STUDIES IN LOBOTOMY*

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THIS REPORT presents the results of a systemic detailed investigation of the first series of psychotic patients at Ste. Anne's Hospital on whom bilateral prefrontal lobotomy was performed for alleviation of their mental illness. The research program was planned to study various metabolic and physiologic functions of these patients before and after the operation. It was considered of some importance to know what effects, if any, may result from the lobotomy procedure either directly from severance of the white matter in the frontal lobes or indirectly through a change in the mental reaction of the patients. It was also thought that any measurable changes in the metabolism or physiology, which may be brought about by this treatment, might aid in the understanding of the means by which frontal lobotomy produces its effects upon the schizophrenic process.

Some of the studies included in this series were: blood cytology, blood chemistry, carbohydrate metabolism, liver function, gastric secretion, gastro-intestinal motility, blood pressure responses to autonomic stimuli, respiratory function, bladder function and body weight.

A similar comprehensive investigation on a larger scale was carried out by the Columbia-Greystone Associates. Their results on a group of 24 topectomy cases and a series of controls were published in a detailed book in 1949.[1] Reference to this work and the results of other investigators in various phases of the effects of lobotomy will be made later in the paper.

CASE MATERIAL AND METHODS

Case material. — Thirty-three male patients were selected for operation. They were chronic schizophrenics (paranoid and catatonic subtypes) in whom other physical methods of treatment, such as electroshock and insulin-coma therapies, had failed and a lobotomy was considered the last resort. Three types of operative procedure (Freeman and Watts, McKenzie, transorbital) were used on this series of patients as shown in Table I. Selection of the cases for the type of operative procedure was done at random, eleven patients forming each group.

Since the selection of patients in the first instance was based primarily on therapeutic rather than investigative requirements, the number of cases for whom we present data varies according to their capacity to co-operate for the different tests. Table I shows the maximum number of co-operative patients before operation in each group. Not in all cases, however, was it possible to carry through the complete investigative program before and/or after lobotomy since some patients become more unco-operative after operation. Reference to this has been made in a previous report.[2] To compensate for this situation, the number of those tests which could be performed on the co-operative patients was increased. Each test was done two or three times before operation, and repeated several times at periodic intervals up to one year following operation. In this way each patient served as his own control and was studied over a longer period. The number of tests referred to in the results is thus much greater than the number of patients in each group.

No attempt is made here to describe the different operative techniques used. All operations were performed by Dr. Harold Elliott at the Queen Mary Veterans' Hospital in Montreal, and he has described the technical procedures in previous reports.[3, 4] It is perhaps worth mentioning that the conventional standard Freeman and Watts lobotomy is considered the most radical of the three techniques used in this study.

TABLE I.

	No. of cases studied	*Age at operation*		*Length of psychosis*	
		Average	*Range*	*Average*	*Range*
Group I (Freeman and Watts technique)..	8	27.3	23–34	4.5	3–7
Group II (McKenzie technique)..........	9	32.1	25–42	5.6	3–8
Group III (Transorbital technique)........	7	28.1	26–30	6.2	5–8

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Blood chemistry.—Blood sugar estimations were done by the Folin modification of the Folin-Wu method, adapted for the spectrophotometer. The pyruvate of blood was first stabilized with iodoacetate and then estimated by the method of Klein.[5] Total blood cholesterol was estimated by the method of Bloor, modified and adapted to the spectrophotometer. Total proteins and protein fractions, separated by Kingsley's modification of Howe's procedure (but at a 1 in 20 dilution), were done by the biuret reaction as described by Gornall.[6]

For the Bromsulphthalein test, the 5 mgm. per kg. dose was used and the reading taken 30 minutes after intravenous administration. The one hour intravenous hippuric acid test was utilized.

Gastric secretion.—Gastric analyses were done after a 12 to 14 hour overnight fast. An intranasal tube was used in all cases. After the fasting residuum was withdrawn, the volume of intermittent (or interdigestive) secretion of the stomach was measured every 15 minutes until a uniform basal rate of secretion was obtained. Usually the time required was one hour. After the volume and acidity of the basal secretion were determined, the gastric secretagogue was administered. The volume and free and total acidity of the gastric secretion in response to the stimulus were then measured at 15 minute intervals for 2 hours or until the basal rate of secretion was resumed.

Free and total acidity were determined on each specimen by titration with 0.1 N sodium hydroxide using Töpfer's reagent and phenolphthalein as indicators. Blood samples for glucose level were taken before and during the insulin test at 15 minute, ½, 1, 1½ and 2 hour intervals.

