The degree of anaemia is not usually severe in early cases. In series A600 only 24% of cases had haemoglobin below 12 g. %. The blood changes were followed in several cases of series B80 (Fig. 4, which illustrates four representative types, with corresponding weight curves). Case 1 shows the response on diet therapy alone. Case 2 had very severe acute sprue (loss of weight 71 lb. (32.2 kg.), dehydration gross), which responded to parenteral liver therapy. Case 3 shows relapse on diet therapy with later response to parenteral liver therapy. Case 4 was a severe acute sprue which failed to respond to diet and liver but responded to transfusion.

In series B80 the initial blood counts showed: (a) macrocytic anaemia (26%); (b) normal haemoglobin and red blood cell count, but macrocytosis (30%); (c) normal blood counts (35%); (d) hypochromic anaemia (9%). In remission the change has always been: from macrocytic anaemia to normal haemoglobin with macrocytosis; to normal counts with complete remission.

Hypochromic anaemia has been uncommon (9%); all were cases of mild sprue, responding to diet therapy alone. Helminthiasis was found in 3 cases only—in one, ascariasis; in one, *Strongyloides stercoralis*; and in one, *Ancylostoma duodenale*.

The following summarizes the red blood cell changes found:

At the onset of sprue the blood changes are slight, even with profound loss of weight. Dehydration may mask some changes. When anaemia develops it is macrocytic from the start in most cases. With remission the macrocytosis persists, the haemoglobin rising slowly. Reticulocytosis is not marked: normoblasts do not appear. As the patient reaches normal weight, and not before, the blood picture returns to normal.

Dehydration at onset and during relapse may obscure the presence of anaemia by producing haemoconcentration. Conversely, in response to therapy haemodilution reveals an abnormal blood count. Plasma protein values confirm this.

The degree of anaemia is not correlated with the degree of glossitis or achlorhydria, though glossitis and anaemia appear at the same time—i.e., at the beginning of remission.

Liver therapy has less effect on the anaemia than on other aspects of sprue. Reticulocytosis is poor and delayed, and is comparable with that in tropical megalocytic anaemia rather than with pernicious anaemia.

Intestinal Absorption during Relapse and Remission Phases

The following brief statement is based upon fat balances, chylomicron counts, blood-sugar curves, and nitrogen balances performed with Major D. A. K. Black, Major R. Clutton, and Major P. Fourman on cases from series B80, fully described elsewhere.

In relapse, diarrhoea is always a prominent symptom, and is accompanied by failure of absorption. In all cases fat absorption has been found grossly diminished as judged by fat balances. Sugar absorption is diminished as judged by flat blood-sugar curves, and in one case a negative nitrogen balance was found, due to increase of faecal nitrogen.

Electrolytes are deficiently absorbed, as judged by excess of faecal sodium with low blood levels. Serum iron, too, was low in one case at the end of a relapse, and rose to normal in remission. Plasma volumes are low in relapse, reflecting dehydration. There is thus evidence that protein, fat, carbohydrate salts, and water are deficiently absorbed in this phase. Whatever the primary absorption defect may be it is rapidly overlaid by secondary deficiencies due to diarrhoea, which is, however, an integral part of this disease.

In the remission phase on diet alone, improved absorption is reflected in gain of weight; chylomicron counts become normal long before steatorrhoea disappears; fat absorption does not improve in proportion with the clinical condition, cessation of diarrhoea perhaps entirely accounting for it. In remission with liver therapy, fat absorption is again only slightly improved; it does not become normal. Blood-sugar curves may improve markedly, but this is not constant.

Ten nitrogen balances showed all such cases to be in positive balance, and plasma proteins rise rapidly to normal.

The rapid improvement of the stools with liver therapy suggests marked increase of water absorption.

