A cohort study of psychosurgery cases from a defined population

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SUMMARY All cases from an urban population treated by psychosurgery over a 20 year period were followed up; 44 out of 47 were available for study, and 33 of these were interviewed. Outcome was measured on a five-point scale, and follow-up was from 1 to 20 years, with a mean of 11; almost all patients previously had had severe, disabling and intractable illnesses. Operations were non-stereotactic (36), stereotactic (6), with double procedures in one case: outcome was better in the non-stereotactic group. On a five-point scale of outcome, 25 of the 33 interviewed patients were placed in the two best categories, as were eight patients of the 11 who were assessed by case records. Adverse effects were reported in 14 cases, but most were not serious. Only one death could definitely be related to operation. Depression, agoraphobia, obsessional neurosis, and certain aspects of schizophrenia all responded well in the majority of cases. Leucotomy should remain available as a treatment of last resort for some intractable psychiatric disorders.

Psychosurgery was one of the earliest physical methods of treatment in psychiatry, having been developed in the late 1930s and coming into widespread use in the 1940s. At that time, the operative procedures were relatively crude, the indications not clearly understood, and the selection of patients often over-enthusiastic; as a result, it is not surprising that the procedure tended to attract increasingly critical attention.¹ However, it would be unjust to suggest that the whole effort was unhelpful or even harmful; at a time when there were very few treatment options for severe psychiatric disorder, many patients suffering from intractable schizophrenic, depressive or neurotic illnesses appeared to benefit greatly. Any such good results, though, tended to be lost in large series, which contained many unsuitable cases.

With the passage of time, the numbers treated by leucotomy have steadily fallen, and in many countries no operations at all have been done for some years. This is partly the result of progress in other forms of psychiatric treatment, particularly medication, but even more the effect of attacks on psychosurgery from outside the professions concerned. For the anti-

psychiatric movement which developed in the mid-1960s, physical methods of treatment were a principal target, and amongst these, leucotomy was singled out for specially adverse attention. In the British Isles, an average of 3.4 operations per million population aged over 15 years were performed during the period 1974-6; mood disorders, anxiety states, and obsessive-compulsive neurosis were the conditions most commonly treated.² The 1983 Mental Health Act has laid down particularly stringent conditions for leucotomy, so that the number of operations currently being performed is very small indeed (37 in England & Wales in 1983).

However, it may be that the pendulum has swung too far away from psychosurgery: in the spectrum of psychiatric disorder, there are still patients who experience intractable distress or disability, even when all non-invasive treatment methods have been fully tried. It therefore seemed important to us to assess the results of the operation, particularly over long periods of time, in a sample of patients who had been treated in relatively recent years. Although all groups of leucotomy patients are, in the nature of things, selective, the value of this information might be enhanced by adopting an epidemiological approach, that is, by taking every person from a defined population who had been treated in this way during a specified period. This would avoid the very marked degree of selectivity which occurs when patients come to a specialised centre from all over the

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country. The results might also be more generally useful if coming from a normal clinical service within the National Health Service, rather than from one with unusually rich resources. This was the background to our study.

Subjects

All subjects were investigated who had received leucotomy operations during the period 1960–80, and at the time of operation lived within the present boundaries of the City of Salford. The overall population has shown a small decline during this period, but is generally very stable and is now a little under 250,000; most residents were born in the area, and any migration is usually quite local.

The Department of Neurosurgery, Salford Royal Hospital has complete records of all operations done there since the service began in the 1940s, and the Salford Psychiatric Case Register has records of all psychiatric contacts in the former borough since 1968, and all in the present city since 1975.³ Examination of records, and local knowledge, makes it almost wholly certain that no Salford residents had leucotomy operations during the study period at any hospitals other than Salford Royal Hospital, the Brook Hospital, Manchester Royal Infirmary, and North Manchester General Hospital. The total number of patients fulfilling the study criteria was 47, but two had to be excluded because no information on them other than their names could be obtained from any other source; one patient died in the post-operative period, and was therefore included only in the category of deaths. The final total of subjects for study was therefore 44 (32 females and 12 males); their ages at operation ranged from 22 to 69 years.

