(Acta Anaesth. Belg., 2019, 70, 53-60)

The observance of evidence-based guidelines for the prevention of postoperative nausea and vomiting is difficult in daily practice of an academic hospital – a retrospective cohort study

C. C. Dusart (*,#), F. J. Lois (**,#), A. H. Steyaert (*)

Abstract : *Background:* Postoperative nausea and vomiting (PONV) are one of the most frequent side effects after anesthesia. Recent guidelines suggest the systematic preoperative calculation of the simplified Apfel score (AS) and a multimodal prophylactic approach in high-risk patients.

Objectives : Our *primary goal* is to evaluate the use of prophylaxis against PONV in laparoscopic gynaecological surgery patients after the introduction of an algorithm. Our *secondary objectives* are to assess the quality of the AS calculation and the prevalence of PONV after the introduction of the algorithm and, to determine specific risk factors of PONV in our population, in order to improve the prophylactic strategy.

Design and setting : Retrospective cohort study of 252 consecutive female patients scheduled for elective laparoscopic gynecological surgery in a tertiary academic hospital between January and August 2016.

Main outcomes measures: The administered prophylaxis and the observance to the institutional algorithm, the rate of AS calculation in consultation and its quality, the prevalence of early-, late- and 24h-PONV and specific population risk factors of PONV.

Results : Twenty-one percent of patients received the recommended prophylaxis, 1% was over-treated, and 78% were under-treated. AS was recorded for 233 patients (92%). 195 AS (84%) were underestimated because the "postoperative morphine use" item was not checked. The most commonly used drug for prophylaxis was propofol (68%). 26% of patients experienced 24h-PONV. Postoperative morphine use was identified as an independent risk factor for 24h-PONV ($p<0.0001$), early-PONV ($p=0.005$) and late-PONV($p=0.007$). Dose of ketamine ($p=0.01$) was also identified as a risk factor for 24h-PONV.

Conclusions : This study demonstrates the difficulties with the implementation of evidence-based guidelines for the preventive management of PONV in daily practice of a tertiary academic hospital. Further studies are needed to evaluate the role of professional-oriented interventions such as feedback or reminder in improving the implementation of evidence-based medicine.

Keywords : Postoperative nausea or vomiting (PONV) ; evidence-based medicine.

Introduction

Postoperative nausea and vomiting (PONV) are one of the most frequent side effects after anesthesia. The general incidence of vomiting is about 30% and the incidence of nausea is about 50%. In a subset of high-risk patients, the PONV rate can be as high as 80%.(1) This incidence is directly related to risk factors and applied prophylaxis.(2)

The risk for PONV in adults can be estimated with the simplified Apfel score (3), whose items include female gender, non-smoking status, history of PONV or motion sickness and postoperative use of opioids. When 0, 1, 2, 3, and 4 risk factors are present, the corresponding incidence for PONV after halogenated anesthesia is approximately 10%, 20%, 40%, 60%, and 80%, respectively (4). Patients undergoing laparoscopic gynecological surgery (female and frequent postoperative use of opioids) are therefore at moderate to severe risk of PONV. Recent guidelines suggest that patients with an intermediate risk score (simplified Apfel score 2) should receive one or two interventions

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Preliminary results were presented at the 2018 Graduation Day.

Internal Review Board approval : Ethics Committee of the Université catholique de Louvain, Chairperson Prof. JM Maloteaux, n° 2017/10FEV/083. A waiver was obtained for consent.

Paper submitted on Feb 4, 2019 and accepted on Apr 28, 2019.

Conflict of interest : None

and that high-risk patients (simplified Apfel score 3 or greater) should receive more than 2 prophylactic interventions as part of a multimodal approach (1).

In 2012, we introduced the systematic calculation of the simplified Apfel score in our pre-operative consultation. Subsequently, the number of patients receiving prophylaxis doubled (56.8% vs. 25.8%) and the use of antiemetic drugs in the recovery room was reduced by 50% (5). On the basis of these results, we introduced a PONV prophylaxis algorithm in 2014. As efficacy of antiemetic interventions is additive if interventions have different mechanisms (2), we decided to titrate their use according to the Apfel simplified risk score (6).