Summary and Conclusion

The diversity of symptoms in sprue as seen in British soldiers in India has been found to be presented in two groups: (a) the symptoms of onset or relapse consisting of diarrhoea, anorexia, weakness, vomiting, and loss of weight; and (b) symptoms of remission: these

are glossitis, cheilosis, distension, scaling of skin, with diminution of the symptoms of onset.

Transition from relapse to remission may be slow, with a mixed symptomatology. Fig. 5 shows diagrammatically the progress of

FIG. 5.—Diagrammatic representation of the course of sprue.

sprue from onset to recovery, death, or development of the classical syndrome, and its relation to malnutrition as it has been seen during these years.

During relapse dehydration is responsible for some of the clinical features. Barium meal examination has shown gross obliteration of the intestinal mucosal pattern. Absorption of protein, fat, carbohydrate, water, and salts is grossly affected.

During remission many of these defects remain for at least 1 to 2 months in spite of rapid gain in weight and marked clinical improvement. Macrocytosis with or without anaemia persists until weight reaches normal. Absorption of fats and sugars returns to normal only after 1 to 2 months, with or without liver therapy. Early in remission, however, improvement appears to occur in protein and water absorption, particularly with parenteral liver therapy.

Signs which may be interpreted as those of deficiency of B vitamins occur at transition from relapse or in early remission.

It will be apparent that remission is in no sense synonymous with cure—criteria for which it is not easy to state.

My thanks are due to the Director of Medical Services, India, for permission to publish this paper; and to Col. H. E. Knott, A.M.S., Officer Commanding, 3 Indian Base General Hospital.

SURGERY AND THE RELAPSE RATE OF MALARIA

BY

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It is generally believed that surgical operations commonly precipitate a relapse of fever in a subject infected with malaria. Manson-Bahr (1941) emphasizes that surgeons should keep the possibility of post-operative relapse constantly in mind. Napier (1943a) considers it advisable, even in cases of possible latent infection, to give a course of cinchona as a routine measure before a surgical operation on anyone coming from a highly malarious area.

An attempt is made in this paper to assess the relapse rate of malaria in relation to surgical procedures; it is based upon personal case records collected during the past three years. The cases are considered in three groups.

Classification of Cases

Group I consists of patients having a history of pre-operative malaria, and also those without such history but in whom an early post-operative attack was suggestive of a previous latent malaria, in all of which cases no form of suppressive or prophylactic antimalarial treatment was given pre- or post-operatively. In this group there are 153 patients, on whom 176 operations were performed.

Group II refers to those cases, with and without a past history of malaria, submitted to operative surgery after the conclusion of a course of suppressive antimalarial treatment and either after or during the terminal "blanket" treatment. The preventive malarial regime consisted of mepacrine 0.1 g. twice daily for the first three days, followed by 0.1 g. once daily for as long as exposure in malarious "battle" areas continued. This suppressive course was then concluded by a "blanket" of mepacrine, 0.1 g. thrice daily for five days; no drug for two days; and pamaquin 0.01 g. thrice daily for three days. There were 147 operations in this group. These cases, as well as those in Group I, were observed in a "rear" hospital area.

Group III consists of surgical cases with or without a previous malarial history, evacuated from battle areas in which all personnel had been treated with daily suppressive mepacrine for a considerable

period. This mepacrine, 0.1 g. per day, was continued throughout the period in hospital, pre- and post-operatively. In this group there are some 1,900 cases. All were observed in a "forward" hospital area.

The relapse rate is considered in relation to major and minor surgery. The distinction is made dependent upon the time taken for the operation: a duration of less than 20 minutes is regarded as minor, and an operation lasting longer than this time is regarded as major. On this basis similar operations may fall into either class: e.g., some appendicectomies and herniotomies are classified as minor, others as major. This method of distinction has, however, seemed the most satisfactory for the purposes of the investigation in that the time factor is probably more closely related to the degree and extent of surgical trauma than any other factors which would lend themselves to general and simple classification.

Group I: No Suppressive Treatment

The incidence of relapses and fresh attacks, their types, and the times of onset after surgical operation are given in Tables I and II.