Study design

Assessment generally followed the method reported by Goktepe *et al.*;⁴ it involved both clinical and social aspects, and was done in two successive stages. In Stage 1, information was extracted from the records of patients, using a specially devised structured schedule, based on that used by Goktepe *et al.*⁴ A provisional assessment of outcome was made, using a five-point scale, on the basis of: degree of clinical recovery, treatment required, and presence of side-effects severe enough to influence the above parameters. In Stage 2, which was performed blind to Stage 1, each patient received a standardised interview, as did a close relative or other informant, who was seen first for the purpose of applying the Katz Adjustment Scale (KAS) to assess the patient's level of social functioning.⁵ This consists of Form R2, which has 16 items indicating level of performance of socially expected activities, and Form R3 with identical items for the level of expectation for performance of social activities. The discrepancy score, arrived at as a function of expectation and performance scores, will be presented in the analysis. Then the patient and the informant were jointly seen, using the structured interview of Goktepe *et al.* with slight modifications.

An overall rating of improvement since the operation was made using a five-point scale, based on that devised by Pippard⁷ and subsequently used by Strom-Olsen & Carlisle⁸

and by Mitchell-Heggs *et al.*⁹ However, level of social functioning was emphasised, rather than the use of treatment, as proposed by Bridges *et al.*¹⁰ The definitions used in this study were those of Goktepe *et al.*:

- I *Recovered* No symptoms, no relapses, no treatment required. Full-time job or potential for full employment (male). Full capacity for housework or work (female). Satisfactory marriage.
- II *Well* Mild residual symptoms and/or occasional mild relapse which has little or no interference with daily life. Full-time job or potential for full employment (male). Full capacity for housework or work (female). Satisfactory marriage.
- III *Improved* Significant symptoms remain and/or several relapses. Changes of work and/or absences of work due to illness (male). Manages little housework or unable to work (female). Unsatisfactory marriage.
- IV *Unchanged* Unable to work (male). Unable to care for house and family (female).
- V *Worse* Severely incapacitating.

All ratings were carried out by the same person (ESH); he was not blind to the fact that the patient had undergone psychosurgery, but we could not find a satisfactory way round this problem. Assignment of patients to a particular outcome category also involves some degree of subjectivity, which is unavoidable.

Diagnosis Since all but two patients were under the care of one of two consultant psychiatrists, the diagnosis of the referring psychiatrist was accepted, because of his long-term knowledge of the patient. However, all patients had received intensive clinical scrutiny whilst psychosurgery was being contemplated, and they were invariably referred for a second opinion. The validity of these diagnoses was checked by examining the case records, and the final classification is in accordance with the WHO Ninth Edition of the International Classification of Diseases. Among the nine patients given the diagnosis of schizophrenia, five had shown one or more Schneiderian first-rank symptoms, two showed primary delusions, and a further two a combination of other delusions and schizophrenic features.

Follow-up Out of 44 patients, 33 were personally interviewed (by ESH), and an informant was also seen in all but two cases. The reasons for lack of contact in the remaining cases were: death, 6 (but information was obtained about two of these from an informant); refusal, 2; could not be traced, 2; and moved away, 1 (but the casenotes from there were examined). The follow-up periods for the sample ranged from 1.08 to 20.16 years, the mean being 11.02. In the case of patients who were not interviewed, their follow-up periods are counted up to the time they were last seen by a psychiatrist; in the case of those who had died, it was up to the time of their death. The follow-up periods were grouped as follows: 0–4 years (1 male, 5 female); 5–9 years (7 male, 7 female); 10–14 (4 male, 13 female); 15–19 (6 female) and 20–24 (1 female).

