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[Articles] Optimization of Conscious Sedation in Plastic Surgery

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Abstract

The administration of conscious sedation by the plastic surgeon must be safe, efficient, and consistent. In the proper setting, with trained staff and appropriate backup, conscious sedation can allow optimal patient satisfaction with expedient recovery in addition to cost containment. The highly effective local anesthesia afforded by dilute, high-volume ("tumescent") infiltration extends the use of conscious sedation to cases previously performed under general anesthesia or deep sedation. The purpose of this analysis was to identify variables in conscious sedation that affect traditional outcome parameters in ambulatory surgery, particularly the duration of recovery and adverse events such as nausea and emesis.

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All perioperative and operative records of 300 consecutive patients having plastic surgical procedures under conscious sedation were carefully reviewed. Patients were ASA class I or II by requisite. Conscious sedation followed a standardized administration protocol, using incremental doses of two agents: midazolam (0.25 to 1 mg) and fentanyl (12.5 to 50 mcg). A subset of patients received preoperative oral sedation. Multivariate statistical analysis was conducted using SPSS 8.0 for Windows (SPSS Inc., Chicago, Ill.).

Of the 300 patients, same-day discharge was intended for 281. Eight procedure categories were defined. No anesthetic complications occurred. As expected, recovery time was significantly correlated with the duration and type of procedure ($p < 0.001$) and the total dosage of both intraoperative sedative agents ($p < 0.001$). Interestingly, a negative correlation with advancing age existed ($p < 0.001$), likely reflecting the significantly higher intraoperative sedative dosing in younger patients ($p < 0.001$). When controlled for the effects of procedure duration and intraoperative sedative dosing, two other variables-use of preoperative oral sedation and postoperative nausea/emesis-significantly lengthened recovery time ($p = 0.0001$ for each). Fifteen unintended admissions occurred secondary to nausea, prolonged drowsiness, or pain control needs.

Conscious sedation is an effective anesthetic choice for routine plastic surgical procedures, many of which would commonly be performed under general anesthesia. In our experience with a carefully structured and controlled conscious sedation protocol, the technique has proven to be safe and effective. This analysis of outcome parameters identified two important and potentially avoidable causes of recovery delay following conscious sedation-oral premedication and nausea/emesis. Nausea and emesis were particularly problematic in that they were responsible for 11 of 15 (73 percent) unintended admissions. Preoperative sedation is valuable in certain circumstances, and its use is not discouraged; however, its benefits must be weighed against its unwanted effects, which can include a prolongation of recovery.

The technique of conscious sedation falls among several anesthetic alternatives for plastic surgery patients. In conscious sedation, as opposed to other modalities, sedative agents are administered at the direction of the surgeon. The technique has been used frequently by practitioners in a wide range of specialties, including oral surgery, cardiology, gastroenterology, and radiology. Conscious sedation gained popularity among many plastic surgeons based on its efficacy and cost-efficiency and on the degree of flexibility it offers to both surgeons and patients. When combined with the highly effective local anesthesia afforded by dilute, high-volume ("tumescent") infiltration, the use of conscious sedation has been extended to cases previously performed only under general anesthesia or deep sedation. The avoidance of general anesthesia removes a number of potential anesthetic complications and reduces the likelihood for the development of deep vein thrombosis and subsequent pulmonary embolus.1

Baker and Gordon 2 emphasized that adequate anesthesia in plastic surgery must accomplish each of the following objectives: (1) reduce or eliminate the pain associated with injection of local anesthetic, (2) reduce or eliminate patient apprehension, and (3) reduce or eliminate recall of the operation.

