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Study of the Association between Anesthetic Agents, Antiemetic Prophylaxis with Dexamethasone, and the Occurrence of Postoperative Nausea and Vomiting

Njall Pouth Clotilde[1*], Ndom Ntock Ferdinand[1], Bilogui Adjessa Willy[1], Amengle Ludovic[2], Ze Mikande Jacqueline[2], Binam Fidele[3]

[1]Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon
[2]Faculty of Biomedical Sciences, University of Yaoundé I, Yaoundé, Cameroon
[3]Department of Anesthesiology and Critical Care, Catholic University of Central Africa, Yaoundé, Cameroon
Email: *Clotildenjall1@gmail.com

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Abstract

Background: Postoperative nausea and vomiting (PONV) can have significant consequences on postoperative recovery and quality of care. The aim of our study was to investigate the association between anesthetic agents, antiemetic prophylaxis with dexamethasone (APD), and the occurrence of postoperative nausea and vomiting. **Method:** We conducted a case-control study (Cases: patients who received APD; Controls: patients who did not receive APD) including 108 patients who underwent surgery in the ENT, traumatology, and gynecology departments of Laquintinie Hospital in Douala. Sociodemographic data and the frequency of PONV within 48 hours post-surgery were collected in both groups and analyzed using R software. Fisher's exact test was used to assess the association between anesthetic agents, APD, and the occurrence of PONV (95% CI, alpha = 5%). **Results:** The mean age of patients was 39.8 ± 10.2 years, with a male predominance (54.6%). PONV occurred in 7 (13%) patients in the case group and in 19 (35.2%) in the control group. Fentanyl ($p = 0.012$) and Halothane ($p = 0.008$) were significantly associated with the occurrence of PONV, while no significant association was found with Thiopental ($p = 0.174$), Propofol ($p = 0.245$), Ketamine ($p = 0.108$), or Isoflurane ($p = 0.604$). **Conclusion:** Anesthetic agents such as thiopental, propofol, ketamine, and isoflurane, when combined with DAP, may have effects on reducing the frequency of PONV.

Keywords

Anesthetic Agents, Antiemetic Prophylaxis with Dexamethasone,

Postoperative Nausea and Vomiting

1. Introduction

Post-operative nausea and vomiting (PONV) remain one of the most frequent and burdensome complications after surgery, with a reported incidence of 20% - 80% depending on patient susceptibility, the surgical procedure and, critically, the anesthetic technique used [1]-[4]. Beyond discomfort, PONV may prolong hospital stays, raise costs, and jeopardise patient satisfaction; in severe cases it can precipitate wound dehiscence, delayed mobilisation and bronchial aspiration with potentially serious respiratory sequelae [2] [5].

Rationale for dexamethasone: Although several anti-emetics are available (ondansetron, droperidol, metoclopramide, neurokinin-1 antagonists), dexamethasone is widely recommended as first-line prophylaxis because it is inexpensive, has a long duration of action (6 - 10 h), and is usually administered as a single intra-operative dose (4 - 8 mg) with a favourable safety profile [6]-[8]. Meta-analyses have shown that dexamethasone reduces the relative risk of early and late PONV by ≈40% without increasing postoperative bleeding or infection [6] [9]. However, its effectiveness may vary when combined with different anesthetic agents, especially volatile anesthetics (e.g. halothane, isoflurane) and potent opioids (e.g. fentanyl), which themselves are potent emetogens [3] [10]. Clarifying these interactions is clinically relevant in settings where resource constraints dictate judicious drug selection.

Research gap and hypothesis: Current guidelines recommend multimodal prophylaxis tailored to individual risk, yet data directly comparing the impact of dexamethasone across distinct anesthetic regimens are scarce [5] [11]. We therefore posed the following research question:

Does intra-operative dexamethasone prophylaxis confer the same reduction in PONV when used with intravenous agents (propofol, thiopental, ketamine) as when used with volatile anesthetics (isoflurane)?

We hypothesised that (H_0) dexamethasone would reduce the incidence of PONV regardless of the anesthetic agent employed, and (H_1) that the magnitude of this reduction would be greater in patients receiving total intravenous anesthesia (TIVA) than in those exposed to volatile agents.