TABLE I.—Incidence of Post-operative Malaria

Operation	No.	Post-op. Relapse	Post-op. "Fresh" Attack	Total
Minor	121	9 cases (7.4%)	4 cases (3.3%)	13 (10.7%)
Major	55	4 cases (7.3%)	1 case (1.9%)	5 (9.1%)
Total	176	13 cases (7.4%)	5 cases (2.8%)	18 (10.2%)

TABLE II.—Analysis of Relapses and Fresh Attacks

Operation	Type of Malaria	Time of Onset in Days after Operation	No. of Cases	Relapse or Fresh
Minor: 13 cases	B.T.	3	1	R
	B.T.	11	2	R
	B.T.	12	1	R
	B.T.	14	1	R
	B.T.	15	3	R
	Clin.	4	1	R
	B.T.	7	3	F
Major: 5 cases	Clin.	3	1	F
	B.T.	2	2	R
	B.T.	11	1	R
	B.T.	12	1	F

"Clin." refers to clinical malaria—i.e., having all the signs and symptoms and a typical reaction to treatment, but no identifiable malaria parasites in blood smears. In the two cases of relapse the previous attacks had been diagnosed as malignant tertian infections.

Relapse Rate

Definite conclusions as to the relapse rate due to surgery are not possible because of a number of problematic features of such an assessment. The most notable difficulty in this regard derives from the fact that the investigation was conducted in an endemic area with an appreciable malarial incidence. In the medical division of the same unit, during the period under review for this group of cases, there were 1,824 fresh cases and 2,285 relapses of malarial fever; and these figures represent approximately one-quarter of all admissions on the medical side. It thus becomes doubtful whether the post-operative attacks were in fact precipitated by the operation or whether they were either fresh or relapsing fevers having no specific relation to the surgical event. In the tables in this paper the heading "Post-op. Relapse" is used to indicate an attack of malarial fever in a case with a history of pre-operative malaria: it could be a relapse or a fresh infection, the former being the more probable. The heading "Post-op. Fresh Attack" refers to the first clinically appreciable malarial fever that has been diagnosed. This attack might also be a relapse—the original infection having been a subclinical one—or a true fresh infection; here the latter contingency is the more probable.

Another element of doubt arises in that the post-operative period, during which it was assumed that the relapse might bear causal relationship with the operation, was defined as 15 days. This exceeds not only the minimum latent period but also the usual incubation period for benign tertian infection—according to Napier (1943b) 8 and 14 days respectively; but this period of 15 days was chosen in order to include the possible influence of various post-operative states (e.g., non-malarial fever, dehydration, exhaustion, and other complica-

tions arising within a week or so after the operation) which in themselves might be regarded as essential precipitating causes of the relapse.

The two features, the local endemicity and the allowance of a period in excess of the average incubation time, would in this investigation tend to raise the figure of the post-operative relapse rate beyond that proportion actually precipitated by the operation; but, even disregarding these influences, the total incidence of relapses amounts to 10%—a surprisingly low figure in view of the expectation of a higher relapse rate as implied by current teaching.

The time of onset of fever is recorded in Table II. The earlier the onset of fever after operation the more culpable does the latter appear as the precipitating factor; and this seems more especially to be the case when the onset of a benign tertian infection occurs within eight days—i.e., the minimal incubation period for this type. Of the 15 cases of post-operative benign tertian fever, 6 occurred within such a period; if the clinical malaria cases be included the ratio becomes 9 early post-operative attacks out of the total of 18. These figures of the earlier relapses, rather than the totals, may be regarded as a truer index of the proportion brought about by the surgical operation. However, even this index is presumptive and not definite, in view of the possibility of fresh infection having been acquired within a few days prior to operation.

Influence of Major and Minor Surgery

The relapse rates following major and minor surgery afford a comparison of significance. If the extent and the duration of the surgical trauma were important causative factors the proportion of relapses occurring after major surgical operations might be expected to exceed that after minor surgery. The incidence in this series of cases does not support such a contention. As the records in Table I demonstrate, the relapse rates after both major and minor surgery are almost identical.

