hypokalaemia, impaired vitamin B₁₂ absorption, steatorrhoea, hypoalbuminaemia, and depressed xylose absorption. In Case 2 similar radiological appearances occurred, but the clinical picture was dominated by excessive loss of potassium in the faeces, with resultant hypokalaemia. Absorption of vitamin B₁₂ and xylose was also impaired, and there was hypoalbuminaemia. Steatorrhoea was not demonstrated in this patient, but the illness was accompanied by low serum cholesterol and plasma carotene levels.

Both patients made a complete clinical recovery and when last seen were without symptoms and had regained their normal weight. In Case 1 this was accompanied by a return to normal of the biochemical parameters, but in Case 2, in which the period of observation was shorter, these improved, but without a complete return to within normal limits.

It is suggested, therefore, that these two patients suffered from a severe acute enteritis which caused enough damage to the small bowel to result in a temporary phase of malabsorption before eventual recovery occurred.

One other possibility must be mentioned—that these patients had latent malabsorption before the acute illness which led to detailed investigation. This cannot be fully excluded; but several facts are against it, notably the patients' apparent state of good health beforehand and the progressive clinical and biochemical recovery which followed the acute diarrhoea. On the other hand an acute enteritis complicating a latent atrophic jejunitis might well explain the clinical and biochemical severity of the illness in our present cases.

If in fact an acute enteritis led to a prolonged phase of intestinal malabsorption, the mechanism of this is uncertain. A similar sequence may follow acute ischaemic episodes in man (Joske *et al.*, 1958), though Cameron and Khanna (1959) have shown experimentally that regeneration of intestinal villi after extensive mucosal infarction is extremely rapid in the rat. It would follow, therefore, that structural mucosal integrity alone is insufficient for normal alimentary function, and that more subtle concepts of tissue organization must be considered. The recent work of Gordon (1958) is relevant to this, and suggests that this post-infectious state may be due to an acute exudative enteropathy rather than to a primary absorptive defect. It is unlikely that the results observed are due to altered intestinal motility, for the available evidence provides little evidence relating absorption to motility. Cummins and Almy (1953) found hypermotility to be associated with increased absorption. Further speculation, however, is not within the province of the present paper.

Summary

Two cases are reported which provide evidence that severe acute enteritis in adults may be followed by a temporary phase of intestinal malabsorption before recovery.

A man aged 66 developed acute bacillary dysentery, and after the acute episode was found to have impaired absorption of fat, carbohydrate, protein, and vitamin B₁₂. This was accompanied by diarrhoea and loss of weight. Both clinical and laboratory abnormalities returned to normal during the succeeding five months, and he has since remained well.

A man aged 75 presented with hypokalaemic neuropathy after an acute episode of dysentery. Investigation showed gross elevation of faecal potassium, and a defective absorption of fat, carbohydrate, protein, and vitamin B₁₂. After the acute episode there was progressive clinical and laboratory improvement.

Since mucosal regeneration in the small bowel is rapid, and prolonged defects of function followed an acute episode, it is suggested that mucosal integrity also is insufficient for normal small-bowel function.

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VOMITING BY OUT-PATIENTS AFTER NITROUS OXIDE ANAESTHESIA

BY

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This is an investigation into some of the factors relating to the occurrence of vomiting after the administration of nitrous oxide and oxygen in the casualty department at Hillingdon Hospital. We kept records of 3,000 consecutive anaesthetics given by anaesthetists of not less than registrar status. The patients were not premedicated and no supplementary drugs of any kind were given: the same intermittent-flow apparatus was used throughout. Whenever possible, patients were instructed to attend at least four hours after their last meal.

The following details were recorded: age and sex of the patient; type of operation done; time since the last meal; time of an accident when one occurred; duration of the anaesthetic, from the start of induction until the nitrous oxide was turned off; presence or absence of vomiting within the first quarter of an hour after operation; and the nature and quantity of the vomitus. (For the purpose of this investigation those patients who retched were recorded as having vomited.)