Four different stimuli for gastric secretion were investigated: (1) A histamine (0.5 mgm.) subcutaneous injection was used to study the gastric phase. (2) Insulin (8 to 15 units intravenously) stimulates the cephalic or nervous phase (vagal) by virtue of the hypoglycæmia which it induces. (3) In order to eliminate any indirect effects due to possible alterations in the carbohydrate metabolism or insulin sensitivity of these patients, prostigmine was utilized in another series of tests in doses of 0.5 mgm. intravenously. Being an anti-cholinesterase drug, it preserves the action of acetylcholine at the vagal nerve endings. (4) The psychic phase of gastric secretion was also studied in some patients by the method of Winkelstein[7] using an orange as the psychogenic stimulus, while in other circumstances the patient was allowed to see and smell some appetizing food with a savoury odour.

Cardiovascular system.—Prior to all tests, the patient was placed in the dorsal recumbent position and allowed to rest for a ½ hour. The blood pressure was then determined, on one arm, with a mercury sphygmomanometer at 2 minute intervals, until stationary values were obtained. Following this, the special test was performed. Measurements were made of changes in blood pressure, and in the case of the carotid sinus pressure tests, pulse rates were determined. During some of the tests, electrocardiographic records (Lead II) were taken.

The *cold pressor test* was performed according to the standard method of Hines.[8] After the baseline blood pressure was determined, one arm was placed in iced water (3 to 5° C.) with the water level above the wrist for one minute. The blood pressure was measured on the other arm at 30 second and one minute intervals during immersion, and at one minute intervals after removal of the hand from the cold water in order to detect delayed pressor effects. This test involves a local peripheral vasoconstriction to the cold, and is probably effective primarily as a means of sympathetic stimulation.

Epinephrine test.—After the control observations, epinephrine (0.05 mgm. in 1 ml. of normal saline) was given intravenously in 2 to 5 seconds, and the blood pressure measured at 30 second and at one minute intervals thereafter until it returned to pre-injection levels for three subsequent readings. In order to evaluate the emotional stimulus derived from the venipuncture, and its possible effect on the cardiovascular system, control injections of 1 ml. of normal saline were administered. The results of injection of physiological saline were essentially negative. Fluctuations in the blood pressure never exceeded 5 mm. Hg.

Carotid sinus pressure.—After stationary control values of pulse rate were obtained, physical pressure was applied to the carotid sinus, alternately to right and left sides. The duration and intensity of the pressure was varied so as to avoid producing loss of consciousness in those with a sensitive carotid sinus and to elicit a maximum effect in those with an insensitive carotid sinus. The maximum duration of pressure was about 60 seconds, the minimum about 15 seconds. Pulse rate counting was continued after the finger was removed from the carotid sinus until recovery to pre-stimulation levels was obtained.

RESULTS AND DISCUSSION

I. *Blood cytology.* Some of the results are shown in Table II. In addition, with each W.B.C. examination a complete differential count was done including the small and large lymphocytes. No significant changes were observed in any examinations with the possible exception of the sedimentation rate. There is a suggestion that, in all 3 groups, the first 3 months' postoperative examinations tended to be above the preoperative level. However, all of the results were more or less within considered normal ranges.

With each blood examination a prothrombin time was also done. Control readings were with bloods from non-mental hospital patients. Curiously, practically all prothrombin readings were anywhere from 1 to 10 seconds above the control readings. However, there was no significant difference between the preoperative and postoperative results.

II. *Blood chemistry.*—A great deal of blood chemistry was done on all the patients in groups 1, 2 and 3, both preoperatively as well as postoperatively. Some of these results are shown in Table III. We had anticipated that if any effects would be induced by these operative procedures, these would likely be shown in respect to the various aspects of carbohydrate metabolism. Insofar as blood pyruvate is concerned, it will be seen that there were no significant changes even though a great number of analyses were done. Similarly, blood cholesterol values showed no change.

In regard to total serum proteins, there may be a suggestion of a slight though non-significant drop in total proteins in the results secured in the first 3 postoperative months. It is possible that this is associated with postoperative trauma. The serum albumin results tend to show the same tendency. Simultaneously with each serum protein estimation, we carried out a quantitative globulin fractionation for total globulin, euglobulin and pseudoglobulin. There were no significant changes in any of these determinations.

A careful study of the results showed that in general there was an appreciable drop in serum cholesterol, total proteins and albumin the first week or two after operation. The serum proteins tended to return to preoperative levels within a week to 10 days after operation; the cholesterol levels tended to remain low for 2 to 3 weeks after operation. These decreases probably are not peculiar to prefrontal lobotomy in schizophrenics, as similar decreases have been noted in these constituents in non-schizophrenic patients following a major operation. There were no particularly significant changes in serum globulins.

