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THE SURGEON AND PAIN*

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Pain is a symptom at once so disabling and so urgent that of all the manifestations of disease it ranks first in the mind of the laity. At the outset it is necessary to remember that capacity for bearing pain varies greatly from individual to individual; it behoves us, therefore, to study the mental make-up of a patient who complains of pain, for an intensity agonizing to one person is tolerable to another. We must next assess the diagnostic significance of the pain, and, finally, apply ourselves to its relief. I believe that it is of some importance to emphasize this order of investigation; too frequently we are led by our sympathy with the sufferings of a patient to alleviate his pain before we have deduced from its severity and its nature the valuable information they so frequently provide.

From a clinical point of view pain may be classified as follows: (1) Pain due to a recognizable cause, which cause can be dealt with—for example, the pain that results from the perforation of a peptic ulcer of the duodenum. (2) Pain due to a recognizable cause, which cause cannot be dealt with—for example, the pain attendant upon inoperable malignant disease. (3) Pain of unknown aetiology, which can or cannot be abolished by surgical measures—for example, the pain of trigeminal neuralgia on the one hand, and the "painful face" that is not trigeminal neuralgia on the other. I shall confine myself to a consideration of the second and third of these groups.

The Peripheral Pathway for Pain

Nerve fibres that mediate sensibility to pain which has its origin in somatic structures pass proximally in somatic nerves, either sensory or mixed, then, possibly, through a plexus, and, finally, they are distributed to the spinal cord by its posterior nerve roots. Soon after they enter the spinal cord they come to an end, and to continue the pathway to the sensorium a new fibre is provided, which rapidly crosses to the opposite side of the cord. This second stage of the pain pathway turns upwards in the antero-lateral tract of the cord, and we must examine the limits of this tract more closely.

For surgical purposes it has a posterior limit on a plane two millimetres anterior to the meridian of the cord, and an inner limit four millimetres from the surface of the cord. In this tract the fibres are arranged in concentric laminae, each of which corresponds to a spinal segment. The fibres representing the lowest segments of the cord are gradually pushed towards the surface by newly arriving fibres representing higher segments, so that in the thoracic portion of the cord the lowest sacral seg-

ments are quite close to the surface—in other words, the segments of the cord from below upwards are represented in the tract by laminae from without inwards.

It is held by some that, in addition to the anatomical pathway I have described, the sympathetic fibres which clothe arteries may help to transmit sensations of certain obscure types of pain towards the spinal cord. This matter has not yet been settled: so brilliant an observer as Foerster of Breslau believes in the existence of this subsidiary pathway in man, but experimental evidence for its existence is lacking. Pain fibres from viscera ultimately reach a nerve strand in one of the three "splanchnic" systems—cervical, thoracic, or pelvic—or the pelvic parasympathetic nerves derived from the second to fourth sacral segments. By the splanchnic systems they are directed to the long paravertebral sympathetic chains, and from thence in turn they reach parent spinal nerves along the rami communicantes of the sympathetic system. They finally enter the spinal cord along its posterior nerve roots. At least, in experimental animals it would appear that they do not all pass towards the brain in the same tracts as do sensations of somatic pain; moreover, I have several clinical observations which point to the same conclusion as regards man. They probably ascend by a series of relays of short fibres, the course of which is nearer the grey matter of the cord than that of the somatic pain tract.

Physiology of the Pathway for Pain

When a mixed nerve or a purely sensory cutaneous nerve is divided it is found that its cutaneous territory, as outlined by clinical tests for absence of sensation, is less extensive than its anatomical distribution. In other words, there is a certain amount of overlap in the functions of sensory nerves. This overlap is most marked in the case of pain fibres, and so the area of lost sensibility to pain is smaller than the area of lost sensibility to touch. This arrangement has a surgical application, for if the surgeon wishes to abolish pain by section of cutaneous nerves he must sever all the cutaneous branches that might conceivably overlap the painful area. On the other hand, he has the satisfaction of knowing that by such a procedure he does not interfere with sensation other than cutaneous sensation—that is, he leaves intact afferent fibres from the motor apparatus of the body, for these travel in motor nerves.