The *primary goal* of this work is to evaluate the use of prophylaxis against PONV in laparoscopic gynecological surgery patients after the introduction of an institutional algorithm. The *secondary objectives* of this study are to assess the quality of the simplified Apfel score calculation in consultation and the prevalence of early- and late-PONV after the introduction of an algorithm as well as to determine specific risk factors of PONV in our population, in order to improve the prophylactic strategy.

Patients and methods

Study design

This retrospective cohort study included 252 consecutive patients who underwent elective gynecological laparoscopic surgery between January and August 2016 at a tertiary academic hospital. Because of the retrospective nature of the study, a waiver was obtained for informed consent (Ethics Committee of the Université catholique de Louvain, Chairperson Prof. JM Maloteaux, n°2017/10FEV/083).

Patients selection

We selected all the patients scheduled for laparoscopic gynecological surgery in the computerized database of anesthetic protocols using the following queries: date of surgery (between January 1, 2016 and August 31, 2016), followed by the names of gynecological surgeons. We excluded from these patients, patients whose intervention was not performed by laparoscopy on the basis of standardized titles. Finally, we excluded patients who had emergency surgery, as they did not have a standard pre-operative consultation.

Institutional preventive management of PONV

A systematic AS calculation is included in the preoperative consultation. The preoperative consultation consists of a database computerized sheet in which many items are checked and validated. For each item, there is a possibility of writing free comments on the sheet. For the AS, the item female sex is automatically checked on the basis of administrative data. Other items of AS need to be checked in the history (smoking) or directly in the AS tab (postoperative morphine use and motion sickness or history of PONV). The score as well as the percentage of risk is then calculated automatically.

The institutional guidelines for PONV prevention in hospitalized adults are available from the website of the service and are listed in Appendix 1. The cost of treatments has been taken into account during the development of this algorithm.

Variables

Data were retrieved from the computerized database of anesthetic protocols and from the patients' electronic file. Data collected were : demographics, medical history (checked and validated items and free comments), preoperative calculated simplified Apfel score, smoking status, history of PONV or motion sickness, preoperative anxiety, length of surgery, maximal pain score (Numerical Rating Scale – NRS between 0 and 10) in post-anesthesia care unit (PACU), presence of nausea or vomiting in PACU, perioperative drugs and fluids consumption, presence of nausea or vomiting and administered drugs on the ward during the first 24 hours, rehydration time and length of hospital stay.

A simplified Apfel score was systematically re-calculated for all women based on their smoking status, PONV or motion sickness history and the probable use of postoperative morphine.

Nausea and vomiting that occurred in the first 2 postoperative hours were defined as early-PONV and nausea or vomiting that occurred later as late-PONV (7).

Statistical analysis

On the basis of previous data (5), we calculated a sample size of 238 patients to detect an improvement of 15% in our PONV prophylaxis use in gynecological surgery with an alpha of 0.05 and a power of 0.9. We included 252 patients per search facility (month query in the database).

Variables were tested for normal distribution with Shapiro-Wilk test. Data are presented as proportions or median value [interquartile range] as specified. Effects are expressed as relative risk (RR) with 95% confidence interval [95% CI]. A *P*-value smaller than 0.05 was considered significant.

Table 1

General characteristics of patients

	Patients, n=252
Age, years	36 [30,5 to 45]
Weight, Kg	65 [57 to 75]
Non-smoking status	192 (76)
History of PONV	80 (32)
Re-calculated AS **2** **3** **4**	 48 (19) 133 (53) 71 (28)
Length of surgery, min	122 [100 to 150]
Use of sufentanil	110 (43)
Use of continuous infusion of Propofol	171 (68)
Multimodal analgesia	140 (55)
Use of droperidol	35 (14)
Use of dexamethasone	89 (35)
Maximum NRS (0-10) in PACU	5 [4 to 6]
Use of postoperative morphine	220 (87)
Length of PACU stay, min	98 [78 to 116]
Re-hydration delay after PACU discharge, min	240 [150 to 360]
Length of hospital stay, days	2 [2 to 2]

For *univariate analysis*, we compared the characteristics of patients who experienced PONV (early-PONV, late-PONV and 24h-PONV) to those who did not. Qualitative and nominal variables were analysed with chi-2 tests for independence, Fisher exact tests and logistic models. To compare qualitative and ordinal variables, we used Cochran-Armitage tests. Quantitative data were analysed using unpaired Student t-test, Mann-Whitney test and one way-ANOVA.

