THE TECHNIQUE OF PRE-FRONTAL LEUCOTOMY.

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MAY I apologize in advance for the many deficiencies of the paper I am about to read. I have not had the time that I would have wished to spend upon its preparation, nor the opportunity to make myself more than superficially conversant with the increasing literature, and I trust that you will excuse such imperfections as will appear.

Had it not been for the insistence of Dr. Cook I should have refrained from producing a paper at all, feeling as I do that my experience is as yet too limited, and that insufficient time has elapsed fully to estimate the end-results of the work already done.

It is my intention to deal mainly with the surgical side of the problem, as that is my proper sphere, and because there is much that may yet be said upon this rather important aspect of the matter.

Since Moniz first carried out the operation of pre-frontal leucotomy in November, 1935, many alterations in technique have been made both by the inventor of the procedure himself and by other surgeons who have followed him in this field.

You will, no doubt, be familiar with the major changes which have taken place. The original method was that of the injection into the white-matter of the pre-frontal region of small quantities of alcohol, then came the introduction of the first leucotome, with its wire loop cutting complete spheres of brain of one centimetre diameter, and since that time both the instrument used for the section and the chosen site of operation have undergone further changes.

The avowed object of the operation is to sever the association tracts between the frontal poles of the cerebral hemispheres and the remaining portions of the central nervous system, and it would seem good practice, therefore, to choose a weapon which would not only achieve this purpose but, at the same time, inflict the minimum of damage upon the surrounding brain substance and its contained blood vessels.

If one regards dispassionately the set of instruments used by almost any surgeon in the practice of his art it is indeed difficult to abstain from criticism. That they are clumsy and but ill-adapted to their work is obvious to the most uneducated eye. They compare, relatively speaking, most unfavourably with the items of the tool kit supplied with the average modern automobile. When contrasted with the delicate, but strong and beautifully designed tools of the dental surgeon they appear even more gross and unsuited for their work than at first sight. And why should this be? It is due only to us surgeons ourselves; we are as a class most unmechanically minded men, and yet we persist in inventing instruments for particular purposes, each one of which we fondly imagine is better suited to achieve its end than anything that has gone before. No finer example of this tendency could be found than in the astonishing creations which have been produced in connection with pre-frontal leucotomy. The last such instrument I was shown, and ardently encouraged to use, more nearly resembled a mechanical egg-whisk than an implement of modern surgery—yet I was assured that Mr. So-and-So found it most satisfactory! At long last we are beginning to follow the sensible path, that of taking the advice of the trained instrument maker, who has had the opportunity of watching the specialist surgeon at work. He, the instrument maker, can and will produce the simplest and most effective structure to deal with a given problem. More than this, he will provide an instrument capable of performing adequately a variety of duties, thus reducing substantially the armamentarium of the surgeon and the confusion of the theatre sister.

Prompted by a recent letter from a psychiatric colleague who asked, "Have you yet published a detailed description of what you do? Could you let me have a

https://doi.org/10.1192/bjp.89.375.194 Published online by Cambridge University Press

copy if you have ?," I propose to describe as carefully as possible what has been my practice.

First, let me confess to you that I have now committed the operation of bilateral pre-frontal leucotomy upon no less than fifty occasions. The method was that of the blind approach, and I would emphasize that this has not been from choice, but because of the conservative attitude of those who are convinced that a surgeon will do more harm within the skull the larger the hole he is allowed to make —an ostrich-like attitude in view of the consistency of the brain substance, the inconstant contours of the cerebral convolutions, and the frequently anomalous arrangement of the blood vessels and fluid-filled spaces of the hemispheres.

Owing to the extremely unpleasant and dangerous habits of many of the unfortunates who have been submitted to me for operation, and to the lack of proper facilities for dealing with the habits of such patients in my own neurosurgical unit, I have been compelled to carry out the procedure of pre-frontal leucotomy under conditions which have been less satisfactory than a neurosurgeon would desire. That this has been so is due in no way to the physicians concerned, nor can I feel that I am wholly responsible. It may well be said, however, that a lower mortality-rate and a lesser number of complications would follow were the patients treated in surroundings which approximated more closely to those of a modern neurosurgical unit.