III. *Carbohydrate metabolism.* In order to obtain further information on possible effects on carbohydrate metabolism a great number of oral and intravenous glucose tolerance tests were done both preoperatively as well as postoperatively. Generally at least one test pre- as well as post-operatively were done per patient—in many instances the tests were repeated at monthly intervals up to one year and 4 months postoperatively. The results are graphically

TABLE II.

BLOOD CYTOLOGY

	Group I			Group II			Group III		
	No. of tests	*Average*	*Range*	*No. of tests*	*Average*	*Range*	*No. of tests*	*Average*	*Range*
R.B.C.									
Preoperative........	8	5.2	4.7–5.9	6	4.9	4.3–5.7	6	4.9	4.5–5.1
Postop. first 3 mos...	8	4.9	4.6–5.3	2	5.3	5.2–5.4	10	4.6	4.1–4.9
Postop. 3 to 12 mos...	12	5.0	4.4–5.2	6	4.9	4.7–5.1	2	4.8	4.8–4.9
Hæmoglobin									
Preoperative........	8	16.2	14.8–17.7	16	15.0	13.0–18.2	15	15.6	14.1–17.0
Postop. first 3 mos...	9	14.9	12.9–15.6	11	15.1	12.0–17.8	13	14.5	12.2–15.6
Postop. 3 to 12 mos..	22	15.5	13.8–17.0	16	15.3	13.4–16.6	2	15.2	15.2
W.B.C.									
Preoperative........	8	7.2	5.3–9.7	15	7.0	4.4–10.1	15	6.6	4.2–11.2
Postop. first 3 mos...	9	8.0	5.2–16.0	11	7.0	5.2–10.9	13	6.2	5.0–7.7
Postop. 3 to 12 mos..	22	6.3	4.4–8.1	17	6.8	4.6–9.1	2	6.0	5.2–6.9
Sed. rate (Westergren)									
Preoperative........	7	7.4	1–21	16	5.4	1–13	15	6.6	2–17
Postop. first 3 mos...	7	9.6	5–20	11	7.0	2–23	12	8.4	3–17
Postop. 3 to 12 mos..	22	9.1	2–35	17	6.2	2–23	2	9.0	3–5

TABLE III.

BLOOD CHEMISTRY

	Group I			Group II			Group III		
	No. of tests	*Average*	*Range*	*No. of tests*	*Average*	*Range*	*No. of tests*	*Average*	*Range*
Pyruvic acid (mgm. per 100 ml.)									
Preoperative........	11	1.0	0.7–1.8	12	1.2	0.7–2.2	12	1.1	0.7–1.6
Postop. first 3 mos...	9	0.9	0.6–1.4	9	1.1	0.9–1.3	11	1.0	0.6–1.3
Postop. 3 to 12 mos..	18	1.0	0.6–1.3	15	1.1	0.7–1.6	2	0.8	0.7–0.8
Cholesterol (mgm. per 100 ml.)									
Preoperative........	9	162	111–224	15	156	119–185	12	158	139–167
Postop. first 3 mos...	6	161	139–185	15	156	128–185	10	161	151–175
Postop. 3 to 12 mos..	19	163	119–275	14	163	145–196	2	167	167
Total protein (gm. per 100 ml.)									
Preoperative........	8	7.2	6.8–7.9	12	7.5	6.6–8.5	11	7.6	6.7–9.6
Postop. first 3 mos...	5	6.9	6.3–7.4	10	7.1	6.2–8.1	12	7.2	6.3–9.2
Postop. 3 to 12 mos..	16	7.3	6.1–8.8	13	7.1	6.1–8.5	2	7.4	7.3–7.5
Albumin (gm. per 100 ml.)									
Preoperative........	8	3.7	2.5–5.8	11	3.8	3.1–4.4	11	3.9	3.3–4.5
Postop. first 3 mos...	5	3.6	3.4–4.9	10	3.8	3.4–4.4	12	3.6	3.0–4.2
Postop. 3 to 12 mos..	16	3.9	3.3–4.7	13	3.9	3.0–4.8	2	3.4	3.1–3.6

illustrated in Figs. 1 and 2. Each point on these graphs represents an average of from 7 to 32 individual analyses.

In general the uniformity is quite surprising. There is no significant change resulting from the operation. However, there is uniformly a significant delay in return to normal which definitely seems to be specific to the group of patients we were dealing with. This may very well signify a lack or delay in insulin secretion resulting from high blood sugar.

At first we had not intended to do insulin sensitivity studies in regard to blood sugar levels. However, insulin was used as a stimulant for gastric secretion and, with this, repeat blood sugar determinations were made. In most instances readings were taken at pre-injection, then at 15, 30, 60, 90 and 120 minutes post-injection.