Results

These are summarised in the table.¹ The fact that 11 patients were not seen could introduce bias into the sample; therefore, to throw light on the number of

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occasions in which there was disagreement between the two phases of assessment, in the case of the 33 patients who were interviewed, their outcome based on case records (Stage 1) was compared with their outcome after being fully assessed (Stage 2) (table 2). It can be seen that there is disagreement on three occasions only, but this is within the "good" outcome grade. Therefore one can conclude that casenote

procedure gave a no more optimistic account than did the interview.¹¹

The illnesses The primary diagnoses of the sample were: Depression (ICD 296.1)—15; Schizophrenia—9 (7 paranoid type, 295.3, and 2 hebephrenic, 295.1); Agoraphobia (330.2)—6; Obsessive-compulsive neurosis (300.3)—5; Hypochondriasis (300.7)—3; Schizo-affective psychosis (295.7)—3; Anxiety states

Table 1 Details of patients

a) Data on patients who were interviewed

Io	Diagnosis	Duration of illness prior to surgery (years)	F/U period (years)	Psychosurg technique ¹	Sex	Age (r)	Outcome	Reported side-effect
1	Hypochondriasis	15	14.4	NS	F	62	I	Nil
2	Depression	4	13.10	"	F	56	I	Nil
3	Agoraphobia	4	9.10	"	F	34	I	Nil
4	Obsessive-Compulsive	9	20.2	"	F	56	I	Nil
5	Obsessive-Compulsive	3	15.1	"	F	32	I	Occ. outspokenness increased volubility
6	Depression	2	15.5	"	F	49	I	Nil
7	Manic-depressive	5	11.10	"	F	52	I	Only 1 epileptic fit, 3yrs after surgery
8	Depression	6	13.6	"	M	48	I	Occ. outspokenness & lack of consideration. Forgetful
9	Depression	7	9.10	"	M	51	I	Nil
0	Hypochondriasis	4	15.10	"	F	62	I	Nil
1	Depression	2	13.11	"	F	35	I	Nil
2	Agoraphobia	5	13.10	"	F	38	I	Occ. irritability & lack of consideration
3	Depression	3	8.11	"	M	52	I	Nil
4	Obsessive-Compulsive	5	8.4	"	M	59	I	Occ. irritability & lack of consideration. Epileptic fits (6-10) on anti-convulsant
5	Depression	20	7.4	"	F	55	I	Hypomaniac episodes (2) within 1st yr of surgery
6	Agoraphobia	10	13.5	"	F	39	II	Occ. epileptic fit on anti-convulsants. Forgetful
7	Agoraphobia	4	13.5	"	F	26	II	Nil
8	Agoraphobia	6	14.2	"	F	27	II	Nil
9	Depression	11	14.6	"	F	42	II	Nil
0	Depression	8	5.7	"	M	52	III	Hypomaniac episodes (2) within 6 mths of surgery. Urinary incontinence at night
1	Depression	10	7.8	S	F	34	III	Nil
2	Hypochondriasis	3	0.6	"	F	60	IV	Nil
		4	6.11	NS	F	61	III	Nil
3	Depression	10	15.9	"	F	37	IV	Nil
4	Depression	16	1.2	S	F	69	V	Severe frontal lobe syndrome
5	Schizophrenia. Referred for obsession	4	13.1	NS	M	22	I	Nil
6	Schizophrenia. Referred for depression	5	12.9	"	F	49	I	Nil
7	Schizophrenia. Referred for depression	13	14.5	"	F	47	I	Nil
8	Schizophrenia. Referred for depression	3	15.7	"	F	39	II	Occasional forgetfulness
9	Schizophrenia. Referred for hypochondriasis	7	12.5	"	M	42	II	Nil
0	Schizophrenia. Referred for anxiety and hypochondriasis	3	8.3	S	F	53	II	Nil
1	Schizo-affective. Referred for depression	17	11.4	NS	F	58	III	Frequent episodes of hypomania
2	Schizo-affective. Referred for depression	11	8.11	S	F	51	III	Frequent episodes of hypomania
3	Schizophrenia. Referred for delusion. Also has IQ 64	12	13.11	NS	F	38	IV	Nil

