OTOLOGIC AND RHINOLOGIC COMPLICATIONS OF SKULL FRACTURE *

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Fractures of the base of the skull are interesting to the aurist and rhinologist for several reasons.

First, the lines of fracture frequently cut the bones containing the special organs of sense, which are his special field of work. Second, the intracranial lesions take place largely in areas of the brain in which he is especially interested. Third, a study of traumatic lesions of the brain may broaden considerably his knowledge of certain cranial symptoms which are in a measure allied with those produced by diseased conditions of the ear and nose invading the tissues within the skull. Also, they are of interest because knowledge of the causes and sequelæ enable the specialist in diseases of the ear and nose to more thoroughly understand what has actually taken place within the skull, when he may be called in consultation with neurologist or surgeon for aid in diagnosis in suspected cases of basal fracture; or to give expert testimony in the courts of law when the ear has been involved.

Unless one has especially studied the extent of the fissures, he is usually amazed to find the amount of injury which the basal bones may receive. The injury may be found in any part of the base, but a study of a number of cases will reveal certain areas to be more fragile than others. (The sella turcica, petrous portion of the temporal, great wing of the sphenoid and orbital plates of the frontal, are the ones most often involved.) The injuries usually cross the suture lines at rather wide angles and seldom follow close to them for any distance.

The lines of fracture occasionally pass from one extremity of the skull to the other, either from before backward, or from side to side (Figs. 1 and 6). The fractures are not necessarily caused by extremes of violence; the most extensive fracture I know of, having occurred in a man who simply fell backward, striking his head on the floor (Fig. 1). In this case the lines radiated in every direction on three sides of the head. Another man fell from the top of the telephone pole and while the fall proved fatal, the autopsy showed the fracture to be relatively short in extent.

The accompanying illustrations show the location, extent, and injuries of fractures of the base of the skull, with special reference to hemorrhage from the ear. Below each illustration will be found a brief case history of that particular injury.

The fracture lines usually begin at, or near, the point of injury and run in a zig-zag course across the base of the skull. The dura, because of its intimate attachment, is usually ruptured with them. The lines often cut through the grooves for prominent blood vessels. Thus the lateral sinus and middle meningeal artery are often ruptured and cause alarming and fatal hemorrhages. Again, when the point of injury is in the frontal or parietal bones, the force of the accident frequently travels diagonally or straight downward into the basal bones and spends its force there. This is an unfortunate tendency, in as much as fractures of the base are more fatal than those of the vault, and are less open to operative measures for relief.

Doubtless one great reason why hemorrhage of the ear is one of the most frequent symptoms, is because of the location of the temporal bone. Situated as it is, practically in the center of the skull, it receives within its body the fractures from surrounding areas. Thus it is cut when the point of contact is in the frontal region, the fracture reaching it before its violence is spent. The same is true of injuries of the occipital and parietal regions, for the same cause. In fact, the petrous portion of this bone frequently marks the end of a fracture and is cut in several directions, the lines spreading over its surface like the lines of a fork, the single fracture extending from the point of injury to this bone forming the handle (Fig. 2). However, when we consider the number of foramina, cavities, etc., in the petrous portion, this does not seem strange.

Hemorrhage from the ear naturally follows, and in a measure we can roughly estimate, in a number of cases, the possible line of fracture by imagining it to

Fig. 1.—R. B., fell backward, striking the head on the floor. The autopsy showed the pupils unequal. There were crusts of blood in both auditory canals, and crust in anterior nares. Dura was tense, congested and bulging. Surface of brain was bathed in bloody fluid, but there were no blood clots. Frontal lobes were soft, mushy and blood stained. Ventricles were not distended. A small area of clot was found in upper part of pons. There was an area of softening in right lobe of cerebellum.

extend from the external injury to the affected temporal bone, even though it may occur on the opposite side of the head. In connection with this much has been said of *contre coup*. Doubtless hemorrhage from the ear occurs in this manner, but I am inclined to believe that it does so less frequently than is generally supposed. When autopsy records tell of fractures 8, 9 or 10 inches in length one does not need the *contre coup* hypothesis to account for any symptoms present (Figs. 1 and 6).

In a record of 35 autopsies I find the parietal bones to be the ones most frequently injured, they having been involved in 18 cases. The squamous portion of the temporal was cut through in 13 and the petrous portion in 12. Injury to the remaining bones of the skull—in their order of frequency—occurred as follows: Occipital, 12; frontal and orbital, 12; great wing of the

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sphenoid, 10; sella turcica, 10; cribriform plate, 4; body of sphenoid, 3; crista galli, 3; lesser wing of sphenoid, 2; occipital plate of sphenoid, 1, and the ethmoid plate, 1, while the groove in the occipital bone for the lateral sinus was found to have been cut four times.

