

FACTORS THAT INFLUENCE POSTOPERATIVE VOMITING*

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WE ARE ALL familiar with the observation that when two patients undergo the same operation, one may vomit repeatedly, while the other may not even be nauseated. Much interest has centred around the reasons underlying these differences, since many anaesthetists and surgeons are reluctant to give powerful anti-emetic drugs unnecessarily to patients who may not have vomited without them.¹ If we could forecast accurately which of our patients would vomit postoperatively, and how severe the symptoms would be, then the unjustified risk of routine anti-emetic drugs could be avoided.² However desirable it might be to the statistician or medical theorist, it is unlikely that such accuracy in prediction will ever be achieved, fortunately for all of us, people are different.

What we can do, following the lead of life insurance companies, is to pick out certain groups of patients in whom the incidence of nausea and vomiting postoperatively is likely to be higher than that of the general population, and by careful assessment, to decide which of the patients in these high-risk groups are most likely to be troubled by symptoms. These patients may then justifiably be given a prophylactic injection of an anti-emetic drug.

The anatomy³ and physiology⁴ of vomiting and the pharmacology of many of the anti-emetic drugs have been ably reviewed by others.^{4, 5, 6} The purpose of this paper is to review the factors reported to influence the incidence and severity of postoperative nausea and vomiting, and to present observations, made during the course of a comparative survey of four anti-emetic drugs, concerning the influence of these factors. The effects of these drugs, methods of observation, and criteria used have been reported elsewhere.⁷ It should be stressed that the method selected a standard premedication (meperidine 50–100 mg and atropine 0.2–0.6 mg) and ten representative surgical operations, drugs and anaesthetics were allocated to patients to achieve an even distribution of variables between groups. This method resulted in the selection of a higher than average ratio of female to male patients in order to provide a greater challenge to the anti-emetic drugs. The observations reported here deal with 1713 patients in this survey who received the standard premedication, and only one injection of an anti-emetic drug during the postoperative period.

For convenience of presentation, the factors reported to influence the incidence of postoperative vomiting are considered under the following headings: (1) those varying with the patient, (2) those in connection with the anaesthetic, (3) those concerned with the operation, and (4) those related to the postoperative period.

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TABLE I
INCIDENCE OF POSTOPERATIVE NAUSEA AND VOMITING IN DIFFERENT AGE GROUPS REPORTED BY DIFFERENT AUTHORS

Age group	Belleville <i>et al</i> (1960) ¹³		Bonica <i>et al</i> (1959) ¹⁰	Burtles & Peckett (1957) ⁹	Coppolino & Wallace (1962) ¹² (placebo group)	Knapp & Beecher (1956) ¹¹ (placebo group)	Smessaert <i>et al</i> (1959) ⁸	Present report, observations in 1713 patients
	Males	Females						
0-9			9 2	53 9			35 5	} 35 6
10-19	14 3	16 3	25 4	45 6	13 2	88	45 3	
20-29	6 1	8 2	21 1	28 4	11 1	80	26 9	
30-39	6 4	12 6	28 9					
40-49	3 5	14 6	30 5	21 9	11 3	78	20 0	
50-59	3 7	13 5	39 4					
60-69	3 1	14 2	33 0	} 40	7 1	88	15 0	
70-79	2 5	6 3	28 5					
80+		8 3						

FACTORS VARYING WITH THE PATIENT

1 Age

The percentage incidence of emetic symptoms in different age groups found by various authors, together with the observations in the 1713 patients surveyed, is shown in Table I. Of the 1713 patients, 177 were in the 0-19 year age group, with an incidence of emetic symptoms of 35.6 per cent, 653 patients were in the 20-39 year age group and 25.1 per cent showed the emetic symptoms of nausea, retching, or vomiting. In the 40-59 year age group, comprising 621 patients, 32.2 per cent showed emetic symptoms, while in the group who were over 60, 29.3 per cent of 256 patients had these symptoms.

This finding of a high incidence in the youngest age group is in agreement with the work of others,^{8,9,12,13} who have concluded that the incidence of nausea and vomiting is greatest in children and adolescents, and subsequently decreases with increasing age. The increased liability of children to vomiting has been attributed to the more frequent use of deep ether anaesthesia, and to the fact that tonsillectomy is the commonest operation in this age group.⁹ However, the choice of agent or depth of anaesthesia may not be the main factor producing the high incidence in this group, since the majority of the 177 children and adolescents in the present survey received a light halothane anaesthetic, a technique associated with a low incidence of emesis in other age groups.

The rise in incidence noted in the 40-59 year age group of the present survey, and also noted by other workers,^{7,10,11} is probably a result of the selection of operations affecting mainly female patients in this age group, since sex greatly influences the incidence of emetic symptoms.