Whilst many American surgeons have advocated local anaesthesia as being most suited to the operation, I must admit to having used a general anaesthetic in all but two of my series, and, as the operation takes but 15 to 30 minutes to execute, and the anaesthetist has invariably been well versed in endotracheal work, I have seen no complications which I could certainly lay at this door. Not for a moment would I deny such advantages of local anaesthesia as the lack of intracranial congestion so often experienced with gas, oxygen and ether, and the opportunities afforded for observing the phenomena which occur at the time of brain section; in suitable cases local anaesthesia is unquestionably the method of choice. Many of my patients, however, by reason of the very frailties which promoted surgical treatment, have hardly lent themselves to such a course, whilst the mere history of others has persuaded me not to lend myself to it. A general anaesthetic is, I feel, a more restful and less anxious business for all concerned.

I have in general taken a point 3 cm. behind the lateral margin of the orbit and 5–6 cm. above the zygoma as the centre of my 2–3 cm. skin incision. The incision is made down to bone, and a self-retaining retractor inserted firmly to give a wide exposure and a bloodless field. A 1 cm. burr-hole is then cut in the line of the coronal suture and a cruciform incision made in the dura.

The instrument used for the section of the white matter is the least damaging of all—an ordinary brain needle, with a side eyelet just short of the blunt point, and a close-fitting stylet. This is introduced in such a direction as to pass close in front of the anterior horn of the ventricle to a depth sufficient to be just clear of the grey matter of the inner aspect of the frontal lobe. The stylet is withdrawn and the needle made to pivot about the point of entrance through the dura so that the blunt inner extremity travels upwards towards the superior surface of the frontal lobe. As the point is made to travel upwards the needle is pushed more deeply into the brain so that the line of the section runs parallel with the falx and does not, as it otherwise would, become steadily more distant from it. When the needle has reached sufficiently close to the upper surface of the hemisphere it is withdrawn and re-introduced along the original line in order to deal with those fibres running from the lower part of the frontal pole; on this occasion the point of the needle is made to travel downwards, again parallel with the falx, and is then brought laterally across the anterior fossa roughly in the same vertical plane as the lesser wing of the sphenoid, until it reaches a point just short of the lateral aspect of the skull. During this part of the section the needle is progressively withdrawn for fear of damaging the grey matter of the orbital surface of the frontal pole.

A wet patty is then left in the opening in the bone whilst the performance is repeated on the opposite frontal lobe.

The first incision made is then closed in three layers with fine, unabsorbable, black silk sutures, after which the second is similarly treated and a head-dress finally applied.

You will observe that I have refrained from giving any measurements regarding

https://doi.org/10.1192/bjp.89.375.194 Published online by Cambridge University Press

the depth to which the brain needle should be inserted. This has been done deliberately to emphasize that there can be no routine or hard and fast rules in such a matter. The width of the human skull in the region under consideration is very variable, and whilst the introduction of the needle to only 5 cm. from the dural opening in one patient might sever the anterior cerebral artery, an insertion to 7 cm. might be inadequate in another.

There are other difficulties of a similar nature: the bone itself may be so thick as to prevent adequate rotation of the needle, and here it is necessary to remove more bone above and below the initial burr-hole to make a wider range of movement possible.

It should be obvious, I feel, that this operation is one not to be undertaken lightly, and calls for fine accurate technique as well as regular experience of intracranial surgery.

The immediate post-operative complications of importance are few in number, so far as my own experience goes, and are common to most other intracranial operations, the most serious of all being that of haemorrhage, either immediate or delayed.

This sequel was the cause of the single death in my series of cases, precipitating a fatal pneumonia. The difficulties of treating such cases at a distance are only too obvious, and I believe that even this one case might have been saved had the patient been operated upon in time.

The progressively falling pulse and respiration rates associated with a rising blood pressure should give ample warning of impending death, and permit of open operation being resorted to. Difficulty would no doubt be encountered in finding the bleeding point, but its eventual control should be comparatively simple.