We then built a *multinomial logistic regression model* to determine independent risk factors for early-PONV, late-PONV and 24h-PONV. The variables kept in the model were variables which were found relevant in the univariate analysis ($p<0.1$) and previously described as risk factors of PONV.

The statistical analysis was performed with JMP version 14.0 (SAS Institute Inc.).

Results

Table 1 lists the general characteristics of the 252 included patients.

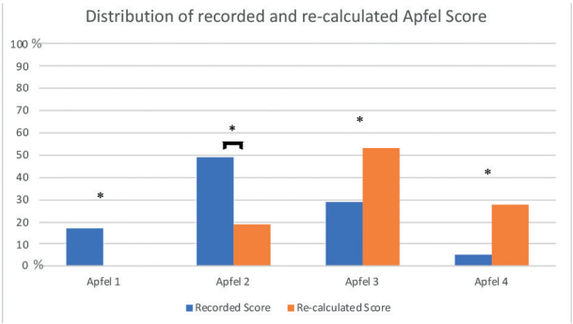

Fig. 1. Distribution of recorded and re-calculated AS.
AS : Apfel Score. * : $p<0.05$.

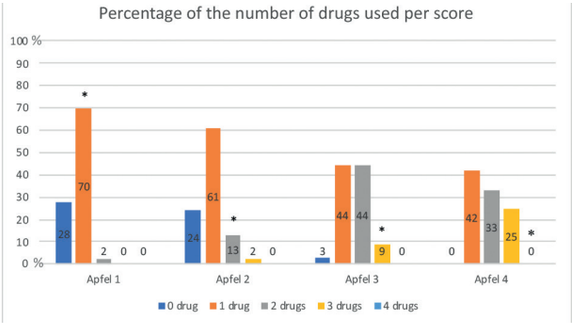

Fig. 2. — Adherence to the PONV prophylaxis algorithm according to the recorded simplified Apfel score.
PONV : postoperative nausea or vomiting. * : respect for algorithm.

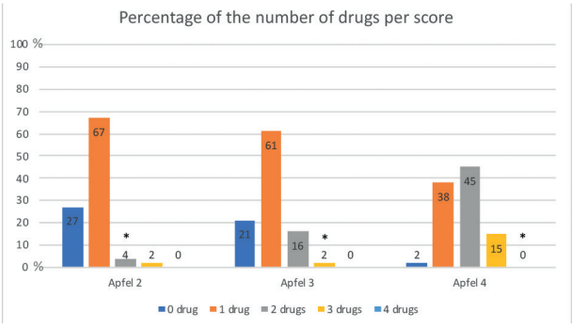

Fig. 3 — Adherence to the PONV prophylaxis algorithm according to the re-calculated simplified Apfel score.
PONV : postoperative nausea or vomiting. * : respect for algorithm.

Quality of the simplified Apfel score calculation

A simplified Apfel score was recorded for 233 patients (92%). Significant differences between recorded Apfel score and re-calculated Apfel score were found for 195 of those patients (84%, $p<0.0001$) (Figure 1). The recorded Apfel score was systematically underestimated because the "postoperative morphine use" item was not checked.

Table 2

Prevalence and treatment of PONV

Early nausea or vomiting (0-2h in PACU)	27 (11)
Rescue treatment in PACU — Alizapride — Ondansetron	 25 (10) 3 (1)
Late nausea or vomiting (2-24h)	47 (19)
Rescue treatment in the ward — Alizapride, n (%) — Ondansetron, n (%)	 12 (5) 6 (2)
Cumulative 0-24h nausea or vomiting, n (%)	66 (26)

Data are presented as numbers (%).