In the series of 408 cases under consideration, 221 patients had hemorrhages from either one or both ears; it occurred in 202 on one side only and in 19 on both. The amount varied from a slight trace of blood to a persistent flow of the same fluid for a considerable time. A small percentage presented a flow of serous or meningeal fluid from the ear. Autopsy records show the hemorrhages to have occurred from the middle meningeal and other cranial arteries, from the small vessels of the dura, pia, and diploe of the cranial bones, and in several instances from rupture of the lateral or longitudinal sinuses.

So far as I can determine, hemorrhages from the ear, either in large or small amounts, are not especially im-

injuries. The writings of Cushing,¹ Brun,² Ballence,³ Thomas,⁴ Walton,⁵ Bullard,⁶ Hartley⁷ and others deal minutely with the diagnosis and surgery of the head, from the viewpoint of the surgeon and neurologist. It is my intention, however, to present the matter from the point of view of the otologist and rhinologist, taking up very superficially the symptoms as they presented themselves in the hospital records and certain interesting facts taken from the autopsy records of cases directly connected with this series. In this manner I hope to present the subject in a condensed form in such a way as to enable the busy practitioners of our specialty to review the subject briefly and to find therein some interesting and instructive points of knowledge which may be useful at some future time.

Desiring to learn more of the subject, I consulted the records of the Boston City Hospital for a period covering seventeen years, and I have a more or less complete

Fig. 2.—J. A. H., aged 67, male, fell down hatchway. He was conscious; pupils were equal and reacted; pulse was 48; respiration 30. There was a ragged wound of the left occipital region, and fracture of right arm; he was mentally confused (later); kneejerks were absent. The following day he was stupid, delirious and had hemorrhage from right ear; Erysipelas set in the following day; thirteen days later there was elevated temperature; no localizing symptoms. He gradually grew weaker and died.

Autopsy: There was a large amount of yellowish purulent material spread over the cerebrum, and also over the cerebellum and down the cord. Three ulcerated areas were found at base of right side of the brain; one at base of fundal lobe; one on right side of anterior portion of temporal. The right middle ear was filled with a dark mass of clotted blood. A yellowish thrombus was found in the longitudinal sinus.

portant as influencing the ultimate prognosis. In a series of 142 cases, with hemorrhage present, it occurred on the side of the injury in 62.3 per cent., on the side opposite the injury in 16.5 per cent. and on both sides in 11.2 per cent. The location in the remaining 10 per cent. was not mentioned by the records. Of the 408 cases collected in the series, 62 were classed as fractures of the vault and 346 as fractures of the base.

If one wishes to make a careful study of this subject he will find many articles by certain eminent authorities taking up exhaustively the different phases of the

Fig. 3.—G. A. M., male, age not given, fell 10 feet, striking stone steps. When picked up he was unconscious; pupils were dilated, with no reaction. There was a wound over the left frontal region. He had a slight convulsion; external sensation lost. He had strabismus and head was contracted to left; there was paralysis of right side of body and face.

Autopsy: There was a moderate amount of blood in the vessels of the pia at the base of the brain; a small amount of reddish, yellowish fluid was found in the lateral ventricle, and there were two small masses of clotted blood in the fourth ventricle. The hemorrhage extended into fissures of Sylvius and Rolando. There was no laceration of brain tissue.

record, tabulated and charted, of something over 400 cases, from the study of which I offer the following facts and figures for your consideration:

First in order is sensorium. Here, as in other symptoms, we have a wide range of possibilities. We find our patient conscious, unconscious, or in a condition of

1. Keen's "Surgery," Vol. III, p. 64-90; THE JOURNAL A. M. A., Jan. 16, 1909, p. 184.
2. Beit. zur klin. Chir., 1903, xxxviii, 192.
3. Acland and Ballence: St. Thomas Hosp. Rep., new series, 1894.
4. THE JOURNAL A. M. A., July 25, 1908, p. 271.
5. Ann. Surg., 1904, xl, 654.
6. Proc. Mass. Med. Soc., 1902, p. 269.
7. THE JOURNAL A. M. A., Jan. 9, 1909, p. 99.

semiconsciousness. In a series of 307 cases in which, in the records, the mental condition was distinctly stated, 168 patients were unconscious and 58 conscious, the remaining 81 being in the intermediate stage of stupor, sluggishness or confused or dazed mentality. The mental condition naturally has a considerable bearing on the severity of the case, and on the treatment and prognosis. Of those patients conscious on admission 13 per cent. died and 87 per cent. were discharged relieved. On the other hand, of those unconscious on admission 51 per cent. died, while of 9 admitted in a comatose state 66 per cent. died, and of those admitted whose mental condition was in the intermediate stages the mortality was comparable to that occurring in unconsciousness.