Table 1 (continued) *Details of patients*

<i>(a) Data on patients who were not interviewed</i>								
No	Diagnosis	Duration of illness prior to surgery (years)	F/U period (years)	Psychosurg technique ¹	Sex	Age (r)	Outcome	Reported side-effect
34	Obsessive-Compulsive	12	11.9	NS	M	63	I	Nil
35	Depression	13	8.11	"	M	48	I	Several attacks of blackout—anti-convulsant
36	Depression	8	1.2	"	F	31	I	Nil
37	Anxiety State	6	8.3	"	M	60	I	Nil
38	Obsessive-Compulsive	11	14.2	"	F	40	II	Nil
39	Depression	7	1.3	"	F	66	II	Nil
40	*Agoraphobia	1	2.0	"	F	43	III	Nil
		3	2.2	"	F	45	II	Nil
41	Anxiety State	3	2.8	"	M	27	V	Severe frontal lobe syndrome—Frequent epileptic fits—chronic cerebral abscess
42	Schizophrenia. Referred for obsession	3	7.2	"	M	27	I	Nil
43	Schizophrenia. Referred for delusion	20	9.5	"	F	41	III	Nil
44	Schizo-affective. Referred for depression	7	4.7	S	F	67	III	Nil

*Cases who had double procedures.

Cases 34, 36, 37, 39, 41 and 44 were dead at time of review—independent information was available on 34 and 36.

35 and 42 refused the interview—38, 40 and 43 moved out of area.

NS = Non-stereotactic, S = Stereotactic.

(300.0)—2; Manic-depressive psychosis (296.3)—1.

Duration of illness before operation was: 5 years or more—65.9%, 2 to 4 years—27.3%, and less than 2 years—6.8%. Almost all patients had very severe, disabling, and intractable illnesses.

Operations There were 46 operations performed on the 44 patients; 36 were non-stereotactic, six stereotactic, one patient had a non-stereotactic operation twice, and a further one had both a stereotactic and a non-stereotactic operation. 33 were done at Salford Royal Hospital, seven at the Brook Hospital, five at Manchester Royal Infirmary, and one at North Manchester General Hospital. The non-stereotactic procedure (modified bimedial frontal leucotomy) used an incision 2 cm anterior to the coronal suture; bilateral incisions were then made in the frontal cortex from a point 1 cm from the falx for a width of 2 cm and usually to a depth of 6 cm, avoiding the frontal horns; the cuts were marked at their deepest points by tantalum clips for subsequent check radiography. Cuts were mainly vertical.

Outcome Of the 33 patients interviewed, 25 were either recovered or much improved (75.8%) and 8 (24.2%) were in the outcome groups III, IV or V. In

the case of non-interviewed patients, the figures are 8 (72.7%) and 3 (23.3%) respectively. (For the total sample, the figures are 34 (77.3%) and 10 (22.7%).) There were six patients in Grade III; they had all improved clinically, in comparison with their pre-operative level, but for two the improvement was not as definite as in those of the groups I and II, while the remaining four patients have been socially impaired, three of them remaining as long-stay in-patients. In Grade IV, there were two patients; one had an initial diagnosis of endogenous depressive illness at the time of referral, but it subsequently became clear that he was suffering from paranoid schizophrenia. The other had a diagnosis of schizophrenia, and was referred due to intractable delusions and tension, but her IQ was recorded as only 64. In Grade V, one patient had a diagnosis of endogenous depression and the other of anxiety state; both were assessed as worse at follow-up, being incapacitated by severe side-effects due to frontal lobe damage. Patients in outcome groups III, IV and V had a high mean duration of hospital stay post-operatively.