The dosage of insulin varied from 8 to 15 units insulin (this would correspond approximately to from 0.1 to 0.2 units per kg. body weight). With the exception of 2 or 3 uncooperative patients, the preoperative insulin tolerance curves were quite typical of those obtained in normal people given approximately 0.1 unit per kg. intravenously.

Postoperatively repeat insulin sensitivity studies were done on all patients up to as many as 16 tests within an 18 month period. Four patients, one in group 2 and 3 in group 1, showed marked but variable resistance to as much as 50 units of insulin given in 2 doses one hour apart. In 3 of these patients this resistance of blood sugar to intravenously administered insulin has persisted up to one year and 4 months postoperatively. One patient, however, showed resistance for the first 6 months postoperatively, but since then has shown a normal sensitivity.

The other patients in the group showed no particular tendency towards a resistance to insulin.

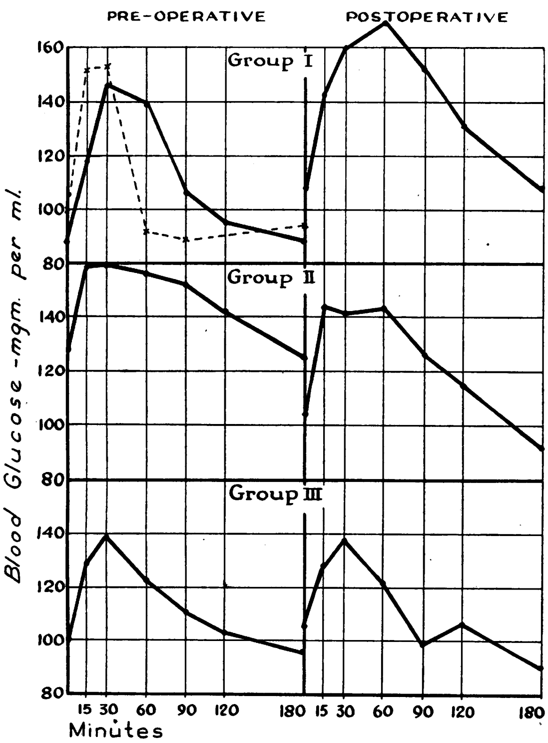

Fig. 1.—Oral glucose tolerance tests.

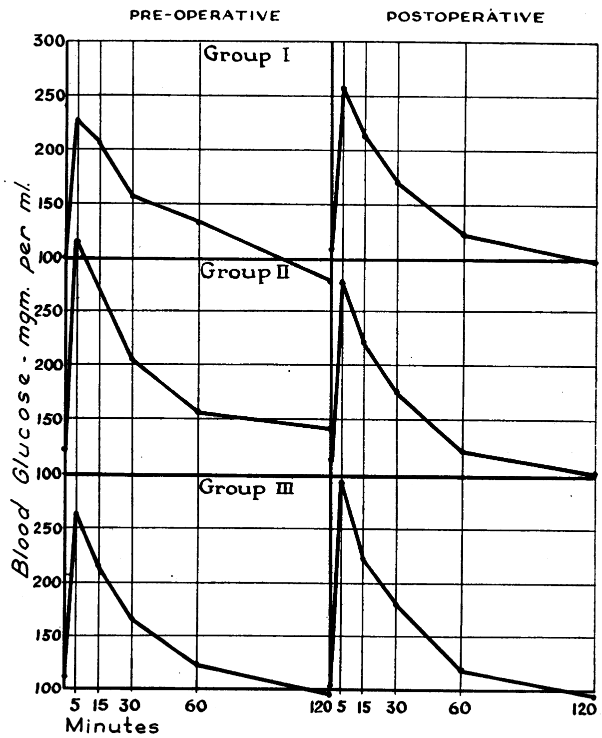

Fig. 2.—Intravenous glucose tolerance tests.

IV. *Liver function tests.*—In addition to the studies reported above, repeated hippuric acid excretion as well as Bromsulphthalein retention tests were done preoperatively as well as postoperatively. The results are tabulated in Table IV. There were no significant changes evident as a result of the operation.

Repeated cephalin-cholesterol flocculation tests were also done monthly on all the patients pre- as well as post-operatively. Five of these showed fairly persistent abnormal results varying from 2+ to 4+. They were all catatonics. One had a history of jaundice some years previously.

