The second positive result is the relationship between nutritional grades and clinical signs. The present result confirms those already reported by Adcock, Hammond, and Magee (1947)—namely, that there was a high degree of association between certain clinical signs and nutritional grades. The present trials go further and show that clinicians of widely different experience seem to agree substantially on the importance and relevance in relation to nutritional assessment of certain signs which have been called "grading criteria." This suggests that these grading criteria could either be used as separate factors (especially if they could be made more objective) or could be combined into a general grading according to some system of weighting. This opens up the possibility of distinguishing between degrees of severity of signs and whether the signs occur singly or in combination with others.

It must, however, be recognized that it may be as difficult to obtain standardization or objectivity for the clinical signs as for the nutritional assessment. Such an aggregate result based on signs need not, of course, be termed a nutritional assessment. In any case it seems doubtful whether it is possible, under present conditions in this country, to differentiate between nutritional assessment and an assessment of general condition or fitness. It must be emphasized that from the very nature of the clinical method perfection cannot be expected. An attempt should be made to assess its good and bad points against possible alternatives and to decide how the method can best be used and what modifications should be made.

Summary

Two trials were made to test the reliability of the clinical assessment of "nutritional state," the first at Sheffield in January, 1949, the second at Tottenham in March, 1950. Five clinicians took part at Sheffield and nine clinicians and a school nurse at Tottenham.

For each child "nutritional state" was taken to include assessments of "general condition" and the incidence of certain clinical signs.

Both for the clinical grades and for the clinical signs there was a considerable lack of agreement between clinicians in their findings for individual children and for the group of children as a whole. A number of children were examined twice, and there was, for the same clinician, considerable disagreement in the findings of the two examinations.

There was a high degree of association between clinical grade and the incidence of certain clinical signs.

Comparison of the clinical assessments made by those clinicians who took part in both trials and the assessments by the different clinicians of different groups of children at Tottenham shows that the clinicians maintained their standards relative to one another and that they could distinguish between groups and generally agree on the order of the differences.

The high degree of association between nutritional grades and the incidence of certain clinical signs suggest that if the latter could be made more objective they could be used separately for grading purposes or could be combined into a general grading according to some system of weighting.

The trials at Sheffield and Tottenham were entirely dependent on the participation of the clinicians and the school nurse. We are especially glad to acknowledge our indebtedness to them and to express our thanks. We wish to make it clear, however, that this paper represents our interpretation of the data and that only our personal views are expressed. This does not imply that those participating in the trials agree with the interpretation of the data or with the views expressed. We wish to record again our appreciation of the valued co-operation of Dr. H. M. Cohen, at Sheffield, and Dr. G. H. Hogben and Dr. P. A. Tyser, at Tottenham. We are also glad to thank Dr. H. E. Magee for his interest and advice.

REFERENCES

Adcock, E. W., Hammond, W. H., and Magee, H. E. (1947). *J. Hyg., Camb.*, **45**, 65.
Bean, W. B. (1948). *J. appl. Physiol.*, **1**, 458.
Franzen, R. (1929). *Physical Measurements of Growth and Nutrition.* Amer. Child Hlth Ass., New York.
Jones, R. H. (1938). *J. R. statist. Soc.*, **101**, 1.

THE PERIPHERAL CIRCULATION DURING GENERAL ANAESTHESIA AND SURGERY

BY

R. B. LYNN, M.D., F.R.C.S.

AND

RALPH SHACKMAN, M.B., B.S., F.R.C.S.

(From the Department of Surgery, Postgraduate Medical School of London)

Changes produced in the peripheral circulation by general anaesthesia may be evident in the flushed warm skin which develops soon after induction, and may be recorded by finger plethysmography (Foster *et al.*, 1945). We have used calf, foot, and hand plethysmographs to measure the circulatory changes which occur when cyclopropane, ether, "trilene," nitrous oxide, oxygen, thiopentone, and gallamine triethiodide ("flaxedil") are used in varying combinations (Tables I and II), and have shown that further readjustment of the circulation develops later during lengthy major operations. The state of the limb circulation can be a considerable aid to the assessment of the general circulatory state of a patient undergoing major surgery under general anaesthesia.

