Remarks
ON
POSTERIOR RHIZOTOMY FOR THE RELIEF OF PAIN.

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THE operation of posterior rhizotomy has been performed at intervals for the last thirty years; the first recorded case I have met with is one by Bennett,[1] in which some of the posterior lumbo-sacral roots were divided for sciatica, without much apparent benefit. Horsley,[2] Chipault,[3] and others have recorded cases; while Abbé[4] operated in two instances for intractable brachial neuralgia, excising the posterior roots and ganglia of the affected nerves, the result being that one case was somewhat improved and the other not benefited. The writer and others have also in the past deliberately divided the posterior roots of dorsal nerves in operating for tuberculosis and malignant disease of the vertebrae, with a view to the relief of pain caused by implication of such nerves as they pass through the intervertebral foramina. The earlier scattered cases have given somewhat doubtful results, but in some a persistent neuralgia has been completely cured by the operation.

The whole subject of rhizotomy came more prominently into notice with the publication of Foerster's work,[5] and was brought before the profession in this country more especially by Hey Groves.[6] In the *British Journal of Surgery* for October, 1914, are recorded a number of cases by various British surgeons, collected and analysed by Hey Groves, but since this date the war has largely diverted the current of surgical work, and in this country little more attention has been bestowed upon the operation.

Foerster adopted rhizotomy in connexion principally with three conditions—namely, the relief of spastic symptoms in the lower limb, especially those due to the cerebral hemiplegia of infants, the gastric crises of locomotor ataxia, and various types of pain. The present paper does not, however, propose to deal with the division of posterior nerve roots for the relief of spasm, as I have not adopted the operation for that purpose, and from the cases of others which I have observed I am not altogether satisfied as to its value, the difficulty of estimating which is largely increased by the fact that the operation has always been accompanied by careful nursing and instruction. We shall therefore for the present confine ourselves entirely to rhizotomy for gastric crises and for other painful conditions.

RHIZOTOMY FOR GASTRIC CRISES.

Gastric crises are conveniently divided by Foerster into two types:

1. The "*Vagal*," in which there is marked nausea, with but little pain or hyperaesthesia.
2. The "*Sympathetic*," in which pain and hyperaesthesia are common, but nausea is as a rule not very prominent.

It is for the latter type of case that rhizotomy is principally recommended, and Foerster adopts bilateral resection of the dorsal roots from the fifth to the twelfth, with a view to cutting off entirely afferent impression within this area. He records 64 cases collected by himself, of which 6 died, 47 were cured or markedly improved, 9 underwent a certain amount of improvement, and 2 were unrelieved.[7]

In the *British Journal of Surgery* are reported 5 cases with no deaths, 2 failures, and 3 successes, but of the latter, 2 were too recent to allow of reliable inference. To these cases is added a sixth, in which death followed an operation for visceral crises in the bladder. Of the failures recorded in the *British Journal of Surgery*, one was a bilateral operation involving the sixth to the eleventh dorsal roots, and one, which involved only the eighth, ninth, and tenth on both sides, was probably too limited to give much hope of recovery. Of the successful cases, two were bilateral, involving the seventh to the tenth roots, and one case of my own, to which reference will be made immediately, was a unilateral division of the fourth to the eighth on the left side.*

*In every case the numbers given are inclusive; thus fourth to eighth means fourth, fifth, sixth, seventh, and eighth.

Personally I have now performed this operation for gastric crises in three cases; and as two of these date back to the year 1914, they afford sufficient ground for judging of the permanency of the cure.

CASE I.

M., the patient already referred to as reported in the *British Journal of Surgery* for October, 1914, is now 54 years of age. He commenced to have gastric crises at the age of 34, the pain being limited to the left side and associated with copious vomiting. The attacks increased in frequency, and were eventually almost continuous, while the intensity of the pain required him to take large quantities of morphine. In March, 1914, the dorsal roots on the left side only were divided from the fourth to the eighth, both inclusive. Relief of pain was immediate, but three attacks occurred at considerable intervals during the first two years after the operation.