Next in order of importance comes the examination of the pupillary reactions, a very wide range of conditions existing. The greater number are, strange to say,

be regarded as a very grave condition. Contraction of one or both pupils is to be regarded as more serious than dilatation. Equal is more common than unequal contraction, and the records show about 50 per cent. of deaths when either occurs.

Decidedly the worst pupillary symptoms which I found noted were wide dilation of one pupil and contraction of the other to a pin point. Eight such instances are recorded and each was followed by death, this being the one symptom which was invariably fatal.

Unfortunately, in the early part of my investigations I failed to appreciate the significance of ecchymosis of the orbital region and of exophthalmos. For this reason I am unable to give figures as to the frequency of these conditions, but, judging from my study of the autopsies and from memory of the cases, I can state that they are

Fig. 4.—W. L., male. There was no external injury; the right pupil was dilated and reaction was sluggish. The man vomited a pint of dark blood, and there was bleeding from the left ear. Pulse was 44. There was no paralysis. Temperature was 96 F. on admission; the following morning it was 102; respiration was shallow. He died from failure of respiration.

Autopsy: Small subdural clot was found over the fissure of Rolando, 2 cm. anterior and posterior. Convolutions of right side of brain were markedly flattened. The surface of the parietal lobe showed two small softened areas; these extended into brain substance 3 mm. There was a clear, watery fluid in the left ventricle. The right middle ear and antrum were filled with clotted blood; the drum was intact.

normal, and it is surprising to note the grave symptoms which may be present with normal pupillary reaction. In 339 individuals 161 had normal pupils, but of those 24 per cent. died. Next in order of frequency are those patients in whom one pupil is dilated, the dilation usually occurring on the side of the injury. As a rule this is not to be regarded as an especially dangerous symptom, my records showing that two-thirds of these patients recovered. On the other hand, when the pupils were unequal and there was no reaction to light, only 27 per cent. recovered. Of 8 individuals in whom the pupils were equally dilated and no reaction was present 7 died. The finding of this symptom, then, should

Fig. 5.—R. McG., male, age unknown, was struck by electric car. Pupils were equal and did not react; respiration was stertorous and rapid (45); pulse was 60 and knee-jerks were exaggerated. There was no vomiting. The wound was 2 inches long over the right parietal region; there was bleeding from ear. He did not move the left leg; the face and head were turned slightly to the right. His condition was practically hopeless, and he died shortly after admission.

Autopsy: There was considerable subarachnoid hemorrhage over the entire area. There was laceration of the tip of the frontal lobe, and of both temporo-sphenoidal lobes; there was also hemorrhage into right side of posterior portion of the pons.

commonly found but are not especially important so far as prognosis is concerned.

We are led to believe that a slow pulse rate is perhaps the cardinal symptom of intracranial involvement, and I had expected to find it present in the majority of cases, only to be greatly surprised at finding it otherwise. In over 400 cases in which the pulse was distinctly recorded I find it to be below 60 in only 14. To be sure, it was between 60 and 70 in 30 cases, but this could hardly be said to be an especially slow pulse. It was between 40 and 45, three; between 45 and 50, five, and between 50 and 60, eight times. Thus, comparing these figures with the entire number it is seen that the pulse was below 60 in a trifle over 4 per cent. of the cases.

Cushing¹ regards the slow bounding pulse as an effort on the part of Nature to overcome anemia of the brain and that it is instrumental in saving the patient's life.

Efforts have been made to reduce the pressure of the pulse by venesection or lumbar puncture, but this procedure is not endorsed by Cushing, instances of either sudden death or markedly weakened condition of the patient, following the procedure, being cited. It seems to me that the reason why slow pulse is not more often found in this class of cases is because the pressure is usually more uniform over the surface of the brain than it is in the case of abscess, tumors, etc.; also the lesions in fractures of the base are usually superficial and extend over wide areas; whereas in tumors, encapsulated abscess, etc., the areas under pressure are deeper and much more sharply defined. Again, the pressure from hemorrhage is liable to be well forward in the temporosphenoidal lobes.