There were nine schizophrenic patients; the seven in outcome groups I and II were all referred because of depression, obsessional symptoms, anxiety, or hypochondriasis which accompanied the schizophrenic process; following operation, they recovered or were much improved from these intractable symptoms. They did, however, require continued neuroleptics to maintain remission of their basic schizophrenic illness; though some relapses have occurred in these patients, they have been fewer, milder, and of shorter

Table 2 *Comparison of outcome: interview v. case records*

	I	II	III	IV	V	Total
Records outcome	22	3	5	2	1	33
Interview outcome	19	6	5	2	1	33

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duration than pre-operatively. The two schizophrenic patients in the poorer outcome groups were both referred due to intractable delusions, and one of these (group IV) was the one with a low IQ.

Surgical Procedures For the cases who were seen, we compared the results of the non-stereotactic (27 patients) and stereotactic operations (five patients) in terms of their respective outcomes; one patient who had both operations was excluded from this part of the analysis. Of the non-stereotactic subjects, 23 were in outcome groups I or II, while of the stereotactic subjects, there were two in groups I and II, and three in III–V. The improvement rate in the former procedure was therefore 85% and in the latter, 40%; the amalgamated results for the whole sample were 86% and 50% respectively.

UNWANTED EFFECTS OF SURGERY

Reports of side-effects were obtained from both relatives and patients, and an overall assessment was made during the interview. For those patients whom it was not possible to interview, information was extracted from their case records. Fourteen patients (12 of whom were seen with informants) had some form of adverse effect, or more than one such effect. Eleven patients had side-effects after a non-stereotactic operation, and three following a stereotactic one; this difference did not reach a statistically significant level.

Epilepsy Six patients developed at least one fit after operation: one of these had a history of previous fits, and another had only one post-operative fit shortly after surgery, with no recurrence during the 12-year follow-up. A further patient developed post-operative cerebral infection, which led to a cerebral abscess and a chronic discharging sinus in his skull; he developed intractable epilepsy, and eventually died whilst in status epilepticus. The remaining three patients have all had more than one fit, but their epilepsy has been well controlled by anticonvulsants, and they are leading virtually normal lives; one of these had a stereotactic tractotomy and the rest a bimedial operation (9%). Anticonvulsants were not used as routine post-operative prophylaxis.

Personality change There were reports of adverse personality traits in four patients, although none were socially incapacitating. Two were "lack of consideration and irritability", one "lack of consideration and social disinhibition", and one "social disinhibition and increased volubility". The relatives of the latter patient described this change as for the better, in that "she could more easily speak for herself and had been less shy".

Memory Impairment Of the 14 patients, four have been reported to have suffered memory impairment, but in no case was it described by the relatives as of

severe or progressive nature, usually involving "forgetting isolated incidents". On clinical examination, registration appeared normal in all these four patients, but there was retention defect in two, and poor concentration rather than memory impairment in the other two.

Hypomania There were four patients in the sample who developed elated mood, hyperactivity, and excitement after operation, for the first time in their illness; two had non-stereotactic operations and two stereotactic. In two cases, the diagnosis was schizoaffective psychosis with pronounced depressive mood: since operation there has been no depressive component if the basic illness relapsed in these patients, but on the contrary, hypomanic features have sometimes occurred then. The other two patients had a diagnosis of endogenous depressive illness; they both recovered from their depressive illness, but each had two episodes of hypomania.

Frontal lobe syndrome Two patients suffered a frontal lobe syndrome (ICD 310.0). One developed cerebral infection, resulting in a chronic cerebral abscess with discharging sinus, after a non-stereotactic operation, and eventually died, while the second developed this syndrome 4 months after a stereotactic operation, though initially she was very well. The first has been included under "Epilepsy" also.

Incontinence One patient remained intermittently incontinent of urine at night, following a non-stereotactic operation; he also developed hypomanic episodes, and was therefore also included under the category of hypomania.