Since then there have been no further attacks, and up to the present time (February, 1921) the patient is entirely free from these. He naturally presents various symptoms of locomotor ataxia, but is quite able to go on with his business, and his general health is good. He presents loss of sensation to pin-prick from the level of the fourth to the eighth dorsal segments, and loss of sensation to cotton-wool over a slightly wider area. There is no tenderness in the abdomen, even on very deep pressure. The sixth, seventh, and eighth motor roots have probably also been injured, as there is a little sinking-in of the lower part of the chest on respiration, and possibly this may be due to degenerative changes in the anterior roots or cornua, as some paralysis was noticed at the time of operation and then passed away in a few days. There are no "trophic" changes of the skin.

CASE II.

B. was admitted to hospital for bilateral pain extending from about the level of the nipple to that of the umbilicus, more intense about the level of the eighth dorsal segment and relieved to some extent by pressure on the epigastrium. Attacks of pain were felt daily and were accompanied by profuse vomiting. I operated upon him in January, 1915, dividing the fifth, sixth, seventh, and eighth posterior dorsal roots, and thus perhaps not extending my section quite far enough down.

In January, 1921, this man was again examined. He presented anaesthesia to pin-prick from the fifth to the eighth dorsal segments on both sides, and to cotton-wool over a rather more extensive area. There was no paralysis of any muscles and deep pressure was felt and roughly localized over the whole anaesthetic area; but there was no tenderness even on the deepest pressure over the subjacent viscera. The skin was normal. The patient states that attacks of pain recommenced about six weeks after the operation, and that they have continued ever since; but they now occur about once in six weeks, instead of daily as before the operation. His general condition as regards locomotor ataxia is bad, and he is much crippled by an arthropathy in the right hip, by difficulties of micturition, and by eye troubles, all associated with the primary disease. It is interesting to note that radiographic examination of the stomach showed on one occasion no abnormality, and on another some delay in emptying the viscus.

These two cases, then, present, after an interval of over six years, the one complete immunity and the other relatively great improvement as regards the crises, which alone the operation was designed to meet. The following is more recent, and does not yet offer materials for a judgement as to the end-result:

CASE III.

Mrs. W., aged 47, consulted me in October last, having suffered for twenty years from attacks of pain in the left side of the abdomen, with vomiting, and great exacerbation of these attacks during the last four years, so that latterly they had occurred every three or four days. She had had an operation performed on the gall bladder, but nothing pathological was there discovered. She presented typical symptoms of locomotor ataxia, which it is not necessary to detail. On November 8th, 1920, I exposed and resected the fourth to the eleventh dorsal roots on the left side only, producing the usual band of anaesthesia. The patient had two attacks of pain within the first week or two after the operation, but thereafter ceased to suffer from these for the six weeks during which she remained in hospital.

It will be noted that in these three cases Foerster's dictum as to the bilateral section of the fifth to the twelfth has not been followed, as I was doubtful whether so extensive an operation was essential. In the cases in which pain was limited to the left side the operation was unilateral only; in Case I, which was completely cured, it involved the fourth to the eighth thoracic roots; in Case III, which is so far relieved, the fourth to the eleventh roots were cut. In the partially relieved Case II the operation was bilateral, and concerned only the fifth to the eighth roots.

Apart from the main issue in the above cases, attention may be called to two points, namely, the completeness and permanence of anaesthesia, and the total absence of any

indication of trophic changes in the affected parts; in both of which respects the operation conforms to the results produced by dividing the sensory root of the Gasserian ganglion.

RHIZOTOMY FOR PAINFUL AFFECTIONS OF THE LIMBS.

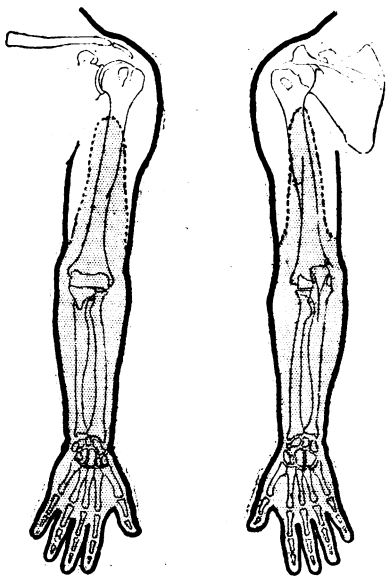
A considerable number of cases of rhizotomy for pain in the limbs have also now been recorded. Foerster[8] has collected 44, of which 6 died and 12 were cured, while 23 showed material improvement and 3 were untraced. In the British collection of cases already referred to there are 15 cases: In 1 the operation had to be abandoned, 1 died, and in 1 the result is unknown. Of the 12 which have been followed up, 8 were cured and 4 were failures. Several of the cured cases were examples of neuralgia of very limited type, in which only one root was divided, and more extensive painful affections were often apparently not relieved even by extensive operations. The great majority of the cases concerned the brachial plexus. The conditions for which the operation has been adopted are of the most varied nature. I have operated in two cases:

CASE IV.