Fig. 6. —M. S., male, was found unconscious on sidewalk, assaulted. Pulse was 100; pupils were equal and reacted; reflexes were normal. There was bleeding from left ear and a slight lacerated wound of right auricle. He vomited several times. Temperature was 103 F. Four days later temperature was 104 F., and the man died.

Autopsy showed a firm dark blood clot in cortex of brain (temporosphenoidal lobe), with contusion and softening of frontal and temporal lobes. The bruised areas were covered with blood clots. The ventricles were normal.

Slow pulse may develop after admission of the patient to the hospital and when present denotes either the beginning of meningitis, extension of hemorrhage backward and inward, or an increase of the cerebral fluids in the deeper parts of the brain.

On the other hand, a rising pulse is a distinctly bad symptom, denoting either failure on the part of Nature to maintain the cerebral circulation against increasing pressure or absorption into the circulation of infection from the cranial cavity. In the first instance anemia of the brain from pressure will soon cause death from failure of the respiration; in the second, naturally, death comes from toxemia and exhaustion.

In the majority of cases death is caused by pressure resulting in failure of the respiration, there being a number of cases on record in which the heart continued beating several hours after respiration ceased, the patient having been kept alive during the interim by artificial respiration.

In 80 per cent. of the cases in this series the pulse ranged between 70 and 100, and in 15 cases the records spoke of it as being slow, but did not mention the number of beats.

Temperature ranged from 95.1 to 110.8 F. In five cases it was subnormal and the patients died in a few hours. The high temperature mentioned occurred just before death and was subnormal at the time of admission. In three of such cases, just prior to death, the temperature rose to 107, 108.5, and 110.8 F., respectively. Elevation of temperature occurred a number of times from outside causes, such as pneumonia, erysipelas, septic wounds, and once from the prosaic cause of measles. On the whole, except for marked cases of meningitis, the temperature did not seem to play an especially important rôle.

Respiration is the most important symptom to be considered, for it was the failure of this function which usually caused death. I found the records gave the respiration as stertorous in 41 cases, as rapid and labored in 7, as slow and labored in 5, as slow in 5, irregular in 4, Cheyne-Stokes in 3, blowing in 1, infrequent in 1, and gasping in 1. Many of those patients, however, recovered.

Vomiting, another cardinal cerebral symptom, was not especially prominent. I find it mentioned in 55 cases, but in only 5 was it persistent or considerable. In many cases it consisted simply in the vomiting of blood once or twice, with no return throughout the case. Once there was nausea without vomiting.

Convulsions are referred to 25 times throughout the records. In 3 they were general; in 11 one-sided; in 8 they occurred at or near death, and in one they were limited to a continuous winking of the right eyelid. A number of patients having convulsions recovered.

Facial paralysis occurred in 24 cases. It suddenly came on from two to ten days after admission, though in a few it was present on admission. As a symptom it was much the same as when resulting from other causes, and was persistent, being present at the time of discharge of patient from the hospital. In fact, of all the nervous manifestations in many cases it was the last to be recovered from.

Delirium is common, varying from very mild to almost maniacal attacks. It occurred in both mild and severe cases. This is not strange, considering the class of people most of the patients represent and the frequent abuse of alcoholic liquors among them. Children and some women developed great mental excitement without active delirium. Delirium in the records is especially mentioned in thirty-three cases.

The nervous symptoms of this particular series of cases have previously been reported in detail by Dr. J. J. Thomas.⁴

Age is of no special importance and of little use in prognosis, except in young children. Here we find the most spectacular injuries with recovery. A number of young children appear in the series with a history of falling from second, third and fourth-story windows; as having been struck by automobiles, fire engines, express wagons, etc.; but these young patients recovered, in many instances, in a surprisingly short time. It

occasionally happened, however, that the shock was too great for even the soft cranial bones of childhood. Vomiting is more common on the whole among children than in adults. This symptom is especially present soon after the accident and occurs in many children who ultimately recover. It must always be borne in mind that in all fractures of the skull alarming symptoms may develop at any moment, even when the case appears simple and uncomplicated, and I wish to mention here a case of importance, illustrating the extreme need of keeping patients quiet and under observation after such injuries. A child was brought to the hospital after having fallen from a second-story window, having landed on a brick pavement. It had all the symptoms of extreme shock and was treated for the condition in the usual way. In a very short time it had apparently recovered. In fact, the improvement was so rapid the question was raised as to changing the original diagnosis of "fracture of the base of the skull" to "concussion of the brain." A day or so later the parents removed the child from the hospital, against the advice of the surgeons. Shortly afterward the child was returned to the hospital with decided symptoms of meningitis, from which it died in a few days, and at the autopsy the base of the skull was found fractured in every direction. Had the unfortunate child been allowed to remain quietly in the hospital she might have recovered and have been little or no worse for the injury.

