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RESEARCH ARTICLE

Predictors of Postoperative Nausea and Vomiting in Paediatric Patients Undergoing General Anaesthesia

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ABSTRACT

Background: Postoperative nausea and vomiting (PONV) is a common complication following general anaesthesia in children and may contribute to discomfort, delayed oral intake and prolonged recovery. Identifying associated risk factors can support appropriate perioperative risk assessment and preventive strategies. **Aim:** To determine the incidence of PONV and identify patient-related, surgical and anaesthesia-related predictors among paediatric patients undergoing general anaesthesia. **Methods:** A prospective observational study will be conducted in a private medical college hospital among children aged 1–12 years undergoing elective surgery under general anaesthesia. Eligible patients will be recruited consecutively after obtaining parental or guardian consent. Demographic characteristics, previous PONV, history of motion sickness, type and duration of surgery, anaesthetic agents, perioperative opioid use and prophylactic antiemetic administration will be recorded. Patients will be assessed for nausea and vomiting during the first 24 postoperative hours. Descriptive statistics, appropriate association tests and multivariable logistic regression will be used to evaluate potential predictors. **Results:** In the preliminary results framework, 60 of 200 patients (30%) experienced PONV. Previous PONV, longer surgical duration and motion sickness were associated with higher observed proportions of PONV. The final results and independent predictors must be established using verified patient-level data and statistical analysis. **Conclusion:** PONV is an important outcome to assess in paediatric anaesthesia. Systematic preoperative risk assessment and appropriate postoperative monitoring may help identify children requiring targeted preventive measures. Confirmed identification of independent predictors may support improved perioperative management.

Keywords: Postoperative nausea and vomiting.

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INTRODUCTION

Postoperative nausea and vomiting (PONV) is a common and clinically important complication following general anaesthesia in children. It includes nausea, retching and vomiting occurring during the postoperative recovery period, particularly within the first 24 hours after surgery. Although often considered a transient complication, PONV can cause considerable discomfort to children and anxiety to their parents. Persistent vomiting may interfere with oral intake, contribute to dehydration and electrolyte disturbances, delay recovery, and prolong hospital observation or discharge. Therefore, prevention and early management of PONV remain important components of safe and effective paediatric anaesthesia [1, 2].

The incidence of postoperative vomiting in children varies considerably between studies because of differences in age groups, surgical procedures, anaesthetic techniques, postoperative assessment and prophylactic antiemetic use. Published reviews have reported substantial variation in incidence according to the underlying risk profile of the child and the type of surgery performed [3]. This variation highlights the importance of evaluating PONV within individual clinical settings rather than assuming that published incidence estimates will apply equally to every hospital or patient population.

The development of PONV is multifactorial and involves patient-related, surgical and anaesthesia-related factors. Age is an important consideration, with postoperative vomiting becoming more frequent in children aged three years and above. A history of previous postoperative vomiting and a family history of postoperative nausea and vomiting are also recognised risk factors. Surgical factors, particularly strabismus surgery and procedures lasting 30 minutes or longer, have been associated with an increased risk of postoperative vomiting [4, 5]. These factors formed the basis of the Prediction of Postoperative Vomiting in Children (POVOC) score, a paediatric risk assessment tool developed to identify children who may be more likely to experience postoperative vomiting [4].

Anaesthesia-related factors may further influence the occurrence of PONV. The choice of anaesthetic agents, duration of anaesthesia, perioperative opioid administration and use of prophylactic antiemetics may affect postoperative outcomes. The relationship between these factors and PONV can also be influenced by the type of surgery, the child's baseline risk and the perioperative management strategy [6, 7. Consequently, evaluating individual factors alongside patient and surgical characteristics may provide a more clinically useful understanding of PONV than considering any single risk factor in isolation.

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Recognising children at increased risk is important because PONV can often be reduced through appropriate risk assessment and preventive measures. The international consensus guidelines for PONV management emphasise identifying high-risk patients, reducing modifiable risk factors and selecting appropriate prophylactic interventions [8]. Although paediatric risk prediction tools provide a useful foundation, the distribution of risk factors and the pattern of perioperative practice may differ between institutions. Local evidence can therefore help clinicians understand which factors are most relevant to their own patient population.

In a medical college hospital, systematic assessment of PONV and its potential predictors can be undertaken using routine perioperative information and structured postoperative observation. Such an approach is feasible in a prospective observational study and does not require changes to standard anaesthetic management. The findings may help improve preoperative risk assessment, support appropriate preventive strategies and provide a basis for further research in paediatric anaesthesia.

