The Prevention of Emesis in Plastic Surgery: A Randomized, Prospective Study

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Perhaps the most unpleasant experience following outpatient plastic surgery procedures is postoperative nausea and vomiting. Postoperative nausea and vomiting often results in delayed recovery time and unintended admission, and it can be a contributing factor to the formation of hematoma following rhytidectomy. Ondansetron (Zofran) has proven benefit in preventing postoperative nausea and vomiting if given before general anesthesia in a variety of surgical procedures. Its utility in cases performed under conscious sedation has not been determined. The purpose of this study was (1) to test the ability of prophylactic ondansetron to prevent postoperative nausea and vomiting in plastic surgery cases performed under conscious sedation, and (2) to determine relative risk factors for postoperative nausea and vomiting and a selection policy for the administration of antiemetic prophylaxis. This was a prospective, randomized, double-blind study. One hundred twenty patients were enrolled after giving informed consent. Patients received a single dose of either placebo or ondansetron (4 mg intravenously) before administration of sedation. Sedation administration followed a standardized institutional protocol, using midazolam and fentanyl. Data were recorded from a series of three questionnaires: preoperatively, immediately postoperatively, and at the time of the first office return. Data were confirmed by means of telephone interview, chart analysis, and nursing documentation. Multivariate analysis was conducted. Nausea and emesis occurred with an overall frequency of 33 percent and 22 percent, respectively. Postoperative nausea and vomiting was associated with statistically longer recovery periods. The incidence of emesis was statistically higher among women, among those undergoing facial rejuvenation, and among those with a history of opioid-induced emesis or postoperative nausea and vomiting following a previous operation ($p < 0.05$). The incidence of postoperative nausea and vomiting paralleled increases in case duration; the incidence of emesis was zero in cases less than 90 minutes in duration. Ondansetron significantly reduced the incidence of emesis overall (placebo, 30 percent; ondansetron, 13 percent; $p < 0.05$). Postoperative perception of nausea was significantly lower among those who had received ondansetron ($p < 0.05$). These results confirm the efficacy of ondansetron for the prevention of postoperative nausea and vomiting in plastic surgery cases under conscious sedation. In those who are at increased risk, prophylaxis should be considered. Such risks include female gender, facial rejuvenation procedures, and a patient history of opioid-induced emesis or postoperative nausea and vomiting following a prior operation. The zero incidence of emesis in cases less than 90 minutes does not support the routine use of prophylaxis in such cases. Patient satisfaction in plastic surgery is derived from the overall subjective experience of the event as much as by the final result. By remaining attentive to patient concerns and optimizing perioperative care, we can improve the subjective experience for our patients. (*Plast. Reconstr. Surg.* 109: 2487, 2002.)

A successful surgical result in plastic surgery is commonly demonstrated through preoperative and postoperative imagery. However, patient satisfaction in plastic surgery is derived from the overall subjective experience of the event as much as by the final result. Because nausea and emesis are frequently cited as the most unpleasant experiences following surgery,[1–4] the prevention of postoperative nausea and vomiting is an important concern to patients and their plastic surgeons.

In our review of 300 aesthetic procedures performed under conscious sedation,[5] postoperative nausea and vomiting occurred in 24 percent of cases and was responsible for a statistically significant delay in recovery time and 10 unintended admissions for observation and treatment. No other single factor had such a dramatic effect on the overall course of events.

From a surgical standpoint, the potential consequences of postoperative nausea and

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vomiting include formation of hematoma, resulting from increases in blood pressure during retching or vomiting.[5–7] For rhytidectomy, even mild postoperative bleeding can equate with major disappointment. Postoperative nausea and vomiting is clearly an untoward event worthy of prevention.