Administered prophylaxis and adherence to the PONV prophylaxis algorithm

Two-hundred and ten patients (83%) received one or more prophylactic drugs. A single drug was used in 140 patients (56%). Two drugs were administered in 55 patients (22%) and three drugs in 15 patients (6%). The most commonly used drug for prophylaxis was propofol in 171 patients (68%). Dexamethasone was prescribed in 90 patients (36%) and droperidol in 36 patients (14%). No patient received ondansetron as prophylaxis.

According to their recorded Apfel score and our institutional PONV prophylaxis algorithm, twenty-one percent of patients received the recommended prophylaxis, one percent was over-treated, and seventy-eight percent of patients were under-treated (Figure 2). Only five patients (2%) received the prophylaxis recommended for their re-calculated Apfel score (Figure 3).

Prevalence of PONV

Sixty-six patients (26%) experienced 24h-PONV. Table 2 presents the distribution of early-

Table 3

Comparison between patients with or without 24h-PONV: Results of the univariate analysis

	PONV + n = 66	**PONV – n = 186**	**Relative Risk [95%CI]**	***P*-value**
Age, years	34.5 [30 to 44]	36.5 [31 to 45]	n.a.	0.71
Weight, kg	64.5 [54 to 73]	65 [58 to 75]	n.a.	0.31
Non-smoking status	51 (77)	141 (76)	1.02 [0.87 to 1.19]	0.81
History of PONV	23 (35)	57 (31)	1.2 [0.67 to 2.19]	0.53
Re-calculated AS			n.a.	0.70
2 3 4	11 (17) 34 (51) 21(32)	37 (20) 99 (53) 50 (27)		
Length of surgery, min	128 [104 to 160]	120 [98 to 142]	n.a.	0.04*
Use of sufentanil	30 (45)	80 (43)	1.05 [0.77 to 1.44]	0.73
Use of continuous infusion of Propofol	43 (65)	128 (69)	0.95 [0.77 to 1.16]	0.58
Use of sevoflurane	25 (38)	66 (35)	1.07 [0.74 to 1.54]	0.73
Use of ketamine	65 (98)	170 (91)	1.07 [1.02 to 1.14]	0.05*
Ketamine dose, mg/kg	0.47 [0.41 to 0.50]	0.45 [0.34 to 0.50]	n.a.	0.04*
Use of clonidine	51 (77)	153 (82)	0.94 [0.81 to 1.09]	0.38
Use of ketorolac	59 (89)	171 (92)	0.97 [0.88 to 1.07]	0.53
Use of magnesium sulfate	51 (77)	139 (75)	1.03 [0.88 to 1.21]	0.68
Multimodal analgesia	36 (54)	104 (56)	0.96 [0.63 to 1.45]	0.84
Use of droperidol	9 (14)	26 (14)	0.98 [0.48 to 1.97]	0.94
Use of dexamethasone	19 (29)	71 (38)	0.76 [0.50 to 1.17]	0.19
Use of one or more prophylaxis	52 (79)	158 (85)	0.93 [0.81 to 1.06]	0.25
Length of PACU stay, min	104 [90 to 120]	95 [75 to 114]	n.a.	0.02*
Maximum NRS (0–10) in PACU	5 [5 to 6]	5 [4 to 6]	n.a.	0.04*
Use of postoperative morphine	66 (100)	154 (83)	1.19 [1.11 to 1.27]	0.0006*
Cumulative dose of morphine, mg/kg	0.1 [0.07 to 0.15]	0.09 [0.04 to 0.14]	n.a.	0.03*
Use of paracetamol in PACU	54 (82)	123 (66)	1.24 [1.06 to 1.44]	0.02*
Re-hydration delay after PACU discharge, min	240 [178 to 360]	240 [143 to 333]	n.a.	0.25
Use of tramadol after PACU discharge	19 (29)	70 (38)	0.76 [0.50 to 1.16]	0.20
Length of hospital stay, days	2 [2 to 3]	2 [2 to 2]	n.a.	0.01*

Data are presented as median [interquartile range], numbers (%) or relative risk [95% confidence interval]. n.a. : not applicable. PONV : postoperative nausea or vomiting. AS : Apfel score. NRS : numerical rating scale. PACU : post-anesthesia care unit. * : significant.

