Reduced Incidence of Postoperative Nausea and Vomiting in Black South Africans and Its Utility for a Modified Risk Scoring System

Reitze N. Rodseth, MBChB, FCA, DA, DCH,*† P. Dean Gopalan, MBChB, FCA, Cert Crit Care,* Hussein M. Cassimjee, MBChB, DA, FCS, Cert Crit Care,*‡ and Saaliha Goga, MBChB, DA§

BACKGROUND: Postoperative nausea and vomiting (PONV) is a common occurrence with a reported incidence between 20% and 40%. In this prospective observational study, we sought to determine the incidence of PONV in a South African population, differentiating between black South African (African) and the remainder of the multiethnic South African population (non-African). We attempted to identify individual risk factors for PONV and to test the performance of the Apfel PONV predictive scoring system in our patient population.

METHODS: The primary outcome for the study was nausea, vomiting or retching, or the combination of both events within 24 hours of surgery. We collected 800 patients, 400 Africans and 400 non-Africans in each group, over a 4-month period.

RESULTS: There was a statistically significant difference in the incidence of PONV between African and non-African groups (27% vs 45%, $P < 0.0001$). Stepwise, backward logistic regression analysis identified female sex (odds ratio [OR], 1.9; 95% confidence interval [CI], 1.4–2.6), non-African ethnicity (OR, 2.1; 95% CI, 1.5–2.82), PONV or motion sickness history (OR, 2.6; 95% CI, 1.8–3.7), and the use of postoperative opioids (OR, 1.4; 95% CI, 1–1.9) to be independent predictors of PONV. The area under the receiver operator curve for the Apfel score was 0.62. When modeling the independent risk factors in our population, the combination of non-African ethnicity, female sex, and a history of motion sickness or PONV resulted in a receiver operator curve area of 0.67.

CONCLUSION: We were able to identify black South African ethnicity as an independent risk factor for decreasing the incidence of PONV. The reason for this observation remains speculative and further investigation is warranted. The inclusion of ethnicity as a risk factor into PONV scoring systems should be explored. (Anesth Analg 2010;110:1591–4)

Postoperative nausea and vomiting (PONV) is a common occurrence with a reported incidence between 20% and 40%.[1] Among many South African anesthesiologists and perioperative nursing staff, there is the perception that this incidence among indigenous black South Africans (African group) is significantly less than in the remainder of the multiethnic South African population (non-African group).

This perception has never been validated, and if incorrect, it may result in the underdiagnosis and treatment of PONV. Patients have indicated that they are willing to pay between US$56 and US$100 for an effective antiemetic because they find PONV more distressing than pain in the postoperative setting, thus emphasizing the importance of correctly identifying its incidence.[2] If the incidence is significantly lower in the black South African population, possible reasons for this should be identified. In addition, this would raise questions regarding the validity of using PONV prediction scoring systems derived and validated predominantly from Caucasian populations for other ethnic groups.

In this study, we aimed to test the hypothesis that the incidence of PONV differs between African and non-African groups in South Africa. In addition, we aimed to identify individual risk factors for PONV and to test the performance of the Apfel PONV predictive scoring system in our population.[3] The Apfel score is a simplified risk score consisting of 4 predictors: female gender, history of motion sickness or PONV, nonsmoking, and the use of postoperative opioids.

METHODS

A prospective observational study was performed at Inkosi Albert Luthuli Central Hospital and St. Aidan's Hospital, Durban, South Africa, after obtaining ethics approval from the Biomedical Research Ethics Committee, University of KwaZulu-Natal (Ref BE051/08). Patients were interviewed 24 hours after their surgery by means of a structured validated questionnaire (Appendix) translated in their first language. Demographic, surgical, and anesthetic data, including postoperative drug administration and nurse-recorded PONV events, were extracted from patient hospital records by means of a data extraction sheet. The decision as to the type and dose of antiemetic drugs, as well as intra- and postoperative opioid analgesia, was left to the discretion of the attending anesthesiologist.

From the *Department of Anaesthetics, Nelson R Mandela School of Medicine, University of KwaZulu-Natal, Durban; †Department of Anaesthetics and ‡Trauma Unit, Inkosi Albert Luthuli Central Hospital, Mayville; and §Department of Anaesthetics, St. Aidan's Hospital, Durban, South Africa.

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Address correspondence and reprint requests to Reitze N. Rodseth, MBChB, FCA, DA, DCH, Department of Anaesthetics, Nelson R. Mandela School of Medicine, Private Bag 7, Congella 4013, Durban, South Africa. Address e-mail to reitzerodseth@gmail.com.