At first sight it would seem that a much better way of securing analgesia would be to attack the concentration of sensory fibres in the posterior roots of spinal nerves. There are, however, serious disadvantages in this method. Division of posterior roots is followed, in the area so denervated, not only by loss of all forms of cutaneous

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sensation, but also by ataxia, from division of fibres subserving the motor apparatus, and, moreover, the muscles in the area become atonic. Especially in a limb this price is too high to pay for relief from pain. There are certain technical difficulties in performing the operation, and perhaps the greatest of these is the ease with which a filament or two may be missed. As each filament is distributed widely over the whole segmental area to which it belongs, when even one is left intact sensation is not entirely abolished, and the operation is not completely successful. It is occasionally found that after apparently complete operations of this type there is an interval of freedom from pain, after which it returns.

Those who believe in the presence of a sympathetic pathway for pain explain these very curious cases thus. When the usual route is interrupted there occurs a reorganization and readjustment of all other available afferent paths—paths previously, as Tinel puts it, "mute and latent," but now pressed into service for the transmission of pain. Sensations are conducted by these paths to the sympathetic trunks, and pass up or down the latter to enter the cord by posterior roots above or below those sectioned. This phenomenon is held to be merely one expression of the remarkable urge, found throughout the entire animal kingdom, for securing harmonious working of the organism as a whole, irrespective of local conditions. I would find this argument more convincing were such cases the rule rather than the exception.

In the spinal cord fibres subserving somatic pain and a certain number of those subserving visceral pain pass upwards in the antero-lateral tract; the remainder of visceral pain fibres employ less definite routes. The concentration of pain fibres in the antero-lateral tract offers an attractive objective for surgical attack. Division of this tract, an operation known as cordotomy, leads to loss of sensibility for sensations of pain and of temperature up to a level which will naturally vary with the depth of section: the deeper the section, the higher the level. The immediate post-operative extent of the analgesic area may not persist, probably because at operation the effects of the cut are intensified by haemorrhage and oedema, so that some fibres are physiologically interrupted, but not anatomically. As these fibres gradually recover their conductivity the analgesic area shrinks. Occasionally local pain may persist in an analgesic area. Such observations raise the possibility that higher centres may be at fault; but that question is outside the scope of this paper.

I have noted on more than one occasion that unilateral division of the antero-lateral tract did not abolish pain arising in the viscus, even when the pain originated in the one of paired organs, such as the kidneys, lying on the analgesic side. After unilateral cordotomy testicular sensation on the analgesic side also remains unaffected. The gastric crises of tabes dorsalis have been abolished in some cases by unilateral cordotomy, whereas in others bilateral cordotomy has been ineffectual.

Surgical Relief of Pain

Before any operation is undertaken that has for its primary object the denervation of a painful part it must first be proved that a frontal attack on the lesion is out of the question. This decision may have to be made in any one of three sets of circumstances.

1. The site of the lesion and the site of the pain are the same. This problem is quickly settled by clinical and, if necessary, pathological examination.

2. The painful area is more extensive than the local lesion, which may happen, for example, when carcinoma of the rectum invades the nerves of the sacral plexus. In

these circumstances care must be taken that any projected operation will not deal only with the visceral component of the pain.

3. The pain is a "referred" pain, and the real lesion distant and possibly not even surgically accessible. For example, certain obscure cases of severe pain about the lower jaw are an expression of cardiac disease, and division of the posterior root of the fifth nerve to alleviate pain of this type would be disastrous.

In addition to patients who suffer from pain of known aetiology, there is a not inconsiderable group who complain of pain, usually about the head, that does not fit into the territory of any nerve or nerves as at present known. These pains are not relieved by stereotyped denervations; indeed, the patients often state that after operation they are worse than before. It is easy to dismiss pain of this type as functional, but this explanation may not be the correct one, and ultimately a clue may be found to the real nature of such cases. In general it may be said that the outstanding features of pain of this type are its constancy and its burning nature. It is well also to realize that certain types of pain of known or partly known aetiology are resistant to surgical denervation—for example, the annoying pain that is often a sequel of herpes in old people, and the neuralgias associated with, or forming an equivalent for, migraine. In my own experience surgical treatment of either of these conditions has been unsatisfactory.

At this point I feel that I must refer to the justification for performing operations solely for the relief of pain. I cannot myself conceive of any adequate argument against suitably planned and competently performed operations for the relief of intractable pain due to pathological conditions which of themselves do not threaten the life of the patient. The duty of the surgeon is not so clear-cut in cases of malignant disease, for there is the alternative of using analgesic drugs, and ultimately these reduce to some form of opium. If the latter course be chosen it involves the use of increasing doses of the drug, with gradual mental and moral degeneration of the patient, and the undesirable subsidiary effects—for example, the effect on the bowel of large doses of opium. I cannot say that such a prospect appeals to me personally, and I doubt if it appeals to the majority of patients or to their friends. On the other hand, if an operative method of relieving pain be chosen, it is essential that it should entail only a reasonable risk, and that the patient has an expectancy of life compatible with that risk. Each patient is a separate problem, and in practice many factors must be considered—the social and economic position of the patient, his mental outlook and his personal wishes, and the attitude of his friends.

