

Putnam (J. J.)

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A DISCUSSION OF THE QUESTION,
WHAT ARE THE PRESENT MEANS OF LOCALISING
INTRA-CRANIAL LESIONS ?

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QUESTION I.

WHAT ARE THE PRESENT MEANS OF LOCALISING INTRA-CRANIAL LESIONS?

Mr. President, and Fellows of the New York State Medical Association: I shall use the opportunity which your courtesy affords me to speak of two or three considerations primarily physiological in their interest, which seem to me important for the *doctrine of localisation*, especially the *relative value* of certain localising signs, and shall leave the task of analysing the recent clinical and pathological material to Dr. Mills, whose masterly review of the whole subject, in his address of 1888, has given him a prior claim in that field.

The general doctrine of localisation stands on a sure footing, and with the main points every one is familiar. At the same time, no one can attempt independently to investigate the subject without realising how immeasurably crude are the inferences and theories and the anatomical conceptions, in the terms of which we represent to ourselves the working of the cerebral mechanism, and any physiological generalisation should be welcome which gives us even a new point of view, and helps us to interpret our clinical observations to better advantage. It is in this spirit that I wish to call your attention to the relative value of certain so called localising signs of cerebral tumors, especially such tumors as lie a little outside of the familiar areas of the central, temporal, and occipital zones, and only impinge upon them, so that the symptoms to which they give rise will be liable to occur rather late in the progress of the case.

These are cases which obviously, and for more reasons than one, are relatively unsuited for surgical treatment. They occur constantly, however, in our practice, and I choose

them because I have several cases of my own in mind in which I think the diagnosis might, perhaps, have been made with sufficient accuracy to justify an operation, and where an operation, if done at the right spot and at the right time, would certainly have completely cured one patient, and might, at least, have partially relieved two more.

It is generally admitted as a clinical principle, that monoplegias and localised paralysis are more valuable as localising signs than mono-spasms or localised convulsions. This has been explained partly on anatomical and partly on physiological grounds. A paralysis, of more than temporary duration, renders it probable that the cortical area corresponding to a set of movements is damaged,¹ or else the small bundle of fibres passing from this area directly downwards; whereas, there is more chance that a localised convulsion may be due to an irritative lesion in the centres standing in physiological relationship with the area in question, or at a distance from it, or even to an unstable nutritive condition of the cortical area itself, without gross lesion of any sort. It has seemed to me that, in accordance with a similar course of reasoning, a distinction, not so important nor so trenchant as this, but yet of practical use, could be drawn between the different classes of symptoms of the same order, *i. e.*, between the different kinds of localised paralyzes on the one hand, and of localised convulsions on the other.

In order to formulate what I mean, I will call attention in the first place to the fact that those functions of the brain which are relatively highly specialised and complex in character are more likely to suffer disturbance than the less highly specialised and complex, or, as one might say, more fundamental functions.

Thus, it was long ago pointed out by Dr. Hughlings Jackson, and is, I suppose, generally admitted, that, given an irritation in the arm or leg area leading to an epileptic attack, the attack will be most likely to begin with the thumb or

¹ It is, of course, important to recognise that paralysis may be "indirectly" produced by pressure and disorders of circulation. This subject has been carefully studied by Wernicke, in his *Gehirnkrankheiten*. Inhibition is also an occasional cause.

fingers in the one case, and the toe in the other, as having more highly specialised¹ functions than the other segments of the limb, and as being represented by groups of ganglion cells, that, in order to do the work for which they are designed, are in a state of what might be called physiological instability.

Although this principle is generally admitted, I do not think that the facts and corollaries related to it have been sufficiently worked out, especially as regards their practical relation to the localising doctrine.

