INCOMPLETE MASTOID OPERATION AS A CAUSE OF DELAYED HEALING.

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The simple mastoid operation as today performed causes no great concern to the competent otologist. The triad of danger points so terrifying to the neophyte—through experience and training—prove no barrier to operation. With the diagnosis established and operation indicated there is usually no hesitancy in regard to operative procedure. By avoiding undue delay the percentage of complications encountered is reduced and hearing conserved to a greater extent.

What then, is our weakest spot in this branch of surgery? With diagnosis for the most part easily established and operation devoid of its terrors, it would seem that the too often extended period of convalescence and the too frequent failures necessitating secondary operation are fields for criticism. Far too often, compared to other fields of surgery, does the post-operative period drag out ten, twelve or more weeks and, then, further operative interference is required to insure healing and a dry middle ear. In the clinic of the civilian hospital this is often lost sight of, for the case is discharged to the out-patient department long before it is completely healed and the dressings are carried on there by someone other than the operator. The experiences in a military hospital have proven a revelation in this respect for the patient could not be discharged until the mastoid was healed and the man able to perform the full duties of a soldier.

We may consider five or six weeks as good time in which to get complete recovery, but how often do we fail miserably in this respect? Surely there must be some reason for this lapse—why some cases go on to a rapid and uneventful convalescence and others, apparently just as favorable at operation, lag so discouragingly.

A case that drags along unduly after operation must be considered in the category of failures, since we are confronted with what is really a case of chronic osteo-myelitis, with its liability of complications, something we hope to avoid after thorough surgery. We endeavor to preserve the hearing by means of the simple mastoid operation, but with a long continuation of the suppurative process in the middle ear there is bound to be a loss in this respect.

Under the heading of failures are grouped those cases—both excusable and inexcusable—resulting in: (1) Death; (2) Complications, whether requiring operation or not; (3) Extended post-operative period, whether requiring further operation or not.

The first two subdivisions may be really considered together, for it is indeed safe to say that a case does not die of mastoiditis *per se*. The lethal blow is dealt by some complications, such as sinus thrombosis and resulting general sepsis, cerebral or cerebellar involvement, or some metastatic process; meningitis or brain abscess.

The condition of the middle ear and mastoid at the time of operation must be considered. In this discussion we will disregard the case where operation was obviously too long deferred, or where there was a chronic suppurative otitis media and similar extenuating circumstances. Given an acute mastoiditis in an otherwise healthy individual, operated upon in what was considered due time, why should there be any unduly extended period of healing?

Three factors enter into this question: (1) The resistance of the individual; (2) the virulence of the infection; (3) the character of the operation.

As we are chiefly concerned with the otherwise healthy individual the first factor need not be considered to any marked extent. The fact that syphilis, tuberculosis and other general diseases retard healing is far too often an easy and plausible excuse, used to palliate one's conscience in the case of delayed healing. Debilitation of the patient from long continued sickness may play a most important part in convalescence. Uncinariasis may be a factor. The condition of the naso-pharynx, the presence of adenoids, diseased tonsils, deviated septa and accessory sinus infections and their well-known relation to the delayed resolution of the middle ear must indeed be considered. But, if in the otherwise healthy patient we try to place the blame for non-healing on the individual's poor resistance, in the majority of cases we will be sadly in error.

The virulence and type of the infection plays a somewhat larger rôle, though here again we must take care not to find ourselves hunting for an excuse for our own surgical shortcomings. We encounter a series of acute mastoids within a certain period of time and, as far as laboratory findings can indicate, of a similar infecting organism. These same cases will vary markedly in their post-operative response in a way unexplained by the nature or virulence of the infection.

By far the leading factor seems to be the character of the operation. It is unnecessary to consider the incomplete so-called mastoid operation of the untrained operator. We are concerned with the modern simple mastoid operation, the more, or less thorough extenteration of the mastoid process.

As commonly considered there are four types of mastoids: (1) Pneumatic; (2) diploetic; (3) diplo-pneumatic; (4) sclerotic.

This last is considered by most authorities a pathological type. It is almost never encountered in the class of cases here discussed. Cheatle objects to the use of this term "sclerosed" or "sclerosis," maintaining that this type is a persistence of the infantile; that in the infantile the "mastoid mass" is either diploetic or dense, and in some cases persists as such in the adult without the formation of air-containing cells from the antrum. Whatever the process, what we are concerned with in this discussion is the type of case in which there is a varying amount of either diploetic bone or dense mastoid mass, associated with an acute mastoiditis.

Politzer gives the occurrence of these in the following ratio: Pneumatic, 37 per cent; diploetic, 20 per cent; diplo-pneumatic, 42 plus per cent; sclerotic (scattering).

In the average clinic they will occur in about this ratio. This is true of the cases from the clinic at U. S. General Hospital No. 14, upon which these observations are based.

The pneumatic mastoid following operation seems generally to rejoice in a shorter and more uneventful period of convalescence than in the other types. Secondary operation is much less frequently required. The cases tardy in healing and those reverting to the operating table are more often found among the diploetic and diplo-pneumatic types. Out of a series of 168 simple mastoids at U. S. General Hospital No. 14, in which the ratio given by Politzer was pretty consistently borne out, there were sixteen cases which came to secondary operation after a long drawn-out period of post-operative treatment. Of these sixteen cases, two were of the straight pneumatic type, five diploetic and nine diplo-pneumatic.