A man had an injury to the right brachial plexus, followed by complete paralysis with anaesthesia and pain in the limb. The latter had, when he came under my observation in 1911, been amputated two or three inches below the shoulder-joint, naturally without giving relief. In March, 1911, I exposed the brachial plexus, finding a dense cicatrix, which extended completely up to the vertebral foramina. I excised the entire plexus, but without affording any relief to the pain.

In November, 1911, he was again admitted to my wards, and osteoplastic laminectomy was performed. The fifth, sixth and seventh arches were displaced. On opening the theca in the middle line, the dura mater was found to be closely adherent to the arachnoid on the right side, and had to be dissected away from the cicatrix thus produced. The roots of one only of the cervical nerves, apparently the sixth, were fairly well defined; but the remainder were contained in one cicatrix, which had to be dissected away from the spinal cord without differentiation between the anterior and posterior roots.

Recovery from the operation was uneventful, and the only marked change produced was paralysis of the cilio-spinal fibres, which had escaped or recovered from the original injury. Pain in the upper limb still continued, and two and a half years after the operation the patient wrote that although perfectly well and able to attend to his business, he did not think that he had obtained any material relief. It is clear that in this instance the roots of the plexus were avulsed from the spinal cord, and it is more than probable that changes had extended upwards in the central nervous system beyond the level of these roots.



CASE V.

CASE V.

J. received a bullet wound in the axilla in November, 1914, and in the early part of 1915 came under my care with extensive paralysis and anaesthesia of the left upper limb and severe causalgia. At that time I sutured the ulnar and inner head of the median nerve in the axilla without benefit.

He came under my care again in January, 1921; the muscles of the upper arm were in fairly good condition; he had slight power of flexion and extension of the wrist; all the intrinsic muscles of the hand were much wasted, the skin glossy, the nails long and curved, the wrist displaced to the radial side and the hand partially fixed in the position of pronation. There was continual pain in the palm, extending upwards in the front of the forearm for about one-third of the distance to the elbow-joint—that is, roughly in the distribution of the median nerve; but, although pain appeared to be severe and operation was welcomed, it could no longer be described as typical causalgia. Atrophy and paralysis involved both ulnar and median nerves. No accurate determination of anaesthesia was possible, but there was patchy loss of sensation to both cotton-wool and pin-prick on both front and back of the useless hand; the limb was quite useless. The general health was a good deal undermined by pain and the use of drugs.

On February 3rd, 1921, the fifth, sixth, and seventh cervical laminae were removed, and the sixth, seventh, and eighth cervical and first dorsal posterior roots were divided inside the theca, the ganglia not being excised. The fifth cervical root was not touched, as it was fairly remote from the affected area, and it was not thought advisable to run the risk of injuring motor fibres to the phrenic nerve. This man passed through one or two vicissitudes in connexion with an attack of influenza and sundry functional nervous phenomena, but by the end of February declared himself free from pain, except for an occasional headache. Anaesthesia did not appear to be quite complete in any part of the limb, except the fingers, but the mental condition made accurate registration impossible. Light touches with cotton-wool were, however, generally not recognized in the area shaded in the diagram, but pin-prick was generally felt in the whole limb, except on the back of the fingers; deep pressure appeared to be recognizable everywhere.