Incontinence of urine occurs with comparative frequency, and occasionally there is incontinence of faeces also, but in no case to my knowledge have they remained permanent. In the vast majority incontinence of urine alone takes place, lasts for a few days and then is seen no more.

Restlessness and irritability, even extending to extreme violence, have been met with, usually in such patients as have exhibited similar behaviour before operation, but on only two or possibly three occasions have the patients proved more violent and uncontrollable after operation than before.

Amnesia, confusion, somnolence and lack of initiative have been common sequelae and have generally been transient, although a few patients have finally subsided into a harmless vegetable existence. Quite a number of patients have gained considerably in weight.

I have touched but lightly upon these sequelae which are, after all, common knowledge, and have been commented upon in detail by other writers, as well as being discussed in detail by Freeman and Watts in their volume, *Psychosurgery*.

Reference to this work, *Psychosurgery*, reveals a number of interesting facts. Out of the author's total of 80 patients it is stated that permanent incontinence of urine was noted in four patients, rectal incontinence in three patients, monoparesis in one, aphasia in two, hemiplegia in one and convulsions in three patients, and, in addition, three patients died.

In most neurosurgical units the operative mortality in this series of Freeman and Watts would have been assessed as four deaths in 80 cases, for one of their patients, in whom the left anterior cerebral artery had been damaged with resultant right hemiplegia, died four months after operation from pneumonia. This should certainly be attributed to the operative interference with its sequelae of hemiplegia, prolonged stay in bed and pneumonia.

Convulsions are said to have occurred in three cases out of 80, and these cases are summarily dismissed by the authors of this work in one short paragraph as if the matter were of only trifling import.

We have therefore in this series of Freeman and Watts an appreciable death-rate directly due to surgical treatment, and a much more appreciable list of serious disabilities following the leucotomy.

That this is a somewhat unpleasant collection of results cannot be denied. Incontinence of urine and faeces, paralysis of one limb or of one half of the body and aphasia—not to mention convulsions—are very real factors to be weighed in the balance when assessing the value of the operation or the need for its performance.

My own experience is, as I have mentioned above, limited to only 50 cases, but I have always been conscious of the dangers which abound in work of this nature.

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I have had one death occurring on the eighth post-operative day caused by bilateral frontal haemorrhage. There have been no serious sequelae of the neurological order reported by Freeman and Watts, but there have been four patients who have had seizures.

In no one of these four patients had convulsions been known to occur before the onset of their mental illness, but two of the four had been treated by convulsion therapy before leucotomy was undertaken.

One patient, four months after leucotomy, suffered a series of 13 major convulsions in the space of a few hours; she recovered well with the usual modes of treatment and now, some months later, has had no further fits. This young woman had been known previously to have a very high blood pressure and albuminuria, and her attacks might therefore be considered to be other than purely cerebral in origin. I prefer, however, to regard them as a sequel of operation.

A second patient, a woman aged 57, had had no convulsion treatment before leucotomy because of a severe kyphosis, but went into *status epilepticus* five months after leucotomy. She remained in *status* for six hours and recovered spontaneously. Three months later she again passed into *status epilepticus*, from which she recovered in about two hours after heavy dosage with sodium luminal. It is now three weeks since the last attack and the patient is being given luminal regularly.

The third and fourth patients, men aged 27 and 48, had each had convulsion therapy before leucotomy. Each patient had seizures passing on to *status epilepticus*, in one case occurring four months after leucotomy and in the other five months. Both patients recovered quite rapidly with the appropriate remedies.

In no one of the four cases have residual physical signs been found at neurological examination.

Ventriculography has been carried out in three of the four cases, using the right pre-frontal burr-hole, and in all three there has been good filling of the ventricular system. No abnormality whatsoever has been observed in the region of the anterior horns to suggest the presence of a space-occupying lesion, such as blood clot, nor has there been even a suggestion of early traction diverticulum.

There is, therefore, no gross organic lesion present in any one of these cases. The fact remains that there are now in the world four more epileptics as a direct result of my surgical attack upon these 50 individuals.

I have, therefore, been responsible for none of the unfortunate neurological complications reported by Freeman and Watts, but I have had an incidence of traumatic epilepsy of 8 per cent. if we can rely upon such a small series of cases as being representative.