2 Sex

All investigators have found an increased incidence in the adult female as compared with the male. Though originally ascribed to psychological factors,¹¹ this increased susceptibility may be due to variations in gonadotrophin levels. Belleville^{6,13} found an increased incidence of nausea and vomiting when female patients were in the third or fourth week of the menstrual cycle at the time of operation. The incidence remained high in postmenopausal and castrated women, where high gonadotrophin levels would be expected, but fell in women over 70, with low gonadotrophin levels, until it equalled that occurring in men. As supporting evidence of this theory, he cites the high gonadotrophin levels found in hyperemesis gravidarum, and the occurrence of nausea following orally administered oestrogens. He found the average incidence to be about twice that seen in men, whereas others have found incidences varying from one and one-half^{9,10,12} to three¹⁴ times greater for women than men.

Smessaert⁸ found the incidence equal in children of both sexes, until the age of 11, when female children began to show a tendency to vomit more than males.

In the 1713 patients of the present survey, 1276 were females and 437 were males. Emetic symptoms occurred in 25.8 per cent of female patients and in 13.3 per cent of male patients during the first six postoperative hours, while over the first 24-hour period the incidence of symptoms in females was 33.2 per cent

compared to an incidence of 17.8 per cent in the male. These differences are highly significant ($p < 0.01$).

To compare the severity of symptoms between patients, points were allotted for each episode of nausea or vomiting; the total points scored over a given period is the emesis score for that patient. The average emesis scores of men and women differ significantly ($p < 0.01$), rising from 0.99 in the first 6 hours to 1.48 in 24 hours in the female, as compared to scores of 0.41 in 6 hours and 0.65 in 24 hours for the male.

These findings, summarized in Table II, show that nausea, retching, and vomiting in these patients was slightly less than twice as common in women than in men, but more than twice as severe.

TABLE II
THE INCIDENCE AND SEVERITY OF NAUSEA AND VOMITING IN MALES AND FEMALES
IN A SERIES OF 1713 PATIENTS

Sex	Number of patients	15 min - 6 hr period		15 min - 24 hr period	
		% patients with symptoms	Average emesis score	% patients with symptoms	Average emesis score
Males	437	13.3	0.41	17.8	0.65
Females	1276	25.8*	0.99*	33.2*	1.48*

*Significantly different from males ($p < 0.01$)

3 Body Structure

Short, thick-set patients vomited more than tall and thin types in the study carried out by Smessaert *et al.*,⁸ but the differences did not reach statistical significance. Significant differences were found by Belleville, Bross, and Howland¹³ between obese and thin patients, who suggested that these findings might be explained by the greater amounts of anaesthetic required by the obese patients.

4 Predisposition or Conditioning

Armer, in 1952,¹⁵ reported that patients with a history of motion sickness showed significantly more postanaesthetic vomiting than those with no such history. Male patients giving a history of previous postanaesthetic vomiting were found by Robbie in 1959¹⁶ to show a higher incidence of symptoms than those who had not previously vomited after anaesthesia, but no significant differences could be detected in female patients.

The 1713 patients of the present survey were visited 24-48 hours after anaesthesia, and questioned about their experiences with the present and previous anaesthetics. Of 1015 patients who had experienced anaesthesia previously, 476 had no emetic symptoms previously, and 539 remembered nausea or emesis (Table III). These 539 patients with previous symptoms showed a much higher incidence of nausea and vomiting with the present anaesthetic (32.3% in 6 hours and 42.7% in 24 hours) than did the 439 patients with no previous emesis.

TABLE III

PREDISPOSITION TO POSTANAESTHETIC VOMITING

Results of a survey of emetic symptoms with previous anaesthesia in 1713 patients compared with the observed incidence following a subsequent anaesthetic

	Number of patients	15 min - 6 hr period		15 min - 24 hr period	
		Number vomited	% vomited	Number vomited	% vomited
No vomiting with previous anaesthetic	476	54	11.3	68	14.3
Vomited with previous anaesthetic	539	174**	32.3	230*	42.7
No previous anaesthetic	570	134	23.6	172	30.2
Could not remember	33	7	21.2	12	36.4
Not questioned	95	18	18.9	20	21.0

*Significantly different ($p < 0.01$) from patients with no previous anaesthetic vomiting

**Significantly different ($p < 0.05$) from patients with no previous anaesthetic vomiting

(11.3% in 6 hours and 14.3% in 24 hours) The differences in the 24-hour period are highly significant ($p < 0.01$), but are less obvious ($p < 0.05$) when the observation period is restricted to a 6-hour period. This finding may explain why Riding in 1963,¹⁷ confining his observations to a 6-hour period, was unable to demonstrate this relationship between previous anaesthetic vomiting and a tendency to increased postanaesthetic vomiting.

Although no separate analysis has been made in the present survey concerning this relationship in women, the 3:1 preponderance of female to male patients in this survey indicates that predisposition, as shown by a history of previous anaesthetic vomiting, is a valid factor in female patients as well as in males.

5 Diseased States

Any condition which causes the patient to be nauseated or to vomit before anaesthesia will, unless relieved by the operation, tend to continue to produce symptoms postoperatively. Such conditions as uraemia, ketosis, or electrolyte or fluid imbalance, occurring in the course of renal failure, diabetes, or intestinal obstruction will increase the likelihood of postoperative vomiting. In any assessment of the effect of drugs or anaesthetics upon postoperative vomiting, these patients should be excluded.¹⁸

ANAESTHETIC FACTORS

1 Preparation

Bodman, Morton, and Thomas¹⁹ found a higher incidence of vomiting in accident or emergency cases compared with elective cases among unpremedicated outpatients anaesthetized with nitrous oxide-oxygen. All of their patients were made to wait at least four hours after the last meal before being anaesthetized, and yet solid vomitus, in greater amounts, occurred more commonly in accident cases. These findings emphasize the need for caution in the use of general anaesthesia for emergency cases.