Protocols for the administration of conscious sedation in plastic surgery have been described using a variety of sedative and analgesic agents, both alone or in combination.3-7 Because no single agent alone is able to meet each of the above objectives, combination regimens are more commonly advocated. Most authors rely on one primary sedative agent combined with an analgesic. Drugs of the benzodiazepine class are the most frequently employed sedative agents, although barbiturates and propofol are found in some protocols.8 Analgesia is commonly achieved with a narcotic agent. An interesting approach has been described by Vinnik, who has reported his extensive experience with diazepam and ketamine, a dissociative anesthetic.9 Across specialties, the most frequently used combination is midazolam with fentanyl. In this series, we describe our experience with a conscious sedation protocol based on frequent, small, titrated doses of these agents. At our institution, this regimen has proven efficacious, consistent, and predictable over the past 8 years.

The purpose of this study was to identify the variables that adversely affect traditional outcome parameters in ambulatory surgery with the intention of refining our practice of conscious sedation. Particular attention was given to causal relations and sequelae of nausea and emesis, in lieu of the known difficulties they can pose in plastic surgery.10-12 In his criteria for the selection of ambulatory surgical patients, Meridy emphasized the importance of minimizing recovery time and the rate of unintended hospital admission.13 In the multivariate analysis, we examined the influence of several variables, including age, procedure type, use of premedication, dose of sedation, etc., on intraoperative patient stability, nausea and emesis, recovery time, and unintended admission.

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Methods

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Patients

All intraoperative and perioperative records of 300 consecutive patients undergoing plastic surgical procedures under conscious sedation were reviewed. No patients were excluded. The Northwestern conscious sedation protocol is part of an approved, hospital-wide program that utilizes two primary agents (midazolam and fentanyl) and that is employed by specialists in interventional radiology, gastroenterology, otolaryngology, pulmonology, gynecology, and plastic surgery. The basic protocol has been employed in more than 1000 plastic surgery cases to date. All procedures in this series were performed by two surgeons, and conscious sedation was administered at the direction of the attending surgeon in all cases. All patients in this study were ASA class I and II by requisite and underwent thorough preoperative evaluation to identify all potential cardiovascular and respiratory risk factors.

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Intraoperative Regimen

Procedures were conducted in the operating facilities of a university hospital, where appropriate back-up and emergency equipment were readily available. In addition to the surgeon and assistant, the operating room team consisted of three nurses: a scrub nurse, a circulator, and a third nurse (non-CRNA) trained and familiar with postoperative or critical care monitoring. The responsibilities of the sedation nurse were the administration of all drugs and continuous patient monitoring. Patients were monitored by means of continuous ECG, pulse oximeter, and noninvasive intermittent blood pressure. Patients were maintained on room air; consequently, oxygen saturation combined with respiratory rate provided a sensitive and rapid means to identify changes in respiratory status. Vital signs, patient comfort, and level of sedation were recorded at 5-minute intervals; the surgeon was notified at each interval of these parameters and of the subtotaled doses of medications administered.

Oral premedication was used when anticipated case duration was greater than or equal to 2 hours. These agents were administered 1 hour before the start of the procedure. The oral premedication protocol consisted of diazepam (10 mg) and MS contin, an oral form of morphine sulfate (15 mg). The intraoperative agents (midazolam and fentanyl) were administered in incremental doses of 0.25 to 1.0 mg intravenously for midazolam and 12.5 to 50 mcg for fentanyl. The minimum dose interval was 5 minutes.

Following completion of the procedures, patients were returned to the ambulatory holding unit, where monitoring continued until discharge criteria were met. All patients were aware that overnight observation could be necessary; in 19 cases, overnight observation was planned preoperatively or requested by the patient. The discharge criteria in the conscious sedation protocol were stringent, and those who could not meet the standards were admitted for observation. "Borderline" patients, usually those who experienced nausea/vomiting, were kept for observation. To buffer expenses in this relatively liberal observation policy, a prearranged "flat rate" fee schedule was organized with the institution.

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Data Analysis

Among the data extracted from perioperative and intraoperative were the following: medical history/ medications, age, procedure type, preoperative and postoperative vital signs, duration of procedure, intraoperative vital signs, duration of recovery, medication dosages, incidence of nausea or emesis, the use of antiemetics, disposition, and the incidence of complications. All data were consolidated in Microsoft Excel 97 and were analyzed by the Department of Biostatistics, Northwestern University Medical School, using SPSS 8.0 for Windows. Intergroup comparison of means was performed using unpaired Student's *t* tests and analysis of variance, where applicable. Multiple group comparisons utilized Tukey's standardized range. Chi-square was used for incidence analysis, and statistical associations were determined using Pearson's correlation analysis.