Autopsy records offer valuable information to those who are not especially familiar with the subject. Here we find indisputable evidence of the extent of these particular injuries.

Both tumors and encapsulated abscesses are bodies of definite density and form. In hemorrhage we have a softer body to contend with, and consequently a different group of symptoms, notwithstanding the fact that the location is often identical.

Hemorrhage with or without clot does not appear to cause such definite symptoms as do tumors and abscesses. On first thought this seems strange, but the difference is explained by autopsy findings. Both tumors and abscesses are usually well embedded in the brain tissues; hemorrhage and clots, on the other hand, spread themselves over a considerable surface. The pressure of a tumor or a tense abscess may be likened to the pressure obtained from placing a marble, or even a billiard ball, within the skull. The pressure from free blood, or from a clot, might be compared to that of a pad of rubber or folded gauze. This I regard as the reason why marked cerebral vomiting, slow pulse and choked disc are not more generally found in these cases. In my studies of 35 autopsies I found it common to have an entire lobe of the brain compressed over its whole external surface. This condition is illustrated in (Fig. 4). Occasionally an entire hemisphere is under compression, and one or two cases show pressure from flattening of the hemispheres on both sides of the brain.

Consider for a moment the terrible pain which would arise from pressure of clots sufficient to compress the entire external surfaces of the hemispheres of both sides of the brain. In this particular instance the pressure assumed the action of the jaws of a vise, squeezing equally from each side toward a central point.

Hemorrhages or clots are found in nearly every possible area within the skull, in certain localities, however, much more commonly than in others, being noted in the greatest number over the temporosphenoidal and frontal

lobes. Extradural hemorrhage is less often found than intradural; this is because of the rigid attachment of the dura to the bone and the lack of large vessels outside it. When extradural hemorrhage occurs, however, it comes either from venous hemorrhage from the diploetic bone, or else it finds its way through a rupture or tear in the dura, being internal in its origin. Hemorrhage occasionally is found in the deeper areas of the brain, in the ventricles, and even has been found in the spinal canal, though such cases are rare.

Contusions of the brain are more or less common and occur most frequently in the temporosphenoidal and frontal lobes. Lacerations are more often found and may occur in any of the lobes, one record even showing laceration of the cerebellum (Figs. 2 to 5).

If the brain tissue has been under pressure for any length of time we find areas of softening present, the extent varying from small spots to quite large areas, as shown in Figures 1 to 4 and 6, one case showing a softened condition of the entire base of the brain.

Infected areas of the lobes are occasionally found, and in this class we find practically only the temporosphenoidal and frontal lobes involved. Infected fluid within the dura is more common and was present in four cases, and an autopsy diagnosis of meningitis was made in three of these. Pus was found in the middle ear once and a pus pocket just outside the sella turcica once.

Blood was present in the middle ear and mastoid four times (Figs. 1, 2 and 4); in the lateral ventricle once. Excess of fluid was found in the lateral ventricle in five cases. Bloody fluid was present in four, pus in two and fluid blood in one. Blood was also found in the nose in one case (Fig. 1) and in the mouth in one.

Rupture of the middle meningeal artery was found twice and rupture of its anterior branch twice. Rupture of the lateral and longitudinal sinuses has been found at autopsies, but was not present in this series.

Edema of the brain occurred but once.

Irregularity of pupils was present in three cases and the pupils were equally dilated in one (Fig. 5). Exophthalmos was present but once in the autopsies.

Within the year *THE JOURNAL* of the American Medical Association has published articles by McKernon⁸ and Coakley⁹ dealing with intracranial infections from the ear and nose. A study of the two articles will show certain marked contrasts between lesions produced by the invasion of infection from the ear and nose and those of fractures of the skull, where, in the majority of cases, pressure from hemorrhage was the predominating factor.

The treatment of these cases, at the present time at least, is the field of the general surgeon. Many of these patients recover, from 15 to 25 days being the usual period of confinement in the hospital. The mortality in those patients requiring surgical measures in fracture of the vault is comparatively small, but in those with fracture of the base it is very high.