2 Premedication

The possibility that drugs given preoperatively could affect the incidence of postoperative vomiting has been largely ignored until recent years. Many investigations into anti-emetic drugs have grouped together patients receiving many different kinds of preoperative medication,^{9, 10, 12, 13} and some have failed to mention which premedications were used.^{2, 8}

Morphine has long been known to cause nausea and vomiting, and narcotic depression can last many hours, extending into the postoperative period.^{20, 21}

Phillips *et al* (1958)²² noted an incidence of nausea and vomiting of 48 per cent in their placebo group, of women premedicated with morphine and atropine, and undergoing minor perineal procedures under a standard anaesthetic sequence. In a later study,²³ using similar methods, but omitting morphine in the premedication, the incidence fell to 18.5 per cent. This effect of morphine was confirmed in a beautifully controlled study by Riding (1960),²⁴ in women subjected to uterine curettage under thiopentone-nitrous oxide-oxygen anaesthesia.

Without any medication, 22.4 per cent of patients showed nausea, retching, or vomiting, but when morphine was given preoperatively, the number of patients affected increased, with increasing doses, up to 67 per cent.

Combining increasing doses of atropine with morphine, however, reduced the incidence to 37 per cent, suggesting that atropine had an anti-emetic effect. This was confirmed by giving atropine alone, which resulted in a fall in incidence from 22.4 per cent in the unpremedicated patient to 11.5 in the patient receiving atropine. Hyoscine and 1-hyoscyamine were as effective as atropine when given alone, but were more effective than atropine in reducing the nausea and vomiting produced by morphine.

The addition of meperidine to the preoperative atropine also increases the incidence of nausea and vomiting as demonstrated in a controlled study carried out by Dundee, Nicholl and Moore (1962).¹⁸

The relationship of morphine, papaveratum, and meperidine to one another in the production of postoperative vomiting has yet to be established. Burtles and Peckett (1957)⁹ found a higher incidence with morphine and papaveratum than with meperidine, as did Feldman (1963)²⁵ in a comparison of four premedications. However, figures reported by Robbie¹⁶ show an incidence of 37 per cent in female patients receiving pethidine and atropine or hyoscine compared with 23.6 per cent in female patients receiving papaveratum or morphine. Belleville (1961)⁶ also found more vomiting with meperidine than with morphine, and suggested that the incidence may vary with the dose of meperidine, the optimum dose for minimal emetic symptoms being 1 mg/kg.

Certainly most preoperative narcotics tend to cause increased postoperative nausea, and the omission of narcotics,²⁶ or their substitution by barbiturates²⁷ or phenothiazines²⁸ has been advocated. Where this has been tried, vomiting has been reduced, but postoperative restlessness has been a problem,²⁶ leading to the reintroduction of narcotics in some instances.²⁹

3 Induction Agents

The use of intravenous agents for induction reduces emetic symptoms.³⁰ A comparison of thiopentone, methohexital, and another induction agent (G29 505)

indicated a higher incidence of emetic symptoms with thiopentone³¹ However, another controlled study³² showed a significantly higher incidence using methohexital compared with thiopentone when given to patients premedicated with pethidine-atropine

4 *Anaesthetic Agents*

The incidence of nausea and vomiting with various anaesthetic agents reported by different authors cannot be compared, since each group of authors used different criteria and different population groups However, the results of some investigators^{6 8 9 10,12 14 17 33 34,35} are shown together in Table VI and the trend for the various anaesthetics may be followed in each column, and appears similar Thus, where ether and cyclopropane are used as the main agent, the incidence is much higher than that for nitrous oxide alone Again, where thiopentone is used alone the incidence is low, rising with the addition of nitrous oxide, and further with the addition of trichlorethylene, narcotics, or cyclopropane The addition of both trichlorethylene and narcotic produces more nausea and vomiting than the addition of ether

There have been few reports on the relative incidence of vomiting after administration of halothane Some authors feel that the addition of halothane to a thiopentone-nitrous oxide-oxygen anaesthetic is followed by a slight but definite increase in emesis^{29 36} However, an anti-emetic effect of halothane has recently been postulated to explain the reduction in vomiting after trichlorethylene anaesthesia produced by a brief exposure to halothane³⁷

The 1713 patients in the present survey received one of four main anaesthetic agents nitrous oxide-oxygen \pm narcotic, nitrous oxide-oxygen-halothane, nitrous oxide-oxygen-ether, or cyclopropane-oxygen