Of the other side of the picture, and before such an audience, it is not within my province to speak. I make no claim to psychiatric knowledge, and would prefer to leave the discussion of this aspect of the problem to those who are qualified by training and experience to do so. I need hardly say, however, that had I not been convinced of the benefits accruing from operation in at least a moderate percentage of cases, I should not have pursued the subject as far as I have.

It has been my duty to put before you to-day the purely surgical side of this problem and I have dwelt for that reason upon the associated dangers and complications. I have done so because, in the first flush of a new enthusiasm, surgeons are all too ready to overlook the occasionally serious, if not fatal, results of their manoeuvres, and to look with a complaisant eye upon the more successful.

It has been unfortunate, in my opinion, that this operation should have attracted so wide an attention in this country, and that those in control of suitable patients should have seen fit to delegate the surgical aspect of the treatment to individuals who, however great their abilities in other spheres, have little or no experience of neurological surgery. It is also to be regretted that in some of the earlier published papers little or no attention has been paid to the purely physical condition of the patients both before and after operation—a matter which is of very real importance to the individual concerned. To be cured of one illness only to fall heir to epilepsy, aphasia or incontinence is an exchange which might appeal to some but not necessarily to all.

Of the operation itself there is much to be said which is often overlooked.

Firstly, whilst the correct plane of section may be fairly accurately achieved, assuming that we are correct in believing this to be the coronal plane, the actual extent of section can never be determined with certainty. The human skull, as we

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know, varies considerably in size and shape, and so also do its contents. Even in the hands of the same surgeon the extent of section will vary considerably from case to case, and from one frontal lobe to the other in any given case. This will be so if the simplest implement, such as the brain needle I have advocated, be used. When the instrument is complicated by wire loops or moving arms the variations will naturally be even greater.

If one assumes for a moment that an identical section be made in each hemisphere, there will still be variations in the result achieved because of the differing amounts of haemorrhage on the two sides, the degree of pressure so produced upon the surrounding white matter and the extent of subsequent scarring.

It would also appear fairly certain that the more complicated the instrument devised for cutting the section, the greater is likely to be the amount of haemorrhage, oedema and scarring—and surely we should aim at the minimum of trauma compatible with effective section?

Let me state clearly that I believe this operation to produce beneficial results, but that I consider it academically and scientifically unsound. We may produce large series of excellent results when greater experience has come our way, when the indications are more perfectly realized and operative sequelae more regularly avoided, but we shall have little precise information regarding the function of the pre-frontal regions of the brain.

The injection of opaque media along the line of section can give only a rough guide as to the true extent of the operation, and there is no guarantee that the material injected has permeated to the limits of the defect made. Neither is it wise to leave in brain tissue material such as thorotrast in view of one's at present limited knowledge of its eventual end and theoretical dangers.

I would suggest therefore that this operation, valuable as it may be in individual cases, should be regarded still as an experimental procedure, justifiable only when all other available methods of treatment have failed, and when experienced psychiatric opinion is convinced that no hope of spontaneous cure remains.

I would put forward a plea that we be allowed to attempt a more soundly based experimental operation, such as the sectional removal of known convolutions of the pre-frontal regions in a series of stages, at intervals suitably placed to allow of full recovery and of physical and psychiatric assessment. Only by some such method over a period of years—and in the hands of an experienced team of workers—can the best results, both clinical and academic, be achieved.

Conclusion.

In conclusion may I thank you for the honour you have done me in inviting me to speak before you to-day. I have told you what I believe to be the truth, and regret only that I have been unable to do greater justice to the occasion.