These two cases are sufficiently indicative of the uncertainty of relieving severe neuralgia by posterior rhizotomy, and Case IV shows very clearly how some painful affections of the limbs may be associated with changes extending into the central nervous system. It is, however, remarkable that of the published records the greatest proportion of good results has been obtained in those cases in which, for a limited neuralgia, one root only has been resected.[9] Beyond all question so limited a resection will not produce anaesthesia in the affected region, and the comparative success of the limited operation must be attributed to some other factor not yet fully explained. The existence of such other factor is also indicated by the success of my comparatively limited operations for gastric crises, and especially by that of Case I. It is also to be noted, both in the case of locomotor ataxia with gastric crises, and of long-standing neuralgia in any region of the body, that the results of operation are much confused by the highly neurotic condition of the patient. Many of these are accustomed to large doses of morphine, of alcohol, and of other drugs, and when in hospital they feel acutely the absence of such drugs. The case last mentioned showed various phenomena due to this cause. As a further illustration of the instability of the central nervous system in such patients, it is perhaps worthy of note that I have seen a case in which, after removal of the Gasserian ganglion, a typical hysterical anaesthesia involved the side of the body operated upon. A similar case has been recorded by Ormerod.[10]

In pleading for a more frequent use of rhizotomy, it appears to me important to point out that the dangers of the operation in practised hands are very much less than would appear from the published results. Thus, Foerster recorded 26 deaths out of 267 operations in which rhizotomy was performed for various reasons; and in the 58 cases collected from the *British Journal of Surgery* we find 6 deaths, the proportion in each case being about 10 per cent. If, however, we investigate the figures of individual surgeons, who have presumably a larger experience in the operation, we find a very different result.

In Burghard's *Manual of Surgical Operations* (1909) I endeavoured to determine the mortality of laminectomy for all causes. An analysis of 50 of my own cases yielded a death rate of 6 per cent., several of which were early cases and were examples of injury or of tuberculous or malignant disease. I was then able to state that "exploratory operations and operations for tumours and allied conditions have been uniformly successful so far as life is concerned; and even in the earlier and more tentative operations for injury there is only one case in which death was probably hastened by operation." At that time I was not able to include any large number of operations for drainage, rhizotomy, or the removal of intrathecal tumours; but since then I have performed many such operations, and the only case of death has been that of an extensive sarcoma involving the cauda equina and conus medullaris, quite irremovable and associated with advanced secondary changes in the bladder and kidneys.

Kuttner has performed rhizotomy 32 times with 2 deaths, Eiselsberg 12 with no deaths, and Elsberg 22 with no deaths. Adding my own to the above cases, we get 71 cases with only 2 fatal results; and every surgeon experienced in laminectomy will agree that the operation *per se* is not more fatal than that of laparotomy. Death is hardly to be contemplated as a result, except in cases where the original disease or the gravely deteriorated general health

introduces a special and serious factor. Even, therefore, if the results as regards cure of pain are still somewhat uncertain, and if we have more to learn as to the selection of cases and the scope of the operation, it is unquestionably well worth while to give these patients the considerable prospect of cure or relief offered by posterior rhizotomy.

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SYMPTOMLESS HAEMATURIA:

*A PLEA FOR EARLY INVESTIGATION.**

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I WISH to direct your attention to the subject of symptomless haematuria, a condition of considerable importance, yet one which receives less attention than it merits; my main object in doing so is to impress on you the fact that such an occurrence is a matter of urgency until a full diagnosis has been made.

"Symptomless haematuria" is a term used to cover all cases in which haemorrhage occurs from the urinary tract unassociated with any other symptom or sign, such, for instance, as pain, urgent or frequent micturition, or a lump. The name is a bad one. In fact it is a misnomer, for haematuria itself, if evident to the naked eye, constitutes a symptom, and its occurrence can therefore never be symptomless. Perhaps it would be better if it were styled "unaccompanied haematuria."

Such unaccompanied bleeding is not at all uncommon, and may be the result of a very considerable number of pathological processes. Indeed there are very few of the many diseases of the urinary tract which do not sometimes give rise to haemorrhage, though with some of them bleeding is characteristic, whilst with others it is exceptional. If you will consider for a moment the vascularity of the organs concerned, it will not seem surprising that this is so. The kidney in particular is an organ of exceptional vascularity, and that portion of the bladder which is most susceptible to disease, namely the trigone, is also very rich in blood vessels.

Yet though so many lesions may be the cause of haematuria, in practice it will be found that unaccompanied bleeding is very suggestive of a urinary neoplasm. Indeed there is a well known dictum which states that "symptomless haematuria indicates a growth of the urinary tract." I quote this phrase to you with diffidence, realizing that medicine abounds with instances of similar dogmata, the majority of which are fertile sources of error and frequently denote a lack of scientific erudition. Yet it is with this probability in his mind that the surgeon will approach the investigation in any given case. That he will frequently find himself mistaken will be impressed on you if I refer to four cases of otherwise symptomless bleeding which have occurred in my own practice recently, and which on further investigation proved to be respectively:

1. A case of scurvy rickets.
2. A case of early renal tubercle.
3. One of that group of cases classified under the title of "essential renal haematuria."
4. Stone impacted in the pelvic outlet, in which, though the patient denied any history of pain, the parenchyma had been markedly encroached upon by back pressure.