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Findings

A total of 440 patients (14.7%) vomited; but a remarkable variation around this proportion was demonstrated when the results were analysed according to the patient's age, the duration of the anaesthetic, and the type of operation performed.

Age.—When the figures for age were divided into their respective decades (Fig. 1) the highest vomiting rate was found in the first (24.2%). In the third, fourth, and fifth decades the rate was lower, averaging 7.9%; it rose for elderly patients to an average of 12.3%. An analysis by individual years of age showed the highest incidence to be in children aged 8 to 10 years, for whom it was 35.0%.

Duration of Anaesthetic.—To investigate the effect of duration the figures were divided according to the length of the anaesthetic in minutes (Fig. 2); the vomiting rate rose steadily from 5.4% for the short procedure to 40.8% for anaesthetics lasting six minutes or more.

Type of Operation.—The 3,000 minor operations with which we were concerned could be conveniently divided into five types, and the vomiting rates for these were as follows: removal of toe- or finger-nails, 5.0%; incision of abscess, 6.3%; cauterizing of warts, 20.5%; reduction of fractures or dislocations, 28.6%; miscellaneous procedures—only 40 cases, 32.5%. The vomiting rates for cauterizing warts and the reduction of fractures are four to five times those for the removal of nails and for incisions; these differences are highly significant ($\chi^2 > 40$, $P < 0.0001$).

Interdependence of These Factors

The foregoing analysis, while showing some striking differences in the incidence of vomiting, might have failed to show the individual effects of age, duration of anaesthetic, and the type of operation performed, for these factors were to some extent interdependent. Thus the type of operation influenced the duration of the anaesthetic: it took longer to treat a fracture than to remove a septic nail. The age of the patient tended to determine the type of operation—one-half of all the older patients came up for incisions, but only about a fifth of all children attended for this operation. A further analysis was done to elucidate this matter. We did this by dividing the patients in each operation group into "young" (under 15 years) and "older," and the anaesthetics into "short" (less than three minutes) and "longer." The division was made at 15 years, as this

produced the greatest difference between the vomiting rates for "young" and "older" patients, and the choice of durations had a similar effect for "short" and "longer" anaesthetics. The results are given in Table I.

Ten comparisons can be made with regard to duration, and in each case the longer anaesthetics still carried the higher vomiting rate. Similar comparisons between young and older patients show a higher vomiting rate for children for all types of operation, except for the cauterizing of warts taking less than three minutes: here the difference between the vomiting rates for the two age-groups was 1.1%, and this was found not to be significant.

Taking the types of operation performed, the vomiting rates for reductions of fractures and cauterization of warts were again higher than those for removals of nails and for incisions, even after taking into account the ages of the patients and the durations of the anaesthetics.

We have already shown (Fig. 1) that the overall vomiting rate for patients over 50 (12.3%) was higher than for patients between 20 and 50 years of age (7.9%). This difference is significant ($\chi^2 = 7.0$, $P = 0.008$), and is explained by Fig. 3, which indicates that the elderly group contained a disproportionately large number of fracture cases, and we have already shown that such cases carry a relatively high vomiting rate. On comparing the vomiting rates for fracture cases and for non-fracture cases separately in the two age-groups we are considering, the difference in incidence was in each case very small and not significant: old age did not by itself affect the vomiting rate.

The Miscellaneous Operations Group

The high vomiting rate (32.5%) in the 40 patients undergoing miscellaneous operations was probably due to the fact that most of them were accident cases and that 29 of these patients were children (see Table I).

Sex

The incidence of vomiting in the two sexes was next examined. There were 1,510 males in the series, of whom 237 (15.7%) vomited; of the 1,490 females, 203 (13.6%) vomited. This difference is not significant. But in case there could have been confounding with regard to age and the type of operation, we divided the data accordingly, and the results are shown in Table II. It might appear that boys were slightly more prone to vomit than girls, and that women were slightly more

FIG. 1

FIG. 2

FIG. 3

FIG. 1.—Incidence of vomiting according to patients' ages. FIG. 2.—Incidence of vomiting according to duration of anaesthetic. FIG. 3.—Proportions of accident cases according to patients' ages.

likely to vomit than men; it would, however, require a much larger series to establish such a difference beyond reasonable doubt.