Objective: To test this hypothesis, our study analysed the association between the choice of anesthetic agent, adjunctive dexamethasone prophylaxis, and the occurrence of PONV in adult surgical patients.

2. Patients and Methods

2.1. Study Type, Period, and Setting

We conducted a case-control study from March to May 2015 at Laquintinie Hospital in Douala (HLD). The study involved patients who underwent surgery in the

ENT, traumatology, and gynecology departments, with the objective of assessing the association between anesthetic agents, antiemetic prophylaxis with dexamethasone (APD), and the occurrence of postoperative nausea and vomiting (PONV).

2.2. Study Population

The study included 108 patients aged 16 years and older who underwent surgery under general anesthesia (GA) and were hospitalized for at least 24 to 48 hours postoperatively. Exclusion criteria were: refusal to participate or continue the study, occurrence of PONV beyond 48 hours after surgery, and contraindication to dexamethasone. To differentiate cases from controls, a number was assigned consecutively to each patient: odd numbers (Group A) were assigned to patients who received APD, while even numbers (Group B) were assigned to those who did not.

2.3. Data Collection Procedure

Data were collected using a pre-established anonymous survey form, completed through medical record review and clinical observation. Collected variables included: sociodemographic characteristics (age, sex), surgical context, administered anesthetic agents (opioids such as fentanyl, volatile anesthetics such as halothane or isoflurane, and intravenous agents such as thiopental, propofol, or ketamine), use or non-use of dexamethasone for antiemetic purposes (dosage of 4 mg for patients weighing < 60 kg and 8 mg for those >60 kg), and the frequency of PONV within 48 hours post-surgery.

2.4. Ethical Considerations

Ethical principles were strictly respected. Authorization was obtained from the management of Laquintinie Hospital in Douala. Patients or their legal representatives were informed of the nature and objectives of the study and gave their free and informed consent. Participation was voluntary and could be withdrawn at any time. To ensure confidentiality, each survey form was anonymous and the database was accessible only to the investigators and their supervisors.

2.5. Data Analysis

Data were entered and analyzed using R software version 4.4.2 and GraphPad version 8.3.4 for Windows. Qualitative data were presented as frequencies and percentages, while quantitative data were expressed as means and standard deviations. Fisher's exact test and the Chi-square test were used to assess the statistical significance of the association between anesthetic agents, APD, and the occurrence of PONV, with a significance level set at 5%.

3. Results

3.1. Age and Sex of Patients

The mean age of patients was 39.8 ± 10.2 years, with no significant difference between group A (39.6 ± 16 years) and group B (40 ± 12.4 years). Most patients were

aged 26 - 35 years (26.9%), followed by the 36 - 45 (21.3%) and 46 - 55 (21.3%) age groups. Patients over 65 years accounted for only 3.7% of the sample.

Regarding sex distribution, males were slightly more prevalent, representing 54.6%, while females accounted for 45.4%. Group A included 48.1% males and 51.9% females, whereas group B had a higher proportion of males (61.1%) and fewer females (38.9%) (Table 1).

Table 1. Age and sex distribution of patients in groups A and B.

Age and Sex	Group A	Group B	Total
	n (%)	n (%)	n (%)
Mean age ± sd	39.6 ± 16	40 ± 12.4	39.8 ± 10.2
Age groups (years)			
[16 - 25[	09 (16.7)	08 (14.8)	17 (15.7)
[26 - 35[	16 (29.6)	13 (24.1)	29 (26.9)
[36 - 45[	10 (18.5)	13 (24.1)	23 (21.3)
[46 - 55[	08 (14.8)	15 (27.8)	23 (21.3)
[56 - 65[	07 (13.0)	05 (9.3)	12 (11.1)
>65 ans	04 (7.4)	00 (0.0)	04 (3.7)
Sex			
Male	26 (48.1)	33 (61.1)	59 (54.6)
Female	28 (51.9)	21 (38.9)	49 (45.4)

Group A: *patients who received antiemetic prophylaxis with Dexamethasone*; *Group B*: *patients who received antiemetic prophylaxis with Dexamethasone*; *n*: *frequency*,%: *percentage*.