Method of Study

The plethysmographs (Barcroft and Edholm, 1943) were constructed of "perspex" and contained built-in thermostatically controlled heating units. Displacement of water (kept at $32° \pm 1°$ C. for the hand and foot, and at $34° \pm 1°$ C. for the calf) was used to measure the limb flows. Snugly fitting diaphragms were bolted to the plethysmograph, and the cuffs, made of thin rubber sheeting, were sealed to the skin with rubber cement. Several turns of self-adhering rubber tape were wound around the cuffs as reinforcement, with care to avoid venous congestion. Thick rubber pressure tubing connected the plethysmograph to a float recorder writing on a mobile bench kymograph.

When calf flows were measured egress of blood from the foot into the calf was interrupted by inflation of an occluding cuff at the ankle above systolic pressure (Barcroft and Edholm, 1943).

Limbs flows were measured, first in the pre-anaesthetic sedated period before the induction of anaesthesia, and then throughout the operative procedure (pre-operative sedation was by morphine, atropine, and hyoscine in varying combinations). Several readings were taken during every five-minute period, and the average value was used as the index of limb flow. The blood pressure and pulse rate were recorded at regular periods throughout the studies.

TABLE I.—*Group I: Minor Operations*

Case No.	Age and Sex	Operation	Anaesthetic	Part Studied	ml./100 ml./minute		
					Resting Flows	Peak Flows	Final Flows
1	19 F	Excision thyroglossal cyst	Thiopentone, N_2O, O_2, trilene	Calf	2·8	7·0	6·0
2	59 M	Cystoscopy and herniotomy	Thiopentone, cyclo., O_2	,,	2·2	7·4	6·0
3	42 M	Herniorrhaphy	,, ,, ,,	,,	1·5	9·5	8·0
4	50 F	Amputation of arm	N_2O, O_2, cyclo.	,,	2·5	6·2	6·0
				Average	2·3	7·5	6·5
5	57 F	Herniorrhaphy	Thiopentone, N_2O, O_2, ether	Foot	1·0	6·5	4·0
6	40 M	Herniotomy	Thiopentone, N_2O, O_2, trilene	,,	2·4	19·0	18·0
7	34 F	,,	Thiopentone, N_2O, O_2	,,	1·4	9·8	10·0
8	27 M	,,	Thiopentone, N_2O, O_2, flaxedil	,,	2·1	30·0	27·0
				Average	1·7	16·3	14·8
9	39 M	Herniorrhaphy	Thiopentone, N_2O, O_2	Hand	4·6	14·0	8·0
10	34 F	Excision thyroglossal cyst	Thiopentone, O_2, ether, trilene	,,	1·4	12·3	11·3
11	36 F	Herniotomy	Thiopentone, N_2O, O_2	,,	2·2	11·0	10·8
12	69 F	Herniorrhaphy and orchidectomy	Thiopentone, cyclo., O_2	,,	11·0	21·5	13·0
				Average	4·8	14·7	10·8

Blood flows were measured in the calf, foot, and hand. Forearm flows were not measured, as it has been generally agreed (Abramson, 1944) that calf and forearm flows are comparable and that both are an index of muscle circulation.

Two groups of patients were studied. Group I included patients undergoing short and relatively minor operations, and Group II those undergoing lengthy major operations. Hand flows were not measured in Group II, because it was found that the presence of a hand plethysmograph on a patient embarrassed the surgeon during a lengthy abdominal operation. We have accepted that hand and foot flows are comparable, and that both are an index of circulation in the skin (Abramson, 1944).