Effect of Anaesthesia

The post-operative incidence of malaria in relation to the types of anaesthetic employed is analysed in Table III.

TABLE III.—Post-operative Malaria in Relation to Anaesthesia

	Intravenous Pentothal	Inhalational	Spinal	Local
Total anaesthetics	77	38	31	30
No. of attacks after minor operations	5	2	1	5
No. of attacks after major operations	2	1	2	0

The number of cases is not sufficient to allow of definite deduction; but there is the suggestion that the proportion of attacks of malaria after local analgesia is higher than after other anaesthetics. The 5 attacks after local analgesia represent a ratio of 1 in 6 cases; for the other anaesthetics the ratio is roughly 1 in 10 to 12 for each variety. It is noteworthy that the local analgesic used contained adrenaline, and that all five cases were minor operations. This finding provides a hint for caution in the use of even minute quantities of adrenaline in operating upon patients who may have quiescent malarial fever.

Type of Relapse

A great proportion of post-operative attacks were due to benign tertian infections: 15 out of 18 were identified as this variety; the types of the remaining 3 were not identified. The incidence of the pre-operative types of infection is given in Table IV.

TABLE IV.—Incidence of Types of Pre-operative Malaria

Type of Malaria	No. of Cases
Benign tertian	64
Malignant tertian	30
Benign and malignant	42
Quartan fever	1
Clinical	11
	148

Comparison between Tables II and IV shows that out of the total of 110 cases of B.T. infection (i.e., 106 with a pre-operative history plus 4 possible latent infections) there were 15 relapses; whereas out of 72 malignant tertian cases there were but two

relapses, the type of which, though not identified during the post-operative attack, might have been malignant. This relative incidence of B.T. relapse accords with the general and far greater tendency of this type to relapse quite apart from surgical influences, and the comparative figures provide no evidence, either way, of surgery as a precipitating factor.

Influence of Immunity

All the patients to whom the figures in Group I refer were British troops. The data collected for Indian troops have not been used in this paper because of the unreliability of the past history: "*buchar*"—i.e., fever—of any origin is apt to be ascribed by Indian troops to malaria. It is of interest, however, to record that, out of roughly 400 cases observed, the post-operative attacks of malarial fever amounted to between 5 and 6%—i.e., approximately half the relapse rate found among British troops. The lower rate among Indians is an expected finding in view of the greater numbers that have acquired an immunity by long residence in endemic areas.

The influence of the factor of immunity, or relative immunity in which there is a lack of febrile response, in so far as it affects post-operative relapse rates in British personnel, may be assessed by consideration of cases having a history of numerous pre-operative attacks. These cases have been abstracted, and the details of the number of attacks which occurred during four half-yearly periods prior to operation are recorded in Table V.

TABLE V.—Cases with Frequent Pre-operative Attacks

Pre-op. Period	No. of Pre-op. Attacks	Case Incidence	Post-op. Relapse
6 months	3 4 to 5	8 7	—
12 "	3 4 to 5 6 to 7	7 9 3	—
18 "	3 4 to 5 6 to 8	3 6 7	—
24 "	3 4 to 6 7 to 10	7 9 5	1 × R.—B.T.

The single relapse after 67 operations is in marked contrast to the remaining cases in this series—viz., 17 post-operative relapses in 109 cases in which there had been less than three attacks during the two-year period preceding operation. The contrast provides very suggestive evidence of the acquisition of an immunity which reduces the liability to post-operative relapse of malarial fever. Table V further indicates that, even during such short periods as 6, 12, and 18 months prior to operation, 3 or more attacks of fever appear to confer a degree of immunity.

Influence of Proximity of Most Recent Attack

The liability to post-operative relapse relative to the proximity of the latest pre-operative attack is indicated in Table VI.