Many other causes of symptomless haematuria might be recalled. Yet in a very large proportion of patients who pass blood in their urine without other symptoms, it will turn out that there is a neoplasm of the urinary tract. Walther, in a study of seventy-four cases of haematuria, both accompanied and unaccompanied by other symptoms, demonstrated that over 50 per cent. were the result of urinary growths, and that of these 72 per cent. were malignant. If his article had only referred to cases of symptomless haematuria the percentage of growths would have been much higher.

Two matters require investigation in all cases:

1. The anatomical point from which the haemorrhage originates.
2. The nature of the pathological processes giving rise to it.

Now I submit that of these investigations the former is a matter of some urgency. The latter could be dealt with at more leisure, but you must know at the earliest possible moment whether the bleeding is from the upper or from the lower urinary tract, and in the first alternative from which side the haemorrhage is coming. This last is the important thing. A growth in the bladder may be seen when the haemorrhage has disappeared, but symptomless bleeding from the upper tract must be diagnosed during an attack, for then the bloody efflux from one ureteral orifice can be seen and the corresponding kidney, or ureter, held culpable. Remember that in all cases which are truly "symptomless" there is only one real guide, and that is the cystoscope. There is no pain; there is no lump. You may get some doubtful information from the presence of blood well mixed with the urine, which is generally held to come from the kidney; or from the presence of worm-like clots which have received their shape from the ureter; but these are unsafe guides, and even they will not tell you from which side the bleeding is coming.

If you wait till there are other symptoms to guide you, you will run the grave risk that the case will become inoperable, yet such procrastination happens with great frequency. Hinman, in an analysis of the published work of eight different surgeons, found that in 709 cases of renal growths haematuria was the onset symptom in 42 per cent., but that when the cases came to operation only 6.6 per cent. showed haematuria unaccompanied either by pain or tumour, and he justly remarks that this "indicates the lost opportunity in making an early diagnosis."

Any of the tumours of the urinary tract is capable of causing symptomless haematuria, and more commonly than not they express themselves in this manner. In order to keep my argument clear I will limit myself to two of the commonest tumours of the tract—namely, papilloma of the bladder and hypernephroma of the kidney. These happen also to be two varieties which very consistently give rise to symptomless bleeding; the former, according to Hurry Fenwick, showing this as its first symptom in 84 per cent. of cases, whilst Israel states that the latter expresses itself thus in 70 per cent.

There is considerable variation in the period of their life-history at which they give rise to haemorrhage; in some cases we find that the first bleeding comes from a growth, papilloma or hypernephroma, which from its size must have been growing unsuspected for a long time. But in many cases it is quite early, when the growth is small. Such a haemorrhage coming from a small growth, whether of the bladder or kidney, may not be repeated before months, or occasionally even years, have elapsed, the growth in the meantime having become wellnigh untreatable. Surely this gives an uncanny importance to that single manifestation, and throws a grave responsibility on the medical practitioner to see that it is not allowed to subside without having been traced to its source. Generally the duration of that preliminary haemorrhage is not great—it is often only a few days or even hours. Denaclara states that in 146 cases of renal neoplasm only once did the primary haematuria last as long as fourteen days.

These two types of tumour each run a peculiar and almost invariable course, in that each in its earlier stage is non-malignant but in its later stage malignant. The papilloma in the early stage is single, has a long slender pedicle, and does not invade submucous planes. In the later stage it becomes multiple, subsessile or sessile, shows the typical tendency of malignant neoplasms to invade and disseminate, and eventually destroys life by anaemia and cachexia. Singularly enough hypernephroma in its early stages is also a benign growth. It is encapsuled, and it grows very slowly. It may exist in this condition for many years—cases have been reported up to twenty years—behaving in exactly the same way as do parotid tumours.

* A portion of a lecture delivered at the Salford Royal Hospital to a post-graduate class (January, 1921).