The surgical treatment of intracranial tumors / by William W. Keen.

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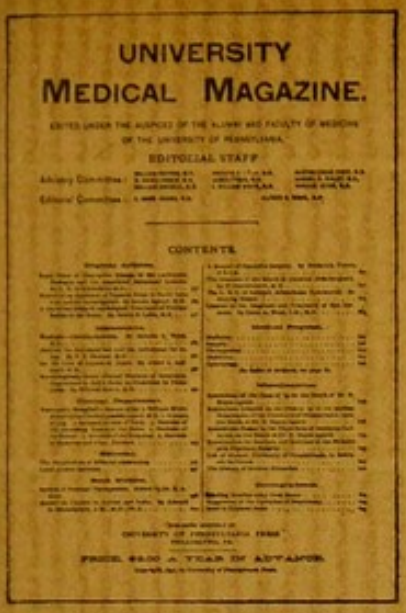
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THE SURGICAL TREATMENT OF INTRACRANIAL TUMORS.

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THE SURGICAL TREATMENT OF INTRACRANIAL TUMORS.[1]

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Diagnosis.—The chief difficulty in the surgical treatment of intracranial tumors is unquestionably the lack as yet of means of making an absolutely exact diagnosis of the location, size, and number of such tumors. This has already been considered by other speakers in this debate, and I simply mention it in passing to emphasize the need. That minute, repeated, and exact experimentation upon animals as well as accurate clinical observation are both necessary to achieve this result is self-evident. No surgeon should attack a brain tumor until he has not only exhausted his own knowledge, but has also called to his help the ophthalmologist and the neurologist, whose observations are indispensable to a correct diagnosis.

Possibly the recent discovery of Röntgen may assist us. By this he has achieved what has heretofore been regarded as impossible,—namely, by means of the cathodic rays from Crookes's tubes of skiagraphing[2] internal parts of the body. Whether intracranial tumors will be also as permeable to these rays as are other soft parts of the body we do not yet know. If they are, it is possible that we may obtain very little additional information. It is, however, within not only the range of possibility, but it would seem to be of probability, that modifications of the method may be discovered by which we may be able to make such tumors visible. Until this discovery is further developed and made actually available, we must rely on the existing methods of cerebral localization.

Opening the Skull.—Possibly the proposition of Doyen may aid us very materially. This bold and able surgeon has recently proposed[3] to make an osteoplastic flap of the entire side of the skull ("temporary hemicraniotomy," as he terms it) by an extension of the well-known Wagner-Wolff method; the scalp forming a hinge on which the flap is turned over by fracturing the base of the bony flap. He has had also the courage of his convictions by operating already on four cases, of which two died and two recovered (one, a microcephalic, was greatly improved, the other, an epileptic, received only temporary

[1] Read in the discussion on Intracranial Tumors before the College of Physicians of Philadelphia, February 19, 1896.

[2] This term proposed by Dr. H. W. Cattell, is the proper Greek form of the mongrel word, shadowgraph, so often used by the newspapers.

[3] Revue de Chirurgie, 1895, p. 689.

benefit). In fact, he claims that "in future cerebral localization is useless in surgery and has only a physiological interest." Whether so extensive a temporary resection will stand the test of time and experience is somewhat doubtful, but should it do so, it will greatly simplify the treatment of tumors.

The mode of access to the tumor, if Doyen's method is not followed, is either by the ordinary method of trephining, using not less than an inch-and-a-half trephine, and making either a single or multiple trephine openings, which may be later connected by sawing or gnawing away the intervening bridges of bone, or by various methods for making the usual temporary osteoplastic resection.

Last summer, Mr. Horsley told me that he had returned to the use of an ordinary straight saw, cutting by means of this either three sides of a square and breaking the fourth, or sawing the fourth if the bone is to be removed entirely. Krause, instead of this, uses a circular saw (which is actuated by the surgical engine, like that which is used by the dentists), with this difference, that the handle of the saw is prolonged on the farther side, so that the saw can be held firmly by both hands. Others use the chisel in one of two ways. If an osteoplastic resection is to be done, the margins of the flap are cut through by such chisels as have been devised by Hartley, of New York, and by Pyle, of Canton, Ohio, or, secondly, by simply chiselling away all the bone over an area such as we wish to uncover. For this method Krause's gouge is the best. Another method is by such drills as those devised by Dr. Cryer, of this city, which are useful and effective, but require an expensive and not easily obtained extra heavy surgical engine. Whichever one of these processes is used requires a considerable amount of time, varying usually from fifteen to twenty-five minutes, and involves a moderate and sometimes a considerable loss of blood both from the scalp and the bone.