3.2. Distribution of Patients According to the Frequency of Postoperative Nausea and Vomiting in Groups A and B

In group A, only 7 patients (13%) experienced these symptoms, while 47 (87%) did not report them. In group B, 19 patients (35.2%) also suffered from nausea and vomiting, whereas 35 (64.8%) did not. Fisher's exact test revealed a significant difference between the two groups ($p = 0.01$), suggesting that the antiemetic prophylaxis with Dexamethasone administered in group A may be more effective in reducing the occurrence of postoperative nausea and vomiting (Figure 1).

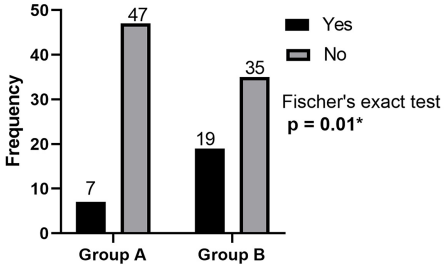

Figure 1. Distribution of patients according to the frequency of occurrence of PONV (Postoperative Nausea and Vomiting).

3.3. Dependence between Anesthetic Agents and the Occurrence of Postoperative Nausea and Vomiting in Patients from Group A and Group B

The analysis of the relationship between anesthetic agents and the occurrence of postoperative nausea and vomiting (PONV) showed that Fentanyl (p = 0.012) and Halothane (p = 0.008) were significantly associated with a higher frequency of PONV. Specifically, 35.2% of patients in group B who received Fentanyl experienced PONV, compared to 13.2% in group A. Similarly, 35.4% of patients in group B who received Halothane presented with PONV, compared to 11.4% in group A. No significant association was found with Thiopental (p = 0.174), Propofol (p = 0.245), Ketamine (p = 0.108), or Isoflurane (p = 0.604). Sufentanil was administered to only one patient, making it impossible to assess its impact (Table 2).

Table 2. Analysis of the dependence between anesthetic agents and the occurrence of postoperative nausea and vomiting in patients from group A and group B.

Anesthetic agents		Groupe A	Groupe B	Total	
	NVPO	n (%)	n (%)	N (%)	p-value
Thiopental	Oui	04 (14.8)	07 (33.3)	11 (22.9)	0.174
	Non	23 (85.2)	14 (66.7)	37 (77.1)	
Propofol	Oui	01 (9.1)	03 (42.9)	04 (22.2)	0.245
	Non	10 (90.9)	04 (57.1)	14 (77.8)	
Kétamine	Oui	03 (15.0)	11 (39.3)	14 (29.2)	0.108
	Non	17 (85.0)	17 (60.7)	34 (70.8)	
Fentanyl	Oui	07 (13.2)	19 (35.2)	26 (24.3)	**0.012***
	Non	46 (86.8)	35 (64.8)	81 (75.7)	
Sufentanyl	Oui	00 (0.0)	00 (0.0)	00 (0.0)	/
	Non	01 (100.0)	00 (0.0)	01 (100.0)	
Halothane	Oui	05 (11.4)	17 (35.4)	22 (23.9)	**0.008****
	Non	39 (88.6)	31 (64.6)	70 (76.1)	
Isoflurane	Oui	02 (20.0)	02 (33.3)	04 (25.0)	0.604
	Non	08 (80.0)	04 (66.7)	12 (75.0)	

Groupe A: *patient ayant reçu la prophylaxie antiémétique à la Dexaméthasone*; ***Groupe B***: *patient ayant reçu la prophylaxie antiémétique à la Dexaméthasone*; ***n***: *fréquence*, **%**: *pourcentage*. ***NVPO***: *Nausées et Vomissements Post-Opératoire*. **p-*value***: *le fischer's exact test a été effectué pour chercher la dépendance entre les différentes molécules anesthésiques utilisées et la survenue des NVPO statistiquement significatif à* $p < 0.05$.

4. Discussion

The present study shows that dexamethasone-based anti-emetic prophylaxis (DAP) is associated with a marked reduction in postoperative nausea and vomiting (PONV) during the first 48 hours after surgery, with a PONV rate of 13% in the dexamethasone group versus 35.2% in the control group [8].