When a comparison is made of the incidence of emesis observed with the various anaesthetics (Table V) the agents fall into two groups Cyclopropane and ether comprise a high-incidence group, where 25 per cent of the patients vomited during the first 6 hours, while nitrous oxide as a main agent and halothane fall into a low-incidence group with approximately 20 per cent of patients vomiting in the first 6 hours The two groups differ significantly ($p < 0.05$) over the first 6 hours, but, perhaps because of the waning influence of anaesthesia and the increasing influence of postoperative analgesic drugs, these differences become less marked when the whole of the first 24-hour period is considered No substantial difference could be detected between nitrous oxide-oxygen, supplemented in some instances by narcotics, and the nitrous oxide-oxygen-halothane technique

Where severity of symptoms is concerned (Table V) two groups again emerge, the average emesis score for halothane being 0.70 and for nitrous oxide being 0.80 as compared to average scores of 1.00 for cyclopropane and 0.96 for ether during the first 6 hours after operation Unlike the incidence, the differences in severity ($p < 0.05$) are maintained when the first 24-hour period is considered

5 *Duration of Anaesthesia*

Adults undergoing plastic surgery of the head and neck in 1945 were observed by Smith³⁸ to show a rising incidence of postoperative vomiting with increasing

TABLE IV
INCIDENCE OF EMETIC SYMPTOMS IN PATIENTS TO ANAESTHESIA REPORTED BY VARIOUS AUTHORS

Anaesthetic agent or technique	Belleville (1961), ⁶ % patients with N R & V *	Bonica <i>et al</i> (1959), ¹⁰ % patients with N R & V	Burtles & Peckett (1957), ⁹ % patients with V	Coppolino & Wallace (1962), ¹² % patients with N & V	Dent <i>et al</i> (1955), ²³ % patients with R & V	Howat (1960), ¹⁴ % patients with N R & V	Moore <i>et al</i> (1958), ²⁴ % patients with N R & V	Riding (1963), ¹⁷ % patients with N R & V	Smessaert (1939), ⁸ % patients with N R & V	Waters (1956), ²⁵ % patients with V
1 ±Thiop N ₂ O/O ₂	—	—	—	—	—	—	—	—	—	—
Cyclopropane-ether	16.5	64.2	33.4	34.3	38.5	—	30.6	35	32	56.5
Ether	26.0	55.6	23.9	8.0	34.6	—	27.3	—	23.3	39.0
Cyclopropane	—	—	46.3	—	—	54.9	—	—	—	—
Trichlorethylene-narcotic	—	43.8	29.5	—	—	43.9	—	—	—	—
Narcotic	—	—	26.1	—	—	41.3	—	7.5	—	—
Trichlorethylene	—	—	28.0†	—	—	35.8	—	5.0	—	—
Halothane	—	—	—	3.4	—	—	—	—	—	—
2 N ₂ O/O ₂ alone	—	—	—	—	—	—	—	—	—	23
3 Thiop N ₂ O/O ₂	14.0	14.5	18.3	10.0	—	32.1	20.6	—	—	—
Thiop alone	—	8.3	—	—	20.1	—	11.1	—	—	—
4 Spinal	—	21.1	—	—	11.1	—	19.3	—	—	—
5 Regional	—	21.7	—	12.8	4.3	—	—	—	—	—

*N = nausea, R = retching, V = vomiting.

†Burtles (1960)²⁶

TABLE V
THE EFFECT OF ANAESTHETIC AGENT ON THE INCIDENCE AND SEVERITY OF
POSTOPERATIVE VOMITING IN 1713 PATIENTS

Anaesthetic agent	Number of patients	15 min - 6 hr period		15 min - 24 hr period	
		% vomited	Mean emesis score	% vomited	Mean emesis score
Thiop N ₂ O/O ₂ ± narcotic	241	20.3*	0.80*	25.7	1.00*
Thiop N ₂ O/O ₂ halothane	717	19.9*	0.70*	26.8	1.14*
Thiop cyclopropane	507	25.8	1.00	32.3	1.47
Thiop. N ₂ O/O ₂ ether	248	25.8	0.96	33.9	1.49

*Significantly different from cyclopropane and ether ($p < 0.05$)

duration of anaesthesia up to three hours. All these patients received a narcotic premedication, thiopentone induction, and were maintained with nitrous oxide and oxygen. A few patients received supplementary cyclopropane or ether to maintain them in first-plane anaesthesia. The rise in incidence with increasing duration was even more evident in those patients receiving supplements.

Bodman *et al* (1960)¹⁹ have shown that each minute of nitrous oxide-oxygen anaesthesia is important, the incidence of postoperative vomiting in their series rose from 5 per cent after 1 minute of anaesthesia to 48 per cent for anaesthesia over 6 minutes. It may be thought that anoxia might have been a contributing factor in the longer anaesthetics, but increased symptoms were found by Dundee *et al*¹⁸ to occur even where an intravenous induction preceded the nitrous oxide-oxygen, there being significantly more emesis with anaesthesia of over 12 minutes' duration than with anaesthesia of less than 7 minutes.