Discussion

At the conclusion of his paper Mr. Wellway said he was very interested in the clinical papers earlier in the day, and would like to hear from critics of the operation how many patients they felt had been made worse by the manoeuvre. A second point was the question of indication for early operation or should they wait for a late operation? If they could take an analogy from other surgical mutilations such as operations on the thyroid gland or on the stomach for peptic ulcer, the general history of surgery had shown that few cases were handed to the surgeon until the risks of operation were very much greater than they should have been. Few ulcers came to the surgeon until they had been given more than, perhaps, their fair share of non-operative treatment, and then as time went on the indications, and particularly the time for surgical intervention, had become increasingly clarified. Knowledge at the present stage was very nebulous on this subject of leucotomy, but as it was crystallized it should be possible at an earlier date to pick out which of the cases would respond to operative measures and they would be offered in the early stages. It was a general dictum amongst orthopaedic surgeons that no fracture should be dealt with by open operation unless closed methods had been given a fair trial first; but on the other hand orthopaedic surgeons as they worked for years on fractured limbs had learnt that certain cases would never respond to closed methods and called for open operation, and they did not, when such cases appeared, say, " I must not resort to the open operation here; I must put him through all the known closed methods until I have made certain that they will fail, as I assume they will," but proceeded at once to the short cut to relief.

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He was fascinated by Prof. Golla's hypothesis. If it was true all medical superintendents should be warned that if these patients could completely overcome any disability that this mutilation gave them, it was surely true that they were entitled to become mentally disordered again in the future, and it might be that the institutions would be refilled by all these patients in five or ten years' time. The syphilologists told him that the only criterion of cure of syphilis was the ability to produce a fresh chancre, and the only criterion of success of this operation was for the patient to be cured and to become disordered again.

Mr. E. J. RADLEY SMITH said there were one or two points he wished to make. He would like to associate himself with Mr. McKissock in regarding this as not a minor operation. It had a definite mortality and at the moment he did not see how that could be abolished. His experience was concerned with 62 cases, of which three had died, all in the first four days, of haemorrhage, and however carefully one might perform the operation haemorrhage in some cases was unavoidable. On many occasions intra-cerebral vessels were dragged out as a loop with the leucotome and had to be tied with no ill result; if they were not dragged out but were sectioned in the brain haemorrhage must follow which might prove fatal. At any rate that was the cause of death in three cases.

Fifty cases had been reported on by Dr. Dax, the results of which were variable. The operation was very imperfect, which alone accounted for much of the variation of the results. In operation on the cadaver an alarming discrepancy had been found between the actual point of insertion of the leucotome and the point where it was thought to have been inserted. Apropos of that he would like to ask other speakers whether they would get results by wider exposure of the brain or by a more careful measurement of the brain. Dr. Dax's paper tended to show —if these early results could show anything—that the psychomotor states were more important than the emotional states. It occurred chiefly to Dr. Dax rather than to the speaker that that fact might point to a section of fibres from the convex surface of the prefrontal lobe rather than a section of those fibres coming from the orbital surface. There was evidence that the prefrontal lobe had those deviations. If the results of other series showed the same result, did it imply that the fibres should be divided from the convex surface and not from the orbital surface, and, if so, should the operation be altered in some way to get at the lower fibres? It had been tried by horizontal section above the orbital surface on the cadaver in a number of instances and in two cases at operation, but it was rather too risky to say anything more about it.

Apropos of the sequelae they had not, so far, produced any epilepsy, but one case showed an isolated fit three months after operation, and that fit was accompanied by definite signs on the other side of the body of an interference with the cerebral function. That isolated fit had not been repeated, and so far there had been no other sequelae in the case. The other cases had not shown any convulsion or epilepsy.

Mr. GEOFFREY KNIGHT spoke of a series of 33 leucotomies which he had an opportunity to perform at Runwell and at the West End Hospital. All these patients were long standing and a chronic group of low potentials, deliberately selected in order that one would be certain that any post-operative change which occurred was a result of the operation and not of any spontaneous or natural means; also in order that one could study any possible harmful effects of the operation before applying it in cases of higher potentiality, and be free to use the series to estimate any difference in effect between different types of operation employed and between sections in the various planes and at different depths.

It was found in these 33 patients, despite the fact that they had been long established and had not showed any improvement under other forms of treatment, that approximately the same relative improvement was obtained as in other published series: eleven cases were not improved, eleven improved, and eleven much improved.