V. *Respiratory function.*—Numerous B.M.R. measurements were done on most patients pre- and postoperatively. Many of these results had to be discarded because of incomplete relaxation of patients during the test. However, those secured with a minimum or no disturbance during the test were all recorded. We accepted a ± 15% change of B.M.R. as being within the normal range. The odd single reading was outside the normal range. Nevertheless, with very few exceptions all the readings fell within the normal range and there was no indication whatsoever of a change postoperatively as compared to the preoperative results. If anything, there seems to be a slight suggestion of a small decrease in those patients who showed a maximum gain in weight.

The respiratory rate and vital capacity studies were also done repeatedly on these patients. None of these results showed any significant tendency to change as a result of the operative procedures.

VI. *Gastric secretion.*—The results of the different types of gastric tests before and after lobotomy are shown in Table V. After an analysis of the individual results in every case was studied, it was decided to combine all the data for each series of gastric tests and treat them as one group. The reasons for this method were: (a) There was an insufficient number of patients in each operative group to make a valid comparison as to type of operation, and (b) no additional information could be gained by presenting the results of each patient separately owing to extreme individual variation.

The results of each series of tests were analyzed similarly. An estimation of the average 15 minute volume and acidity (free and total) secreted over a 1½ or 2 hour period post-stimulation was made for all tests on the patients studied before and after lobotomy. Likewise the maximum volume and acidity per 15 minute interval secreted in response to the stimulus were averaged and recorded. The maximal secretion

TABLE IV.

LIVER FUNCTION TESTS

	Group I			Group II			Group III		
	No. of tests	*Average*	*Range*	*No. of tests*	*Average*	*Range*	*No. of tests*	*Average*	*Range*
Hippuric acid (gm.)									
Preoperative........	8	1.53	0.50–3.58	11	1.64	0.15–4.00	9	1.51	1.02–2.17
Postop. first 3 mos...	6	2.21	1.22–3.21	3	1.18	0.98–1.88	8	1.56	1.02–1.94
Postop. 3 to 12 mos..	10	1.56	0.42–2.57	15	1.52	0.84–2.07	4	1.80	1.66–1.95
B.S.P. %									
Preoperative........	9	5.88	2.6–10.0	12	4.45	1.9–8.3	13	5.22	1.0–13.8
Postop. first 3 mos...	6	6.98	4.0–10.0	8	3.36	1.9–8.0	8	4.82	1.9–9.0
Postop. 3 to 12 mos..	10	3.69	1.0–7.9	9	3.68	1.1–6.4	3	5.16	3.6–7.9

TABLE V.

	No. of tests	*Average volume* Per 15 min.	*Max. 15 min.*	*Average free acid* Per 15 min.	*Max. 15 min.*	*Average total acid* Per 15 min.	*Max. 15 min.*
Histamine							
Preoperative.........................	25	28.1	43.5	57.8	74.6	67.6	87.5
Postoperative first 3 months...........	14	25.6	40.6	55.9	76.9	64.7	86.5
Postoperative 3 to 12 months..........	12	23.0	38.4	44.1	76.0	54.2	85.3
Prostigmine							
Preoperative.........................	29	32.3	58.6	32.9	36.6	43.3	46.4
Postoperative first 3 months...........	15	28.8	43.3	32.1	35.1	41.6	45.1
Postoperative 3 to 12 months..........	12	34.2	61.0	24.5	34.2	34.0	43.2
Insulin							
Preoperative.........................	21	32.5	45.6	68.8	86.7	79.1	97.5
Postoperative first 3 months...........	11	34.5	51.2	65.2	83.7	74.5	93.3
Postoperative 3 to 12 months..........	26	31.0	51.4	51.3	63.2	66.1	74.2
Psychic							
Preoperative.........................	12	17.6	22.7	32.5	41.8	44.7	54.6
Postoperative first 3 months...........	8	14.8	21.4	42.1	44.6	53.4	55.1
Postoperative 3 to 12 months..........	14	14.7	19.4	20.0	24.3	30.3	35.7

in the insulin tests invariably occurred at the time when the blood sugar was at its lowest level.

It was apparent that the average figures could obscure any individual changes from pre- to post-operative period within the group. However, no uniformity in trends was observable and the stability of the average figures in the table was not due to an equal number of patients showing either an increase or decrease in their results. The ranges of variability are not indicated in the table for purposes of clarity in presentation

TABLE VI.

	No. of tests	Average volume	Average free acid	Average total acid
Residual				
Preoperative	87	30.2	32.8	44.6
Postoperative first 3 months	48	32.8	27.8	32.1
Postoperative 3 to 12 months	64	35.7	22.0	27.7
Basal secretion (average 15 min.)				
Preoperative	87	18.0	29.8	39.9
Postoperative first 3 months	48	16.7	26.3	38.0
Postoperative 3 to 12 months	64	16.0	21.0	32.2

TABLE VII.