Where respiration is controlled, and a thiopentone-nitrous oxide-oxygen relaxant technique is used, however, the duration of anaesthesia up to three hours has little effect.³⁹

Where more potent inhalational agents are involved, Belleville *et al* (1960)¹³ found significant increases in vomiting with increasing duration of anaesthesia in women anaesthetized with cyclopropane for up to three hours. Similar trends were noted with ether, and by other authors with a variety of anaesthetic agents,⁹ including halothane.³⁶ Knapp and Beecher (1955)¹¹ were unable to demonstrate a relationship of duration to symptoms with ether anaesthesia, but the majority of their anaesthetics lasted from three to five hours, and 82 per cent of their patients had symptoms.

The capacity of the body tissues to absorb nitrous oxide is saturated in the first 30 minutes of anaesthesia, but there is an almost infinite capacity to absorb anaesthetic concentrations of ether, cyclopropane,⁴⁰ and probably halothane. Evidently the greater the mass of anaesthetic agent absorbed, the greater the tendency to emetic symptoms. A dose-response relationship has been postulated by Belleville (1961)⁶ to explain some incidental findings noted in his own series and in those of other investigators, namely a decreased incidence of emetic symptoms

(a) where endotracheal tubes are used,

(b) where experienced anaesthetists give the anaesthetic and not the inexperienced,

(c) where muscle relaxants are used,

(d) where light levels of anaesthesia are used,

(e) in extra-abdominal procedures,

(f) in thin patients as opposed to obese patients,

since all these factors tend to decrease the total amount of anaesthetic agent absorbed by the patient

6 Anaesthetic Adjuvants

Vomiting may follow hypertension accidentally produced by vasopressors, including oxytocic drugs such as pitocin and ergometrine¹⁰ Anticholinesterase drugs such as neostigmine and edrophonium, used to reverse a curare-like block at the end of anaesthesia, are often followed by signs of vagal stimulation, including salivation, nausea, retching, and vomiting

FACTORS DEPENDENT UPON THE OPERATION

It is important to realize that each operation is performed for certain indications, which are symptoms occurring at certain stages of a disease. These indications will select certain age groups of the population, and the proportion of males to females in these selected groups will remain relatively constant. By contrast, similar operations performed for different indications do not necessarily affect the same age group, and may therefore have different incidences of nausea and vomiting.⁴¹ Riding (1960)⁴² had drawn attention to the different age distributions in patients undergoing the operation of dilatation and curettage in comparison with those undergoing evacuation of retained products, and has shown that these two groups differ in the percentage incidence of emetic symptoms.

It is therefore evident that it is not justifiable to pool the data from several operations in considering the influence of operative site on postoperative vomiting. Nor is it justifiable, in view of the influence that age and anaesthetic agents may have upon incidence, to pool the results where different techniques or agents are used for different age groups. Burtles and Peckett (1957)⁹ recognized that selection of deeper ether anaesthesia for children undergoing tonsilectomy had influenced the greater incidence seen in this group as compared with adults undergoing dental extractions.

Since both pooled operation data and observations from groups receiving particular anaesthetic agents for certain operations form the basis of most reports in the literature, it is not surprising that there is little agreement between investigators concerning all except the last of the following factors

1 Site of operation

Dent *et al* (1955)³³ found significant differences in incidence of postoperative vomiting in head and neck operations (38%) compared with intra-abdominal (30%) and extra-abdominal (21%) procedures. A high incidence in head and

neck operations was also found by Smessaert *et al* (1959)⁸ and in fenestration and eye operations by Burtles and Peckett (1957)⁹. Neither these investigators, nor Knapp and Beecher (1956),¹¹ could confirm the higher incidence found in intra-abdominal in comparison with the extra-abdominal procedures, by Dent *et al* (1955),³³ but the findings of this latter group are supported by Bonica and his associates (1959),¹⁰ and by Belleville, Bross, and Howland (1960)¹³

In the 1713 patients of the present survey, the distribution of different anaesthetics in each of the control and treated groups undergoing ten selected operations was kept constant. While attention is directed to differences between each operation (Table VI), it can be seen that all the intra-abdominal procedures showed a higher incidence of vomiting than the extra-abdominal procedures, and that this difference holds true for those operations confined almost entirely to one sex (e.g. vaginal and abdominal hysterectomies compared with D and C or breast operations). Further, this difference is maintained in comparing operations with a similar sex distribution but different duration e.g., the duration of operation for appendectomy is shorter than for varicose veins, but the incidence of vomiting is higher. These findings therefore support the contention that intra-abdominal procedures produce more emetic symptoms in more patients than extra-abdominal procedures.

2 *Position of the Patient*

The highest incidence of postoperative nausea and vomiting was observed by Burtles and Peckett (1957)⁹ to occur in patients operated upon in the reverse Trendelenburg position, whereas their lowest observed incidence was in operations in the lithotomy position. It is evident that the incidence of emetic symptoms noted with any one operative position will be the average of symptoms observed in all the operations performed in this position. Hence, these investigators noted a higher than average incidence in fenestrations, eye operations, and thyroidectomies, customarily performed in the reverse Trendelenburg position, and a lower than average incidence in genitourinary procedures, customarily performed in the lithotomy position.

It would appear that the influences of position and operation on postoperative vomiting are interdependent, and should not be considered separately, except for an alternative position for the same operation.