There is no single cause of postoperative nausea and vomiting. Patient characteristics, type of surgery, and the style of anesthesia all contribute independent risk factors.[2,5,8–10] The administration of prophylactic agents should be directed to those at increased risk to provide a more cost-effective strategy and to avoid potential side effects that some prophylactic agents may cause.[8]

Ondansetron (Zofran, GlaxoSmithKline, Research Triangle Park, N.C.) is a selective antagonist of serotonin with a profound antiemetic effect and few to no side effects. Ondansetron prophylaxis has proven benefit in conjunction with general anesthesia in a variety of surgical procedures.[11–19] However, its utility in conscious sedation has not been determined. The purpose of this study, therefore, was twofold: (1) to determine the efficacy of prophylactic ondansetron in plastic surgery procedures performed under conscious sedation, and (2) to determine relative risk factors for postoperative nausea and vomiting and a selection policy for the administration of prophylaxis.

Materials and Methods

Design

This was a prospective, randomized, double-blind study.

Patients

One hundred twenty patients gave informed consent to participation under the guidelines and direction of the Institutional Review Board of Northwestern University.

Procedures

The summary of procedures performed is seen in Figure 1. The majority of procedures were aesthetic surgery procedures scheduled for same-day discharge. Seventeen patients were preoperatively scheduled for overnight observation. In our 1999 review of conscious sedation, the incidence of postoperative nausea and vomiting was zero in cases of less than 1 hour duration. For this reason, only patients undergoing procedures with an expected duration of 1 hour or greater were included.

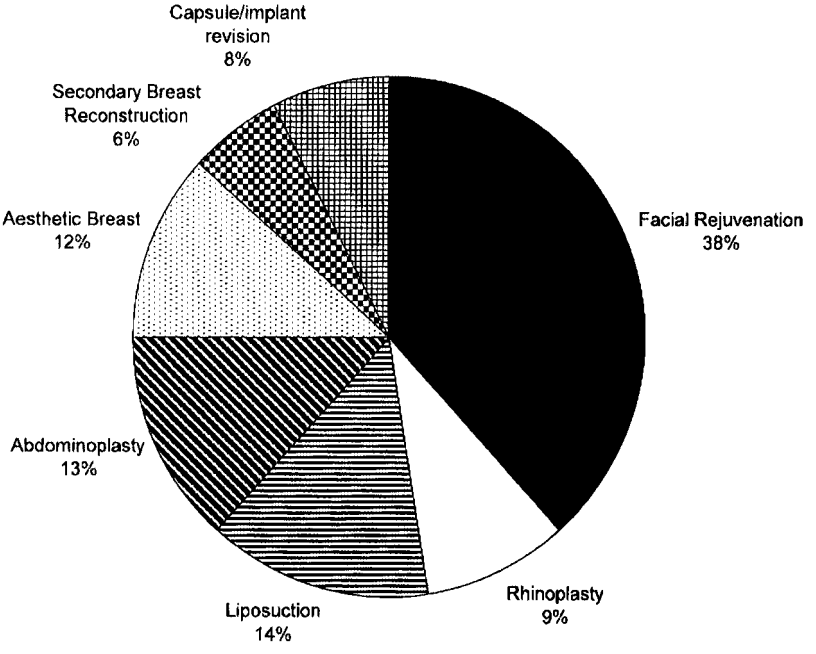

FIG. 1. Procedure demographics. The majority of procedures performed were aesthetic surgery cases. Facial rejuvenation procedures included rhytidectomy, endoscopic brow lift, platysmaplasty, or a combination of the above. Aesthetic breast procedures included mastopexy, augmentation, reduction, or a combination of the above. Liposuction was performed with ultrasonic assistance in 18 percent of cases. All patients were supposed to be discharged on the same day.

Conscious Sedation Regimen

Sedation administration followed a standardized institutional protocol using two intraoperative agents: midazolam and fentanyl. The incremental titrated dosing technique, as previously published, included premedication with oral diazepam (10 to 20 mg 1 hour prior) in all cases and a single dose of clonidine for patients undergoing facial rejuvenation procedures or those under treatment for hypertension. Since the time of publication, the preoperative use of an oral opioid agent (MS Contin, Purdue Frederick, Stamford, Conn.) has been omitted from our regimen, and the use of intraoperative fentanyl has declined. [The average dose of fentanyl per case in the previous study (1992 to 1997) was 247 μg (123 μg/hour). In this series (1997 to 1999), the use of fentanyl was decreased to 167 μg per case (65.9 μg/hour).] These alterations addressed the observed associations with recovery delay and postoperative nausea and vomiting that were reported.