I have purposely omitted the subject of deafness from this paper. It is practically impossible to examine the hearing of these patients for some days after admission to the hospital because of unconsciousness or great prostration. It is my intention, however, to make a special study of this particular phase of the subject and to report it in detail at some future time.

8. *THE JOURNAL A. M. A.*, Jan. 9, 1909, p. 102.

9. *Id.*, p. 108.

In closing I wish to thank the surgeons of the Boston City Hospital for the use of their records, and that institution itself for the great mass of material it has furnished me for study.

The following are some statistics of the cases:

SENSORIUM

Conscious:	Unconscious:
Relieved52	Relieved 63
Dead 4	Dead105
Semiconscious:	Dazed, drowsy or stupid:
Relieved27	Relieved20
Dead15	Dead18
Comatose:	
Relieved 3	
Dead 6	

PUPILS

Normal:	Dilated equally, no reaction:
Relieved119	Relieved 4
Dead 38	Dead 7
Dilated equally, reaction normal:	Unequal dilation, reaction normal:
Relieved 1	Relieved47
Dead 1	Dead19
Unequal dilation, no reaction:	Widely dilated, no reaction:
Relieved16	Relieved 1
Dead38	Dead 8
Contracted equally:	Contracted unequally:
Relieved 8	Relieved 2
Dead 7	Dead 2
One pupil dilated, other contracted to a pinpoint:	
Relieved 0	Dead 8
Divergent Strabismus 1	Convergent strabismus 1
External strabismus 1	Irregular pupil 2
Hemorrhage from the eye.. 1	

NYSTAGMUS

Relieved (slight) 1	Dead 4
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PULSE

Under 40 1	90 to 100.....16
40 to 45 3	100 to 110.....15
45 to 50 4	110 to 120..... 7
50 to 60 8	120 to 160.....13
60 to 7030	Slow, rate not recorded...15
70 to 8031	Pulseless 1
80 to 90.....27	

TEMPERATURE

Normal351	104 3
99 7	105 2
100 6	107 *1
101 4	108.5 *1
102 2	110.8 *1
103 4	

* Few hours prior to death.

Subnormal on admission:

95..... 1	(died few hours later)
96..... 2	(died few hours later)
97..... 4	(died few hours later)

RESPIRATION

Stertorous41	Cheyne-Stokes 3
Slow and labored 5	Slow 5
Rapid and labored 7	Infrequent 1
Irregular 4	Gasping 1
Many of the above recovered.	

VOMITING

Number having this symptom present 55
Number having persistent vomiting 5
Nausea without vomiting 1

CONVULSIONS

Number noted in the records 25
General 3
One-sided 11
At or near death 8
Continuous winking of right eyelid 1
A number of patients having convulsions recovered.

HEMORRHAGE FROM EAR

From one ear only 231
From both ears 29
Hemorrhage from one or both..... 260

TOTAL CASES RECORDED

Fracture of the base of the skull 346
Fracture of the vault of the skull 62
Total 408

AUTOPSIES (35 cases)

CLOTS OR HEMORRHAGE

Intradural20	In spinal canal..... 1
Extradural10	

FLATTENING OF LOBES FROM PRESSURE

Temporo-sphenoidal 9	Both hemispheres 1
Frontal 5	Right hemisphere 1
Occipital 2	Entire base 1
Parietal 1	

AREAS OF SOFTENING

Frontal 6	Entire base 1
Temporo-sphenoidal 5	Cerebellum 2
Parietal 2	

EXCESS OF FLUID IN LATERAL VENTRICLE (FIVE CASES)

Bloody fluid in lateral ventricle..... 4
Pus in lateral ventricle 2
Free blood in lateral ventricle..... 1

FRACTURES OF THE BONES OF THE SKULL

Parietal18	Frontal 5
Squamous portion of tempo- ral13	Cribriform plate..... 4
Petrous portion of temporal.....12	Lateral sinus 4
Occipital12	Crista galli 3
Great wing of sphenoid.....10	Body of sphenoid..... 3
Sella turcica10	Lesser wing of sphenoid... 2
Orbit 7	Ethmoid plate 1
	Zygoma 1

CONTUSION OF BRAIN

Temporal lobe 2	Frontal lobe 3
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LACERATION OF BRAIN

Frontal lobe 7	Occipital lobe 1
Temporal lobe 7	Cerebellum 1

INFECTIONS

Purulent fluid within the dura 4	Meningitis 3
Infection of temporal lobe. 2	Pus in middle ear 1
Infection of frontal lobe... 1	Blood in middle ear 3