Results

Group I: Short and Minor Operations (Table I).—The pre-anaesthetic limb flows averaged 2.3 ml. per 100 ml. in the calf, 1.7 ml. in the foot, and 4.8 ml. in the hand. An increase in limb flow began immediately after the induction of anaesthesia, but the maximum increase in flow often did not develop until 15 to 30 minutes had elapsed (Figs. 1, 2, and 3). The average peak flows during operation were 7.5 ml. per 100 ml. in the calf, 16.3 ml. in the foot, and 14.7 ml. in the hand. In 11 of the 12 patients in this group the marked increases in limb flow persisted throughout the duration of the operations; even the single exception (Case 12) had a final flow which was 20% greater than the pre-anaesthetic resting level.

Group II: Lengthy Major Operations (Table II).—The pre-anaesthetic limb flows averaged 2.4 ml. per 100 ml. in the calf and 2.3 ml. in the foot. The average peak flows during operation were 7.8 ml. per 100 ml. in the calf and 9.2 ml. in the foot. These increased flows were not maintained as the operation progressed, and the final flows in this group averaged 2.3 ml. per 100 ml. in the calf and 2 ml. in the foot (Figs. 4 and 5).

Discussion

(For the purpose of the discussion of the significance of the changes in limb flow and blood pressure the values of the changes are expressed as percentages of the corresponding primary resting levels. For example,

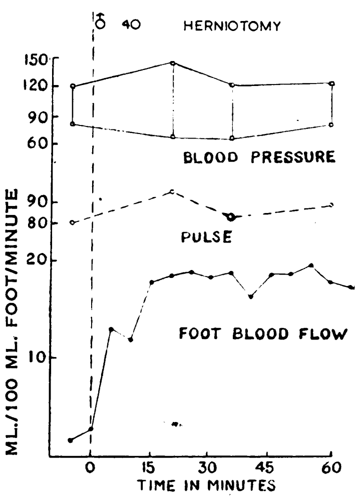

FIG. 1.

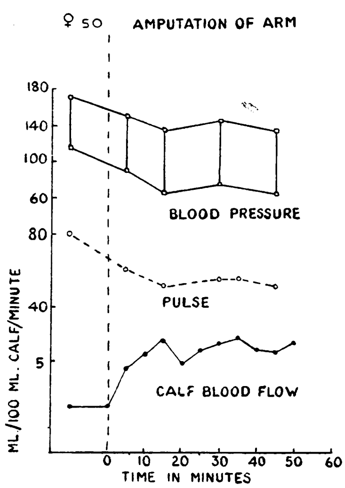

FIG. 2.

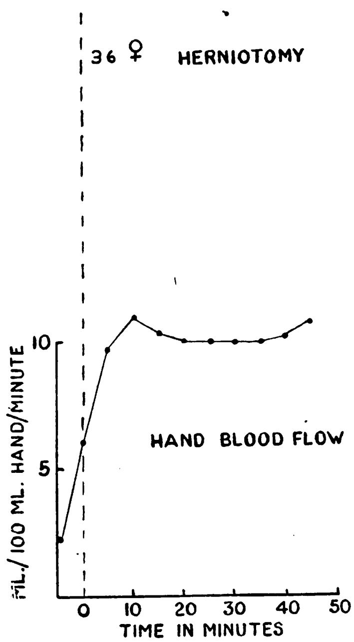

FIG. 3.

FIGS. 1, 2, and 3 (Minor Operations).—Zero time indicates induction of anaesthesia. The pre-anaesthetic readings are averages taken over periods of time varying from 10 to 30 minutes. The limb flows are maintained during operation.