Thus, if it is true that the complex movements of the fingers are, on the one hand, more easily set in action, and, on the other hand, more easily paralysed by slight irritation of a corresponding cortical area, or of associated cortical areas at a distance, than the less mobile muscles of the shoulder, then a localised convulsion or localised paralysis of the shoulder would have a greater localising value than a convulsion of the muscles of the hand, *i. e.*, would more surely indicate the presence of an irritative lesion at the shoulder centre, than a convulsion of the hand muscles would indicate a lesion at the hand centre; and such is, I believe, the case. Under many circumstances, to be sure, the error in the latter estimate would be unimportant. If we have to deal with a spasm localised in the thumb or fingers, and conclude that the lesion is at a certain spot, whereas it is really a few millimetres away, or covers a larger area than we supposed, and caused a convulsion in those parts only on account of their special irritability, the operation may nevertheless be successful, and we may never discover our mistake.

Indeed, there must be few tumor-operations where the convulsions near the growth are not more or less displaced, and often they are broadened to twice their natural size, or flattened to the thinness of cardboard, so that minute localisation on the outside of the head would be impossible.

¹ It is not improbable that some better expression than "highly specialised" could be found to represent this idea. The underlying notion is, that the movement of the whole arm, for example, usually culminates in that of the hand, as regards those acts in which the cortex cerebri is specially concerned.

There are cases, however, where this error is of importance,—those, for instance, where convulsions in the head are excited by pressure transmitted from a considerable distance, or by oedema and anaemia. This occurred in a case in which Dr. H. H. A. Beach operated at my request, as a matter of last resort for a supposed tumor of the frontal region. I had been led to this diagnosis by the occurrence of a disorder of speech, wrongly interpreted as motor aphasia, which had recurred at intervals throughout the whole course of the case, and by a twitching of the flexors of the right hand, associated with a slight but distinct paresis of the finger extensors. These latter symptoms were of late appearance, not showing themselves, in fact, until the patient was semi-comatose, but they recurred frequently through two or three days. The tumor was found, post-mortem, in the inferior parietal lobule just in front of the angular gyrus, separated by a space of three quarters of an inch from the motor area.

The case has been published,¹ but in view of this meeting I have sought and obtained some facts about the history to which I shall refer later, which might, I think, have led to a fairly correct diagnosis had they been thoroughly utilised.

In striking contrast with this case, where convulsive movements of the fingers with paresis of the extensors were set up in consequence of pressure from a distance, I will refer briefly to another,² in which a convulsive action at the shoulder occurred, of several minutes' duration, not attended by complete loss of consciousness, but associated with slight tonic contraction of the trunk muscles. This also took place at an advanced period in the course of the case, though not in the pre-terminal stage. I witnessed the convulsion myself almost throughout, and had it not been that this was the only attack of the kind that had been known to occur, though there had been many others of a more general character, we should have considered it, taken together with certain other *in front of* of the corroborating signs, as sufficient warrant for operating *the central* *for the shoulder*.

¹ Boston Med. and Surg. Jr., 1890.

² Ibid.

Had we done so, we should have come directly upon the tumor, which lay at the posterior end of the middle frontal convolution, and had rolled over the upper edge of the hemisphere towards the falx, strongly compressing the intervening parts.

My thesis, which I shall be glad to see sustained or contradicted, is, that this shoulder convulsion might have been considered, for the reasons I have stated, as a localising sign of a high degree of value, in spite of the fact that no other attack of this character was seen. Convulsions confined to the shoulder are rare, but in the few recorded instances of which I have seen reports, there has been a distinctly localised cause; whereas, there are a number of cases on record where convulsions beginning in the hand or face were apparently due to lesions quite a little distance from where one would have expected to find them. Several instances of this are recorded in Rolland's monograph on Jacksonian epilepsy. One case, reported by Dr. Hughlings Jackson, is especially important.¹ It is the case of a large superficial growth in the leg and trunk area, and most of the attacks began, as usually happens, in the toe, and spread upward over the leg. They would next involve the arm, but instead of appearing first in the parts represented in that part of the arm area nearest to the leg area, they first affected the fingers, and then the arm. Sometimes the fits began in the hand, and sometimes, again, they began by a sort of aphasia—a prolonged attack of speechlessness without loss of consciousness. I shall revert again to the worthlessness of such attacks of speechlessness as localising signs, even when, as here, they usher in the attack, or where, as in the case of my patient with tumor of the inferior parietal lobe, they constitute the whole seizure. As regards convulsions beginning at the shoulder, it must be admitted that, though they are rarely excited by organic irritations at a distance, and are certainly less easily excited even by lesions close to the shoulder area than the convulsions of the toe, hand, fingers, or face are, yet they do occasionally occur spontaneously without gross lesion of the cortex. Such a