In regard to the type of operation employed, he naturally selected for the first nine one which appeared to give adequate effect with the least possible disturbance of tissue, and he chose the rotating blade leucotome devised by Crombie because it appeared to be an admirable instrument which caused minimal disturbance in the cortex, yet opened a considerable plane of the central core of the frontal lobe. The results of the operation were eminently satisfactory in five out of nine cases, but in two cases of paraphrenia in which the initial post-operative effect had been amazingly good with complete subsidence of hallucinosis, after six weeks the symptoms began to creep back and were attended by irritability and a certain amount of aggressiveness. It seemed as though the immediate post-operative benefit was compounded of two actions, and he wondered whether a more permanent effect might be produced if a larger procedure was used.

In the remaining cases the Freeman technique was employed in six and in the others a combination of the Freeman and Crombie techniques. It was thought that might show a significant difference either because fibres from the orbital region would be divided (on which Freeman laid great stress), or merely because of the greater quantitative effect in the numbers of fibres affected. He first of all introduced the rotating blade leucotome and then completed the operation with a blunt Freeman blade. He thought this was the safest method because after dividing the central area with the rotating blade one could feel any resistance, and if so it could be removed and inserted at a slightly different plane, which might account for the fact that he had not had a single case of haemorrhage so far.

As a further experiment in one case he deliberately employed the section further back. The patient was of a low potential in whom it was desired to obtain the maximum result, and the

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result was deplorable. Any section performed further back than 3 cm. behind the orbit was definitely dangerous and should not be used, although there was evidence that the effect of leucotomy was increased as one went further back.

It did seem that there was a quantitative difference of effect according to the total number of fibres divided, and in time it might be possible to select the type of operation performed according to requirements. Loss of initiative and spontaneity might be quite a welcome change in chronic mania, but not when it was desired to reduce obsessional neuroses. The Crombie operation was sufficient in a case of good potential, and where it was desired to produce a lessening effect in violently aggressive, long-standing cases, the more extensive operation of Freeman was likely to give more certain and permanent effects, although it was likely to be attended by slightly harmful neurological sequelae.

Major J. S. McGregor (Warlingham) said that in the absence of his surgical colleague, Mr. Crombie, he would like to say a few words in defence of two instruments with which he had something to do in their designing. The first was the rotating blade, and the other was described as an egg-whisk by Mr. McKissock. Both were designed to do the minimum amount of damage to the cortex, and in 30 cases very few complications had been produced, and certainly not epilepsy. Their findings were very much in agreement with those of Mr. Knight, who was of the opinion that the Crombie method was a reasonably safe method, while the Freeman was a more drastic procedure, probably more suitable for more deteriorated cases. At a recent meeting this question was discussed with Mr. Knight, and as a result of that discussion one case was re-operated upon which had shown an initial improvement, but which had relapsed after some six weeks, making a much bigger and more drastic enlargement, without producing any results at all.

Sir Laurence Brock said he ventured to intervene because he had an announcement to make which he felt would be of interest. He had a special interest in this question, because he was Chairman of the Burden Neurological Institute, which had done so much of the pioneer work in England. No one could read, as he had done, all the reports which had come to the Board about this operation without being struck by the extraordinary divergence in the results claimed by different hospitals in which it had been adopted. To some extent this might be due to differences in the way in which patients were chosen. Some reports almost suggested that the patients had been chosen because they were so bad that no operation could make them any worse. Anyhow, whatever the cause might be, the results reported differed so widely that the Board felt that it was most important that they should be carefully collated and analysed. As soon as circumstances permitted, it was proposed to prepare a report on the general lines of the reports made by Admiral Meagher on malarial treatment, and by Dr. Rees Thomas and Dr. Wilson on insulin and cardiazol. This could not be done during the war with a depleted staff and medical superintendents working under great pressure; but he wished to make an appeal to those who had adopted this operation that they should, so far as practicable, collect material in anticipation of the report which with their help it was proposed to prepare.