Table 4

Model effects and likelihood-ratio tests

24h-PONV		
Response variables	Chi-2	p-value
Length of surgery	2.665	0.10
Use of ketamine	0.216	0.64
Dose of ketamine	3.406	0.06
Use of postoperative morphine	17.018	<0.0001*
Cumulative dose of morphine	0.004	0.94
Early-PONV		
Response variables	Chi-2	p-value
Use of continuous infusion of Propofol	0.003	0.96
Use of sevoflurane	0.060	0.81
Use of one or more prophylaxis	2.688	0.10
Use of postoperative morphine	7.986	0.005*
Late-PONV		
Response variables	Chi-2	p-value
Length of surgery	3.095	0.08
Dose of ketamine	6.037	0.01*
Use of postoperative morphine	11.442	0.007*
Cumulative dose of morphine	0.056	0.81

* significant

and late-PONV and their treatment. The median time between admission in the PACU and the first episode of early-PONV was 11 [0 to 41] minutes. Median dose of morphine at that time was 2 [0 to 6] mg.

Risks factors of PONV

24h-PONV

Table 3 compares the characteristics of the patients who experienced 24h-PONV (PONV+) to those who did not (PONV–). In *univariate analysis*, factors associated with the occurrence of 24h-PONV were length of surgery (p=0.04), use (p=0.05) and dose (p=0.04) of ketamine, maximum NRS in PACU (p=0.04), use of paracetamol in PACU (p=0.02), and postoperative use (p=0.0006) and dose (p=0.03) of morphine. Patients who experienced 24h-PONV stayed longer in the PACU (p=0.02) and in the hospital (p=0.01). The independent risk factors for 24h-PONV remaining after *logistic regression* was the use of postoperative morphine (p<0.0001) (Table 4).

Early-PONV

In *univariate analysis*, factors that decreased the prevalence of early-PONV were the use of propofol (p=0.02) and the use of a prophylaxis (p=0.006). Factors that increased early-PONV were the use of sevoflurane (p=0.03) or the use of postoperative morphine (p=0.03). The maximum NRS at PACU was higher in patients with early-

Table 5

Comparison between patients with or without early-PONV : Results of the univariate analysis

	PONV + n = 27	**PONV – n = 225**	**Relative Risk [95%CI]**	***P*-value**
Non-smoking status	21 (78)	171 (76)	1.02 [0.82 to 1.27]	0.83
History of PONV	8 (30)	72 (32)	1.03 [0.80 to 1.34]	0.80
Length of surgery, min	121 [92.75 to 150]	120 [100 to 150]	n.a.	0.91
Use of sufentanil	15 (56)	95 (42)	1.31 [0.91 to 1.91]	0.19
Use of continuous infusion of Propofol	13 (48)	158(70)	0.68 [0.46 to 1.02]	0.02*
Use of sevoflurane	15 (56)	76 (34)	1.64 [1.12 to 2.41]	0.03*
Use of ketamine	26 (96)	209 (93)	1.03 [0.95 to 1.12]	0.47
Ketamine dose, mg/kg	0.47 [0.38 to 0.51]	0.45 [0.35 to 0.5]	n.a.	0.31
Multimodal analgesia	13 (48)	127 (56)	0.85 [0.56 to 1.28]	0.41
Use of droperidol	3 (11)	32 (14)	0.78 [0.25 to 2.38]	0.65
Use of dexamethasone	7 (26)	82 (36)	0.71 [0.36 to 1.38]	0.27
Use of one or more prophylaxis	17 (63)	193 (86)	0.73 [0.55 to 0.98]	0.006*
Length of PACU stay, min	100 [90 to 115]	97 [77 to 116.5]	n.a.	0.25
Maximum NRS (0–10) in PACU	5.5 [5 to 6]	5 [4 to 6]	n.a.	0.01*
Use of postoperative morphine	27 (100)	192 (85)	1.17 [1.11 to 1.23]	0.03*
Cumulative dose of morphine, mg/kg	0.10 [0.07 to 0.15]	0.09 [0.04 to 0.14]	n.a.	0.10
Use of paracetamol in PACU	22 (82)	155 (69)	1.86 [0.73 to 4.74]	0.17
Length of hospital stay, days	2 [2 to 3]	2 [2 to 2]	n.a.	0.28