Operation in One or Two Stages.—The skull being opened, we may follow one of two courses. First, especially if the tumor is small, we may proceed with its extirpation and the closure of the wound, or, secondly (and this is especially applicable to tumors of large size), the first part of the operation may be terminated so soon as the brain is exposed and the hemorrhage checked. The wound is then temporarily closed, and the remainder of the operation is completed after the lapse of from three to six days. In other words, the tumor is attacked either by an operation in a single stage or an operation in two stages, as may be thought best. In large tumors I should certainly advise that the operation should be divided into two stages. Hemorrhage and shock, the two principal dangers in connection with the removal of cerebral tumors are thus minimized. It has, however, the disadvantage of a possible infection. Two operations

double the danger of infection, which is always a real one even in the hands of the most skilful. Weighing the probabilities of the two methods, however, in any large tumor, I should be distinctly disposed to operate in two stages rather than one.

Hemorrhage.—The control of hemorrhage is one of the difficult problems in connection with the removal of the cerebral tumors. The hemorrhage may arise either from the vessels of the dura, from the vessels and especially the veins of the brain itself, or, thirdly, from the sinuses. Hemorrhage from the diploë is so easily and effectively controlled by Horsley's antiseptic wax that it may be dismissed at once. For hemorrhage from the vessels of the meninges, the ligature is an efficient means of control. If the dura be cut and an artery bleeds, the cut end can be tied just as any other vessel. If it be necessary to ligate the vessel in its continuity in a dura unopened, though with torn vessels, it can be secured by passing a fine silk thread by means of the finest semicircular Hagedorn needle under the dura and around the vessel, care being taken by lifting the dura not to wound the underlying cerebral veins themselves.

For venous hemorrhage, the best method also, is the ligature. Rarely can the vessel be seized by the forceps and a ligature applied. The best method is again by the semicircular Hagedorn needle of suitable size, to pass a silk or catgut ligature through the cerebral tissue immediately below and around the vein, and then to tie the vessel by drawing with equal force on the two ends, not constricting the vessel with so much force in tying the knot as to tear through its weak walls. Sometimes packing and hot water (not over 110° F.) will aid greatly, especially in arresting any copious oozing. If the sinuses are torn or opened, the hemostatic forceps may be used to grasp the opening, if it is small, or, as I have done in one case, by three pairs of hemostatic forceps placed alongside of each other, the opening can be closed. The forceps may then be allowed to remain *in situ*, being enveloped, of course, by the dressing, and may be safely removed after three days. Should this method not be available, then the sinus should be plugged with iodoform gauze, the end of which protrudes through the scalp wound and can be safely removed again after three days. I have removed it even in twenty-four hours with success.

I would especially lay stress on the fact that any of the superficial sinuses of the brain may be exposed with almost perfect safety by gnawing away the bone over them after having separated the sinus gently from the skull by Horsley's dural separator or a probe. The point where the parietal veins enter the superior longitudinal sinus should be avoided, if possible, as these are large vessels and a great amount of blood may be quickly lost. Hemorrhage from the sinuses,

however, can be controlled again by packing, if not by the hemostatic forceps, or possibly by fine suture. In several cases I have thus exposed both the superior longitudinal and the lateral sinuses over a large part of their extent, and have opened the sigmoid portion of the lateral sinus on several occasions, and very easily controlled the hemorrhage by packing with a small strip of iodoform gauze.

In separating the dura from the brain, great care must be taken as we approach the superior longitudinal sinus. The veins of the brain widen into venous bays (the parasinoidal spaces) from which the hemorrhage will be often more profuse and alarming than from the sinus itself. One case I lost distinctly from the profuse hemorrhage from such a parasinoidal space, as I was not able quickly enough to control the bleeding by packing. The loss of blood from the cerebral veins is certainly more dangerous than the loss of an identical amount from other veins of the general system. It seems to drain the brain of blood so suddenly, and to make such an intense impression on the important nervous centres in the brain and cord as to be incompatible with life. Hence, when the finger gently introduced under the dura in the neighborhood of the superior longitudinal sinus perceives any attachment of the dura to the brain, we should be most careful to desist from any further separation of the parts, lest by doing so these large veins be torn and a parasinoidal space opened. On no consideration should this be done until the bone has been first widely gnawed away over the point of the adhesion to give ample room instantly to deal with possible hemorrhage.

Not uncommonly we can avoid a great deal of hemorrhage from the cerebral tissue by lifting the pia from the underlying convolutions so as to avoid the veins by working under them. The pia can be drawn out of the deep sulci in this manner with relative ease. Great care must, of course, be used in manipulations under such a displaced pia.