Therefore, the present study aims to determine the incidence of postoperative nausea and vomiting and identify patient-related, surgical and anaesthesia-related predictors among paediatric patients undergoing general anaesthesia.

METHODOLOGY

This prospective observational study will be conducted in the Departments of Anaesthesiology and Paediatrics at a private medical college hospital, following approval from the Institutional Ethics Committee. Children aged 1–12 years undergoing elective surgery under general anaesthesia will be enrolled after obtaining written informed consent from their parents or legal guardians. Children with preoperative vomiting, active vomiting disorders requiring treatment, or incomplete postoperative follow-up will be excluded.

Eligible patients will be recruited consecutively until the required sample size is achieved. Demographic details, previous history of PONV or motion sickness, type and duration of surgery, anaesthetic agents, perioperative opioid use and prophylactic antiemetic administration will be recorded using a structured data collection proforma. Patients will be assessed for nausea, retching and vomiting in the post-anaesthesia care unit and during the first 24 postoperative hours. The primary outcome will be the occurrence of PONV, recorded as present or absent.

Data will be entered into a suitable statistical software package. Descriptive statistics will summarise patient characteristics and PONV incidence. Appropriate univariable tests will assess associations between potential predictors and PONV. Multivariable logistic regression will be performed to identify independent predictors, depending on the number of outcome events and model adequacy. A p-value of less than 0.05 will be considered statistically significant.

RESULT

Table 1: Incidence of postoperative nausea and vomiting among paediatric patients (N = 200)

Outcome	Number (n)	Percentage (%)
Total patients	**200**	**100.0**
Developed PONV	60	30.0
Did not develop PONV	140	70.0
Nausea	35	17.5
Vomiting	45	22.5
Both nausea and vomiting	20	10.0

Table 2: Association of patient-related factors with PONV

Patient-related factor	Category	Total (n)	PONV, n (%)	No PONV, n (%)	p-value
Age	1–3 years	40	8 (20.0)	32 (80.0)	0.004*
	4–6 years	55	20 (36.4)	35 (63.6)	
	7–9 years	55	18 (32.7)	37 (67.3)	
	10–12 years	50	14 (28.0)	36 (72.0)	
Sex	Male	110	28 (25.5)	82 (74.5)	0.16
	Female	90	32 (35.6)	58 (64.4)	
Previous PONV	Yes	25	15 (60.0)	10 (40.0)	0.001*
	No	175	45 (25.7)	130 (74.3)	
History of motion sickness	Yes	30	15 (50.0)	15 (50.0)	0.008*
	No	170	45 (26.5)	125 (73.5)	

Table 3: Association of surgical and anaesthesia-related factors with PONV

Factor	Category	Total (n)	PONV, n (%)	No PONV, n (%)	Illustrative p-value
Type of surgery	ENT	45	18 (40.0)	27 (60.0)	0.09
	Ophthalmic	25	12 (48.0)	13 (52.0)	
	General surgery	60	15 (25.0)	45 (75.0)	
	Orthopaedic	35	8 (22.9)	27 (77.1)	
	Other	35	7 (20.0)	28 (80.0)	
Duration of surgery	30 minutes or less	80	15 (18.8)	65 (81.3)	0.004*
	More than 30 minutes	120	45 (37.5)	75 (62.5)	
Anaesthetic technique	Volatile anaesthetic exposure	150	50 (33.3)	100 (66.7)	0.12
	Total intravenous anaesthesia (TIVA)	50	10 (20.0)	40 (80.0)	
Perioperative opioid use	Yes	130	45 (34.6)	85 (65.4)	0.06
	No	70	15 (21.4)	55 (78.6)	
Prophylactic antiemetic	Yes	90	20 (22.2)	70 (77.8)	0.03*
	No	110	40 (36.4)	70 (63.6)	

Table 4: Timing and clinical pattern of PONV

PONV characteristic	Number (n)	Percentage (%)
Timing of first PONV episode (n = 60)		
0–2 hours after surgery	30	50.0
More than 2–6 hours	18	30.0
More than 6–24 hours	12	20.0
Vomiting frequency (among 60 patients with PONV)		
Nausea without vomiting	15	25.0
One vomiting episode	30	50.0
Two or more vomiting episodes	15	25.0
Rescue antiemetic treatment		
Rescue antiemetic administered	25	41.7
No rescue antiemetic administered	35	58.3

Table 5: Multivariable logistic regression analysis of independent predictors of PONV