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Results

The cases of 300 consecutive patients were analyzed. Demographic data are presented in Table I. Midazolam and fentanyl were used in all cases with an average dose of 7.5 mg and 250 mcg, respectively. Medication dosages for each of the agents correlated statistically with the duration of the procedure (Fig. 1). The types of procedures performed are summarized in Figure 2. The three most predominant categories were reconstructive breast (which included expander/implant exchange, revisions, and nipple reconstruction), liposuction, and major aesthetic facial procedures (which included rhytidectomy, brow lift, and combination facial procedures). It is noteworthy that several procedures typically thought to be associated with significant intraoperative discomfort were performed under conscious sedation. These included ultrasound-assisted liposuction, subpectoral breast augmentation, and subpectoral implant exchange with capsulotomy/ capsulectomy.


TABLE I

Demographic …

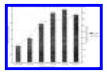
Fig. 1


Fig. 2

No significant cardiac, hemodynamic, or respiratory complications were encountered, and in no instance was a reversal agent employed. Anesthesia staff were available as back-up but were not consulted in any case. All procedures were completed in their intended fashion. Same-day discharge was planned for 281 patients (93 percent). Nineteen patients (6.3 percent) were scheduled preoperatively for admission/observation. Complications were limited to nausea/emesis, transient alterations in blood pressure, and unintended admission (Table II).

TABLE II

Complicatio…

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Nausea and Emesis

The overall incidence of nausea of emesis was 24 percent, which includes those complaining of postoperative nausea or emesis (63 of 300, 21 percent), intraoperative nausea and emesis (23 of 300, 7.7 percent), or both. Statistically significant associations between postoperative nausea or emesis and the doses of both intraoperative agents, midazolam and fentanyl, were observed ($p < 0.0001$ for each), regardless of procedure type or duration. A statistically significant association with intraoperative nausea was seen only with midazolam ($p = 0.001$). Transient hypotension (discussed below and defined as the observation of systolic blood pressure < 90 mmHg for 5 minutes) was also observed to independently increase the incidence of postoperative nausea or emesis. The use of preoperative oral sedation did not seem to independently increase the incidence of nausea/emesis. Patients with significant postoperative nausea or emesis were treated with an antiemetic (prochlorperezine, droperidol, or ondansetron), and only those whose symptoms resolved were cleared for discharge.

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Blood Pressure Variation

Most patients experienced some degree of intraoperative blood pressure variation, typically reflecting the level of sedation or discomfort. For the purposes of analysis, transient hypotension was defined as a systolic blood pressure < 90 mmHg for at least 5 minutes. Successful treatment of these 61 patients was achieved with an increase in intravenous fluids in all cases (Table II).

Transient hypertension (defined as a systolic blood pressure > 150 mmHg for at least 5 minutes) required treatment in two patients in whom the increase was sustained despite discontinuation of painful stimuli. Both patients had histories of hypertension controlled with a beta blocker; both patients were treated successfully with a dose of intravenous metoprolol (50 mg).

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Recovery Time

As might be expected, recovery time was statistically associated with the duration of the procedure and with the intraoperative doses of both midazolam and fentanyl ($p = 0.0001$ for each) (Tables III and IV). An inverse relationship with age was observed; longer recovery times among young patients paralleled higher intraoperative medication dosages despite typically shorter case duration. Two other important associations were observed: the use of preoperative oral sedation and the incidence of postoperative nausea or emesis both significantly increased recovery times ($p = 0.0007$ and 0.0001, respectively) when controlled for the confounding effects of intraoperative medication dose and procedure duration.

TABLE III

Pertinent ...

TABLE IV

Incremental...