Randomization

Patients were randomized in a double-blind fashion to receive one of the following before administration of sedative agents: the study arm received a single dose of ondansetron (4 mg intravenously), and the control arm received a single administration of placebo (saline intravenously) (Fig. 2). Postoperatively, any patient experiencing postoperative nausea and vomiting was given ondansetron rescue therapy (4 mg intravenously).

Data

Demographic data were obtained through a preoperative questionnaire and chart review.

TABLE I
Multivariate Analysis*

Independent variables
Age
Weight
Alcohol use
History of postoperative nausea/emesis
History of motion sickness
History of opioid-induced nausea
Procedure
Duration of procedure
Dosage of versed
Dosage of fentanyl
Outcome parameters
Nausea scale—linear analogue: 1–10
Recovery time
Disposition
Incidence of nausea
Incidence of emesis

* Independent and dependent variables (outcome criteria) are listed.

Dependent variables were obtained from two postoperative questionnaires—the first in the recovery area and the second at the time of follow-up. The incidence of nausea and emesis were surveyed, and the severity of nausea was estimated on a linear analogue scale of 0 through 10. Data were confirmed by means of nursing record/chart review and by means of telephone interview. Operative records were reviewed for additional procedure-related variables. A summary of independent and dependent variables is given in Table I. Data were consolidated in Microsoft Excel 97 for Windows (Microsoft Corporation, Redmond, Wash.), and the Biostatistics Group of the Department of Preventative Medicine, Northwestern University, performed analysis using SAS software (SAS Institute, Inc., Cary, N.C.). The determination of independent risk factors was limited to the control group (placebo) to eliminate the influence of treatment. Intergroup

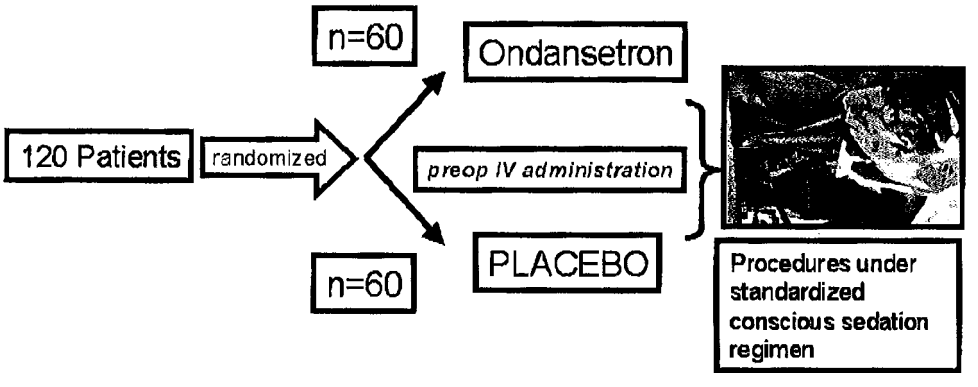

FIG. 2. Study design. Patients were randomized to receive ondansetron or placebo. The medications were administered before sedation. All patients underwent procedures under a standardized, institution-wide protocol for conscious sedation administration.

TABLE II
Gender Association

Gender	*n*	Incidence of Nausea* (%)	Incidence of Emesis* (%)
Male	16	3 (19)	1 (6.3)
Female	104	36 (35)	25 (24)
Total	120	39 (33)	26 (22)

* $p < 0.05$. The control (placebo) group was evaluated to determine postoperative nausea and vomiting incidence without the influence of treatment/prophylaxis. The incidence of nausea and emesis was significantly higher among women.

comparison of means was performed using unpaired Student's *t* tests and analysis of variance, where applicable. Multiple group comparisons used Tukey's standardized range. The chi-square test was used for incidence analysis, and statistical associations were determined using Pearson correlation analysis.