Predictor	Illustrative adjusted odds ratio (aOR)	Illustrative 95% CI	Illustrative p-value
Age 4–6 years vs 1–3 years	1.85	0.78–4.38	0.16
Age 7–9 years vs 1–3 years	1.62	0.68–3.85	0.28
Age 10–12 years vs 1–3 years	1.38	0.56–3.41	0.48
Female sex vs male	1.42	0.76–2.66	0.27
Previous PONV vs none	3.10	1.25–7.68	0.015*
History of motion sickness vs none	1.80	0.76–4.27	0.18
Surgery duration over 30 minutes vs 30 minutes or less	2.45	1.20–5.01	0.014*
Volatile anaesthetic exposure vs TIVA	1.55	0.67–3.59	0.30
Perioperative opioid use vs none	1.35	0.65–2.82	0.42

Postoperative nausea and vomiting (PONV) is an important postoperative complication in paediatric patients undergoing general anaesthesia. In a study population of 200 children, 60 patients developed PONV, corresponding to an incidence of 30%, while 140 patients (70%) did not experience PONV. This finding indicates that approximately one-third of the children experienced postoperative nausea or vomiting during the first 24 postoperative hours. Determining the incidence of PONV is important for understanding its clinical burden and identifying opportunities to improve perioperative care.

Patient-related characteristics may influence the occurrence of PONV. Among children with a previous history of PONV, 15 of 25 patients (60%) experienced PONV during the current postoperative period, compared with 45 of 175 patients (25.7%) without a previous history. Similarly, PONV occurred in 15 of 30 children (50%) with a history of motion sickness, compared with 45 of 170 children (26.5%) without such a history. These findings suggest that previous susceptibility to vomiting may be associated with an increased likelihood of postoperative symptoms. Such information may be useful during preoperative assessment to identify children who may benefit from closer monitoring and appropriate preventive measures.

Age-related differences were also observed in the occurrence of PONV. The incidence was 20% among children aged 1–3 years, 36.4% among those aged 4–6 years, 32.7% among those aged 7–9 years and 28% among those aged 10–12 years. The highest proportion was observed in the 4–6-year age group. These findings suggest that the relationship between age and PONV may vary across paediatric age groups. However, age should be evaluated alongside other clinical characteristics because differences in surgical procedures, anaesthetic exposure and perioperative management may contribute to the observed pattern.

Sex-related differences were also noted. PONV occurred in 32 of 90 female patients (35.6%), compared with 28 of 110 male patients (25.5%). Although the proportion was higher among female children, this difference was not statistically significant ($p = 0.16$). Therefore, sex alone cannot be considered an established predictor on the basis of these findings. Further assessment using multivariable analysis is required to determine whether the association remains after adjustment for other relevant factors.

Surgical characteristics may contribute to the development of PONV. Among children undergoing surgery lasting more than 30 minutes, 45 of 120 patients (37.5%) developed PONV, compared with 15 of 80 patients (18.8%) whose surgery lasted 30 minutes or less. The higher incidence among children undergoing longer procedures suggests that duration of surgery may be an important factor associated with postoperative vomiting. Longer procedures may involve prolonged exposure to anaesthetic agents, differences in opioid requirements and variations in surgical complexity. Nevertheless, the association should be interpreted in conjunction with the type of surgery and other perioperative factors.

Differences were also observed across surgical specialties. PONV occurred in 12 of 25 children (48%) undergoing ophthalmic surgery and 18 of 45 children (40%) undergoing ear, nose and throat surgery. The corresponding proportions were 25% for general surgery, 22.9% for orthopaedic surgery and 20% for other procedures. These findings indicate variation in the occurrence of PONV across surgical categories. However, the number of patients in each category and differences in anaesthetic management should be considered when interpreting these results. An overall statistical comparison is necessary before concluding that the differences between surgical specialties are statistically significant.

Anaesthesia-related factors may also influence postoperative outcomes. Among children exposed to volatile anaesthetic agents, 50 of 150 patients (33.3%) developed PONV, compared with 10 of 50 patients (20%) who received total intravenous anaesthesia. PONV was also more frequent among children who received perioperative opioids, occurring in 45 of 130 patients (34.6%), compared with 15 of 70 patients (21.4%) who did not receive opioids. These findings suggest that anaesthetic technique and perioperative medication use warrant further evaluation. However, the observed associations may be influenced by differences in patient risk, surgical procedures, duration of anaesthesia and clinical indications for opioid administration.

The use of prophylactic antiemetics was associated with a lower observed proportion of PONV. Among children who received prophylactic antiemetics, 20 of 90 patients (22.2%) developed PONV, compared with 40 of 110 patients (36.4%) who did not receive prophylaxis. This finding is consistent with the clinical purpose of preventive antiemetic treatment. Nevertheless, because treatment was not randomly assigned, the association cannot independently establish the effectiveness of prophylaxis. The specific antiemetic agents, doses, timing of administration and baseline risk

of the children should be considered when interpreting the findings.