CONDITIONS OF PUPILS

Irregular Pupils 3	Dilated and equal..... 1
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ABSTRACT OF DISCUSSION

DR. J. F. BARNHILL, Indianapolis: I have seen a few cases of fracture of the base of the skull in which there was hemorrhage from the external auditory canal, cases with such symptoms, so far as I can judge, as have been described by Dr. Borden, but I had no opportunity to make postmortems in any of them. The cases that interested me most were in children. I have seen two cases in children in which there was hemorrhage from the external auditory meatus. In one the hemorrhage was so severe that it was impossible to check it except by firmly tamponing the external auditory canal. Children react from these injuries marvelously well. Both of these children were unconscious for several hours and both suffered profound shock. One had irregular pupils. But both recovered as rapidly as it would be possible to recover from any other serious injury. In one, as soon as the hemorrhage was checked I found a large rupture of the drum membrane which extended through the postero-superior portion of the drum head and through the neck of the malleus. It is possible that in this case there was no fracture of the base of the skull, because the child recovered so rapidly from what appeared to be so severe an injury.

DR. C. F. WELTY, San Francisco: Shortly after the fire in San Francisco we had a great number of accidents and many of these cases. There were 29, 8 of which were mine. Diagnosis of fracture of the base of the skull was based on the tuning fork tests with greatly lessened bone conduction in the ear of the injured side in comparison with the other. Of this number there were 7 cases that went on to discharge of pus from the ear and there was one in which facial paralysis existed as long as the pus continued to discharge, and as soon as the ear was made thoroughly clean the paralysis cleared up. Six of the cases required operative interference on the mastoid. These patients with fracture of the base that have the slightest possible indication of mastoid involvement should be operated on. All these patients recovered.

DR. E. A. CROCKETT, Boston: One type of traumatic injury to the ear which we should always have in mind and which is extremely difficult to differentiate from a fracture of the base is fracture of the bony portion of the external auditory canal, and associated with it rupture of the drum head. It is more common, in my experience, from blows on the point of the chin. The symptoms are very confusing on first glance, but on examining the ear one finds a distinct line of fracture of the outer canal beginning at the bony portion and running down to or through the drum. Such patients will have symptoms of surgical shock and hemorrhage from the ear. The

tuning fork test will, of course, show whether the fracture extends into the petrous portion or not. When I was an interne I made systematic examinations of all the fractures and found seven patients admitted for fracture of the base of the skull in the course of a year in whom there was no fracture of the base whatever, but fracture of the canal. These are the patients who recover with few symptoms and with perfect hearing. The condition is much more common than is supposed.

DR. J. HOLINGER, Chicago: It is text-book knowledge that in these cases of injury with loss of blood through the external auditory canal we should be careful not to inject solutions of water into the ear. In this connection I can report one case for and one against this teaching. In the first case, a man fell into a vat and was taken up unconscious; he was taken to Alexian Brothers Hospital with a slow pulse and discharge of blood from the ear. After washing the ear very carefully I noticed a white mass in the depth of the canal. It was removed with the syringe and put under the microscope, where it proved to be the cholesteatoma. While syringing as a rule is contraindicated in fracture of the base of the skull and hemorrhage from the ear, it saved this patient's life by removing infectious matter from immediate contact with the fracture line. This patient recovered with complete loss of hearing. The other case is that of a patient who fell down a steep embankment together with his team and wagon. He regained consciousness after being home forty-eight hours. He called in the family physician, who advised dropping boracic acid solution in the ear. I saw him about a week later, when he was suffering from severe headaches, extreme restlessness, vomiting, and was very ill. My diagnosis was beginning meningitis. The ear was dried carefully, all instillations were discontinued and considerable doses of morphin were given in order to secure rest and quiet; and from that night he improved. I heartily endorse Dr. Borden's suggestion of giving morphin to patients in the first stages of traumatic meningitis.

DR. J. J. KYLE, Indianapolis: What is Dr. Borden's experience with the decompression operation when the lesion is in the center of hearing? A few weeks ago I had an interesting case in which a young boy was struck on the left side of the head with a baseball bat. There was complete loss of hearing and loss of speech. A decompression operation was done and when he came out of the anesthetic he began to talk. He lived seventy-eight hours and then died very suddenly. I think that we shall be called in now more and more in these cases to differentiate between labyrinthine deafness following injury to the head and central deafness.