Data are presented as median [interquartile range], numbers (%) or relative risk [95% confidence interval]. n.a. : not applicable. PONV : postoperative nausea or vomiting. NRS : numerical rating scale. PACU : post-anesthesia care unit. * : significant.

Table 6

Comparison between patients with or without late-PONV: Results of the univariate analysis

	PONV + n = 47	PONV – n = 205	Relative Risk [95%CI]	*P*-value
Non-smoking status	36 (76)	156 (76)	1.00 [0.84 to 1.20]	0.94
History of PONV	17 (36)	63 (31)	0.92 [0.73 to 1.16]	0.47
Length of surgery, min	136 [105 to 162]	120 [97.5 to 105]	n.a.	0.009*
Use of sufentanil	18 (38)	92(45)	0.83 [0.57 to 1.26]	0.41
Use of continuous infusion of Propofol	34(72)	137(67)	1.08 [0.88 to 1.32]	0.46
Use of sevoflurane	15 (32)	76 (37)	0.86 [0.54 to 1.36]	0.50
Use of ketamine	46 (98)	189 (92)	1.06 [1.00 to 1.12]	0.11
Ketamine dose, mg/kg	0.47 [0.40 to 0.5]	0.44 [0.34 to 0.5]	n.a.	0.08
Multimodal analgesia	28 (60)	112 (54)	1.09 [0.83 to 1.42]	0.53
Use of droperidol	6 (13)	29 (14)	0.90 [0.39 to 2.05]	0.80
Use of dexamethasone	12 (26)	77 (38)	0.67 [0.40 to 1.14]	0.11
Use of one or more prophylaxis	39 (83)	171 (83)	0.99 [0.86 to 1.15]	0.94
Length of PACU stay, min	109 [90 to 122]	96 [76 to 114]	n.a.	0.02*
Maximum NRS (0–10) in PACU	5 [4.75 to 6]	5 [4 to 6]	n.a.	0.11
Use of postoperative morphine	47 (100)	172 (84)	1.19 [1.12 to 1.26]	0.003*
Cumulative dose of morphine, mg/kg	0.10 [0.06 to 0.16]	0.09 [0.05 to 0.14]	n.a.	0.07
Use of paracetamol in PACU	38 (81)	139 (68)	1.19 [1.01 to 1.41]	0.07
Length of hospital stay, days	2 [2 to 3]	2 [2 to 2]	n.a.	0.02*

Data are presented as median [interquartile range], numbers (%) or relative risk [95% confidence interval]. n.a.: not applicable. PONV: postoperative nausea or vomiting. NRS: numerical rating scale. PACU: post-anesthesia care unit. *: significant.

PONV(p=0.01) (Table 5). *Logistic regression* identified the use of postoperative morphine (p=0.005) as an independent risk factor for early-PONV (Table 4).

Late-PONV

In univariate analysis, predictive factors of late-PONV were length of surgery (p=0.009) and use of postoperative morphine (p=0.003) (Table 6). The duration of surgery and the duration of PACU stay (p=0.02) were shorter in patients without late-PONV. The length of hospital stay was longer in patients with late-PONV (p=0.02). *In logistic regression*, the use of postoperative morphine (p=0.007) and the dose of ketamine (p=0.01) were identified as independent risk factors (Table 4).

Discussion

This retrospective study demonstrates that the use of a prophylaxis algorithm is problematic in a tertiary academic hospital, as only 21% of patients received the prophylaxis recommended by institutional guidelines. The level of calculation of AS in consultation was high, but the quality of the calculation was poor. Despite this, the prevalence of PONV was relatively low (26%) in our high-risk population. Unsurprisingly, we found the use of postoperative morphine as risk factor of PONV but also the dose of ketamine as a risk factor of late-PONV.