TABLE VI.—Proximity of Pre-operative Attack Relative to Post-operative Relapse

Type of Malaria	No. of Cases having an Attack within a Pre-operative Period of:						Totals	
	1 mth.	2 mths.	3 mths.	4 mths.	5 mths.	6 mths.	Cases	Relapses
B.T. ..	19 (2R)	3 (1R)	6	7 (2R)	8 (1R)	5 (2R)	48	8
M.T. ..	5	1	5	1	1	4	17	—
B.T. and M.T. ..	—	—	—	—	—	3	3	—
Clinical	1 (1R)	—	1	2	—	2	6	1
Total ..	25 (3R)	4 (1R)	12	10 (2R)	9 (1R)	14 (2R)	74	9

The figures in parenthesis give the number of post-operative relapses.

Out of a total of 13 post-operative relapses 9 occurred in the 74 cases in which there had been an attack of fever within the 6 months prior to operation—an incidence of about 12%. The remaining 4 relapses occurred in the 102 cases in which there had not been a pre-operative attack within this period—an incidence of about 4%. There is thus some evidence that post-operative relapse is more likely to occur when there has been a recent—within 6 months—pre-operative attack. Corre-

lation with the data given in the preceding section on the influence of immunity brings the conclusion that the possibility of post-operative relapse is enhanced by the occurrence of one or two attacks during this period of six months, but that the occurrence of three attacks markedly reduces it.

Group II: Surgery after Suppressive Treatment

In this group the period of observation after operation was not limited to 15 days; a longer period was allowed in order to cater for the effects of "blanket" treatment, which was often begun at the time of operation, and which would tend to delay the onset of relapse. The findings in this group of cases are recorded in Table VII.

TABLE VII.—Relapse Rate Following Suppressive Treatment

Past History	No. of Operations	No. of Post-op. Attacks	Type	Time of Onset	
				After Op.	After Completing "Blanket" Course
Previous malaria, positive	68	6 (9%)	6 × B.T.	8 wks.	6 wks.
				14 days	20 days
				14 "	5 "
				14 "	21 "
				4 wks.	8 wks.
No history of prior malaria	79	5 (6%)	4 × B.T. 1 × M.T.	18 days	11 days
				13 "	23 "
				3 "	30 "
				4 wks.	8 wks.
				20 days	8 "

With reference to the 79 cases in which there was no history of previous malaria the significance of the 5 post-operative attacks is not readily calculable; for, apart from the possibility of a post-operative fresh infection having occurred, the proportion of cases with a previously suppressed malarial infection is unknown. The post-operative incidence of 6% is, however, an indication that this particular form of suppressive and "blanket" treatment cannot be regarded as assuring freedom from attacks after surgical procedures. This is more strongly indicated by the figures of the cases which did present a history of previous malaria. In these 68 cases there was a relapse rate of 9%—a proportion closely similar to that found in Group I, in which suppressive treatment had not been given. It therefore appears that the relapse rate of malaria following surgery is not affected by previous suppressive and "blanket" treatment of the type used in the Group II series of cases.

Of the 11 post-operative attacks, 6 followed major and 5 followed minor operations—a finding in agreement with that in the Group I series, where there was also no appreciable difference in the influence exercised by the two grades of severity of surgical operation.

Group III: Surgery and Continued Suppressive Treatment

This group consists of some 1,900 surgical cases seen in a "forward" hospital during the 1945 campaign season. They were admitted to the hospital after 3 to 14 days from the time of being wounded. In addition to their wounds, the great majority of patients had undergone severe physical exertion, followed by evacuation over long distances by road, air, rail, and river steamer. The battles had taken place in areas which were hyperendemic for malaria and in which unprotected personnel developed nearly 100% malarial infection. Almost every patient had had at least one operation before coming under my observation, and 743 were submitted to further operative treatment. All the patients had been taking suppressive mepacrine, 0.1 g. daily, for a considerable time, and this was continued during the evacuation stages and throughout the period of observation in hospital.