¹ *Brain*, 1882-'83, 364.

case is reported by Baxter.¹ This, however, only serves to call to mind how infinitely more numerous are the spontaneous fits beginning in the hand, face, or foot. It should also be noted, as one of the unexplained phenomena of cerebral pathology, that some lesions cause no localised convulsions, while others, of apparently the same kind, excite a great number. Even a superficial cortical or meningeal lesion of considerable extent may cause convulsions beginning in the hand, or confined to it.

Another kind of evidence that cortical areas corresponding to highly specialised movements have a special irritability is furnished by direct physiological evidence of an important kind. Thus, Paneth² and, according to him, Vulpian also, have found the facial centres in the case of the dog more irritable to electricity than other areas,—so much so, that Paneth says it brought quite a disturbing element into some of his experiments. I shall refer again to this point, as bearing on the question of electrification of the cortex on the operating table for purposes of localisation, but now will simply throw out the question whether these differences in irritability have not perhaps been the cause of misconception with regard to the finer points in localisation, as, for example, the relation of the extensor area to the flexor area. It has become well known, mainly through the admirable experiments of Hooper and Bowditch,³ of Boston, on the varying effects of stimulation of the recurrent laryngeal nerve under different conditions of etherisation and rapidity of interruption of the current, and of Bowditch, Perkins, and Ellis⁴ on "The Action of Sulphuric Ether on the Peripheral Nervous System," especially of the frog, that where the same nerve supplies antagonistic sets of muscles, the action of either set may be made to predominate by changing certain conditions of the experiment, and especially by giving ether in considerable quantity. I am not aware that these experiments

¹ Brain, 1882.

² Pflüger's Archiv., 1888.

³ N. Y. Med. Jr., 1885-'88.

⁴ Amer. Jour. Med. Sciences, 1887.

have been systematically repeated with the cortex of the brain, though I have assisted Drs. Bowditch and Hooper in making one attempt to do so; but the observations bear new and important testimony to the difference in vulnerability between the flexors and the extensors, and the nervous arrangements for their innervation, which should not be lost sight of. It will be remembered that Bergmann¹ has recorded an interesting case, in which he excised for epilepsy an area in the posterior central convolution, which he considered purely on general grounds to be the centre for the extensors of the fingers; and, in fact, the extensors were powerless immediately after the operation, though the patient did not recover from the epilepsy. The post-central convolution is not, however, the place where the electrical observations of Mills,² Lloyd,³ and Nancrede⁴ on the human subject have shown the extensors of the fingers to lie, and the question is whether this paralysis in Bergmann's case was not an affair of greater vulnerability, or exclusive representation in the cortex, such as makes the extensors suffer more than the flexors in ordinary hemiplegia. In support of this view, I would again recall the fact that in my patient already alluded to, the disordered circulation and pressure due to a tumor at a distance excited clonic spasm of the finger flexors, and paresis of the extensors. A similar case of paresis of the finger extensors, indirectly due to a tumor of the temporal lobe, and passing away after operation, is reported by Barker.⁵

A patient was recently treated at the Massachusetts General Hospital, in the service of Dr. A. T. Cabot, for a severe fracture of the occipital bone, leading, as the autopsy showed, to multiple contusions and small haemorrhages, with small spots of softening, over the surface of both hemispheres. I examined the brain carefully, and can assert that the motor areas for the hands were not involved in any gross lesions,

¹ *Archiv. für Klin. Chirurgie*, 1889; *Hirnehirurgie*.

² *Am. Jr. of Med. Sc.*, 1888.