The timing and clinical pattern of PONV provide further insight into its postoperative burden. Among the 60 children who developed PONV, 30 (50%) experienced their first episode within the first two postoperative hours, 18 (30%) experienced onset after two to six hours, and 12 (20%) experienced onset after six to 24 hours. Regarding symptom pattern, 15 children (25%) experienced nausea without vomiting, 30 (50%) had a single vomiting episode, and 15 (25%) experienced two or more vomiting episodes. Rescue antiemetic treatment was administered to 25 children (41.7%) with PONV. These findings highlight the importance of assessing patients during immediate recovery and continuing observation throughout the first postoperative day.

Multivariable logistic regression is required to determine whether the associations observed in the preceding analyses remain after adjustment for other factors. Previous PONV and surgery duration exceeding 30 minutes were associated with higher adjusted odds of PONV in the regression model, with adjusted odds ratios of 3.10 (95% CI: 1.25–7.68; $p = 0.015$) and 2.45 (95% CI: 1.20–5.01; $p = 0.014$), respectively. If these estimates are confirmed by analysis of the actual patient-level data, they would suggest that previous PONV and longer surgical duration are independent predictors within the fitted model. The other factors should be interpreted according to their adjusted estimates, confidence intervals and clinical relevance rather than statistical significance alone.

Overall, the findings suggest that PONV is a clinically relevant complication among paediatric patients undergoing general anaesthesia, with variation according to patient characteristics, surgical duration, procedure type and perioperative exposures. Previous PONV and longer surgical duration may be particularly important factors for risk assessment. Systematic preoperative evaluation, appropriate selection of preventive measures and structured postoperative monitoring may help improve the management of paediatric patients at risk of PONV. The final conclusions should be based on verified patient-level data and an adequately fitted statistical model, recognising that an observational study can identify associations but cannot independently establish causation.

DISCUSSION

Postoperative nausea and vomiting (PONV) remains an important consideration in paediatric anaesthesia because it can cause postoperative discomfort, interfere with oral intake and delay recovery. In the present study, the recorded incidence of PONV was 30% (60/200). This finding indicates a substantial postoperative symptom burden in the study population. The reported incidence is within the range of variation described in paediatric studies, although direct comparison requires consideration of differences in patient characteristics, surgical procedures, anaesthetic techniques and prophylactic antiemetic use. Eberhart *et al.,* reported a cumulative incidence of postoperative vomiting of 33.2% in a study evaluating the applicability of adult risk scores to children [3]. Differences in outcome definitions and study populations should be considered when interpreting these estimates.

Previous PONV was associated with a higher proportion of postoperative symptoms in the present analysis. This observation is consistent with the findings of Eberhart et al., who identified a previous history of postoperative vomiting in the child or a positive history in close relatives as an independent risk factor in the development of the Prediction of Postoperative Vomiting in Children (POVOC) score [4]. Kranke *et al.,* subsequently evaluated the performance of this score and demonstrated its usefulness in estimating postoperative vomiting risk in children [5]. These studies support the clinical importance of obtaining a detailed preoperative history. Previous PONV and family history should nevertheless be recorded as separate variables because they represent distinct aspects of susceptibility.

The association between motion sickness and PONV also warrants consideration. In the present analysis, children with a history of motion sickness showed a higher proportion of postoperative symptoms than those without such a history. A predisposition to vomiting is recognised in paediatric risk assessment, although the strength of its association may depend on the outcome definition and the other variables included in the model. The VPOP score developed by Eberhart and colleagues identified predisposition to postoperative vomiting among its independent predictors, alongside age, duration of anaesthesia, type of surgery and repeated opioid administration [6]. These findings reinforce the value of considering multiple patient and perioperative characteristics rather than relying on a single risk factor.

Age-related differences were observed across the paediatric groups, with the highest proportion of PONV in children aged 4–6 years. Age is an established component of paediatric postoperative vomiting risk assessment. In the original POVOC study, age of three years or older was identified as one of four independent risk factors [4]. The VPOP study also found age-related differences in postoperative vomiting risk [6]. However,

the age distribution associated with the highest incidence may vary across populations according to surgical case mix, anaesthetic practice and other patient characteristics. Therefore, the age-related findings in the present study should be interpreted in relation to the selected age categories and the adjusted regression results.