For this purpose two things were essential. One was a careful follow-up of cases after operation, not merely for three or six months, but for much longer, and the other was to do what had already been done in some cases (he thought Dr. Ström-Olsen mentioned it earlier in the discussion), and wherever possible to test the difference between the intelligence of patients before and after operation. Those who had been so fortunate as to obtain a copy of Freeman and Watts's *Psychosurgery*, a book which was difficult to get in this country, would remember the chapters by Dr. Hunt, the Associate Psychologist at the Washington Hospital, on the intelligence tests carried out there. He did not know whether the number of cases in that series was sufficient to be statistically significant. But, so far as the tests went, they seemed to indicate that, while there was some slowing down of thought processes, there was at the same time a compensating gain in accuracy. If that result was confirmed by further tests, it would be interesting and suggestive, but Dr. Hunt's results were, of course, open to the criticism that the first test was made when the patient was already suffering from mental disorder. Sir Laurence wished to suggest that, while it was extremely important that before operation and a reasonable period after operation intelligence should be tested so far as it was ever capable of being measured by batteries of tests, this should be supplemented if possible by obtaining information about the intelligence of the patient before he became ill. They could hardly expect to be so fortunate as to get hold of patients who had been submitted to the same kind of tests when they were normal, but it should be possible to obtain information about school records sufficient at least to show whether the patient before the onset of mental disorder was above or below average intelligence or merely average. Any information of this kind, and any records of personality changes obtained as the result of a careful and systematic follow-up, would add greatly to the value of the report which the Board hoped to prepare. He appealed to them, therefore, to co-operate in this task by keeping the completest possible records, hard pressed though they were; indeed, without their co-operation the report would tend to be merely statistical and to lose much of its value.

Mr. Willway, in replying on the discussion, did not quite agree that they had to know why the method worked before it was used.

Prof. J. MacDonald thought he was right in saying that Mr. Willway made a statement that there were no post-operative signs. Was that the experience of other surgeons? Was there

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any alteration in the superficial as well as the deep reflexes? Were there absolutely no post-operative neurological signs present in these cases?

Mr. WILLWAY said that it was clear that the other surgeons had not found them. Mr. McKissock had mentioned some very shocking post-operative complications; he himself had mentioned two; Capt. Lambert Rogers reported epilepsy following one case. He had not seen any change in the reflexes in any of his patients except the case in which he used the larger technique for the first time in which the patient did show an extensor response. He thought Prof. Golla should reply to the discussion; he was the clinician, while he himself was the busy surgeon, and did not always examine all the patients after he had operated. There had not been any ataxia or permanent unconsciousness, nor any disabling complication in the other cases.

Prof. GOLLA confirmed Mr. Willway's statement. All the cases were examined thoroughly and there had never been any permanent disturbance of the central nervous system.

Mr. MCKISSOCK, also in reply, said that although he had measured the majority of cases on which he had operated before making the initial incision, he thought the most important thing was to look at the patient's skull and consider where the incision should be made. No series of measurements would ever give a really accurate point.

With regard to neurological signs, these certainly did occur, but in none of the cases had any of these transient signs remained permanent. He was interested to observe that after his confession of the production of four epileptics, several others had come to light.

He had nothing to add with regard to leucotomes; he still considered them barbarous.

Lt.-Col. A. A. W. PETRIE, in moving a vote of thanks to the openers of the discussions, said it gave him great pleasure to voice the sentiments of the meeting in thanking the distinguished surgeons and others who had contributed to their deliberations. Prof. Golla had given a most illuminating address, and had brought forward some interesting facts and hypotheses.

He had been particularly interested in hearing the description of the technique of the actual operation and was sure the President shared this interest.

He could not help feeling further progress would be made in this direction. Different types of cases might need somewhat different technique, and as Mr. McKissock had hinted, developments on the lines of more open operations, in specially indicated areas of the brain, might occur. This would obviate such a blind operation as was at present being performed, and he felt that the distinguished neuro-surgeons themselves would feel happier if they were able to divide the brain by more modern methods, such as surgical diathermy, and avoid tearing methods with blunt instruments, and so lessen the liability to sequelae, such as epilepsy.

He appreciated the many technical difficulties, especially as they were often dealing with a class of case upon whom elaborate operations were barely feasible owing to their disturbed conduct.

Dr. Golla had indicated that other mechanical methods of treatment might be devised, but it did seem possible that they were entering on a phase of development with neuro-surgery playing a real part in treatment.

The vote of thanks was accorded by applause and the meeting terminated.

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