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Table 1. Anesthetic Technique

	African (n = 400)	Non-African (n = 400)	P
Propofol (mg/kg)	2.28	2.13	0.013
MAC hours	1 h 32 min	1 h 51 min	0.355
Morphine administered	222 (56%)	218 (55%)	0.831
Morphine (mg/kg)	0.11	0.09	0.006*
Fentanyl administered	252 (63%)	236 (59%)	0.218
Fentanyl (μg/kg)	1.71	1.63	0.207
Intraoperative antiemetic	52 (13%)	88 (22%)	0.001*
Ondansetron (4 mg)	37	64	0.004*
Dexamethasone (4 mg)	15	24	0.188
Muscle relaxant used	255 (64%)	255 (64%)	1
Neostigmine reversal received (2.5 mg)	236 (59%)	231 (58%)	0.885
Duration of surgery (SD)	102 min (18–187min)	103 min (37–169min)	0.908
Postoperative opioids administered	208 (52%)	215 (54%)	0.671
Papaveretum			
Patients treated	167	175	0.616
Dose (mg/kg)	0.42	0.38	0.128
Tramadol			
Patients treated	41	40	1
Dose (mg/kg)	1.52	1.62	0.606

Mean (SD); n (proportion).
*$P < 0.01$.

Table 2. Incidences of Postoperative Nausea and Vomiting

Intervals	African (400)	Non-African (400)	P
0–24 h			
Nausea	98 (25%)	169 (42%)	<0.0001*
Vomiting	41 (10%)	94 (24%)	<0.0001*
Nausea and/or vomiting	106 (27%)	178 (45%)	<0.0001*
0–2 h			
Nausea and/or vomiting	20 (5%)	30 (8%)	0.147
2–24 h			
Nausea and/or vomiting	86 (22%)	148 (37%)	<0.0001*

Mean (SD); n (proportion).
*$P < 0.01$.

Eligibility

All patients aged 18 years or older undergoing general volatile-based anesthesia for elective surgery with propofol induction were considered eligible for inclusion into the study. Patients whose tracheas were not extubated immediately postoperatively and those who had received intraoperative nitrous oxide were excluded. Written informed consent was obtained from all patients at the time of the postoperative interview.

Measurements

We used the guidelines published by Apfel et al.,[4] "How to Study Postoperative Nausea and Vomiting," in the design and reporting of this study. The primary outcome for the study was nausea, vomiting or retching, or the combination of both events within 24 hours of surgery. Vomiting, which included retching episodes, and nausea were inquired about separately.[4] Questions were asked relating to a history of PONV, motion sickness, smoking, and expectations of PONV. Patients were asked to categorize themselves as African (indigenous black South African) or non-African.

Study Design

A pilot study performed on 198 patients at Inkosi Albert Luthuli Central Hospital found an incidence of 55% in the non-African group and 31% in the African group. Our power analysis showed that group sizes of 384 would be adequate to detect a 15% difference in the incidence of PONV with a power of 0.95, 2-sided $P = 0.01$ (GenStat Release 12.1 [PC/Windows XP], VSN International, Hempstead, UK). Eight hundred patients (400 Africans and 400 non-Africans) were recruited over a 4-month period (September 1, 2009, to December 10, 2009) stratifying 200 men and 200 women to each group. All data analyses were performed by SPSS 15.0 for Windows (SPSS, Chicago, IL), using the χ^2 test for categorical data and Student t test for normally distributed continuous data.

RESULTS

The details regarding the anesthetic technique are provided in Table 1. As shown in Table 2, a statistically significant difference was found between the African and non-African groups (27% vs 45%, $P < 0.0001$) when examining the incidence of PONV in the first 24 hours. This was despite that the mean PONV risk calculated from the Apfel score was equal between groups (African 38.4% vs non-African 39.9%; $P = 0.265$). To further match the 2 groups, a subanalysis excluding all 253 patients who received antiemetics intraoperatively ($n = 140$) or had a history of PONV or motion sickness ($n = 154$) was performed. The remaining 547 patients were 308 Africans (46% female) and 239 non-Africans (43% female). The incidence of PONV was 22% (67 of 308) in the African group and 44% (104 of 239) in the non-African group ($P < 0.0001$).

Stepwise, backward logistic regression analysis was performed on the entire study population to identify independent predictors of PONV, the results of which are reported in Table 3. This was repeated for the African and non-African populations.

When modeling the independent risk factors in our population, such as non-African ethnicity, female sex, and a history of motion sickness or PONV, the resultant receiver operator

Table 3. Independent Predictors of Postoperative Nausea and Vomiting (PONV)

	Risk factor	OR (95% confidence interval)
Entire population	Female sex	1.9 (1.4–2.6)
	Non-African ethnicity	2.1 (1.5–2.8)
	PONV or motion sickness history	2.6 (1.8–3.7)
	Postoperative opioids	1.4 (1–1.9)
African population	Female sex	2.8 (1.7–4.6)
	PONV or motion sickness history	5.7 (3–10.8)
Non-African population	Female sex	1.58 (0.99–2.2)
	PONV history or motion sickness	1.7 (1.1–2.7)
	Postoperative opioids	2 (1.3–3)

OR = odds ratio.

curve (ROC) area was 0.67. The Apfel score resulted in a ROC area of 0.62. On substituting the nonsmoking risk factor in the Apfel score for non-African ethnicity, the ROC improved to 0.67.