By the time of review, seven patients had died, including one who was not included initially in the total sample; he died in the third post-operative week, after developing a septic foot that progressed to bacteraemia and bronchopneumonia, and it is uncertain whether or not this death was related to the operation. The causes of death were: myocardial infarct (3); myocardial infarct and breast cancer (1); bronchopneumonia (1); carcinoma of the bronchus (1), and unknown (1). One patient's death can be directly related to the operation, since he died whilst in status epilepticus, his epilepsy being due to chronic cerebral infection. In the case where the cause is unknown, the patient was operated on for a severe intractable anxiety state, recovered post-operatively, and a year later was discharged from follow-up. Subsequently, he never required psychiatric help, but died 8 years after psychosurgery; it seems fairly certain that this was unrelated to the operation.

Clinical changes after operation The mean duration of admissions for the patients who were seen, in weeks, for a period before operation identical to the period between operation and follow-up, following a

mirror-image design, was 17.25 and 7.0 for patients in outcome groups I and II, and 32.3 and 123.6 for patients in the other two groups. Figures for the whole sample are 19.9 and 6.5, and 45.9 and 123.9 respectively. Since all patients returned to the referring hospital for further rehabilitation, the length of this routine admission was included in the total mean periods. Patients in the good outcome groups had therefore spent a shorter average time in hospital, compared with those in the poorer outcome groups.

The number of courses of ECT given during comparable periods before and after operation showed a striking reduction among the interviewed patients in outcome groups I and II (from 65 to 3), but a less marked reduction for the others (from 32 to 9). There was considerable reduction (from 27 to 1) after operation in the number of suicide attempts among patients in the outcome groups I and II, although they were not characterised by fewer attempts before operation. Again, the reduction was less marked for patients in groups III, IV and V (from 19 to 6). The corresponding figures for the total sample are from 88 to 3 and from 37 to 9 for courses of ECT given, and 32 to 1 and 19 to 6 for the number of suicidal attempts.

Social assessment Assessment of social functioning, in terms of marital adjustment and work capacity, was included in the structured interview and thus influenced the assessment of outcome. To assist in assessing general adjustment and social behaviour, the KAS was completed on 33 patients; for this purpose, the informants were interviewed prior to seeing the patient. For patients in outcome groups I and II, the mean was 1.16 (SD 1.238), and for those in the poorer outcome groups, 6.38 (SD 2.0659); *t* value was 8.85. Level of *p* (with df 31) < 0.0005. Patients in outcome groups I and II appeared to be functioning as normal, and this would be expected on the basis of their relatives' accounts.

Discussion

This study has inevitable limitations, including the lack of a control procedure. However, it has generally been regarded as ethically unacceptable to allocate patients randomly to psychosurgery or to some other form of treatment, and in view of the length of our subjects' illnesses and range of their previous treatments, they might reasonably be regarded as their own controls. We did not consider it feasible to construct an ad hoc retrospective control group, in view of the lengths of time involved. Among this group of patients who were interviewed, 66% of whom had been ill for 5 years or more, 76% either completely recovered or retained only mild symptoms which caused little or no interference with their lives.

Out of the 27 who had non-stereotactic operations, 23 did well, whereas of the five patients who had stereotactic tractotomy, only two did so, a result in favour of the non-stereotactic operations; but caution is needed in drawing conclusions from this, not least because of the very different numbers having the two kinds of procedure. If non-interviewed patients are added to the sample, 77% fall into the good outcome groups, 37 had non-stereotactic operations, and 31 of these did well; six patients had stereotactic operations, and three of these did well.

Evaluation of the outcome depended on a clinical assessment, but objective support for the validity of this method seemed to emerge in evidence of a reduction in treatment needs (less mean admission period and less ECT required) and in suicidal behaviour. These findings were confirmed by assessment of general adjustment and social behaviour. The whole issue of outcome rating for procedures such as psychosurgery is a very difficult one,¹² but we believe that it was done in this study as objectively as is reasonably possible.