This efficacy can be explained by several physiological mechanisms. Dexamethasone modulates the release of pro-inflammatory cytokines and dampens the inflammatory response that triggers nausea reflexes [11] [12]. It also exerts an anti-edematous effect on neurons within the vomiting center, preventing excessive activation of vagal and sympathetic afferent pathways [7], and may stabilize the blood-brain barrier, reducing its permeability to circulating emetogenic substances [8]. Together, these actions account for dexamethasone's central role—often alongside 5-HT_3 antagonists—in multimodal PONV-prevention protocols [9].

Analysis of the an aesthetic regimen revealed a significant association between PONV and the use of fentanyl and halothane. Opioids with high μ-receptor affinity, such as fentanyl, stimulate the chemoreceptor trigger zone and potentiate the vomiting center, increasing the likelihood of PONV, especially at high cumulative doses or without prophylaxis [1] [9]. Halothane, a highly blood-soluble volatile agent, persists after discontinuation and can irritate the respiratory mucosa and impair gastrointestinal motility, further elevating PONV risk [13] [14]. Although its use has declined in favor of more modern agents, halothane remains common in resource-constrained settings for economic reasons.

By contrast, no significant association was found with thiopental, propofol, ketamine or isoflurane, findings consistent with previous work [6]. Propofol possesses intrinsic anti-emetic properties attributed to inhibition of serotonin release in the gut and reduced excitability of the chemoreceptor trigger zone [9]. Thiopental primarily acts on GABAergic pathways and does not markedly influence emetic circuits [15]. Ketamine, when used at low induction or analgesic doses, rarely increases PONV, and isoflurane has a more favorable elimination profile and less impact on gastrointestinal motility than halothane [6] [7].

Optimal PONV prevention therefore requires combining pharmacological prophylaxis with dexamethasone (and, when indicated, 5-HT_3 antagonists), careful selection of an aesthetic agents to limit highly emetogenic opioids or volatile agents, and systematic consideration of individual risk factors such as female sex, prior PONV and surgical type [7].

The study's limitations include a small sample size and short inclusion period, which may reduce statistical power to detect additional associations. Real-world anesthesia is inherently multimodal, complicating isolation of individual drug effects, and unmeasured confounders such as patient comorbidities, provider experience and surgical duration can influence outcomes [11] [13]. Larger prospective, randomized trials with longer follow-up and detailed patient-centered assessments are warranted [9].

5. Conclusion

Our findings confirm the pivotal role of dexamethasone prophylaxis in reducing PONV and highlight the importance of selecting less emetogenic anesthetic agents, particularly avoiding halothane when possible and minimizing opioid exposure. Implementing these strategies can enhance postoperative comfort and overall

quality of care in contemporary anesthetic practice.

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We extend our thanks to all the patients who voluntarily agreed to participate in the study.

Ethical Approval

Ethical approval was obtained from the Ethics Committee of the University of Douala, Cameroon (No. 2337 CEI_UDo/02/2024/T) and authorized by the management of Laquintinie Hospital in Douala (No. 487/AR/MINSANTE/DHL).

Consent to Participate

All participants provided informed consent before their inclusion in the study. The consent process ensured that participants fully understood the purpose of the research, their role in the study, and their rights, including the right to withdraw at any time without any negative consequences.

Confidentiality

The privacy and confidentiality of all participants were safeguarded throughout the study. Data were anonymized to ensure that no participant could be identified.

Availability of Data and Materials

The data used in this study can be made available upon request by the reviewers.

Authors' Contributions

NPC, AL, conceptualised the study, designed the experimental approach, and developed the writing plan. NPC, MBJ and ZMJ were responsible for participant recruitment and laboratory analyses. Statistical analysis was performed by, NPC and NTF. NPC, drafted the initial manuscript, while ZMJ and BF critically reviewed and revised it. All authors made substantial, direct, and intellectual contributions to the work and approved the final version of the manuscript for publication.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the author used ChatGPT to translate the manuscript into English. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be interpreted as a potential conflict of interest.

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