³ *Ib.*

⁴ *Ib.*

⁵ *Brit. Med. Jr.*, 1887.

and yet on the day before his death, although able to move his arms freely, he showed a striking picture of paralysis of motion of the fingers, and especially of the extensors. On these grounds, and in accordance with the principle which I have been trying to illustrate, I suggest it as probable that the spasm of the extensor muscles and paralysis of the flexors are more valuable than the reverse conditions as localising signs of cortical lesions. In speaking of paralysis of the extensors, the distinction should probably be made between the interosseous extensors and the forearm extensors. Some clinical reports speak of "the claw hand," as met with in cortical paralysis, and it is not impossible that the intrinsic extensors would behave differently from the long extensors.

To sum up, I suggest, as a rule to which many individual exceptions could no doubt be found, that the following list indicates somewhere near the relative liability of the parts mentioned to be thrown into convulsion by irritations in their neighborhood:

1. Hand (*a.* flexors; *b.* interossei; *c.* extensors).
2. Face (*a.* zygomatics; tongue (?); *b.* platysma).
3. Toe and foot.
4. Elbow.
5. Leg.
6. Shoulder.
7. Trunk.

Conversely, convulsions beginning in the parts toward the lower part of this list would be of greater value as localising signs than convulsions of the hand and face.

As, I believe, another instance under this same general principle, I beg leave to contrast sensory and motor aphasia, or the power of comprehending spoken language and the power of accurate speech, with regard to their value as localising signs. If we consider for a moment the language function as a whole, and entirely apart from its anatomical representation, we may fairly say that the comprehension of speech is certainly a more "fundamental" element of this function than the power of speech. It is earlier and more

readily acquired, and requires less subtle and less perfectly adjusted cerebral activity for its maintenance. It is, therefore, less likely to suffer from general pressure and anaemia, and less liable to be disturbed in the initial discharge of an epileptic seizure. It is obvious that this principle, so far as it is a logical one, is virtually a corollary of the theory of "devolution" of Hughlings Jackson, and is based on similar reasoning to that followed at various times by Spencer, Ross, and many others of that school. It would not indeed surprise me if the neurologists present had already adopted what was of real value in the idea, although I am not aware that any such analysis has been actually published. The spoken word, falling upon the ear, drags out, as it were, with little conscious effort on the part of the hearer, a number of associations, sufficient for working purposes at least; whereas, in order that ideas should be expressed even so accurately as not to excite attention, many cerebral processes must converge, as it were, simultaneously, and with a certain degree of force. It may be sufficient for the practical purposes of the sportsman if he brings down his game, no matter where it is wounded, but to penetrate the vital part with a single bullet will call for far higher skill. For accurate speech, it is not only necessary that the ganglionic centres, both sensory and motor, and the association tracts uniting them, should be intact, but, as the interesting observations of Grashey¹ have shown, the storage power on the part of the nerve cells must not be deficient. If it is deficient, the impressions and concepts in the mind will fade out of existence before they have found expression, and the memory will have to be constantly refreshed by the actual presence of the concrete object of thought. That auditory speech-symptoms are of greater localising value than motor speech-symptoms, is, as I think, beyond a doubt; and the fact would be more generally recognised if loss of speech were not so much more striking and more familiar than loss of comprehension, and if we were not still strongly under the influence of Broca's remarkable dis-

¹ Arch. für Psychiatric, etc. 1887.

covery, which, in spite of all that has been written since that day, chains every disorder of speech function, in the minds of most medical men, to the notion of a lesion in the third frontal convolution. We should gratefully recognise the penetration and insistence of Wernicke, who placed the doctrine of sensory aphasia on a sure foundation, and the skill and industry of those who have given clearness to its expression, and have collected pathological data in its support. Prominent among the latter is your colleague, Dr. Starr,¹ whose work will long be referred to for its accuracy of thought and expression, and for the thoroughness with which it utilises all available facts.

The clinical point which I desire to make is this: If, in a given case, we have a *disorder of speech* of which we desire to make use as a localising sign, we should resist the temptation to infer a lesion of the frontal lobe until we have thoroughly probed the question whether the symptoms may not have been due to general pressure or anaemia, to fatigue, to inhibition, to interruption of association-tracts, and, finally, to a lesion of the special centres for speech-comprehension in the left temporal lobe. If, on the other hand, we find *disorder of speech-comprehension*, we can infer with a good deal more probability a lesion in the temporal lobe (especially the left), or its immediate neighborhood.²

It is true that the motor aphasia caused by impairment of the sensory element in the language function is not identical with the motor aphasia observed in typical cases of injury limited to Broca's area. Still, it remains true, I believe, that among the puzzling mixtures of *emissive* speech-symptoms, which many cases of aphasia present,—symptoms of paraphasia, diminished vocabulary, substitution of general for special terms (Jackson), loss of nouns, alliterations, and the like,—there is none which should rank as a localising symptom of the same value with the loss or marked impairment of

¹ Brain, 1889.