Pre-operative differences between outcome groups that could be of predictive value were that patients in the three poorer outcome groups had a longer duration of illness before operation and of pre-operative in-patient stay; it is possible, therefore, that they were somewhat more ill than the others. So far as diagnosis is concerned, depression, either as a primary diagnosis or secondary to other major psychiatric disorders, responded extremely well, especially if of an endogenous and/or recurrent nature. During the period in which patients were recruited, lithium came into more widespread use for affective disorders, and we cannot wholly exclude the possibility that some of the earlier cases might have shown some response to it; however, the overall severity of the series argues against this significantly affecting the results. Our data confirmed the view¹³ that schizophrenia per se is not helped by psychosurgery, but that secondary depression, anxiety, obsessional symptoms, and hypochondriasis can be relieved, rendering the basic illness much more amenable to management. The agoraphobic patients in this series all did well following bimedial operation, as did the obsessional patients. There was little age difference between the two groups: the better outcome group had an average age of 45 (46 overall), and those with poorer outcomes one of 47 (50 overall).

Marks *et al*¹⁴ reviewed the outcome of a group of patients with severe agoraphobia, most of whom had a bimedial operation, and found that they did significantly better than a retrospectively selected control group, as was the case in the study by Tan *et al*¹⁵ of patients with obsessive-compulsive disorder treated by the same operation. The results of stereo-

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tactic tractotomy in obsessional states were stated, both by Strom-Olsen & Carlisle⁸ and by Goktepe *et al*⁴ to be 50% improvement, while Birley¹⁶ reported 75% improvement following bimedial operations. Mitchell-Heggs *et al*⁹ found improvement in the same condition to be 67% following limbic leucotomy, but poor results (30% improvement) were reported by Sykes & Tredgold¹⁷ following orbital undercutting. It thus appears^{9 15 16} that in obsessional states, psychosurgery should aim to produce a lesion not only in the lower medial quadrant of the frontal lobe, but also in the cingulate gyrus; severing the connection from the frontal lobe to the cingulate gyrus (Fronto-limbic "northern" pathway⁶) may be even more effective. The bimedial operation achieves that, but stereotactic tractotomy produces a lesion only in the subcaudate region.

There are general risks associated with any surgical operation, and this is clearly the case with psychosurgery. The risk of epilepsy is increased after bimedial operations, and there is also an increased risk of a hypomanic swing, after a few months, in patients with endogenous depressive or schizo-affective illnesses, following either a bimedial or a stereotactic tractotomy operation. In this study, there were distressing and socially incapacitating frontal lobe syndromes in two patients, one (who eventually died) following a bimedial operation, and the other after stereotactic tractotomy. A possible explanation¹⁸ is that the target areas for stereotactic surgery are in deeper parts of the brain, where many tracts, connections, and nuclei are in close proximity, and from which fibre radiations emerge; despite the greater accuracy of this operation, a small variation in either the location or the size of a primary lesion may produce correspondingly large variation in secondary effects. Moreover, the ceramic rods which carry the yttrium also contain a small amount of terbium 160, which has a half-life of 72 days; an atom of this contaminant, on decaying, gives up $\frac{1}{4}$ of the beta-ray energy of an atom of yttrium. Although the total dose is small, there is still a very small possibility, because rods remain fixed in the lesions, of extension of the lesion from this source.¹⁹

Adverse post-operative effects on personality were reported by the relatives of four patients, but none were detected at interview, except for the increased volubility of one patient, and none were socially incapacitating. Although not to be dismissed, therefore, personality changes in this series do not seem to represent an unacceptable consequence of operation, in comparison with the benefits. The effects on concentration and memory were also mild, and caused very little interference with daily life. One patient remained intermittently incontinent, at night only, following a bimedial operation. There was only

one death in the series, related to a bimedial operation. Furthermore, in assessing the importance of real risks associated with psychosurgery, it is necessary to take into account the high incidence of suicidal attempts found *before* operation, the 15% risk of death from suicide in severe affective disorders,²⁰ and the finding that the mortality rate in a follow-up study of patients suffering from severe neurosis was three times the expected frequency.²¹ The prognosis of patients referred for psychosurgery is likely to be even worse than these figures suggest, because they have the most severe illnesses, characterised particularly by being intractable to treatment over a prolonged period of time.