When we come to plan operations for the relief of pain we are confronted with two different anatomical arrangements of pain fibres, according to the somatic or visceral origin of the pain.

1. Somatic pain fibres from the periphery are first concentrated in nerve trunks, may then pass through a plexus, spread out over posterior roots, and, finally, are concentrated in the antero-lateral tract. This tract is the most logical point of attack for the surgeon, for he is certain that by dividing it properly he is securing maximal analgesia with minimal effect on other forms of neural conduction, either motor or sensory.

2. Visceral pain fibres are concentrated in a strand or strands of one of the splanchnic nerves. They spread out again over the "roots" of the strand; they may extend still further in the sympathetic paravertebral chains; from thence they may have a choice of many posterior roots over which to enter the cord; and in the cord itself they have a choice of at least two routes—the antero-

lateral tract and the ground bundles close to the grey matter. The most logical point to attack visceral pain fibres is the particular splanchnic strand in which they are first concentrated.

Operations for the Relief of Somatic Pain

Peripheral Nerves.—It is possible to interrupt a peripheral nerve by section, by crushing, or by the injection of chemicals such as alcohol and formalin. The method has a very limited application. It is sometimes used in the treatment of pain in an amputation stump, but here it is often unsuccessful, the pain recurring because of interstitial changes in the nerves above the level of their interruption. It may be used to allow of proper dressing of the very painful ulcers of the foot associated with obliterative arterial disease, in an attempt to limit or to avoid amputation. This can be done without causing any paralysis other than of the small muscles of the sole, a sequel that can be discounted by the use of an arch support. According to the site of the ulcer the nerves dealt with are chosen from posterior tibial, anterior tibial, cutaneous branch of musculo-cutaneous, external saphenous, and internal saphenous. It will be appreciated that if such a procedure is to be completely successful the painful area must be accurately mapped out, so that allowance can be made for overlap.

Cranial Nerve.—Intracranial division of the glossopharyngeal nerve is most successful in the treatment of glossopharyngeal neuralgia. This condition is characterized by explosions of severe pain, which are usually touched off from a trigger zone in the tonsillar area. There appear to be two forms of the disease: a more common one, in which the pain is felt in and around the tonsil, and a rarer one, in which it is felt deep in the ear. Swallowing precipitates an attack, and a useful point in diagnosis is the temporary freedom from pain that follows cocaineization of the fauces and tonsil on the affected side. The nerve is approached through the posterior fossa of the skull; it is easy to identify as it enters the jugular foramen. Division of the nerve does not lead to any motor paralysis. The sensory loss is not troublesome, and does not ultimately interfere with swallowing.

Posterior Roots.—Of recent years the field of posterior spinal rhizotomy has been greatly restricted. This restriction naturally followed the disappointing results and the post-operative disabilities of extensive procedures, and the high mortality associated with the operation. With the perfection of the operation of division of the antero-lateral tract (cordotomy), a much safer procedure, the problem of dealing with pain arising as high as the fifth thoracic segment was greatly simplified. However, division of the antero-lateral tract above the accession of the fibres supplying the arm is a formidable operation; occasionally, therefore, the roots of the brachial plexus (fifth cervical to first thoracic) are divided in lesions of the arm and axilla, usually of the nature of inoperable malignant disease.

On the other hand, division of the posterior root of the fifth cranial nerve is one of the most satisfactory operations in surgery. It is used in the treatment of paroxysmal trigeminal neuralgia, the pain of which is not exceeded by that of any other malady. This disease is usually unilateral, and generally appears first in the territory of the second or third division of the nerve: pain beginning in the first division in the territory of the supra-orbital nerve is quite uncommon. The pain appears and disappears suddenly, and a paroxysm may be started by a touch on the face, especially if a definite "trigger zone" is present, so that washing and shaving, eating and talking, and even any movement of expression are all rigorously avoided. There may be remissions and intermissions,

during which the patient is free from pain, and these may have a seasonal incidence. The diagnosis is made from the story and from the absence of neurological signs.