3 *Hypotension during the Operation*

An increased incidence of postoperative vomiting was found by Belleville, Bross, and Howland (1960)¹³ following hypotensive episodes both in the operating room and in the recovery room. Although Coppolino and Wallace (1962)¹² noted a differing incidence of hypotension with various anaesthetics, they found a lowered incidence of nausea and vomiting in those patients who had been hypotensive.

Of the 1713 patients surveyed, data on hypotension was recorded in 1706 patients in the operating room and 1672 patients in the recovery room (Table VII).

In the operating room, the groups showing marked hypotension (a 30–40% fall,

TABLE VI

THE EFFECT OF OPERATION ON POSTOPERATIVE NAUSEA AND VOMITING
 Indicating the commonest age group of patients and the sex distribution found in each operation
 (1713 patients treated with no medication, or one of four anti-emetic drugs)

Operation	Peak age incidence	Group receiving no anti-emetic			All patients (treated and untreated)		
		Number of patients	Number and % of males	% patients with symptoms 15 min - 24 hr	Number of patients	Number and % of males	% patients with symptoms 15 min - 24 hr
Vaginal hysterectomy	40-59	25	0	56	128	0	44 5
Cholecystectomy	40-59	42	6 (14%)	52	216	48 (22%)	42 1
Abdominal Hysterectomy	40-59	22	0	36	109	0	36 7
Appendectomy	20-39	25	6 (24%)	44	162	48 (30%)	35 2
Tonsillectomy	0-19	25	4 (16%)	32	163	57 (35%)	33 1
Breast	40-59	29	1 (3%)	24	192	12 (6%)	28 1
Varicose veins	20-39	26	9 (35%)	23	165	39 (24%)	27 3
Haemorrhoidectomy	40-59	26	12 (46%)	31	127	63 (50%)	19 7
Herniorrhaphy	20-60	39	34 (87%)	18	216	170 (81%)	18 5
Dilatation and curettage	20-39	55	0	16	235	0	17 0

TABLE VII

EFFECT OF HYPOTENSION IN THE OPERATING ROOM IN 1706 PATIENTS AND IN THE RECOVERY ROOM IN 1672 PATIENTS ON THE 24-HOUR INCIDENCE AND SEVERITY OF POSTOPERATIVE NAUSEA AND VOMITING

% fall in systolic B P	Operating room			Recovery room		
	No of patients	% with symptoms	Average emesis score	No of patients	% with symptoms	Average emesis score
None	1339	30.2	1.34	1185	29.7	1.21
1-29	257	28.0	1.12	314	27.4	1.12
30-40	87	20.7*	0.40*	140	32.1	1.61
41+	23	21.7*	0.65*	33	36.4	1.45

*Significantly different from those with no fall in systolic B P ($p < 0.05$)

or a greater than 41% fall in systolic blood pressure) were found to have a significantly lower incidence of emetic symptoms ($p < 0.05$) and significantly lower average emesis scores ($p < 0.05$) when compared with those showing no hypotension. Since these differences show up in the untreated and drug-treated groups wherever the sample size is large enough, as well as in the pooled data, and in the 6-hour and 24-hour periods, it is felt unlikely that these differences have arisen by chance. It is concluded that hypotension in the operating room is associated with less postoperative emesis rather than with more. A possible explanation of this finding may be that patients exhibiting hypotension under anaesthesia are usually treated by lightening the anaesthesia, and thus they receive a lower total dose of anaesthetic agent.

No such correlation can be found in the present survey in patients exhibiting hypotension in the recovery room. Although the figures appear to show a reversal of the trend seen in the operating room, the differences are not uniform in the treated and untreated groups, and never attain statistical significance.

4 The Use of Gastric Tubes

All investigators who have examined the effect of gastric suction on the incidence of vomiting agree that their use results in a marked decrease in vomiting.^{8,9,11,13} It remains to be proved whether a similar reduction in nausea and retching occurs.

FACTORS RELATED TO THE POSTOPERATIVE PERIOD

1 Handling, Position Changes, and Movement

Five cases were reported by Wangeman and Hawk in 1942⁴³ where, following morphine, patients showed emetic symptoms in the erect or sitting positions, which were relieved by recumbency. Comroe and Dripps (1948)⁴⁴ compared the incidence of nausea and vomiting in ambulatory and bed patients following narcotic injections, and found it more than doubled in patients that were up and about. Depression of postural reflexes as shown by response to passive tilting can be demonstrated with morphine,⁴⁵ other narcotics,⁴⁶ and with some phenothiazines.⁴⁷ Morphine has also been shown to increase the emetic responses to vestibular stimulation.⁴⁸

Increased nausea and vomiting can thus be expected to occur in response to movement or changes of position in patients premedicated with narcotics. It is a clinical impression, which remains to be proved, that most anaesthetics and depressant drugs produce an increased susceptibility to emesis in response to movement or tilting.