² I do not think it necessary to discuss the possibilities of trans-cortical and sub-cortical sensory aphasia (Wernicke, Fortschritte der Med., 1886-'87), as I am only trying to illustrate a principle, and not studying the details of localisation.

speech-comprehension. It is true that tumors, even at the distance of the frontal lobe, occasionally cause symptoms of sensory aphasia, as in Case V of Oppenheim's¹ recent and valuable collection, but this only shows the caution with which all rules for localising are to be applied, especially in the case of tumors.

Not only does the loss of auditory impressions entail aphasia, but, as has already been intimated, the loss of visual impressions may have a similar effect.

The subject is too complicated to enter upon here, but I am now compelled to believe that if I had had the importance of these possibilities sufficiently in mind when studying the case to which I have above alluded, my diagnosis would have been a different one. The tumor, primarily subcortical, but eventually cortical, lay at the posterior border of the inferior parietal lobe, directly above the posterior end of the fissure of Sylvius. The first symptom, and one which recurred at intervals, was an attack of speechlessness lasting for five or ten minutes. The patient declared afterwards that he understood what was said during the attack, and could have expressed himself in writing; and that on one occasion he did write, though I do not know to what extent. Both of these statements were probably far less strictly true than he believed. Speech in the intervals of the attacks was rather slow and hesitating, enunciation was sometimes imperfect, and occasionally false words were used. I saw him but twice, and noticed no reason to suspect loss of visual impressions, but as he kept at work which involved book-keeping, not without more difficulty, as I then thought, than his general condition would explain, I did not inquire sufficiently into that point, and was still further misled by the motor symptoms mentioned above as involving the flexors and extensors of the right hand. I have since learned that he had difficulty in recognising his wife and friends, though, curiously enough, the fresh advent of a friend or relation not constantly seen would occasionally rouse him into a better

¹ Arch. für Psych., Vols. XXI, XXII.

recognition. The mention of a person's name would convey a faint impression of his personality, but these impressions were of short duration, and soon faded away. On one occasion, when wishing to use a tooth-brush, he took down his razor and held it under the running water before discovering his mistake, and this while still attending to his work. There was considerable impairment of reading and ciphering, even quite early, but only very little loss of the comprehension of speech. It is now evident to me that the disorder of the associated tracts connected with the visual apparatus should have been made the basis of the localisation. Attacks of temporary speechlessness are certainly of little value as localising signs.

There are other parts of this important subject on which it would be interesting to speak, but I will ask your attention only to one or two practical points. I have already alluded to the physiological observations of Paneth on the varying irritability of different cortical areas. I wish now to refer to the further experiments of Bubnoff and Heidenhain,¹ quoted by Prof. William James in the interesting chapter on the Summation of Stimuli in his recent work on psychology. It was found by these observers not only that a series of quickly recurring stimuli had a cumulative action on the cortex cerebri, but that when the electrical irritation of a given cortical area failed of its effect in calling out a certain contraction, that result would follow if the skin over the muscles concerned was gently stroked, or if a sympathetic or semi-voluntary movement of the limb happened to take place in the course of the experiment. The practical value of this suggestion, in view of the rapidly diminishing irritability of the exposed cortex, needs no reinforcement, and it would have been welcome in a recent case of operation for epilepsy, done by Dr. J. C. Warren, at the Massachusetts General Hospital, on my suggestion. It manifestly gives the explanation of the interesting observation by Dr. Lloyd,² and another

¹ Pflüger's Arch., 1889.