	No. of tests	Average Systolic	Average Diastolic	Range
Group I				
Preoperative	27	120.8	68.9	Sys. 108–132 Dias. 50– 80
Postoperative first 3 months	26	114.6	69.5	Sus. 103–140 Dias. 53– 90
Postoperative 3 to 12 months	28	114.7	72.0	Sys. 105–132 Dias. 60– 80
Group II.				
Preoperative	24	115.8	72.7	Sys. 100–134 Dias. 60– 94
Postoperative first 3 months	16	113.6	70.2	Sys. 104–127 Dias. 48– 85
Postoperative 3 to 12 months	13	114.3	73.8	Sys. 106–124 Dias. 60– 86
Group III				
Preoperative	12	117.0	77.6	Sys. 99–130 Dias. 62–100
Postoperative first 3 months	10	116.9	77.6	Sys. 106–124 Dias. 70– 82
Postoperative 3 to 12 months	3	109.6	77.0	Sys. 104–121 Dias. 70– 87

of the results. The variability was within the expected range considering the difficulties attendant upon an investigation of this type on psychotic patients. There was as much variation in the results before operation as occurred after operation.

From the figures presented in Table V it is evident that there was no change in the gastric secretion (volume and acidity) in response to either histamine or prostigmine after operation. Both of these drugs act peripherally on the gastric glands. In the case of the psychic secretion and cephalic stimulation of the gastric secretion with insulin, there was a tendency for the acidity (free and total) to decrease in the later postoperative periods (4 to 12 months). However, the number of patients studied during this period was too small to make this observation a significant one; and besides, it was not a consistent change in all the patients studied.

Further analysis of the data on basal secretion (Table III) obtained in the gastric studies indicated that this latent reduction in acidity in response to psychic or cephalic stimulation may not be a specific phenomenon but rather a reflection of the general tendency of the gastric acidity of these lobotomy patients to diminish with time. This could be due to their quieter disposition, being less excited or disturbed by the procedure during this period. Table VI is a summary of all the data on the residual and basal secretion volumes and acidity obtained from every gastric test on all patients investigated before and after lobotomy. It can be seen that without the administration of a gastric stimulant the trend after operation was a lower acidity with increase in time after operation.

There have been varied reports in the literature concerning the effects of lobotomy on gastric secretion. These were done in the early postoperative periods and none could be found with a follow-up of one year. An increased acidity was noted by Reed[9] in response to a testmeal 4 to 6 weeks after operation. Petersen and Buchstein[10] also noted an increased acidity in response to histamine after lobotomy. Varga *et al.*[11] using histamine, caffeine and insulin before and after prefrontal lobotomy noted a "diminished acid-secreting activity of the gastric glands" both in humans and dogs. Other investigators found no significant difference in the amount of gastric secretion or the gastric acidity after frontal lobe surgery. Peyton *et al.*[12] state that the volume and acidity of the average 24 hour gastric secretion, and also in response to insulin injection, were not changed in 10 patients with prefrontal lobectomy. Carpenter[13] studied gastric acidity in response to a testmeal, adrenaline and insulin in a group of bilateral frontal topectomy patients. He found no demonstrable effect on gastric secretion within 5 weeks after surgery. The results in our series of gastric tests before and after lobotomy in general tend to agree with these latter authors.[12, 13]

VII. *Blood pressure.*—The average results of several blood pressure readings before and after lobotomy are recorded in Table VII. The postoperative recordings were made after the patients had recovered from the immediate effects of the operation (approximately 10 days). The resting blood pressure values were all within the normal range. The average figures for Groups I and III in the table seem to indicate a tendency for the systolic blood pressure to diminish after operation. But these changes were small and within an expected range of variability, considering that with time the patients were more able to relax for the tests. In this connection it is of interest to note that Chapman *et al.*[14] found no consistency in the results of blood pressure on lobotomy patients up to one year after operation.

Response to epinephrine.—The average figures presented in Table VIII are based on the changes observed at the peak of response to the stimulus as compared to resting blood pressure values. All groups showed an average increased systolic pressure response to epinephrine within the first 3 months after operation. This was a fairly consistent result in the majority of individual patients. No consistent changes or trends were observed in the diastolic pressures of these patients. In Groups II and III the change was of a transitory nature and stability was usually achieved at preoperative levels after 3 months. In Group I the response to the drug gradually increased with time and was sustained up to one year after operation. No explanation for this effect can be offered other than the fact that the patients in this group had a more

TABLE VIII.