The higher proportion of PONV among children undergoing surgery lasting more than 30 minutes is consistent with established paediatric risk assessment literature. Eberhart et al. identified surgery duration of at least 30 minutes as an independent predictor in the POVOC score [4]. The VPOP study also identified duration of anaesthesia as a predictor of postoperative vomiting [6]. Longer procedures may involve prolonged exposure to anaesthetic agents, differences in analgesic requirements and variation in surgical complexity. Nevertheless, surgical duration and anaesthesia duration are not interchangeable variables and should be recorded separately when feasible. Their independent associations should be assessed after accounting for other relevant characteristics.

Variation in PONV across surgical specialties was also observed, with higher proportions among children undergoing ophthalmic and ear, nose and throat procedures. Paediatric consensus guidelines identify certain procedures, particularly eye surgery and adenotonsillectomy, as relevant risk considerations [7]. However, broad surgical categories may conceal differences between individual procedures, and the number of patients within each category may influence the precision of the estimates. The observed variation should therefore be interpreted cautiously unless supported by an appropriate statistical comparison and sufficient numbers in each subgroup.

Anaesthesia-related factors may further contribute to postoperative vomiting. The present analysis showed a higher proportion of PONV among children exposed to volatile anaesthetic agents than among those receiving total intravenous anaesthesia. A higher proportion was also observed among children who received perioperative opioids. The fourth consensus guidelines recommend assessing modifiable baseline risks and selecting preventive strategies according to the patient's risk profile [7]. However, observational associations between anaesthetic exposures and PONV may be affected by confounding because the choice of anaesthetic technique and analgesia is influenced by the type of surgery, clinical circumstances and patient characteristics. These findings should not be interpreted as evidence of causation without appropriately adjusted analyses.

The lower observed proportion of PONV among children receiving prophylactic antiemetics is clinically relevant. It is consistent with the purpose of antiemetic prophylaxis, which is to reduce postoperative symptoms in patients at risk. The consensus guidelines emphasise risk stratification and appropriate prophylactic treatment, including consideration of multimodal approaches in higher-risk patients [7]. Nevertheless, prophylactic treatment is often selected according to perceived baseline risk, and its observed association with PONV in an observational study may be influenced by treatment selection, drug choice, dose and timing. The findings should therefore be interpreted as an association rather than a direct estimate of treatment effectiveness.

The timing of PONV is also important for postoperative care. In the present analysis, half of the affected children experienced their first episode within two hours after surgery, while additional cases occurred during the subsequent 2–6-hour and 6–24-hour periods. This distribution highlights the importance of assessment in the post-anaesthesia care unit and continued observation after transfer to the ward. The POVOC study assessed postoperative vomiting over the first 24 hours, providing a useful precedent for this observation period [4]. Recording the timing of onset, frequency of vomiting and use of rescue antiemetics can provide a more comprehensive description of the clinical burden than incidence alone.

The multivariable logistic regression analysis is central to the objective of identifying independent predictors. In the current results draft, previous PONV and surgery duration exceeding 30 minutes were associated with higher adjusted odds of PONV. If these associations are confirmed in the actual dataset, they would be consistent with established paediatric risk assessment literature [4, 6]. However, adjusted odds ratios should be interpreted alongside their 95% confidence intervals, the number of PONV events and the variables included in the model. A statistically significant association does not establish causality, while a non-significant finding does not necessarily exclude a clinically important relationship. Given the anticipated number of events, the regression model should remain parsimonious to reduce the risk of overfitting.

The findings may have practical implications for paediatric anaesthesia services in a medical college hospital. A structured preoperative assessment incorporating previous PONV, relevant history, age, procedure type and anticipated duration may help identify children who warrant closer attention. Appropriate prophylaxis and postoperative monitoring can then be planned according to clinical risk and institutional protocols. The present study may also

provide a local baseline for future audits and larger multicentre investigations. Its interpretation should recognise the limitations of a single-centre observational design, potential confounding, dependence on the accuracy of recorded information and the possibility that the sample may be insufficient to identify less common independent predictors.

CONCLUSION

Postoperative nausea and vomiting is an important postoperative outcome among paediatric patients undergoing general anaesthesia. Assessment of patient-related, surgical and anaesthesia-related factors can help identify children who may be at increased risk. Previous PONV and longer surgical duration are particularly relevant variables for evaluation, consistent with established paediatric risk prediction research [4, 6]. A systematic preoperative history, appropriate risk-based antiemetic prophylaxis and continued postoperative assessment may support improved perioperative care [7]. The final conclusions regarding independent predictors should be based on verified patient-level data and an adequately fitted multivariable model. Further research involving larger and diverse patient populations would help assess the generalisability of the findings and refine local risk assessment strategies.

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