Looking at procedure duration in hourly increments (Table IV), those procedures requiring less than 1 hour utilized the lowest sedative dosing and were not associated with a single incidence of postoperative nausea or emesis. Average recovery times were acceptable (70 minutes), and no unintended admissions occurred in this group. The longest recovery times were seen in those cases requiring more than 3 hours, where sedative dosage was significantly higher. Postoperative nausea or emesis was seen in nearly 38 percent of cases lasting between 3 and 4 hours. It should be noted that a decrease in fentanyl dosing was observed during the study period, reflecting a conscious effort by the surgeons to address the possibility of narcotic induced postoperative nausea.

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Disposition

Of the 281 patients for whom same-day discharge was planned, 15 patients were admitted for overnight observation (Fig. 3). The majority (10 of 15, 66 percent) were admitted from the recovery area for treatment of persistent postoperative nausea or emesis. One patient was admitted through the emergency department several hours after discharge with postoperative nausea or emesis. Four other patients had unintended admissions (three for pain control and one in whom drowsiness and dizziness resulted in failure to meet discharge criteria at the end of the day). Unintended admission was much less of a problem (< 5 percent) in those cases lasting less than 3 hours than it was in longer cases (Table IV).

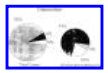

Fig. 3

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Discussion

A number of techniques for conscious sedation administration have been advocated by plastic surgeons, using a spectrum of agents and a certain degree of variation in practice styles. Rather than the advocacy of any one style, the purpose of this work was to improve the efficiency of conscious sedation administration in one the most commonly employed regimens. Before addressing technique refinement, the primacy of safety cannot be stressed enough. Continuous monitoring by a well-trained staff, a thorough understanding of the sedative agents, and the availability of back-up assistance are all prerequisites in a strictly defined protocol for conscious sedation; safe performance also requires careful patient selection and, obviously, experience. The preoperative evaluation must identify any and all potential risk factors, eliminating all patients with significant comorbid conditions. Vinnik stressed the importance of patient selection, emphasizing the expectation of intraoperative blood pressure variation and patient tolerance thereof.[14,15] Such variation was seen in this series as well, with management limited to increases of fluid rate in cases of transient decrease. Transient elevations were addressed with success by a pause in painful stimuli in all except two patients who required a single dose of metoprolol.

Conscious sedation, strictly defined, requires that the patient must be responsive at all times to verbal command. The use of small incremental doses of sedative agents allows the maintenance of such a state. Titration is guided by the continuous reappraisal of the patient's state of alertness and of the respiratory rate and room air oxygen saturation. The avoidance of a cumulative dosage effect requires the selection of primary agents with a short duration of activity/half-life. Midazolam has been a popular primary agent in conscious sedation based on such a pharmacokinetic profile (onset of action 1.5 to 3 minutes, redistribution half-life 6 to 15 minutes, and elimination half-life 1.2 hours). When using midazolam as a primary agent, it should be noted that respiratory depression by this agent is first manifested by a decline in respiratory rate, rather than a decrease in tidal volume. Therefore, oxygen saturation decreases may occur slightly later, underscoring the need to monitor respiratory rate and oxygen saturation.[16]

As Baker and Gordon alluded, the dose of sedative agents is tapered throughout the procedure, reflecting the initial requirement for comfort during the injection of local anesthetic and far reduced needs thereafter.2 The minimization of narcotic agents can and should be accomplished with this in mind. In the course of the present series, the usage of fentanyl significantly declined as this became apparent.

Two very important outcome parameters in outpatient surgery are length of recovery time and the minimization of the unintended admission.13 In this study, we were able to identify several independent variables affecting these parameters. Case duration and sedative dosage were correlated with one another; as they increased, both were associated with recovery delay and unintended admission. Patients whose cases lasted less than 1 hour were discharged within an average of 70 minutes, and none were admitted. It should be noted that nausea/emesis was not observed in this group. Recovery delay became most noteworthy in those cases lasting more than 3 hours. The type of procedures was important as well. When controlled for duration, two procedures-ultrasound-assisted liposuction and subpectoral breast augmentation-were independently associated with significantly higher sedative administration and recovery times. One unplanned admission occurred in a patient who underwent breast augmentation.

