, Long CD, et al: Preventable anesthetic mishaps: a study of human factors. *Anesthesiology* 1978;49:399–406.
3. Utting JE, Gray TC, Shelley FC: Human misadventure in anesthesia. *Can Anaesth Soc J* 1979;26:472–8.
4. Cooper JB, Newbower RS, Kitz RJ: An analysis of major errors and equipment failures in anesthesia management: considerations for prevention and detection. *Anesthesiology* 1984;60:34–42.
5. Caplan RA, Posner KL, Ward RJ, Cheney FW: Adverse respiratory events in anesthesia: a closed claims analysis. *Anesthesiology* 1990; 72:828–33.
6. Keenan RL: Anesthetic mortality. *Semin Anesth* 1992;11:89–95.
7. Mallampati SR, Gatt SP, Gugino LD, et al: A clinical sign to predict difficult tracheal intubation: a prospective study. *Can Anaesth Soc J* 1985;32:429–34.

8. Benumof JL: Management of the difficult adult airway. With special emphasis on awake intubation. *Anesthesiology* 1991;75: 1087–110.
9. A report by the Am Society of Anesthesiologists Task Force on Management of the Difficult Airway: practice guidelines for management of the difficult airway. *Anesthesiology* 1993;78:597–602.
10. Dougherty TB, Nguyen DT: Anesthetic management of the patient scheduled for head and neck cancer surgery. *J Clin Anesth* 1994;6:74–82.
11. Kubota Y, Uchida I, Kimatch H, et al: The amnesic effects of diazepam for intubation in more than 1000 cases. Fifth world congress of anesthesiologists. Amsterdam: Excerpta Medica, 1972;97.
12. Rogers MC, Smith RM: *Anesthesia for Infants and Children, 4th ed.* St. Louis: C.V. Mosby, 1980:164–91.
13. Cormack RS, Lehane J: Difficult tracheal intubation in obstetrics. *Anaesthesia* 1984;39:1105–11.
14. Rogers MC, Smith RM: *Anesthesia for Infants and Children, 4th ed.* St. Louis: C.V. Mosby, 1980:152–63.
15. Tiret L, Nivoche Y, Hatton F, Desmonts JM, Vourc'h G: Complications related to anesthesia in infants and children: a prospective survey of 40,240 anesthetics. *Br J Anaesth* 1988;61:263–9.
16. Hodges RJH: Induction of anesthesia in young children. *Lancet* 1960;1:82–8.
17. Wallace CT: Anesthesia for plastic surgery in the pediatric patient. *Clin Plast Surg* 1985;12:43–50.
18. Lavy DM: Psychic trauma of operations in children. *Am J Dis Child* 1955;69:7–25.
19. Eckenhoff JE: Relationship of anesthesia to postoperative personality changes in children. *Am J Dis Child* 1962;86:587–91.
20. Hori T: The effect of head rotation on the pressure of the endotracheal tube on the vocal cords. *J Jpn Dent Soc Anesth* 1996;24:13–31.
21. Sugiyama K, Hirose I, Kotani Y, et al: Problems in using the RAE endotracheal tube for Japanese infant and children. *J Jpn Dent Soc Anesth* 1982;10:239–45.
22. Sugiyama K, Mietani W, Hirota Y, Matsuura H: Displacement of the endotracheal tube caused by postural change: evaluation by fiberoptic observation. *Anesth Pain Control Dent* 1992;1:29–33.
23. Shibutani T, Niwa H, Kim Y: Location of an endotracheal tube by palpation at the suprasternal notch. *J Jpn Dent Soc Anesth* 1997; 25:29–32.
24. Keenan RL, Boyan CP: Decreasing frequency of anesthetic cardiac arrests. *J Clin Anesth* 1991;3:354–7.
25. Cullen SC, Comroe JH, Brown EB, Beecher HK, Maloney JV: Problems in ventilation. *Anesthesiology* 1954;15:416–435.
26. Egbert LD, Bisno D: The educated hand of the anesthesiologist. A study of professional skill. *Anesth Analg* 1967;46:195–200.
27. Kubota Y, Toyoda Y, Nagata N: Tracheobronchial angles in infants and children. *Anesthesiology* 1986;64:374–576.
28. Steward DJ: The "not-so-educated hand" of the pediatric anesthesiologist. *Anesthesiology* 1991;75:555–6.
29. Spears RS Jr, Yeh A, Fisher DM, Zwass MS: The "educated hand."Can anesthesiologists assess changes in neonatal pulmonary compliance manually? *Anesthesiology* 1991;75:693–6.
30. Atkinson RS, Rushman GB, Lee JA: *A Synopsis of Anaesthesia, 10th ed.* Bristol, England: Wright, 1987:318–61.
31. Cohen MM, Duncan PG, Poke WD, Wolkenstein C: A survey of 112,000 anaesthetics at one teaching hospital (1975–83). *Can Anaesth Soc J* 1986:33:22–31.
32. Kubota Y, Toyoda Y, Kubota H, et al: Frequency of anesthetic cardiac arrest and death in the operating room at a single general hospital over a 30-year period. *J Clin Anesth* 1994;6:227–38.
33. Chopra V, Bovill JG, Spierdijk J: Accidents, near accidents and complications during anaesthesia: a retrospective analysis of a 10-year period in a teaching hospital. *Anaesthesia* 1990;45:3–6.