2 Duration of Postoperative Sleep

After nitrous oxide-ether anaesthesia, Knapp and Beecher (1956)¹¹ found that the longer their patients slept, the fewer the patients who experienced emetic symptoms. Belleville, Bross, and Howland (1960)¹³ reported a shorter postoperative sleep among those patients who vomited, whether treated or untreated, also suggesting a lower incidence with slower awakening. In the 1713 patients of the present survey it was not possible to show any differences approaching significance in comparing either the incidence or the severity of postoperative emetic symptoms with the duration of postoperative sleep (see Table VIII).

TABLE VIII

THE EFFECT OF THE DURATION OF POSTOPERATIVE SLEEP ON THE INCIDENCE AND SEVERITY OF POSTOPERATIVE NAUSEA AND VOMITING IN 1712 PATIENTS

Awakening time in minutes	Number of patients	15 min - 6 hr		15 min - 24 hr	
		% patients with symptoms	Average emesis score	% patients with symptoms	Average emesis score
0-15	682	21.1	0.79	27.0	1.17
16-30	512	22.9	0.86	29.9	1.34
31-60	370	23.5	0.83	32.4	1.27
60+	149	26.2	1.04	30.2	1.52

3 Early Fluid and Food Intake

It was observed by Burtles and Peckett,⁹ and accepted by many other investigators^{10, 49} that vomiting may follow closely after the first postoperative intake of drinks or food.

4 Drug Therapy

The extent to which drugs reduce the incidence of postoperative nausea and vomiting is considered in many of the references given in this review. There is evidence⁷ that drugs given prophylactically, before the onset of emesis, are more effective in reducing symptoms than drugs given after vomiting has occurred. However, this aspect of the control of postoperative emesis is undergoing continuous reappraisal with established and new agents, and lies outside the scope of this review.

CONCLUSIONS

It is possible to pick out certain operations with a higher than average incidence of postoperative nausea and vomiting. Females, obese patients, and those with a history of motion sickness or severe vomiting after previous anaesthesia, are especially liable to emetic symptoms when undergoing these operations. Careful selection of pre-anaesthetic medication and anaesthetic agents, with maintenance

of light levels of anaesthesia, and avoidance of movement and posture changes in the immediate postoperative period will reduce the incidence and severity of these emetic symptoms. Consideration should be given to the use of a nasogastric tube to reduce symptoms.

Where severe postoperative pain is likely to require the use of narcotics, or in other circumstances where a particular anaesthetic technique or agent may be indicated, any increased liability to postoperative vomiting may be mitigated by the prophylactic use of an anti-emetic drug.

In any individual circumstance, the disadvantages posed by the side-effects of the anti-emetic agent chosen must be weighed against the advantages to the patient of a reduction in the liability to postoperative emetic symptoms.

The use of anti-emetic drugs to control symptoms once they are present is likely to be less effective than giving the drug before the end of anaesthesia, but avoids the possibility of giving medication unnecessarily to many patients.

SUMMARY

The factors reported in the literature to influence the incidence of postoperative nausea and vomiting have been reviewed in relation to the patient, the anaesthetic, the operation, and the postoperative period. Where applicable, these reported factors have been compared with the author's observations made during the course of a comparative trial of anti-emetic agents.

RÉSUMÉ

Lorsque deux malades subissent la même opération, il arrive que l'un vomit abondamment alors que l'autre n'a pas la moindre nausée. Dans ce travail, nous allons voir les facteurs qui peuvent intervenir dans la fréquence et la gravité des nausées et vomissements postopératoires, puis, nous présenterons les observations que nous avons faites au cours d'une étude comparée de quatre médicaments antiémétiques en regard de l'influence de ces facteurs.

Ces facteurs qui sont susceptibles d'influencer les vomissements postopératoires ont été étudiés sous les aspects suivants

- 1) ceux qui varient selon le malade,
- 2) ceux qui ont rapport à l'anesthésie,
- 3) ceux qui concernent l'opération,
- 4) ceux qui ont trait à la période postopératoire.

Pour ce qui est des facteurs qui varient selon le malade, il est à noter que les vomissements étaient plus fréquents chez les enfants et que, à mesure que les malades avançaient en âge, les vomissements étaient plus rares.

On a attribué la tendance à vomir chez les enfants au fait que l'amygdalectomie est l'opération la plus fréquente et que, le plus souvent, on administre une anesthésie profonde à l'éther, cependant, la majorité des adolescents observés au cours de notre étude ont reçu une anesthésie légère à l'halothane, technique qui a donné un faible taux de vomissements chez les personnes plus âgées.

Chez les adultes, les femmes vomissent plus que les hommes. Attribuée

d'abord à des facteurs psychologiques, cette susceptibilité plus grande peut être due à des variations d'activité glandulaire. Les données résumées dans le tableau II montrent que, chez ces malades, les nausées, les efforts et les vomissements étaient environ deux fois plus fréquents chez les femmes et environ deux fois plus graves.

Les sujets gros et courts ont présenté plus de vomissements que les grands et minces. On a noté des différences importantes entre les obèses et les maigres.

Dans cette étude, les malades présentant une histoire antérieure de vomissements postanesthésiques ont eu plus de nausées et de vomissements que les autres.