Two cases of post-operative malaria occurred; in both there was reason to believe that the men had evaded taking the daily dose of mepacrine. There is thus strong evidence that this form of treatment suppresses malarial fever even in the presence of severe trauma, prolonged physical strain, and extensive surgical operations.

Summary and Conclusions

This paper records observations upon the relapse rate of malarial fever in relation to surgical procedures.

In a series of 176 surgical operations performed on patients with a history of previous malarial infection, and to whom neither suppressive nor prophylactic antimalarial treatment was given, there was

a post-operative attack of malarial fever in 10% of cases. The conditions under which observations were made render it certain that this figure of 10% is in excess of the relapses brought on by surgical operation; and the investigation tends to throw doubt upon the validity of the assumption that surgery commonly precipitates relapses of malarial fever.

The relapse rate was practically the same whether the surgical operation had been of major or minor variety.

Local analgesics containing adrenaline were followed by a higher proportion of attacks of fever than were other forms of anaesthesia.

The relative incidence of the types of post-operative relapse conformed to the general relapse rate, and was predominantly due to benign tertian parasites.

Three or more attacks of malarial fever during a period of two years preceding operation appeared to confer a degree of immunity and to reduce the incidence of post-operative relapse.

A first or second attack within a period of six months preceding operation seemed to increase the liability to post-operative malaria.

The findings in the first series of cases are compared with those found in 147 operations upon patients who had received and completed suppressive treatment before operation. The post-operative relapse rate in cases with a history of pre-operative malaria in this second group was found to be practically the same as that in which suppressive treatment had not been administered.

In the third group of 1,900 surgical battle casualties suppressive mepacrine, instituted a considerable time before the battle trauma and continued throughout the period in hospital, virtually eliminated post-operative malaria.

REFERENCES

- Manson-Bahr, P. (1941). *Manson's Tropical Diseases*, 11th ed., p. 84, Cassell, London.
Napier, L. E. (1943a). *Principles and Practice of Tropical Medicine*, p. 83, Thacker-Spink, Calcutta.
— (1943b). *Ibid.*, p. 76.

VINESTHENE ANAESTHESIA FOR REPAIR OF HARE-LIP AND CLEFT PALATE

BY

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Operations for the repair of hare-lip and cleft palate have in the past presented the anaesthetist with many difficulties. The patients are small babies or very young children, and therefore require more careful handling than adult patients; there is considerable interference with the airway; and there is the ever-present danger of blood finding its way into the air passages. The introduction of endotracheal anaesthesia solved the problem of keeping the airway open, but in the early days the anaesthetic vapour was delivered through a rubber catheter to the region of the larynx, and a free passage for returning air had to be assured. It was not until the modern method of to-and-fro intratracheal anaesthesia came into use that it was possible to pack off the larynx adequately, and so eliminate the danger of inhaled blood and allow the surgeon to have complete control of the field of operation. Ether, or gas-oxygen-and-ether, is the common anaesthetic chosen, but lately the use of vinesthene with gas and oxygen has been found to give even better results.

Properties.—Vinesthene is divinyl ether— $(\text{CH}_2:\text{CH})_2\text{O}$ —to which has been added 3.5% absolute alcohol and 0.01% of a non-volatile oxidation inhibitor to render it less volatile and more stable. It is decomposed by acids, with the formation of aldehydes, one being formaldehyde, so it is considered safer to use only freshly opened bottles of the drug; like other ethers, it decomposes when exposed to light and air. Vinesthene is highly inflammable and as explosive as ethyl ether when mixed with air, oxygen, or nitrous oxide.

Some Aspects of Vinesthene as an Anaesthetic

Compared with other anaesthetic substances vinesthene possesses various advantages. It is less irritating than ethyl ether or ethyl chloride, causing very little salivation, and produces no nausea or vomiting after short administrations, and rarely very slight vomiting after longer administrations. In one series of 364 patients of varying ages, but consisting mostly of dental cases, no vomiting was reported (Goldman, 1936). Unlike chloroform, vinesthene does not cause any cardiac or respira-

tory depression. The induction is quick and recovery remarkably rapid.