There are two methods of treating the disease: (1) by the injection of alcohol into the affected nerve or into the Gasserian ganglion; and (2) by division of the posterior root of the fifth nerve. Of the two I prefer the second. When the pain does not involve the territory of the first division of the nerve the fibres of the root subserving the cornea may be spared, and so is avoided the danger of injury to the anaesthetic cornea, and consequent corneal ulceration. Even when the cornea must be rendered anaesthetic the exercise of a little care is, as a rule, sufficient to avoid ocular complications. It should be emphasized that the modern operation is safe, and when the original diagnosis has been correct the results are permanent. Usually the root is exposed after elevation of the temporal lobe of the brain; the scar is not seen, as it is placed within the limits of the hairy scalp.

Antero-lateral Tract.—Division of the antero-lateral tract in order to abolish the pain of incurable disease was originally suggested by Dr. Spiller of Philadelphia. The field of this most valuable operation is a wide one, and the indications for its application may be grouped as follows: (1) Pain due to the presence of an irremovable tumour, which is pressing upon or infiltrating contiguous nerves. The distressing pain of widespread malignant growths in the pelvis is an instance. (2) Pain due to pressure upon nerves by bony outgrowths—for example, in spondylitis—and pain due to arthritis—for example, of the hip. (3) Pain due to intractable neuritis, as that of diabetes, or neuritis of the cauda equina. (4) Pain in amputation stumps of the lower extremity.

The operation may be performed for pain originating as high as the fifth thoracic segment, although in rare instances it has been used for pain originating as high as the eighth cervical segment. The technical point of importance is the avoidance of injury to the crossed pyramidal tract, which is situated posterior to the proposed line of section. The division is usually made after removal of the spines and laminae of two vertebrae—the third and fourth thoracic as a rule. In cases where the pain is unilateral, and likely to remain so, a unilateral cordotomy suffices. Bilateral cordotomy is necessary: (1) When the pain is bilateral, and when, though unilateral at first, it is likely to become bilateral, as in malignant growths of the pelvis that involve first one and then the other lumbo-sacral plexus. (2) When the pain is in part visceral in type.

After a successful cordotomy there is not any impairment of muscular power or of muscular co-ordination, and the evacuation and control of urine and faeces is preserved. The risk of the operation is not high when the physical condition of many of these patients is taken into account; but it is my conviction that the operation should be considered much earlier than it usually is. I believe that when pain first appears in incurable disease, a surgeon has the responsibility of suggesting cordotomy to the patient and to the friends. For this reason, also, I do not think that cordotomy should remain a specialist's operation, but it should be included in the armamentarium of all surgeons who are likely to have to deal with such cases.

Occasionally even bilateral cordotomy fails to relieve visceral pain; certain forms of tabetic gastric crises fall into this group. It may be noted also that cases are on record in which the analgesia has not been permanent; this may be due to an insufficiently deep cut into the cord, or, possibly, to sensations of pain pressing into service for their transmission the posterior columns of the cord—the latter possibility an example of the well-known biological urge towards wholeness of the organism.

Operations for the Relief of Visceral Pain

I cannot deal with all the operations that have been devised for the relief of purely visceral pain. I shall deal with the pain of angina pectoris, and with that which arises from disease of the pelvic viscera, because these two types illustrate the anatomical and the physiological principles involved in surgical treatment.

ANGINA PECTORIS

Let us leave on one side the mechanism of production of anginal pain as well as the desirability or not of its suppression, and try to work out a satisfactory procedure for its relief. I have already stated that the greatest concentration of pain fibres from a viscus is to be found in the sympathetic strands in its vicinity. In the case of the heart these are in the cardiac plexus, but a direct attack on this is obviously out of the question. After the first concentration we must look for a "spread" over sympathetic roots; this is over a vertical extent, the upper boundary of which is the junction of the superior cardiac nerve with the superior cervical ganglion, the lower boundary the ramus communicans of the fifth thoracic nerve. To extirpate all the nerves in this spread is obviously undesirable. If it be remembered, however, that the highest available sympathetic connexion to the spinal cord is by way of the ramus communicans of the first thoracic nerve, the vertical extent of attack can be greatly reduced.