It is fair to presume a greater degree of success for the primary mastoidectomy in the pneumatic type, for the average aural surgeon will not consider his operation complete until he has followed out every cell and pretty thoroughly extenterated the mastoid, removing all possible foci for recurrence, or continued suppuration. In some cases, with cells extending forward into the root of the zygoma and over the external auditory meatus even to the tempero-mandibular

articulation, or upward and backward into the occipital there may be considerable difficulty, but with the help of the radiograph a thorough exenteration is usually accomplished. In the two pneumatic mastoids mentioned above, the operators in each case frankly failed to reach all the cells and reoperation was necessary.

In the diploetic and diplo-pneumatic types we have a different condition to deal with. The operator upon reaching what he feels is solid, sound bone, is apt to consider discretion the better part of valor and stop before completely exenterating the mastoid. In the majority of cases he wins out and the mastoid heals in a varying period of time, but from our observations, in about 12 per cent of the cases reoperation is necessary. The diploe may contain quite as much potential trouble as the cells of the pneumatic type. Unless the mastoid is completely cleaned out to its boundaries we may have a condition simulating a chronic osteo-mycelitis, resulting in at least an extended period of healing and possibly requiring further operative procedure.

Let us consider the mastoid as a collection of cellular or diploetic, or dense bone; a matrix, surrounded by the cortex corresponding to the outer table of the skull and on the internal aspect by the plates of the inner table. It is posterior to the hard bony external meatus wall and anterior to the plate covering the lateral sinus. Above is the plate forming the floor of the middle fossa. The cortex of the mastoid surrounds this at the tip and encroaches inward and upward, forming the prominence of the groove for the insertion of the posterior belly of the digastric muscle. This cellular or diploetic matrix sometimes extends into the substance of the petrous portion.

As the lateral sinus bends forward and downward, forming the so-called knee, it makes an angle with the floor of the middle fossa above. Sometimes this angle is very acute and the space within it very narrow, with consequent temptation on the part of the operator to overlook this, especially if solid. Doing so may be a cause of continued suppuration and necessitate a secondary operation later. Frequently as the sinus swings downward, inward and slightly backward below the knee before making its exit through the posterior lacerated foramen, there is another angle or space formed between its plate and the prominence of the digastric groove. This is frequently overlooked in operating, the surgeon making a beautiful excavation to the tip from the plate covering the sinus but neglecting to dissect out this important angle. This is a favorite site for a perisinus abscess.

Too many mastoid operations may be likened to sweeping a room without touching the corners. These corners or boundaries of the mastoid should be thoroughly cleaned out to insure healing. Whether pneumatic or diploetic or a combination of the two, the zygoma, the cells or diploe just posterior to the external auditory meatus, the tip, and the angles between the sinus and the floor of the middle fossa and the sinus and the digastric groove should be as thoroughly exenterated as possible. Leaving these points should no more be thought of than of neglecting to open the antrum. The cases requiring secondary operation all showed one or more of these points neglected at the first operation. For the most part, after cleaning these out thoroughly the cases went on to a rapid and uneventful convalescence. One case showed at the second operation an area of necrotic dura where the angle between the sinus and the floor of the middle fossa had been overlooked. He exhibited marked signs of cerebral irritation, soon meningitis developed and death ensued on the third day. Post mortem examination revealed an abscess of the temporo-sphenoidal lobe. Three cases developed sinus thrombosis. In one the space between the sinus and the digastric groove had been overlooked; in another, the angle between the sinus and the floor of the middle fossa, and in the third both of these places had been neglected at the first operation. A perisinus abscess was found in each case at the neglected point.

In this series of secondary operations four cases presented incomplete exenteration of the zygomatic area; two, of the posterior meatal area; one, of the tip; eight of the superior angle between the sinus and the floor of the middle fossa; and nine, of the space between the sinus and the digastric groove.

These observations are based upon the work of the oto-laryngologic staff at U. S. General Hospital No. 14, which, because of its connection with the School of Oto-laryngology, Medical Officers Training Camp, Camp Greenleaf, was quite large and of constantly changing composition. The operators were men of training and experience, from various parts of the country and may be well considered as typical of the otologists of the country. As a rule, due to this constant change of personnel, the secondary operation was usually performed by someone other than the original operator. In this way possibly franker and more unbiased criticism was obtained. In practically every case the after-treatment, at least the immediate care of the case was handled by the operator so that the question of the proper conduct of the case from the operator's point of view can be largely discounted.

In these cases which came to secondary operation, undoubtedly, the original operator cleaned out all soft and necrotic bone and felt that he had reached the limits of the mastoid. But diploetic or dense bone was left, as shown by the later operation, in each case. This diploetic bone, while apparently healthy at that time, contained potential trouble, suppuration continued and later this area became frankly diseased. In no case where the mastoid was completely exenterated, care being taken to outline the sinus and the boundaries of the mastoid cavity, whether pneumatic or diploetic, was secondary operation required. It was not deemed necessary to uncover the sinus itself but simply to outline the dense bony plate covering it. Where this was eroded, as in a perisinus abscess, the course pursued was obvious. These cases healed rapidly and went to duty in from four to six weeks. The middle ear would be dry in from two to five days, as a rule.