TABLE II.—*Group II: Major Operations*

Case No.	Age and Sex	Operation	Anaesthetic	Part Studied	ml./100 ml./minute		
					Resting Flows	Peak Flows	Final Flows
1	50 M	Gastrectomy	Thiopentone, cyclo., O_2, flaxedil	Calf	1·0	3·0	1·0
2	72 F	Colectomy	Thiopentone, O_2, cyclo., flaxedil	,,	6·0	15·0	8·0
3	62 M	Gastrectomy	Thiopentone, cyclo., O_2, flaxedil	,,	2·5	15·0	2·0
4	64 F	,,	Thiopentone, cyclo., O_2	,,	1·5	5·9	1·0
5	35 F	,,	Thiopentone, N_2O, O_2, flaxedil	,,	1·4	5·3	2·0
6	44 M	Laparotomy	,, ,, ,, ,,	,,	3·5	8·0	2·0
7	43 M	Closure of vesico-perineal fistula	Thiopentone, cyclo., O_2	,,	1·7	5·0	2·0
8	47 M	Gastrectomy	Thiopentone, cyclo., O_2, flaxedil	,,	1·2	5·2	0·6
				Average	2·4	7·8	2·3
9	68 F	Gastrectomy	Thiopentone, cyclo., O_2, flaxedil	Foot	1·3	2·5	0·7
10	70 F	,,	,, ,, ,, ,,	,,	2·2	8·5	2·0
11	80 F	,,	,, ,, ,, ,,	,,	2·0	5·0	1·0
12	46 M	,,	,, ,, ,, ,,	,,	2·8	13·3	4·9
13	52 M	,,	,, ,, ,, ,,	,,	2·5	13·0	2·0
14	38 M	,,	,, ,, ,, ,,	,,	2·0	12·5	1·5
15	36 F	Exploration of gall-bladder and common bile duct	,, ,, ,, ,,	,,	3·0	9·5	2·0
				Average	2·3	9·2	2·0

if a limb flow increases from a resting basal level of 2 to a peak of 8 and subsequently decreases to the original level of 2, the increase from the basal level to the peak flow is recorded as 300%, while the subsequent fall is also 300%. Similarly, if a primary mean arterial pressure of 100 increases to 120 in the period of the peak flow and subsequently declines to 80, the increase is recorded as 20%, while the subsequent decrease is 40%.)

It has been confirmed by venous occlusion plethysmography that the peripheral circulation undergoes profound changes during general anaesthesia and surgical operations. Increased limb flows are maintained during the whole period of relatively minor operations and during the earlier phases of more prolonged and severe operations. During the later phases of more prolonged and severe operations the limb flows decline in most cases and become equal to or somewhat less than the pre-anaesthetic resting levels.

An increased limb flow might represent a passive response to an increase of blood pressure, without change in calibre of the vessels in the limb concerned, or could result from active vasodilatation in the limb vessels. But consideration of the simplified version of Poiseuille's formula R=   (where R=resistance, P= mean blood pressure, and F=flow) makes it clear that enormous increases of blood pressure would be needed to produce the large increases in limb flow that we have noted and which averaged the equivalent of 360% of the average pre-anaesthetic resting flow. As the maximum increase in mean blood pressure that we have noted in any single patient was only 33% above the corresponding pre-anaesthetic resting pressure, and in fact, as can be seen in Figs. 1, 2, 4, and 5, the blood pressure usually remained virtually unaltered from the pre-anaesthetic level, it is concluded that the increase in peripheral blood flow noted during anaesthesia results from active vasodilatation in the limb vessels.

The decrease in limb flow from the peak level, noted in the later stages of the more severe operations, could be due to a fall in blood pressure or to relative vasoconstriction in the limb vessels. But the average decrease in flow from the peak of vasodilatation was equivalent to 270% of the average pre-anaesthetic flow, while the corresponding average fall in mean arterial pressure was equivalent only to 19% of the average pre-anaesthetic pressure. Therefore it is unlikely that alteration in