DISCUSSION

Ethnicity as a Risk Factor for PONV

Ethnicity has been proposed as a risk factor for future investigation in the development of PONV.[1] This study has directly compared the incidence of PONV between different ethnic groups. Despite that there were more PONV risk factors in the African group (younger age, fewer smokers, less intraoperative antiemetics, and more intraoperative morphine administration), the incidence was still lower than that of the non-African group. The non-African group had a stronger history of PONV and motion sickness compared with the African group (102 vs 52; $P < 0.0001$), adding internal consistency to our findings.

The role of the hepatic P-450 cytochrome system and in particular the CYP1A2 and CYP2E1 isoenzymes has been examined as a potential factor in the etiology of PONV.[5] It has been postulated that volatile metabolism by the CYP2E1 poor metabolizer phenotype may be a risk factor for the development of PONV.[5,6] This allele has not been identified in black South Africans in the province in which our study was conducted, possibly explaining the lower incidence of PONV observed.[7] Variations related to opioid sensitivity and metabolism may offer additional explanations for these findings.[8] Postoperative opioid administration was identified as an independent risk factor in the non-African group but not in the African group, further supporting this hypothesis.

Risk Factors and Prediction Scores

As shown by Apfel et al.,[9] currently used risk prediction models are imperfect, and it is unlikely that future models will improve prediction accuracy unless other stronger risk factors are found. We have identified black South African ethnicity to be a significant predictor of decreasing the incidence of PONV in our population. Being a black South African reduces the risk of PONV equivalent to the reduction observed between being a male or female. The inclusion of ethnicity into risk prediction models in populations of mixed ethnicity warrants further investigation. In ethnically homogenous populations, such a risk factor would be shared among all members and its inclusion would not be justified.

Limitations and Confounders

This is a prospective observational study and no attempt was made to standardize either the intra- or postoperative management of the patients, other than that described in the Methods section. As a result, 2 aspects should be considered.

First, the 2 groups were not demographically identical. The African group was statistically younger (40.44 vs 49.57 years; $P < 0.0001$), had fewer smokers (108 vs 134; $P < 0.0001$), and received higher doses per kilogram of intraoperative morphine and less intraoperative antiemetics. Despite these factors, all of which are associated with an increased risk of PONV, the incidence of PONV in our African group was 60% less than in the non-African group.

Second, although increasing surgical duration has been well documented as a risk factor for PONV, the role of specific types of surgery remains contentious with its inclusion into only 2 of the 7 frequently used scoring systems for adults.[1] We did not attempt to control for different types of surgery in our study. In the traditionally higher-risk operations such as ear-nose-throat, gynecological, orthopedic, and general surgery, both groups were statistically similar. More African patients underwent plastic surgery ($P = 0.007$), another traditionally high-risk surgery, but still experienced less PONV.

Data collection was performed by a range of individuals of varying ethnic backgrounds, and the questionnaire was presented in the patient's first language to overcome potential social and language bias. In an attempt to identify any potential cultural bias in the concept of nausea, we performed a logistical regression using vomiting as an end point. This identified female sex (odds ratio [OR], 2.7), non-African ethnicity (OR, 2.6), a history of PONV or motion sickness (OR, 1.6), and the use of postoperative opioids (OR, 1.6) as risk factors, findings consistent with our primary outcome.

The relatively high rate of PONV in the non-African group may have been related to the low incidence of prophylactic antiemetic use in the entire study population.

CONCLUSIONS

We were able to identify black South African ethnicity as an independent risk factor for decreasing the incidence of PONV. Thus, the inclusion of ethnicity into PONV scoring systems in a multiethnic society should be explored. The reason for our observation remains speculative and further investigation seems warranted. In addition, we have shown that although the incidence of PONV in the African population is significantly lower than that of the non-African population, the absolute incidence remains clinically significant and undertreated.

AUTHOR CONTRIBUTIONS

RNR helped to design and conduct the study, analyze the data, and write the manuscript. PDG helped to design the study and write the manuscript. HMC and SG helped to conduct the study and write the manuscript.

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Appendix

Postoperative PONV Questionnaire

1. Are you a smoker or have you smoked regularly in the last two months?

2. Have you ever had surgery before?

   If yes was it a general or regional anaesthetic?

   If yes did you experience any postoperative nausea or vomiting?

3. Do you experience motion sickness when you travel in a car/boat/train/plane?

4. Have you experienced any nausea after your operation?

   How bad was the nausea that you experienced – please mark it on this line

   0 _____ 10

   (no nausea at all) (worst nausea imaginable)

   When did it occur? 0-2 or 2-24 postoperatively?

5. Have you experienced any vomiting after your operation?

   How bad was the vomiting – please mark it on this line.

   0 _____ 10

   (No vomiting at all) (Worst vomiting imaginable)

   When did it occur? – 0-2 or 2-24 hours postoperatively?

6. Did you receive any treatment for you nausea and/or vomiting? If yes – did it make you feel any better?

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