The method of after-treatment employed seemed of minor significance. The Carrel-Dakin and the dichloramin treatment was tried on a number of cases but without startling results. The main factor seemed to be the character of the operation. By far the best results were obtained in the cases which had a thorough exenteration regardless of type and in which the after-treatment largely consisted of "scientific neglect." A clean operation followed by lightly packing the cavity with either plain or iodoform gauze for about five days, after which the packing was pretty much eliminated except for light wicks to the antrum for a few days, offered the best results.

Sometime ago I had occasion to operate upon a mastoid which had persistently refused to heal. The man had had two previous mastoid operations performed by two different operators, the first eight months before and the second four months before. While the middle ear was perfectly dry and had resolved, the wound had not closed but was discharging and bare bone could be felt with a probe. There was no constitutional disease of any kind and the patient was in otherwise perfect health. The mastoid was of the diploetic type. It had been fairly well exenterated except for the angle between the sinus and the floor of the middle fossa. The continued necrotic process had exposed the dura over the middle lobe for an area about 4 mm. in diameter, upon which was a small bit of granulation tissue. The angle was thoroughly curetted out and the plate covering the dura was removed until normal dura was found. The mastoid healed in good time, considering the duration of the process and its consequent devitalization, convalescence was uneventful, and the man went to duty in about eight weeks.

The pathologic changes in acute mastoiditis, according to Beck, occur in two ways: (1) Cell route or confluent mastoiditis, and (2) vascular or osteophlebitic mastoiditis. In the diploetic, or dense mastoid, it is more probable that the infection takes place by the latter method. This would explain the necrosis taking place after the first operation, when the area in question appeared perfectly solid, much more readily than the confluent process, especially where ample drainage has been established. However, neither this, nor the question of whether the infection reaches this area after operation as a factor of the continued suppuration, or is already there, possibly latent, is of greatest importance. The main thing is that this same area of diploetic or dense bone may be the cause of continued suppuration in the mastoid cavity, possibly requiring secondary operation or resulting in untoward complication and therefore care should be taken to thoroughly exenterate this, outlining the boundaries. Often this is exceedingly difficult to do, for we may encounter a mastoid in which there is what simulated an inner plate but what is really a dense partition in the mastoid mass and having small cells or diploe underneath. As pointed out by Bigelow, the radiograph may be of the greatest possible assistance in gaining a conception of the extent of the cavity, stereographic plates being of especial value. However, if operation is not deemed complete until the solid inner plate, or its underlying substance if absent, is reached and the boundaries outlined, especially in the angle between the sinus and the floor of the middle fossa and in the space between the sinus and the digastric groove, our efforts will be crowned with a greater percentage of success.

CONCLUSIONS.

1. The period of convalescence is mainly dependent upon the character of the operation. This is generally the cause for delayed or non-healing mastoids. Early healing and uneventful convalescence depends upon thorough exenteration.
2. Cases of delayed healing and requiring secondary operation are met with more frequently in the diploetic and diplo-pneumatic types, where there is a persistence of the diploe or "dense mastoid mass."
3. The cause of this is neglect upon the part of the operator of certain areas, this oversight being less likely to occur in the cellular mastoid.

4. The "favorite points" overlooked are: the angle between the sinus and the floor of the middle fossa, the space between the sinus and the prominence of the digastric groove, and less frequently, the zygoma, posterior meatus wall and the tip.

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Report of a Case of Meningitis Following Operation Upon the Middle Turbinate, with Autopsy Findings Showing an Old Perforation of the Cribriform Plate of the Ethmoid.

T. J. HARRIS, *Ann. Otol., Rhinol. and Laryngol.*, 1919, xxvii, 1241.

Harris reports a death from pneumococcic meningitis at Fort Oglethorpe following the removal of a cystic middle turbinate by means of the cold snare. The patient gave a history of having sustained a fracture of the nose twelve years before which had incapacitated him for two weeks at that time but had caused him no trouble since.

The diagnosis made on microscopic examination of the tissue removed at operation was acute phlegmonous rhinitis superimposed upon chronic hypertrophic rhinitis. The postmortem findings showed that the contributory cause of death was operation upon cystic degeneration of the middle turbinate complicated by failure in the formation of the cribriform plate of the right ethmoid bone on the side operated upon.

When the brain was removed it was noted that the anterior lobe of the cerebrum was adherent to the cribriform plate of the ethmoid of the right side. The fact that some of the brain structure was torn in the removal indicated that the condition was chronic. In the middle portion of this cribriform plate was an opening 5 mm. in diameter with a necrotic center. This necrosis included the dural covering. In the opinion of the pathologist there was little doubt but that the perforation in the plate had existed since the time of the injury twelve years before and that there was probably a direct communication between the cystic turbinate and the brain.