Certaines conditions, comme l'urémie, l'acidose, un déséquilibre de l'eau ou des électrolytes, augmentent la probabilité de vomissements postopératoires. Lorsqu'on veut évaluer les effets de médicaments ou d'anesthésiques sur les vomissements postopératoires, on devrait exclure cette catégorie de malades.

Les cas d'accidents et les cas d'urgence présentent plus de vomissements que les cas de chirurgie électorale, et la prémédication à l'aide de certains produits comme la morphine peut quelquefois provoquer des vomissements. L'addition d'atropine ou d'hyoscine à la prémédication diminue les nausées et les vomissements causés par la morphine. Si l'on remplace les narcotiques par les barbituriques ou les dérivés de la phénothiazine pour la prémédication, on diminue les vomissements mais l'agitation postopératoire devient un problème. Si l'on observe la fréquence des vomissements selon les agents anesthésiques, notre étude (tableau V) nous conduit à deux groupes d'agents. Les vomissements sont plus fréquents après le cyclopropane et l'éther, et moins fréquents après le protoxyde d'azote comme agent principal et l'halothane. Les différences sont moins marquées au cours des 24 premières heures. Quant à la gravité des symptômes, ils sont à peu près les mêmes, quel que soit le groupe d'agents utilisés.

La fréquence des nausées et des vomissements varie proportionnellement à la durée de l'anesthésie. On a rapporté, cependant, que si l'on utilise la technique de respiration contrôlée et le mélange anesthésique thiopentone-protoxyde-curare, la durée de l'anesthésie a peu d'influence si elle est de moins de trois heures. Belleville a comparé les différents résultats et il est à noter que la fréquence des vomissements a diminué

- a) lorsqu'on a intubé les malades,
- b) lorsque l'anesthésie a été administrée par des anesthésistes d'expérience,
- c) lorsqu'on a utilisé des myorésolutifs,
- d) lorsque l'anesthésie a été légère,
- e) lorsque les opérations sont extra-abdominales, et
- f) lorsque les malades sont maigres.

Tous ces facteurs ont pour effet de diminuer la dose d'anesthésiques requise.

L'hypertension produite par les vaso-presseurs, y compris les ocytociques, peut être suivie de vomissements. Les médicaments anticholinestériques produisent souvent des nausées, des efforts et des vomissements. Les auteurs sont loin d'être unanimes quant à l'influence du site de l'opération sur la fréquence des vomissements postopératoires. D'après ce travail, les opérations abdominales sont plus souvent suivies de vomissements que les opérations extra-abdominales,

cette différence reste vraie pour des opérations pratiquées sur des malades du même sexe. Cette même différence persiste si l'on observe chez le même sexe des opérations de durée différente, exemple l'appendicectomie est plus courte que la cure de varices, mais elle est souvent suivie de vomissements.

Il semble que l'influence de la position et celle de l'opération sur les vomissements postopératoires sont solidaires et qu'on ne doit pas les dissocier sauf dans le cas de positions différentes pour la même opération.

De notre étude, il découle que l'hypotension peropératoire coïncide plus souvent avec une faible incidence de vomissements postopératoires. A la salle de réveil, on n'observe pas cette corrélation, ce serait plutôt le contraire qui se produirait. On peut donner une explication plausible de l'observation ci-dessus au sujet des malades présentant de l'hypotension peropératoire, on traite ordinairement ces malades par une anesthésie plus légère et, ainsi, ils reçoivent une plus faible dose d'anesthésique. Bouger les malades, les changer de position semble augmenter le taux de nausées et de vomissements, lorsque ces malades avaient reçu des narcotiques en prémédication. Nous avons l'impression clinique que la plupart des anesthésiques et des médicaments déprimants augmentent le danger des vomissements à la suite de ces changements de position que l'on fait subir aux malades.

Nous n'avons pas réussi à établir de relation entre la fréquence ou la gravité des vomissements postopératoires et la durée du sommeil après l'opération.

Conclusions

Il est possible de désigner certaines opérations qui, plus que d'autres, sont suivies de nausées et de vomissements. Les femmes, les obèses et ceux qui présentent une histoire de mal des transports, ou des vomissements graves après une anesthésie antérieure, sont plus exposés à vomir lorsqu'ils subissent ces opérations. Un choix judicieux de médicaments pré et peranesthésiques, une anesthésie peu profonde et l'absence de manipulation et de changements de position du malade immédiatement après l'opération contribuent à diminuer la fréquence et la gravité de ces symptômes. Dans le même but, il faut penser à l'usage du tube naso-gastrique.

Lorsqu'on prévoit que les douleurs postopératoires devront être calmées par des narcotiques, ou lorsque les circonstances exigent l'usage d'une technique anesthésique en particulier, toute probabilité de vomissements postopératoires peut être diminuée par les médicaments antiémétiques.

Dans tous les cas, on doit tenir compte des effets secondaires de l'agent antiémétique en regard des avantages espérés quant à la diminution des vomissements postopératoires.

Lorsque les symptômes sont déjà installés, on présume que les antiémétiques sont moins efficaces que s'ils sont administrés avant la fin de l'anesthésie, d'autre part, on peut ainsi éviter de donner des médicaments sans nécessité à beaucoup de malades.

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