On the other hand, vinesthene is a very potent anaesthetic, and it is as well for the anaesthetist to become really familiar with the drug in minor surgery before using it for lengthy operations. This was stressed when the substance was first investigated in this country (Shipway, 1935), and again by later workers. Ravdin *et al.* (1938) say: "It is exceedingly potent, and even though the traditional margin of safety is wide, the lethal concentration is such that the anaesthetic should be administered with due regard for its potency."

Some investigators have found that vinesthene may produce liver damage. Orth *et al.* (1940), for instance, found that weekly administrations of vinesthene to dogs produced central-zone necrosis of the liver and a progressive decrease of urea-clearance values, and a case of hepato-renal damage has been reported in a patient who had a second administration of vinesthene, lasting 104 minutes, ten weeks after the first administration, lasting 40 minutes (Hawk, Orth, and Pohle, 1941).

Ravdin (Ravdin *et al.*, 1937) has suggested that vinesthene should be used for short administrations only, as he believes that liver necrosis may follow long administrations even when every precaution to prevent anoxaemia has been taken, and he regards vinesthene as more toxic than ethyl ether. As a result of later work (Ravdin *et al.*, 1938) he and his fellow workers consider that vinesthene is not contraindicated in the presence of renal or cardiac disease, as there is no evidence that further damage is caused in such cases.

More recently vinesthene has been used extensively for war surgery by one anaesthetist (Ogus, 1941), who records the almost daily use of this substance for a year by open and closed methods. He specially commends the convenience of administration under war conditions, the lack of nausea and vomiting even in the case of patients with full stomachs, the rapid induction and recovery. He considers vinesthene combined with gas and oxygen to be superior to gas-oxygen-and-ether, but is careful to observe the safe dose limit of no more than half an hour's administration, set by the Council of Pharmacy and Chemistry of the American Medical Association, and adds a limit of 50 to 75 ml. by the open method at one time.

Convulsions occurring under vinesthene anaesthesia have been recorded in America and in this country. Dawkins (1940) published nine cases of convulsions—four occurring in patients who were undergoing major operations and five among children in the dental department. Another isolated case has been recorded (Boston, 1940), and I myself have seen two cases occurring in children after vinesthene anaesthesia for dental extraction. These convulsions resemble ether convulsions except in the fact that those following a short administration of vinesthene (e.g., for dental extraction) may occur some few minutes after the child has recovered consciousness. Ether convulsions always appear to be controlled by the intravenous injection of a barbiturate, and none has been recorded after an induction with a barbiturate. But the four cases reported by Dawkins (1940) showed convulsions with vinesthene following induction with hexobarbitone (evipan).

The recent work carried out by Williams and Sweet (1944) throws a new light on the subject of anaesthetic convulsions. They investigated, by means of electro-encephalography, 22 cases in which convulsions under anaesthesia had occurred, and obtained abnormal results in about three-quarters of them. Paroxysmal outbursts of abnormal waves were seen in over half, and larval epileptic attacks in a quarter, of the cases. The incidence and nature of the abnormal results were identical with those found in a large number of idiopathic epileptics, and were not considered to be the result of the convulsion. They came to the conclusion that all the evidence presented supports the view that anaesthetic convulsions are primarily due to an inborn but latent epileptic liability; that the factors which precipitate a convulsion in these predisposed persons vary between individuals, but many of the factors which have been incriminated are well-recognized precipitants of epileptic fits in conscious subjects; and that the main difference between fits lies in the degree of predisposition to convulsions, the many factors which arise during anaesthesia being merely precipitants of the convulsion. Williams and Sweet (1944) point out that anaesthetic convulsions are more rare among epileptics than among normal patients, and give the explanation that the