	Group I			Group II			Group III		
	Average change	*No. of tests*	*Range*	*Average change*	*No. of tests*	*Range*	*Average change*	*No. of tests*	*Range*
RESPONSE TO EPINEPHRINE									
Systolic B.P.									
Preoperative	58.8	16	28–110	72.1	14	50–90	64.9	11	44–80
Postop. first 3 mos.	66.6	16	54–88	81.9	9	64–112	70.1	8	26–96
Postop. 3 to 12 mos.	81.7	23	54–116	71.6	10	56–64	59.3	3	40–80
Diastolic B.P.									
Preoperative	18.6	14	–40 to 60	26.1	14	–30 to 40	22.4	10	–34 to 38
Postop. first 3 mos.	18.3	16	–30 to 50	31.9	9	20–50	20.3	8	–18 to 28
Postop. 3 to 12 mos.	27.7	23	–20 to 56	21.6	10	–24 to 30	18.6	3	–30 to 16
RESPONSE TO COLD PRESSOR TEST									
Systolic B.P.									
Preoperative	14.5	30	0–36	15.6	25	2–30	18.0	23	4–34
Postop. first 3 mos.	21.6	32	12–43	20.4	17	10–34	20.3	13	2–40
Postop. 3 to 12 mos.	15.1	34	2–34	17.6	16	8–30	12.8	5	4-32
Diastolic B.P.									
Preoperative	18.0	30	6–42	13.6	25	0–44	19.2	23	4–38
Postop. first 3 mos.	15.8	32	0–44	17.1	17	6–32	24.6	15	8–44
Postop. 3 to 12 mos.	13.4	34	0–40	21.6	16	10–38	12.4	5	0–18

radical type of operation (Freeman and Watts), whereas the patients in Group III who showed least change from preoperative levels had a less severe type of lobotomy (transorbital).

Rinkel *et al.*[15] reported an "overreaction" in the pressor response to epinephrine after lobotomy; whereas, Glaser[16] noted a slight, transient hyper-reaction to the drug after topectomy.

Cold pressor test.—The average systolic pressure in each group of patients represented in Table VIIII showed a transient increased reaction within the first 3 months after lobectomy. Again the greatest average systolic increase (7.0 mm. Hg.) occurred in Group I and the smallest (2.0 mm. Hg.) in Group III. There was a concomitant change in diastolic pressure in Groups II and III, whereas Group I showed a slight decrease.

Examination of the early postoperative data indicated that most of the rise in systolic pressure in response to the cold pressor test occurred during the first month after operation. This is an interesting observation in view of the fact that many of the patients during this period showed an increased sensitivity to unpleasant stimuli in general. Reference to this transitory increased reaction to obnoxious stimuli has been made in a previous report.[2] It would be justifiable, therefore, to conclude that the transient increased blood pressure response to the iced water could be the result of an increased subjective psychic reaction to the stimulus, rather than an enhanced local peripheral vasoconstriction. Glaser[16] also attributes changes in the cold pressor test results to the "emotional reactivity" of chronic schizophrenic patients after frontal topectomy.

Carotid sinus pressure.—Results of pressure on the carotid sinus were inconsistent. There was no evidence of any increased sensitivity of the carotid sinus after lobotomy. The percentage of cases responding to the pressure stimulus with a slowing of the pulse rate was the same before and after operation. Nor was it easier to elicit a response after lobotomy. This is contrary to the findings of Rinkel *et al.*[15] who noted a definite increased reaction to carotid sinus pressure in a group of lobotomy patients.

VIII. *Body weight.* In all patients the body weights were followed very carefully before as well as after operation. The results reported pre- as well as post-operatively are recorded in Table IV. These show that there were marked changes. Twelve patients showed an appreciable increase in body weight during the first 6 months