² Am. Jr. of Med. Sc., 1888.

by Dr. Nancrede,¹ both of whom found that they could excite the same convulsions as those from which the patient had suffered by electrical excitation of a single point on the cortex, while in Lloyd's case the rest of the cortex is said to have given positively no response. I had already thought of the possibility of finding such an irritable spot as this before seeing either Lloyd's or Bubnoff's observations, and had tried to do so in the case just alluded to, but was only partially successful, probably because too long a time elapsed before the electrodes were applied. The case was one of that interesting class of localised epilepsies supervening on infantile hemiplegia, where the epileptic tendency is so strong and yet the tendency of the discharge to spread laterally is often so slight, possibly on account of the relatively feeble activity and associations of the affected parts. It is possible that the morbid state of the cortex partially explains its failure to respond to electricity.²

It has occurred to me that we might perhaps borrow another leaf from the physiologists, and try to intensify the cortical activity, either before or during an operation, when it is desired to discover the area which is responsible for the initiation of epileptic attacks, by giving one of the drugs which have been found to have that effect.

Unilateral neuritis has been held, I believe first by Hughlings Jackson, to have some significance as indicating the presence of a tumor of the opposite side of the brain. The reverse was true in my case of tumor of the middle frontal convolution, and I have therefore looked through a large number of reported cases, and found that, as Oppenheim³ points out, the facts are, if anything, the other way; but the sign is really of little value.

The question whether an operation will be performed will always be largely determined by the temperament of both physician and patient, as well as by social considerations. Occasionally it happens that a tumor is found to compress the

¹ Am. Jr. of Med. Sc., 1888.

² Compare Oppenheim, Berl. Kl. W. Schr. 1890, p. 677.

³ L. c.

brain, and yet has no attachment to it, and only a very trifling one to the floor of the skull. In such a case, an operation would probably restore the patient to absolute health, and such a chance is of course worth taking. It is often said of many surgical operations, that they should not be undertaken except in favourable cases for fear of bringing surgery into disrepute; but the reputation both of surgery and of the surgeon will not suffer permanently at the hands of intelligent people.

Oppenheim, of Berlin, has recently published an analysis of a series of twenty-two cases. Like almost all the German physicians, he takes a conservative position on this subject, yet he says that in two cases of this series an operation would have been, in all probability, successful. Two cases of twenty-two is certainly a good percentage.

Now, let me say a word with regard to certain observations which are usually made on patients where tumor of the brain is suspected. Thermometric observations of the surface-temperature of the head should be made repeatedly, for there are many factors which might affect the results. I have now a case in mind where the thermometer marked at one time a higher temperature on the part corresponding to the tumor than on the opposite side, while at another time no such elevation of temperature was present. Again: Before deciding that there is no weakness on one side of the body as compared with the other, we should not only have the patient squeeze a dynamometer, but should cause him to exert a sustained effort for a sufficient length of time for us to judge of this point. Tests of skill, such as rapid movements of the fingers, should also be tested carefully and methodically.

I come now to speak of the prognosis in epileptic cases.

It is well known that in some of these cases the simple removal of the bone has brought about considerable benefit, even where no portion of the cortex of the brain has been removed, as Dr. Keen has done on several occasions. These observations are not generally held to be of much value, since the patients have not been followed a sufficient length

of time. I have communicated with a number of persons who have operated and removed portions of bone which appeared perfectly healthy, and two of these gentlemen have answered. One says that his case is now, after a long period of years, perfectly well; the other speaks of two cases, both of whom were considerably benefited by the operation. In the young girl with hemiplegia and epilepsy supervening, to whom I alluded, the brain was exposed with the intention of removing a portion corresponding to the epileptic area. There were a number of distinct adhesions between the dura mater and pia mater, and lines of thickening along the vessels, showing that slight meningitis had existed. These adhesions were broken up, and the electrical examination not proving satisfactory, the wound was closed. The patient improved for six months, although she had a slight numbness in the hand. Then she had one attack. It remains to be seen whether or not there will be permanent benefit. I cannot say whether these slight adhesions were the cause of the epilepsy, or whether the disease will eventually develop in the usual way; but I think it will probably not do so, as these cases are usually more amenable to treatment after operation.