Attention may be focused on the posterior roots of the upper five thoracic nerves, but rhizotomy of these would be a formidable operation for so poor a surgical risk. It has been found possible, however, to block afferent cardiac fibres outside the spinal canal by injecting alcohol into and around the upper five thoracic ganglia of the sympathetic chain on the left side. This is not a serious procedure; many good results have followed its application, and I have myself used it with satisfaction. The plan is a compromise between the ideal one of attacking at the most concentrated zone, with high risk, and attacking over a wider front, at a low risk.

PELVIC VISCERAL PAIN

The first "zone of concentration" of sympathetic fibres from pelvic viscera is conveniently—perhaps too conveniently—open to surgical attack as the presacral nerve in front of the fifth lumbar vertebra. In it pass afferent fibres connected with the bladder, the rectum, and certain of the internal genital organs; and it is usually easy enough to resect, with a minimum operative risk. Before employing presacral neurectomy for pain of pelvic origin, it is necessary to be satisfied that the strand does not contain extrinsic nerves which transmit impulses indispensable to the proper functioning of any viscus. Such fibres appear to be absent, for presacral neurectomy is followed by singularly little disturbance of function; indeed, the only really undesirable sequel is sterility, though not impotence, in the male.

The operation has been applied with success in certain cases of intractable cystitis, and in the palliative treatment of inoperable malignant disease of the bladder. It has also been utilized for the relief of intractable dysmenorrhoea, when the pain is of a colicky type; these patients must be very carefully selected. It is, however, by no means certain that the beneficial effects of the operation are directly due to the division of pain fibres alone, although these are undoubtedly present in the nerve. Probably the division of vaso-constrictor fibres that traverse the nerve diminishes the intensity of symptoms due to inflammatory disease by improving the blood supply of the diseased part; and in "obstructive" dysmenorrhoea the efforts of the uterus to get rid of its

contents may be assisted by a reduction in the tone of the cervix as a result of division of some of its extrinsic nerve supply.

Summary

1. There are available a number of surgical procedures which have for their sole object the abolition of pain.
2. Certain of these constitute the treatment of choice for the appropriate condition.
3. None of these operations is to be employed without an assessment of its possible remote effects.
4. Certain of these operations might well be employed more frequently in malignant disease, and at an earlier stage.

FAMILIAL ACHOLURIC JAUNDICE SIMULATING LEDERER'S ANAEMIA

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The differentiation between acholuric jaundice and the acute haemolytic anaemia associated with the name of Lederer may present considerable difficulty, a fact which is well exemplified by the following case records.

Case I

A boy, aged 10, complained on April 19th, 1934, of pain in the left side of the upper abdomen; he felt sick, and vomited repeatedly throughout the day, the vomitus being green and watery. During the following day he was slightly better, but had similar vomiting at night. He did not sleep well, complaining of headache, and became delirious. On April 21st his condition was worse, and he was admitted to hospital. He had been noted to be feverish and to have dark-coloured urine. His bowels had been regular, but were loose on admission, following Gregory's powder.

CONDITION ON ADMISSION

On admission he was seen to be a well-developed but rather thin boy, showing an extreme degree of pallor of the lips and mucous membranes. The skin was of a slightly yellowish colour, and there was a definite icteric tinge in the conjunctivae. He was very restless, with sighing respirations. The temperature was 102°, pulse 140, and respirations 25. The spleen was enlarged, extending beyond the costal margin medially to within an inch of the mid-line and downwards to about the level of the umbilicus. It was firm in consistence and slightly tender, but no friction could be distinguished. The liver was not enlarged, and there were no signs of enlarged lymph glands. The heart appeared slightly dilated, and loud blowing systolic murmurs could be heard all over the praecordia. No abnormalities were found in the other systems. The urine contained urates, but chemical and microscopical examination revealed no evidences of blood, albumin, sugar, or acetone.

The faeces contained no occult blood. The blood findings were: red blood corpuscles 1,500,000 per c.mm.; haemoglobin 18 per cent.; colour index 0.6; and white blood cells 6,000. The blood film showed small, well-filled cells. There was slight variation in size; the majority appeared somewhat smaller than normal, but regular in shape. No primitive cells of either the red or the white series were present. Reticulocytes numbered less than 1 per cent. The fragility of the cells did not appear to be increased, the range being 0.45 to 0.35. Van den Bergh test, direct reaction delayed positive; icteric index 10.

BLOOD TRANSFUSION AND SPLENECTOMY

On April 22nd the patient was transfused with ten ounces of citrated blood. Following the transfusion the boy was less dyspnoeic, but there was no improvement in the blood count and no reticulocyte response. Accordingly he was