Nature and Quantity of the Vomitus

We have so far studied only the occurrence of vomiting. When we consider the quantity and nature of the material vomited, we find that of the 440 patients who retched or vomited, 326 (74.1%) produced no more than an eggcupful of fluid; 80 (18.2%) produced up to a cupful, generally fluid only; 34 (7.7%) brought up a basinful—large quantities of solid or semi-solid material. Twenty-nine of the patients in this last group had suffered accidents, and received treatment on the same day; they vomited large quantities, in spite of the fact that their anaesthetics had been delayed until at least four hours after the last meal. In 16 of these accident cases the interval from the last meal to the anaesthetic was 4½ hours; in 10 the interval was between 5 and 5½ hours; in two of them it was 6 hours; and in the remaining one the interval was as long as 7½ hours. Of the remaining five patients who vomited copiously but had not suffered accidents on the same day, two were anaesthetized 4½ hours after their last meal: the other three (all teenagers incidentally) afterwards admitted that they had disregarded instructions and had eaten a large meal less than three hours before operation.

Time of Treatment of Accident Cases

In this series 705 patients came with fractures or dislocations: 526 were treated on the same day as their accident and 149 (28.3%) vomited; the 29 who brought up such large quantities were all in this group. The remaining 179 patients with similar injuries attended on the day after the accident, or later, and were given the usual pre-operative instructions with regard to fasting; 53 vomited (29.6%), but on no occasion was the quantity large. Though the incidence of vomiting is almost the same, the difference in those bringing up very large quantities in the two groups is highly significant ($P < 0.001$).

Discussion

We were here concerned with vomiting as it occurred after the simplest possible anaesthetic. The results were not confused by the effects of other agents or drugs given before, during, or after the procedure. Further, the patient was directly observed by the administrator in every case.

There seems little doubt, so far as short out-patient procedures are concerned, that the age of the patient, the duration of the anaesthetic, and the type of operation done can each directly affect the incidence of vomiting. These factors should therefore be taken into account when designing experiments to assess the effects of drugs or techniques that may influence the vomiting rate.

The age of the patient and the type of operation are not under the anaesthetist's control, but the duration of the anaesthetic can be influenced to some extent, and a good deal of vomiting can be prevented by making the anaesthetic as brief as possible: for instance, the administration need not be started until the surgeon is quite ready. It is doubtful if many of the anaesthetics in our own series could have been made much shorter, but had it been possible to reduce by one minute all those lasting more than two minutes then the total number of patients vomiting would probably have been reduced by over a third.

It is difficult to say what quantity of vomitus is dangerous, but there can be little doubt that the risk is greater for patients capable of producing a basinful of solid or semi-solid material. Fortunately, none of our 34 patients who vomited so much suffered any ill effects, but they present a problem. In this series the time allowed for the stomach to empty was arbitrarily fixed at four hours, and the patients and nursing staff were instructed accordingly. In spite of these precautions, and disregarding those individuals who ignored the instructions, 31 patients vomited so much that it was clear their stomachs had emptied little in four hours. Nearly all these patients were accident cases, having anaesthetics on the same day as their accidents: this

TABLE I.—Patients Divided According to Operation, Age, and Duration of Anaesthetic