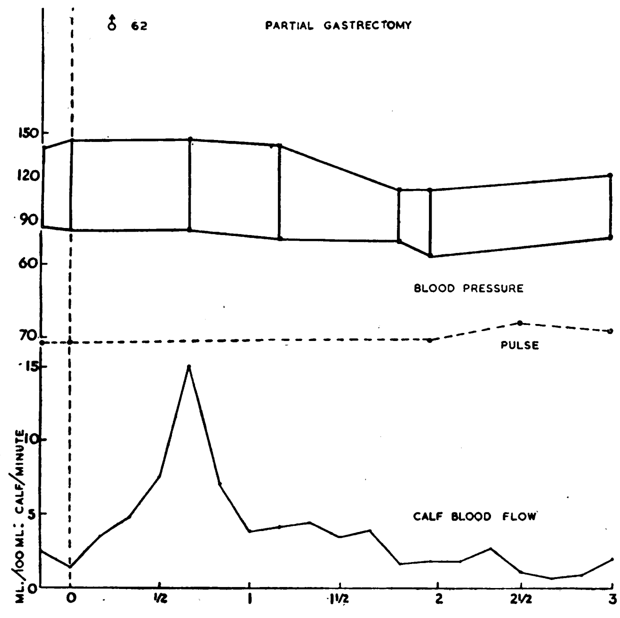

FIG. 4.

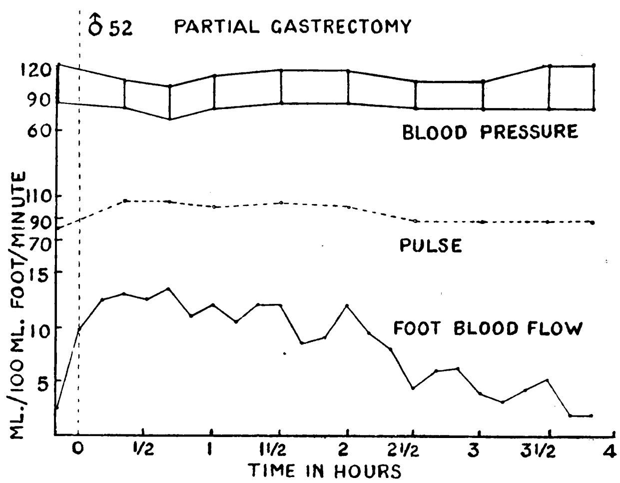

FIG. 5.

FIGS. 4 and 5 (Major Operations).—The increased limb flows are not maintained during the later phases of the operation.

mean arterial pressure alone could account for the large decrease in limb flow, and it is concluded that the change is due to a relative vasoconstriction in the peripheral circulation.

The rapid onset of vasodilatation after induction of anaesthesia suggests that the primary alteration in calibre of the peripheral vessels is an expression of release of normal vasomotor tone, and is due to the action of the anaesthetic agent on the vasomotor centre. But the vasodilatation could also be due to a direct action of the anaesthetic agent on the walls of the blood vessels (Cushny, 1928). The large distribution of vasomotor nerves to the skin, and the great number of arterio-venous anastomoses in the foot and hand (Lewis, 1936) could both equally well account for the relatively greater flows which develop in these regions.

The development of relative vasoconstriction in the later stages of the major operations probably expresses a circulatory readjustment for maintenance of the blood pressure. It occurs despite the fact that the amount of anaesthetic used increases in proportion to the length of the operation.

There is a limit to the duration and degree of vasoconstriction that can occur during lengthy major operations. This limit has not been determined, and may indeed vary from patient to patient. But it can be inferred that intense and prolonged vasoconstriction is indicative of maximal compensation and presages overt clinical shock.

We are grateful to Professor Henry Barcroft, of the Department of Physiology, St. Thomas's Hospital, for guidance.

REFERENCES

Abramson, D. I. (1944). *Vascular Responses in the Extremities of Man in Health and Disease.* University of Chicago Press, Chicago.
Barcroft, H., and Edholm, O. G. (1943). *J. Physiol.*, **102**, 5.
Cushny, A. R. (1928). *Textbook of Pharmacology and Therapeutics*, 9th ed. Churchill, London.
Foster, A. D., jun., Neumann, C., and Rovenstine, E. A. (1945). *Anesthesiology*, **6**, 246.
Lewis, T. (1936). *Vascular Disorders of the Limbs.* McMillan, London.