Removal of the Tumor.—The tumor, when discovered, may be removed either by the finger if it be well encapsulated, or if not, then by the knife, which should be held vertical to the surface so as to injure the adjacent cortex as little as possible. At the same time we must remember, especially in cases of sarcoma or its allies, that the infiltration of the cerebral tissue extends some distance beyond the tumor proper. Therefore, some of the apparently healthy brain tissue must be sacrificed for the purpose of safety. This may induce paralysis of important centres, but no such calamity can compare with the certainty of a return, and, therefore, of a future fatal issue by a less thorough removal. Not uncommonly the scoop or curette may answer for the purpose of removing any remaining portions of the tumor after the main part has been removed.

Even in cases in which the tumor is too large to be removed with safety, a partial removal often gives very great relief, especially to the intolerable headache and other similar distressing symptoms, and this partial removal may be attempted not only once, but, as I have done it in one case, three times, and each time with great relief.

Should it be impossible to remove any of the tumor, the mere removal of the bone over the tumor will often give very great relief. The most remarkable case that I know of is one of Mr. Horsley's, in which, having experienced the comfort which followed the removal of half of the occipital bone, the patient later returned and begged him to remove the other half of the occiput, a wish which he gratified with a happy result.

Sometimes the dura is involved in the tumor, and must therefore be sacrificed. The danger of fungus cerebri is relatively small when the dura is closed after being opened, and especially if the brain substance itself has not been interfered with. In such cases, as I suggested a few years ago, the dura may be replaced by a bit of the pericranium. A piece of this, a little larger than is sufficient to make good the lost piece of dura, is cut entirely loose from the under surface of the flap of scalp and is sewed in place by a few interrupted sutures. In doing so, while I am not sure that it is needful (for I have not had the opportunity of making a post-mortem in any such case), I have always, on theoretical grounds, however, turned the pericranium upside-down, so that the osteogenetic surface should be external. If, then, any bone is developed from this osteogenetic surface, it grows away from the brain instead of into it. Such a closure of the dura is the most efficient means that I know of for the prevention of fungus cerebri, and thus avoids one of the most serious dangers which may follow such an operation. I have thus utilized the pericranium in two cases with success.

Drainage.—Excepting cases of abscess, gunshot wounds, intracranial hemorrhage, and cysts, it is my rule at present not to drain. Occasionally, on account of hemorrhage, it will be necessary to leave some iodoform gauze protruding from the wound and this acts as a drain. In such cases, however, I always insert a stitch in the scalp at the time of operation, so that as soon as the gauze is removed, the wound may be entirely closed, or, should there be need for drainage for twenty-four or forty-eight hours after removal of the gauze, I insert a small bit of gauze to keep open only the skin wound, and the stitch is tied as soon as the need has passed. If no drain be employed, very frequently by the second or third day the flap will bulge considerably by reason of the accumulation of wound fluids under the scalp. If this is the case, and all the more if it is attended with headache or other pressure symptoms, I either insert a pair of for

ceps between two of the sutures, and thus give exit to the wound fluids, or sometimes cut a stitch for the purpose of gaining sufficient room for the evacuation of the fluid. The avoidance of a drain is not only important in securing a much earlier union of the edges of the wound, but also removes an occasional but very real danger of later infection.

Closure of the Opening in the Skull.—A month or more after the patient has entirely recovered from the operation, the question of closing the opening in the skull will naturally arise. Until this closure is effected (and sometimes it is best never to close it) I always direct the patient to wear a skull-cap, on the inside of which is sewn a bit of tin a little larger than the opening, the sewing being made possible by first covering the tin with some silk.

Sometimes the opening in the skull can be closed immediately by replacing the bone in one of two ways. Macewen first cut the piece of bone removed into a large number of small pieces, which he sprinkled over the opening. I think it much better, however, if it is intended to replace the bone at the primary operation, to replace it in bulk. I have now in about fifteen cases replaced a button of bone an inch and a half in diameter and the entire thickness of the skull, and in not a single case has the button lost its vitality. If this is to be done, however, the button of bone must be very carefully kept warm and moist, by placing it in a cup in a 1 : 2000 bichloride or some similar solution and placing this cup in a basin of water with a thermometer, so that the water shall be kept from 105° to 100° F.