Age	Duration	Removals of Nails		Incisions		Cauterizations of Warts		Reductions of Fractures and Dislocations		Miscellaneous		Totals	
		No. of Patients	No. Vomiting	No. of Patients	No. Vomiting	No. of Patients	No. Vomiting	No. of Patients	No. Vomiting	No. of Patients	No. Vomiting	No. of Patients	No. Vomiting
Young	Short	59	3 (5.1)	124	8 (6.4)	109	14 (12.8)	56	9 (16.1)	15	1 (6.7)	363	35 (9.6)
	Long	34	5 (14.7)	89	12 (13.5)	234	68 (29.0)	250	114 (45.5)	14	10 (71.4)	621	209 (33.6)
Older	Short	190	5 (2.6)	491	13 (2.6)	72	10 (13.9)	69	6 (8.7)	3	0 (0)	825	34 (4.1)
	Long	115	7 (6.1)	534	45 (8.4)	204	35 (17.1)	330	73 (22.1)	8	2 (25.0)	1,191	162 (13.6)
Totals		398	20 (5.0)	1,238	78 (6.3)	619	127 (20.5)	705	202 (28.6)	40	13 (32.5)	3,000	440 (14.7)

"Young" means under 15 years. "Short" means less than 3 minutes. The numbers in parentheses are percentages.

TABLE II.—Patients Divided According to Operation, Sex, and Age

Operations	Males				Females			
	Young		Older		Young		Older	
	No. of Patients	No. Vomiting	No. of Patients	No. Vomiting	No. of Patients	No. Vomiting	No. of Patients	No. Vomiting
Incisions	118	15 (12.7)	513	23 (4.5)	95	5 (5.3)	512	35 (6.8)
Removals of nails	69	7 (10.1)	150	5 (3.3)	24	1 (4.2)	155	7 (4.5)
Cauterizations of warts	174	50 (28.6)	126	23 (18.3)	169	32 (18.9)	150	22 (14.7)
Reductions of fractures and dislocations	186	82 (44.1)	145	24 (16.6)	120	41 (34.2)	254	55 (21.6)
Miscellaneous	23	7 (30.4)	6	1 (16.6)	6	4 (66.6)	5	1 (20.0)
Totals	570	161 (28.2)	940	76 (8.1)	414	83 (20.0)	1,076	120 (11.2)

"Young" means under 15 years. The numbers in parentheses are percentages.

agrees with the often recorded observation that an accident may prolong the emptying time of the stomach. In the light of this experience, it would seem that if a general anaesthetic must be given to a patient who has suffered an accident shortly after eating a large meal the safest course would be to postpone the operation until the next morning and instruct the patient not to have breakfast that day. If this does not prove acceptable to the surgeon then the risk must be faced that in about 1 in 18 accident cases the patient can bring up a dangerous quantity of vomitus four hours or more after the last meal. But, of course, the longer the interval between the meal and the accident the less likely is the stomach to be full.

When by force of circumstance a patient who may not have an empty stomach must be anaesthetized we regard it as sound practice to fill his lungs with oxygen as soon as the nitrous oxide is turned off. This will tide the patient over the brief but dangerous post-operative period when emergence vomiting may occur; if there is breath-holding or momentary obstruction, hypoxia may be avoided.

Summary

Vomiting occurred in 14.7% of 3,000 consecutive out-patients to whom nitrous oxide was administered. Children were more prone to vomit than adults; the longer the anaesthetic the higher the incidence of vomiting; some types of operation carried a much higher vomiting rate than others. The rate was as high as 45.5% or as low as 2.6%, depending on the presence or absence of these factors. Comparative studies are likely to be misleading unless such variability is taken into account.

About 1 in every 18 out-patients undergoing an operation for an injury sustained the same day brought up a potentially dangerous quantity of vomitus, despite an interval of over four hours between the last meal and the anaesthetic.

ACUTE HYPERCALCAEMIA FROM CARCINOMATOSIS WITHOUT BONE METASTASIS

BY

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Hypercalcaemia was for many years linked mainly with hyperparathyroidism, and the effects of the hypercalcaemia *per se* have been overshadowed by the bizarre bone disorder, renal stones, and nephrocalcinosis. In recent years hypercalcaemia has been demonstrated in a number of other disorders and its direct clinical effects have been recognized.

The objects of this case record are to stress the importance of the clinical syndrome of hypercalcaemia and its treatment, and to describe its occurrence with unusual acuteness in carcinomatosis without demonstrable bone secondaries.