Results

The average patient was 45 years old and weighed 147 lb; the gender distribution was 104 women and 16 men. The average procedure lasted 152 minutes. Average dose was 14.3 for midazolam and 167 mg for fentanyl. Nausea and emesis occurred with an overall frequency of 33 percent and 22 percent, respectively. Of those receiving placebo, the incidence of emesis was statistically higher among women (Table II). In accord with previous observations, the incidence of postoperative nausea and vomiting paralleled increases in case duration. The incidence of emesis was zero in cases less than 90 minutes in duration (Fig. 3). With each advancing duration interval, a statistically greater incidence of nausea and emesis was seen (chi-square test, $p < 0.05$). The highest incidence of nausea and emesis (55 percent and 36 percent, respectively) was seen in cases of greater than 240 minutes' duration. There was a statistical association of procedure duration to the doses of each of the agents administered, midazolam and fentanyl (Pearson correlation, $p < 0.05$). However, a statistical association between midazolam or fentanyl doses and the incidence of nausea/emesis was not observed (Student's *t* test, $p > 0.05$ in each case).

Age has previously been associated with nausea incidence. Typically, a higher incidence is seen among younger patients. In this study, however, when patients receiving placebo were stratified into age blocks, no group appeared to have a statistically greater incidence of postoperative nausea and vomiting. Postoperative nausea and vomiting was statistically associated

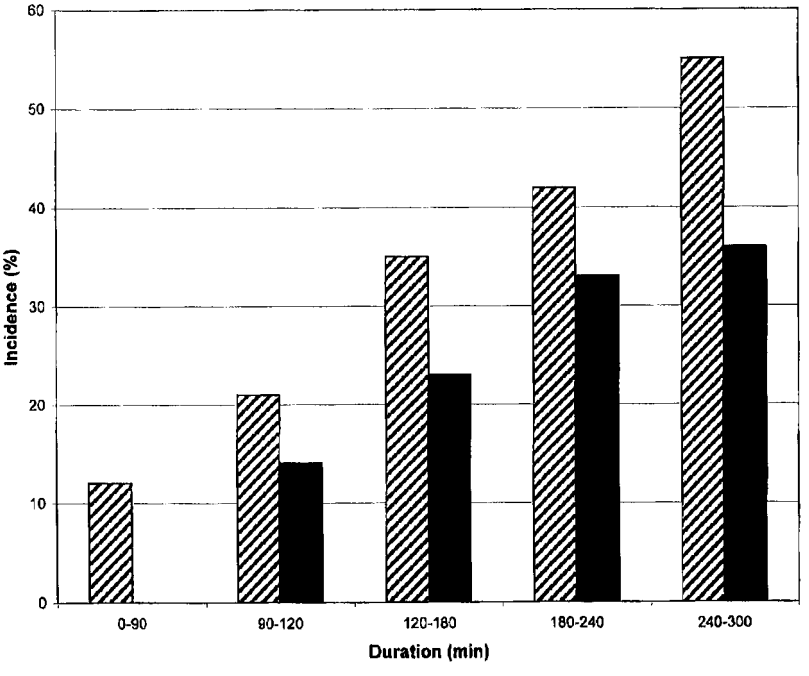

FIG. 3. Influence of procedure duration on the incidence of nausea and emesis. Overall, in procedures lasting less than 90 minutes, the incidence of postoperative nausea and vomiting was zero. At each time interval, a statistically significant increase in the incidence of postoperative nausea and vomiting was observed. *Striped bars*, incidence of nausea; *filled bars*, incidence of emesis.

TABLE III
Patient History

	n	Incidence of Nausea* (%)	Incidence of Emesis* (%)
History of motion sickness†			
Positive	46	17 (37)	11 (24)
Negative	55	18 (33)	13 (23)
History of opioid-induced nausea‡			
Positive	18	11 (61)	8 (44)
Negative	102	28 (27)	18 (18)
History of postoperative nausea and vomiting in prior surgery§			
Positive	49	22 (45)	14 (31)
Negative	52	14 (27)	10 (19)

* $p < 0.05$. Again, the control (placebo) group is evaluated to determine postoperative nausea and vomiting incidence without the influence of treatment/prophylaxis. A history of motion sickness did not appear to affect the incidence of postoperative nausea and vomiting. However, a history of postoperative nausea and vomiting in prior surgeries and a history of nausea following the use of opioid analgesics were associated with significantly greater rates of postoperative nausea and vomiting.