A hundred years ago last month the first conference on international health problems was held in Paris, when the representatives of 12 nations met to discuss quarantines and lazarettos in the Mediterranean. After six months' work the first International Sanitary Convention was signed. The Republic of Venice had introduced quarantine in the fifteenth century, and every maritime country eventually followed suit; but the systems used by the various governments were different and often conflicting. Also the cholera epidemic of 1832 had shown that the quarantine systems were unable to prevent the spread of disease and badly needed re-examination; the result of this situation was the Paris conference. From that time international co-operation steadily increased, and in 1907 the first permanent health organization was founded in Paris—the Office International d'Hygiéne Publique. Its duties were primarily to ensure the functioning of the quarantine conventions, to draw up new ones, and to act as a centre of information on pestilential diseases. Until it was absorbed by the World Health Organization in 1947 the Paris Office performed these tasks with ever-increasing efficiency. By the end of the 1914–18 war other health problems which required international action had arisen, such as the control of narcotic drugs, the international standardization of sera, vaccines, and so on; also there was the need for uniformity in the classification of the causes of death. The League of Nations Health Organization, the predecessor of W.H.O., was established in 1921. (A fuller account appeared in *The Times* of July 23.)

THE FAMILY DOCTOR AND DIABETIC COMA

BY

J. C. PEASE, D.M., M.R.C.P.
Senior Registrar, Radcliffe Infirmary, Oxford

AND

A. M. COOKE, D.M., F.R.C.P.
Physician, Radcliffe Infirmary, Oxford

Diabetic coma most frequently develops outside hospital, therefore we feel it important to draw attention to some of the ways in which the patient and his family doctor can prevent the onset of coma.

Since 1922 there has been a fall in the incidence of diabetic coma (Joslin, 1946). The reasons for this decline are the introduction of insulin therapy, the use of sulphonamide and antibiotic drugs, the increasing number of diabetic clinics—the last resulting in better control of both patient and disease—and a greater understanding of the disease by patient and doctor.

The mortality of diabetic ketosis has fallen because diabetic precoma is treated more effectively, with the result that fewer cases progress to coma, and also because the management of diabetic coma is improving each year. The chief factors responsible are the larger doses of soluble insulin given in the early stages of the illness, the more liberal use of intravenous fluids—a form of therapy revolutionized by the introduction of the "drip" method of transfusion (Marriott and Kekwick, 1935)—a clearer understanding of the type of fluids which should be given, the realization of the importance of gastric lavage, and the control of infections by sulphonamides and antibiotics. In spite of all these advances in treatment diabetic coma still occurs and all too often results in death.

The figures given in Table I illustrate the difference in prognosis between precoma and coma. The cases have been divided into two periods, each of nine years. October, 1941, was taken as the mid-point of the 18 years because the Radcliffe Infirmary Diabetic Clinic was started in that month. In defining diabetic precoma and coma we have used the former expression when a patient is conscious but drowsy from diabetic ketosis, and the latter when he is unconscious from the same cause.

TABLE I.—*Outcome of 111 Cases of Precoma and 74 Cases of Coma, 1932–50*

	Year	Alive	Dead	Survival
Coma	1932–1941 (Sept.)	2	34	·6%
	1941 (Oct.)–1950	15	23	39%
Precoma	1932–1941 (Sept.)	22	5	81%
	1941 (Oct.)–1950	80	4	95%

The four deaths which occurred between 1941 and 1950 in the precoma group were due to (1) pulmonary embolus, (2) toxaemia after amputation of a gangrenous leg (an anaerobic infection), (3) acute dilatation of the stomach, and (4) a cerebral vascular accident. In each instance the patient had recovered from the precoma but died within a few days of admission.

Comparison of the two periods shows that the prognosis for both precoma and coma has improved since 1941, but that the death rate for diabetic coma is still very high.