The Later Closure of such an Opening.—For this König has adopted a very ingenious method. At any late time after the opening has been made, by accident or by a surgical operation, he has dissected away the scar over the opening and has then outlined an adjacent flap of the shape and somewhat larger in size than the original opening to permit of shrinkage. The flap is not separated from the skull, but under it he chiselled away the outer table in fragments, these fragments being left adherent to the under surface of the flap. By sliding the flap into place so as to cover the opening, he has in that manner closed some very large gaps. The place left bare by the transplanted flap is then covered in by skin-grafting by Thiersch's method. The most extensive application of this method that I know of was in a case of Schönborn,[1] in which there was an opening in the forehead six or seven centimetres broad and twenty-five or twenty-six centimetres long. Two parallel transverse incisions were made, thus outlining a rectangular flap, the bases or ends of which on each side were not divided, but left continuous with the scalp. The scar over the opening having been resected, the outer table under this flap was then

[1] Beiträge Centralblatt für Chirurgie, 1891, p. 88.

chiselled loose and the flap with its attached fragments of bone was slipped forward so as to fill the gap. The space left by the flap was then covered by Thiersch's skin-graft. After four months, the bone having become solidified, as the patient was annoyed by the growth of hair on his forehead, Schönborn very ingeniously detached the scalp from the fragments of bone, which had been transplanted by the first operation and swung it back into place, having first, of course, removed the skin-grafts which he had placed there. The bone filling the original opening was then covered by skin-grafting, so that the forehead was furnished with skin which had no growth of hair from it.

Such a bone-bearing flap can be placed directly upon the brain in spite of the ragged character of the bone fragments on its under surface. In a case of this kind Czerny[1] had the opportunity of examining such a bone-bearing flap at a second operation and found it perfectly smooth, and Titze[2] has covered in the brain itself by a similar operation.

I have recently adopted a little different method which seems to me to possess some advantages. A young man had severe and frequent epileptic attacks in consequence of a compound fracture from the kick of a horse. On November 21, 1890, I exposed the opening in the skull, removed a considerable amount of cystic connective tissue lying over the brain and endeavored to close the opening by transplanting a bit of bone from the skull of a lamb. The operation failed, however, since the lamb's bone underwent partial absorption, and finally the necrosed fragment had to be removed. The operation was followed by very great improvement in his epilepsy, the fits diminishing in frequency from one in about three weeks to two in a year. Within the last few months they have become more frequent, and on January 18, 1896, at the Orthopedic Hospital, I reopened the wound, removed a considerable amount of loose, spongy scar tissue, the interstices of which were filled with cerebro-spinal fluid. Then, to close the opening by bone, I chiselled away the adjacent outer table of the skull in quite large fragments, by means of a gouge and hammer. I found the gouge much better than a flat chisel. These fragments were then scattered over the surface of the brain so thickly as to leave no space between any two. When I say they were placed on the brain tissue, it is scarcely an exact statement, for they were rather placed upon the spongy scar tissue which filled up the entire opening. When he went home three weeks later, these fragments had become quite solidified, and I have every reason to believe that they will fill the opening in the skull by fusing into a true bony

[1] Verhandlungen der deutschen Gesellschaft für Chirurgie, 1892.
[2] Archiv für klinische Chirurgie. 1893, XLV, 227.

tissue. If so, it will be an efficient protection for his brain, and he can do without his bit of tin and the skull-cap.

One advantage of this method over König's, of an osteoplastic flap, is that one can obtain as much bone as is needed from the adjacent portions of the skull, and at the same time not produce puckering of the scalp from displacing the flap on its pedicle. Another is that it does away with the necessity of skin-grafting. A possible objection might be that the nourishment of such fragments of bone would be much better if left attached to the scalp. This, from my experience in replacing large pieces of bone so frequently, as well as in the present case, is not, I think, a valid objection.

Fränkel some time since proposed to fill the opening by a disinfected celluloid plate, a procedure which has been adopted in a number of instances with very good success. I regard either of the methods already described as very much better than Senn's decalcified ox-bone, which has failed in my hands, or the use of other foreign bodies.

The Future of Operations for Brain Tumors.—The future of the surgery of brain tumors is encouraging. While there are tumors which are not found, the percentage of these is diminishing from year to year, and even in some cases in which the tumor has not been found, the relief from pressure and especially from the agonizing headache has been very marked. Moreover, there are cases on record in which the tumor, while irremovable, has disappeared. Only last summer, I saw one case, operated on by Mr. Horsley, in which, from former experience, he expected such a result as likely to follow.

A large factor in the increasing success is that physicians who naturally see such cases first are appreciating the need for early operation, so soon as a definite diagnosis can be made and the location of the tumor can be determined. The only exception that I would make to such a rule are gummata, and even in these cases I should not be disposed to wait beyond two or three months, and possibly even not beyond the six weeks' limit proposed by Horsley.

Two-thirds of the cases submitted to operation recover, and while the later histories of many of them have not been published, yet we know that a considerable number have lived for several years and may be deemed definitely cured.

The very first brain tumor that I operated on, December 5, 1887,[1] is still alive, and after over eight years is in much better condition than at the time of operation, though still disabled by the atrophy of the optic nerve and more or less mental and physical disturbances, resulting from the tumor being present for twenty-four years before it was removed.

[1] American Journal of the Medical Sciences, October, 1888.