† Not all subjects provided a response to this item.

‡ Includes those with history of nausea following opioid-containing analgesics.

§ Those without surgical history were unable to respond.

with the type of procedure. When controlled for confounding variables, those undergoing facial rejuvenation procedures appeared to be at greater risk. Again focusing on the control group only, a history of motion sickness did not produce a statistically greater risk (Table III). However, a history of nausea following the use of opioid analgesics (i.e., codeine) was associated with a greater than twofold higher incidence of both nausea and emesis ($p < 0.05$). A history of postoperative nausea and vomiting (those who had previous surgery) yielded similar findings ($p < 0.05$).

As expected, postoperative nausea and vomiting was again associated with statistically longer recovery periods ($p < 0.05$). Eight patients required unintended overnight admission for observation. Of these, the cause for admission in four patients (50 percent) was postoperative nausea and vomiting.

Ondansetron significantly reduced the incidence of emesis overall (placebo, 30 percent; ondansetron, 13 percent; $p < 0.05$). In each of the high-risk subgroups noted above, the significant reduction in emesis incidence was consistent (Table IV). Finally, the perception of nausea severity, as measured by means of linear analogue scale, was significantly higher among those who had received placebo (4.07 versus 1.94, $p < 0.05$).

DISCUSSION

In the anesthesia literature, Macario et al. reported on preoperative patients who were asked to list potential untoward events in order of undesirability and to allocate a hypothetical sum of $100 to the prevention of the listed events. Not surprisingly, nausea and emesis were at the top of the list for undesirability and were allocated the largest fraction of the hypothetical funds.[20] In plastic surgery, a field that is highly dependent on patient satisfaction, it is unwise to view nausea and emesis as untoward events concerning only the anesthesiologist. As plastic surgeons, we have an important perspective on anesthetic needs, and we often provide direction for the manner in which anesthesia is delivered. Certainly this is true for conscious sedation.

Nausea and emesis are not simply issues of

TABLE IV
Subgroup Analysis

Subgroup	*n*	Incidence of Nausea		Incidence of Emesis	
		Placebo (%)	Ondansetron (%)	Placebo (%)	Ondansetron (%)
Female gender	104	20/52 (38)	16/52 (31)	18/52 (35)	7/52 (13)*
Facial rejuvenation procedure	46	6/25 (24)	8/21 (38)	5/25 (20)	4/21 (19)
History of postoperative nausea and vomiting	49	12/26 (46)	10/23 (43)	9/26 (35)	5/23 (22)*
History of opioid-induced nausea	18	5/9 (55)	6/9 (66)	5/9 (56)	3/9 (33)*

* $p < 0.05$. Of these groups previously identified as carrying a greater risk for postoperative nausea and vomiting, ondansetron significantly reduced the incidence of emesis. Subjectively, however, treatment did not appear to eliminate the sensation of nausea.

comfort. Postoperative nausea and vomiting can be responsible for the formation of hematoma following rhytidectomy.[6–9] This may be the result of transient increases in blood pressure that occur during retching. The significance of postoperative bleeding is so great that many practices, including ours, incorporate the use of a preoperative antihypertensive in selected patients undergoing facial rejuvenation despite a low incidence of the complication.