We therefore conclude that modified leucotomy still has a place in psychiatric treatment, (though as a measure of last resort) a view supported by most British psychiatrists.²² The number of cases for which it will continue to be indicated are very few, but in those cases, it may be the only treatment method which can restore a worthwhile quality of life.

Appendix

Illustrative Case Histories

Case 1 A 35 year old married woman, who worked as a shop assistant, gave a 3-year history of endogenous depression, characterised by diurnal variation, early morning insomnia, loss of appetite and weight, loss of feeling and libido, ideas of unworthiness, and suicidal feelings. She also developed a fear of leaving home when severely depressed. She had two courses of ECT as an out-patient, but failed to maintain improvement and had to be admitted, when a third course of ECT was given, together with tricyclic antidepressants. After a brief improvement, she was tried on combined tricyclics and MAOIs, but had to be readmitted. She deteriorated, refused further ECT, and was discharged to attend the Day Hospital, where she failed to continue individual psychotherapy, and abreaction did not bring any change. Her husband had been caring for her throughout the illness, but his job was threatened due to the time lost from work. The patient remained in a state of chronic distress, experiencing no real emotion except anxiety and depression. She had a bimedial operation, was discharged after 4 weeks of rehabilitation, was followed-up as an out-patient for 3 years, and then discharged from attendance. She was reviewed 14 years after the operation, when she owned and was running her own business; she had never required further treatment for depression. Her husband had been delighted with her condition, and described the operation as a "miracle". There was an occasional complaint of forgetfulness, such as where she had put things, but this has been mild and non-progressive. She was rated I.

Case 2 A 60 year old bus inspector who had been a well-adjusted married man gave a 6 year history of anxiety, precipitated by him being forced to change jobs, and characterised by irrational fears and worries, preoccupation with morbid ideas, tension in his head and neck, palpitation, sweating and poor sleep. With a benzodiazepine, he showed

some improvement, but soon relapsed when he went back to his new job. He was subsequently admitted to hospital three times with recurrence of the anxiety state and occasional depressive symptoms. He was tried on large doses of benzodiazepines, tricyclic antidepressants and MAOIs, but without lasting improvement; courses of ECT made him worse. He had attempted suicide once, when his wife threatened to divorce him. He remained chronically anxious, frightened, and depressed. After a bimedial operation, he was rehabilitated for 3 weeks and discharged. Subsequently he was seen twice as an out-patient and then discharged; by then, he appeared to have recovered, and had resumed his job satisfactorily. He retired aged 65 and died 4 years later. The cause of death was unknown, but throughout the 9 year post-operative period he never relapsed nor required any treatment. He was rated I.

Case 3 A 47 year old married machinist who had been happily married, a very competent mother, and who worked steadily, had a psychotic episode after the birth of her second child which lasted a week. She developed the conviction that her husband wanted her to die and to supplant his mind for hers, influencing the children against her; she became very worried, restless, and depressed. After the first episode, she had many relapses with the same delusion, and at times with auditory hallucinations of her husband conspiring with the children to get rid of her. She initially responded to neuroleptics and ECT, but in the 5 years before referral her illness became chronic and deteriorating, with only brief remissions. She remained full of paranoid preoccupation and in a persistent state of agitation and depression. She had six psychiatric admissions, five prolonged ECT courses, and had attempted suicide three times. She failed to respond to large doses of phenothiazines and tricyclic antidepressants. After a bimedial operation, she was discharged with much reduction of her agitation and depression; she then gradually improved further, and her psychotic state was well controlled on low doses of a depot neuroleptic. She was reviewed 14 years after the operation, and her husband described it as a "miracle"; she was continuing on a very small dose of depot, which caused no side-effects. She was rated I, since she required no treatment for depression, and the depot injections were at a minimal dosage.

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