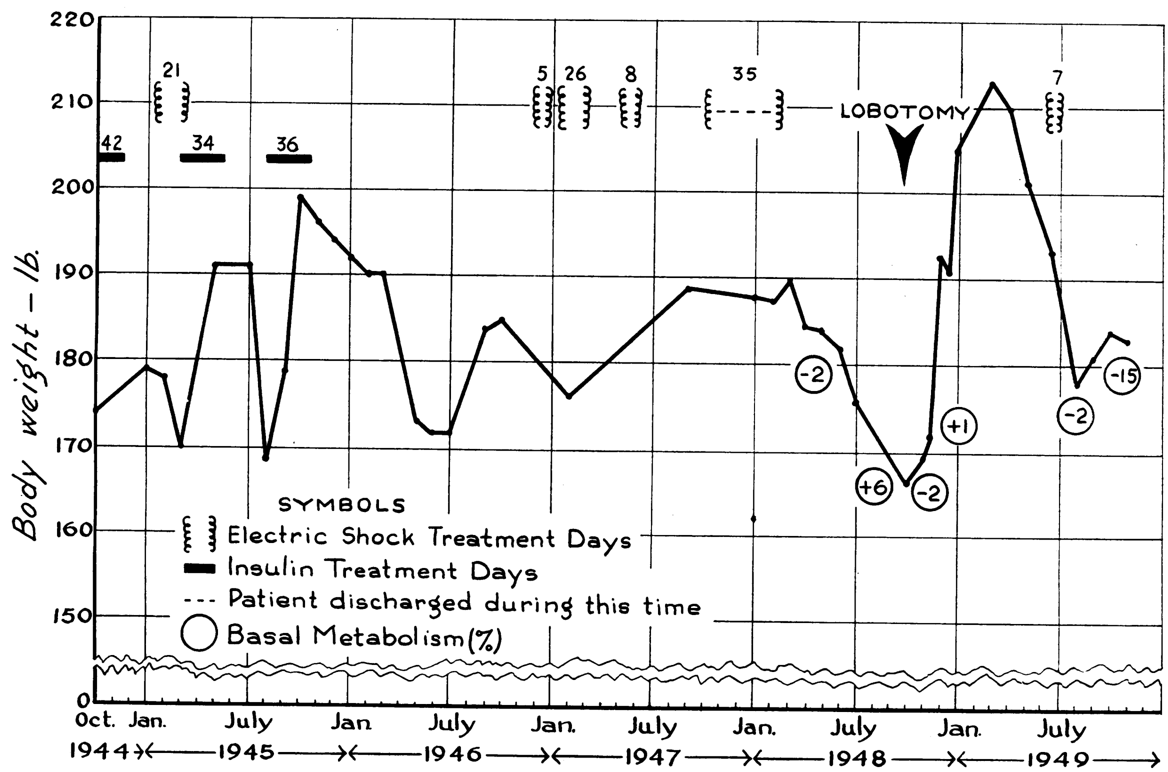

Fig. 3.—Changes in body weight with therapy: patient A.M.

postoperatively. On the other hand, 21 patients showed no change in body weight or an appreciable decrease.

All of these patients had had other forms of treatment prior to lobotomy, namely ICT and EST. Most patients showed similar changes in body weight, although to a lesser degree, following these other forms of treatment. It seems to us that these changes are purely the result of variations in food intake by these patients. A typical result on one patient is shown in Fig. 3. This shows the marked fluctuations in body weight usually associated with any form of treatment.

SUMMARY AND CONCLUSIONS

In this report we have briefly reviewed the comprehensive studies that have been carried out in a group of 33 psychotic patients before and after lobotomy. These studies included blood cytology, blood chemistry, carbohydrate metabolism, liver function, gastric secretion, blood pressure responses to autonomic stimuli, respiratory function and body weight. In general our findings have been similar to results that have been published by other authors. Although very interesting, they have not given much additional aid in understanding how lobotomy produces its effect upon the schizophrenic process, nor have they helped greatly towards better selection of patients for this treatment.

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A POST-SANATORIUM INSTITUTION FOR REHABILITATION IN TUBERCULOSIS

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THE DEPARTMENT of Veterans' Affairs of Canada quietly opened the doors of a tuberculosis rehabilitation centre in London, Ontario, for the benefit of the Canadian veteran of World War II, on July 14, 1947. Dr. R. A. Benson, as Medical Superintendent of the Peterborough Veterans' Hospital for tuberculosis, and Edward A. Dunlop, as superintendent of Casualty rehabilitation for the Department of Veterans' Affairs gave birth to the idea. The institution was proposed on the fact that convalescent health and occupational centres had been established to care for all casualties other than those veterans suffering from tuberculosis, while there was also felt the great need for the availability of such a post-sanatorium rehabilitation institution for all persons who had required sanatorium treatment. It is known as Western Counties Veterans' Lodge.

We are all aware of the fact that in-sanatorium rehabilitation in tuberculosis is essential. We know, unfortunately, that in the post-sanatorium period there still exists for many nothing but the out-dated home convalescence. There are, however, many varied programs throughout the world. Without elaborating on these, it is the purpose of this article to explain the method of institutional rehabilitation in tuberculosis, as it was offered by the Department of Veterans' Affairs of Canada to the veterans who were anxious to accept further "institutional" rehabilitation in the post-sanatorium period.

THE PATIENT OR REHABILITANT

The people coming to this centre were all male veterans accepting admission on a voluntary basis. The centre has operated for three and a half years, with a capacity of 150 "living-in" patients. The source of veteran patients was insufficient to maintain more than an average strength of about 140 for a period of one year.