Case Report

The patient, a man aged 49, had been perfectly well until six weeks before admission to hospital. For three weeks he was vaguely unwell but able to work; he then became increasingly drowsy, so that he would sleep all day, and,

in the last fortnight, complained of abdominal discomfort, constipation, polyuria, polydipsia, and vomiting so severe that he could not keep even fluids down in the previous 48 hours. He had lost 2 stone (12.7 kg.) in this time.

On admission his weight was 14 stone (88.9 kg.), temperature normal, and pulse 90. He appeared pallid but not anaemic. The most striking clinical feature was drowsiness, so marked that he would drop off to sleep while talking. General examination was normal; blood-pressure 150/80.

Investigations on Day of Admission.—Hb, 96%; W.B.C., 7,200/c.mm., normal differential; E.S.R., 6 mm. in 1 hour. Urine: trace of albumin, scanty R.B.C. and W.B.C., no casts, no Bence Jones protein. Fasting blood sugar 95 mg., blood urea 34 mg., serum calcium 16 mg., inorganic phosphate 2.2 mg./100 ml.; alkaline phosphatase 20 K.A. units; serum sodium 138, potassium 2.6, chloride 106 mEq/l.; electrophoresis, slight rise in gamma-globulin; x-ray examination showed chest, skull, spine, pelvis, and femur to be normal; electrocardiogram showed features consistent with hypercalcaemia.

A diagnosis of hyperparathyroidism was made and the patient was put on a high fluid intake with glucose and potassium supplements. During the next 10 days vomiting almost ceased and abdominal discomfort subsided. There was no spontaneous bowel action. His drowsiness gradually increased. The serum calcium rose steadily to 18 mg./100 ml., the phosphate remaining below 3 mg./100 ml. The urine output fell and the blood urea rose to 90 mg./100 ml. Urinary calcium excretion was 350 and 550 mg. in 24-hour periods. The hypokalaemia persisted. W.R. was negative.

It was felt to be unsafe to delay any longer, and exploration of his neck was undertaken by Mr. W. H. G. Jessop on the 11th day after admission. A small swelling in the thyroid proved to be a cyst; no other abnormality was found.

He remained unconscious for 36 hours after operation and his condition appeared terminal. The day after operation 100 mg. of hydrocortisone was put in the drip, followed by 100 mg. of cortisone intramuscularly twice daily. Within six hours he began to improve, and next day was able to recognize his relatives, talk, and take fluids. Serum calcium had fallen to 14 mg./100 ml. from a maximum of 18 mg.; blood urea was 77 mg./100 ml. Six days after operation his calcium was 11.5 mg./100 ml., phosphate 3.4 mg./100 ml., and sodium, potassium, and chloride were within normal limits. There was considerable difficulty in maintaining electrolyte balance, particularly in keeping up the serum potassium, and he became increasingly drowsy and the blood urea rose to 158 mg./100 ml. This fell to 105 mg., but the calcium rose again to 16.2 mg./100 ml. in spite of continued cortisone. He died nine days after exploration. Sodium E.D.T.A. had no effect on this terminal rise in calcium.

Necropsy showed widespread abdominal carcinomatosis, the primary being thought to be in the tail of the pancreas, histologically an adenocarcinoma. There was also marked fat necrosis in the omentum, and pancreatitis. Macroscopic examination of several bones failed to show any metastasis.

Discussion

It seems that all this man's symptoms were the direct result of the hypercalcaemia. He never complained of abdominal pain, and such discomfort as he had subsided on admission, when the vomiting also ceased; it seems likely on this history that the pancreatitis found at necropsy was of a few days' duration at most, and unlikely that it caused the hypercalcaemia. The cardinal features of hypercalcaemia are thirst, polyuria, vomiting, lassitude, and loss of weight, mental disorder and drowsiness being particularly marked in acute cases. Other important symptoms are hypotonia, constipation,