Many authors have examined the usefulness of prophylactic antiemetics. Nearly all of the previous reports have been conducted in series of patients undergoing general anesthesia.[11,13,15,16,18,21–23] Efficacy has been demonstrated most clearly in procedures with the highest incidence of postoperative nausea and vomiting. These include surgery of the inner ear (70 percent), ophthalmologic surgery/strabismus surgery (80 percent),[24] intraabdominal surgery (40 to 70 percent), and laparoscopy (40 to 77 percent). Ondansetron is only one of many agents that have been tested. It is not the only one with demonstrable efficacy; however, several reports have suggested improved efficacy of ondansetron over metoclopramide, droperidol, and prochlorperazine.[1,12,16,25,26] Ondansetron was selected on the basis of its negligible side-effect profile. In contrast, the side effects of the alternatives (prochlorperazine, droperidol, metoclopramide, and Benadryl) can include undesirable central nervous system effects such as drowsiness, dysphoria, and extrapyramidal reactions.[1,27,28] Ondansetron was shown in this study to reduce the incidence of postoperative emesis and the perception of nausea severity. We saw no adverse events directly attributable to the use of ondansetron. Tramer et al. suggested that the use of prophylactic ondansetron is not a cost-effective means of controlling emesis in a trial that compared this treatment with symptomatic treatment as needed (rescue therapy).[29] When given as a matter of protocol to all patients, this may be true. However, we suggest that an administration protocol must take into consideration the relative risk for nausea and the coincidences of its occurrence in particular subsets (like rhytidectomy). Furthermore, even if rescue therapy eventually provides relief, it has not prevented the incidence and therefore has not addressed the patient's subjective concerns. In the future, studies in the plastic surgery population might examine the comparative efficacy and overall outcome (including side effects) with other less costly, alternative prophylactic agents. It is also conceivable that the incidence of postoperative nausea and vomiting might be reduced even further with alterations in the anesthetic regimen.

How common is postoperative nausea and vomiting in aesthetic surgery? Obviously, the incidence of postoperative nausea and vomiting is dependent on a number of factors, including patient characteristics, the types of procedures performed, and the style of anesthetic. Some authors have cited a relatively higher incidence of postoperative nausea and vomiting among women.[2,12] Incidence also varies with age. The lowest incidence occurs in infants, with a progressive increase to peak incidence in the 6- to 16-year age group (34 to 51 percent).[24,30–32] In adulthood, the incidence appears to decrease (14 to 40 percent). Vance et al. demonstrated a two-fold higher incidence among children (up to 12 years) compared with adults undergoing aesthetic procedures.[9] In this study, we did find a higher incidence among women. The age group with the highest incidence appeared to be 41 to 50 years; however, this likely reflected the type of surgery performed (facial rejuvenation) and duration. History of motion sickness, previous history of postoperative nausea and vomiting, and history of nausea following the use of opioid agents have all been associated with an increased incidence of postoperative nausea and vomiting.[2] Of these, we found that a history of postoperative nausea and vomiting and history of nausea following opioid agents indeed led to a higher incidence of postoperative nausea and vomiting. Facial rejuvenation procedures carried a higher incidence of postoperative nausea and vomiting, even when controlled for duration and agent dosage. This effect may not be directly attributable to the surgical site (it is more likely multifactorial); however, the implication for use of antiemetics in such cases remains.

In determining use of prophylactic antiemetics, the expected procedure duration provides a final useful criterion (Fig. 3). The incidence of postoperative nausea and vomiting in this study again paralleled the increase in procedure duration, even when controlled for the dosage of either administered agent. In cases lasting less than 90 minutes, the incidence of nausea (12 percent) and the incidence of emesis (0 percent) do not support the routine use of antiemetics for procedures with such dura-

tion expectations. The findings of this study and the previous review, both of which carefully inquired on incidence data, demonstrated nausea and emesis overall in approximately 30 percent and 20 percent of patients, respectively. Whether alternative sedation regimens, such as propofol infusion or the dissociative technique based on ketamine,[33] have more optimal outcomes remains to be determined. Such comparison should be conducted in a standardized, prospective fashion, addressing the full spectrum of outcome criteria.

CONCLUSIONS

The problem of postoperative nausea and emesis is an important concern to patients undergoing plastic surgery and their surgeons. Ondansetron is effective in reducing the incidence of emesis and the perception of nausea severity. Those at greatest risk might be expected to derive the greatest benefit from treatment. On the basis of our experience, inquiries should be made preoperatively regarding the patient's history of postoperative nausea and vomiting following surgery and a history of nausea following opioid agents. Women appear to be at relatively greater risk. Those undergoing facial rejuvenation are good candidates for prophylaxis on the basis of both the results presented here and the significant potential consequences that can result in this group. Patients without risk factors, who are undergoing procedures of relatively short (less than 90 minutes) duration, appear to be at least risk and therefore stand to derive the least benefit.

It serves both our patients and our practice to be attentive to the events and environment resulting from surgery. Ultimately, the postoperative photograph is not the only predictor of patient satisfaction.

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