Age was inversely correlated with recovery time, likely reflecting the significantly higher sedation requirements that were seen among younger age groups. A diminished sedative need in elderly patients should always be kept in mind, particularly in the early stages of the procedure when dose administration tends to be higher.

The incidence of nausea and emesis was 24 percent overall. The incidence was highest in those cases lasting longer than 3 hours. Intraoperative nausea was treated during the procedure and typically resolved, causing no substantial increases in recovery time. Postoperative nausea/emesis was more problematic, causing statistically significant increases in recovery time and unintended admission. Postoperative nausea or emesis was responsible for 11 of 15 unintended admissions. In one case, postoperative nausea or emesis led to the inability to hold down pain medications, compounding the problem and resulting in an unnecessary emergency room visit. Postoperative nausea or emesis was associated with the dose of both intraoperative agents. In light of the commonly acknowledged association between narcotic agents and nausea, this observation further highlights the recommendation to limit fentanyl to the minimal doses required for adequate analgesia. We do not, however, recommend eliminating fentanyl altogether, even though the removal of a potential respiratory depressant may seem advantageous. Several authors have reported an 8 to 18 percent incidence of significant pain recollection even *with* supplemental analgesia.3,5 In addition, it has

been shown by Kissin et al. that subanalgesic doses of fentanyl potentiate the beneficial hypnotic effects of midazolam.17

The use of oral premedication 1 hour preoperatively is helpful in eliminating patient anxiety before surgery. In addition, it can allow a smoother titration of sedative agents in the critical early stages of a procedure. However, the use of oral premedication was also significantly associated with increased recovery time when controlled for other confounding variables. The beneficial effects of premedication must be weighed against these findings. Again, addressing concerns with narcotic use, oral morphine in the premedication regimen has been discontinued in our practice since the completion of this study. No alteration in patient comfort or satisfaction has been observed subjectively since that time.

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Conclusions

In the appropriate setting and under a well-defined protocol, conscious sedation can be a safe, efficient, and flexible anesthetic option for a variety of routine plastic surgical procedures. Its utility is most easily seen in cases of short duration, in which one can anticipate relatively brief recovery periods and expedient discharge. The incidence of nausea/emesis and the use of preoperative oral sedation were both shown to have deleterious effects on recovery time and unintended admission. A logical approach to the administration of sedative agents, including minimization of narcotic agents and gradual intraoperative dose tapering, may provide a means to optimize outcome in these procedures. The benefits of oral premedication must be weighed against its unwanted effects. Prophylactic antiemetics in conscious sedation are currently under prospective evaluation as an adjunct to outcome optimization.

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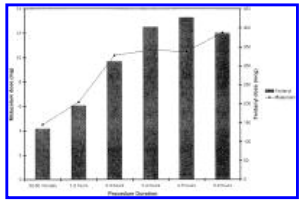

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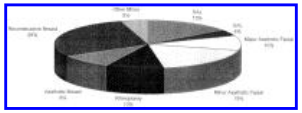

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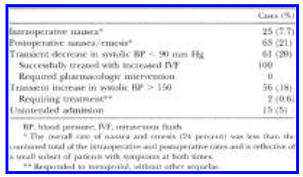

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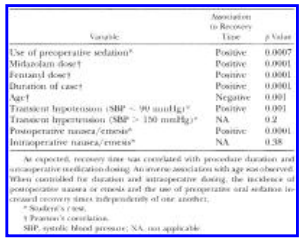

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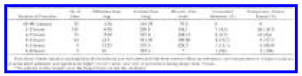

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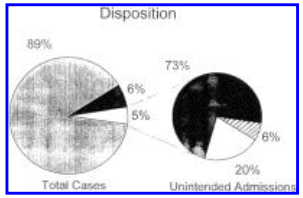

☐ Fig. 3

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