Previous studies have shown that several factors can influence the adherence to recommendations over time. First, professional-oriented interventions (education, reminders, feedback) are particularly important (8). An initial lecture was given to all practitioners. However, the guidelines were not regularly recalled. In addition, no regular feedback was given to practitioners regarding adverse events in the postoperative period. Secondly, the practitioner's personal beliefs about the effectiveness of the treatment is known to curb the implementation of guidelines. It is not excluded that an anesthesiologist regularly taking care of gynecological patients has not been convinced of their usefulness. Therefore, it will be important to organize more professional-oriented interventions such as regular feedbacks of adverse events or reminder of guidelines.

The quality of the calculation of AS was very low. The systematic error in the calculation was due to an underestimation of the postoperative use of morphine. This is of particular interest because postoperative morphine use was found as a risk factor of PONV in our - population. A first

explanation to the no-check of morphine use is a lack of time during the consultation to complete the score. A second explanation is ignorance of the level of pain intensity after gynecological laparoscopic surgery by 1st or 2nd year residents performing consultations. Finally, the explanation could be the misunderstanding of the Apfel score tool. Indeed, some residents interpret the item "postoperative morphine use" as an element of past medical history and not as a high probability of use after the scheduled surgery. Because a correct calculation is the first step towards correct patient management, it seems very important to train 1st and 2nd years residents to the use of simplified Apfel score.

Our prevalence of PONV is relatively low (26%), even if our patients combine many factors associated with a high risk of PONV, e.g. female sex, use of postoperative morphine, and young age. This could be explained by the frequent use of an anesthetic regimen based on continuous infusion of propofol associated to a multimodal analgesia, with no or limited use of intraoperative opioids, which is recommended in some guidelines in order to reduce PONV(1). Indeed, use of propofol is associated with a 20% reduction in the risk of PONV (2). Moreover, opioid-free anesthesia (OFA) has been associated to with a large reduction in relative risk of PONV compared with balanced anesthesia after bariatric surgery (9). Finally, multimodal analgesia can reduced the baseline risk for PONV by minimizing postoperative opioids(1).

Not surprisingly, we found the use of postoperative morphine as a risk factor. In contrast, we found no difference between patients with and without PONV with respect to smoking status or history of PONV or motion sickness. Indeed, all items in the Apfel score have not the same relevance. For example, female gender is the strongest patient-specific predictor (OR 2.57 (95% CI, 2.32 to 2.84) (13), but our patients were exclusively female.

The dose of ketamine was also found as a risk factor for late-PONV in our population. This was somewhat unexpected, because ketamine is known to reduce PONV when used in a multimodal approach reducing postoperative opioids use (10). Nevertheless, Song et al. found an increase in the intensity of nausea in a study of 50 women undergoing lumbar surgery. The increase in nausea could be explained by the fact that ketamine inhibits the reuptake of serotonin at the terminal synapses (11). This would explain why the increase of the administered dose would be a risk factor in our population. In patients at high-risk for PONV, it would therefore be careful to limit the dose of ketamine administered as part of multimodal analgesia, to improve analgesia without increasing the risk for NVPO (12).

Major limitations to this work are linked to the retrospective design of the study. Nevertheless, all data have been encoded prospectively in the computerized database of anesthetic protocol, which limits the missing or potentially erroneous data.

Conclusions

This study demonstrates the difficulties with the implementation of evidenced-based guidelines for preventive management of PONV in daily practice of a tertiary academic hospital.

This study also highlights the importance of the multimodal approach of prevention of PONV, e.g. OFA or multimodal analgesia - as a mean to reduce the risk of PONV, even though a particular attention should be paid in the choice and doses of drugs administered as part of a multimodal analgesia, for example for the dose of ketamine, to achieve beneficial analgesic effects while limiting side effects.

Further studies are needed to evaluate the interest of professional-oriented interventions such as regular feedbacks of adverse events or reminder of guidelines in improving the implementation of evidence-based recommendations.

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Appendix 1

Institutional preventive management of PONV