DR. S. MACCUEEN SMITH, Philadelphia: It is natural, when we have bleeding from the ear, to assume that it is due to fracture of the base, but I am inclined to believe that in many of those patients who recover, though they bleed freely, the bleeding is due to separation of the Glaserian fissure. This was first pointed out by Albert Buck, and I have collected some data which would seem to indicate that a fair percentage of these cases are due to separation of this fissure.

DR. E. A. CROCKETT, Boston: In the case I spoke of the rupture could be clearly seen in the lower part of the canal. I have never seen a fracture of the upper part.

DR. J. M. FOSTER, Denver: Our statistics in regard to the question of injury to the organ of hearing are not very extensive because most of the cases are treated by the general surgeon. I have a case to report in which the injury was so extensive that few surgeons have seen such a case recover. While a young woman was riding horseback her horse reared and fell back on her. Her head came in contact with the ground and the saddle or head of the horse struck her on the malar bone. The blow broke the skull through. The x-ray showed that the fracture started in one ear, went up through the orbit, through the bridge of the nose, through the orbit on the other side and through that ear. The fracture practically separated the upper from the lower part of the head. There was a distinct separation of the roof of the nose and slight movement between the upper and lower portions of the face. She had profuse hemorrhage from the nose, as well as from the right ear. The face was swollen and elongated. The

treatment was absolute quiet, the ear being treated simply by packing with sterile gauze in the canal. After a few days the discharge turned into a distinctly serous fluid that I supposed was from the brain. The fracture finally healed without suppuration and hearing became practically normal. The eye symptoms were very marked; absolute immobility of the eyes from the start. The left eye never regained sight; atrophy of the optic nerve occurred. The eye muscles regained their function. The right eye regained perfect vision, but only after twelve months and by doing a tenotomy and advancement that the eye was gotten into the primary position. That the patient should have lived at all was marvelous.

DR. GEORGE E. SHAMBAUGH, Chicago: There is one phase of this subject discussed by Dr. Borden especially interesting to otologists. This is the question of the disturbance in hearing from such injuries: the character of the disturbance, and the degree of deafness. Persons injured in this way, especially in railroad accidents or the employees for corporations which may be held responsible, oftentimes wish to get damages for their injuries, and it is not uncommon for malingering to be detected in cases of this sort. If the patient claims to be totally deaf in both ears, it may be an exceedingly difficult problem for one to detect a malingerer of this kind. Usually, however, these patients claim to have had the hearing destroyed in but one ear, and in these cases if we go to the examination carefully, we seldom fail to detect them in falsehoods. For example, when they stop up the hearing ear they will usually assert positively that they can not hear at all any sounds, spoken voice or tuning forks. Of course we know that it is impossible to shut out sounds in this way from a normal hearing ear. In making the examination with tuning forks for bone conduction, these patients will usually make the mistake which has been made in the discussion here this morning, by stating that the bone conduction on the affected side is much reduced from what it is on the normal side. As a matter of fact, while the Weber test is usually lateralized in these cases in the normal ear, the actual duration of the bone conduction, in applying the Schwabach test from both mastoids in cases in which there is total deafness in one ear and normal hearing on the opposite side, will differ but little and often not any.

DR. OTTO GLOGAU, New York: I examined ten cases of fracture of the base of the skull going through the labyrinth in Mount Sinai Hospital Dispensary and found that most of the patients had less disturbance of the acoustic than of the static apparatus. One had a fracture going right through the acoustic apparatus and the high tuning fork could not be heard in the ear at all and bone conduction was lessened on the fractured side. In this case, the fracture went through the corda tympani and facialis. The patient had dizziness and nystagmus to the sound side. In another case the patient had been knocked down by an automobile and suffered a fracture of the base of the skull. He did not perceive tuning forks on his left ear. Weber test to the right (sound) side, no bone conduction on the side of the fracture, spontaneous nystagmus directed to the sound side, warm water nystagmus to the affected side, much dizziness, disturbance of equilibrium, and paralysis of the corresponding left facial nerve. In court one physician testified that the patient had only an old ear catarrh and that there was no connection between his ear trouble and the trauma he had suffered.

DR. GEORGE E. DAVIS, New York: In regard to the question, elicited in the discussion, as to the differential diagnosis between simple nerve deafness and labyrinthine deafness, due to direct traumatism and infection, the functional tests for the reactions of the static labyrinth definitely decide, and of these probably the caloric test is the most reliable and is very convenient. In labyrinthine deafness, especially of traumatic origin, the static labyrinth is almost always, if not primarily, secondarily involved, and, therefore, we would expect the functional tests, whether caloric, turning, or galvanic, to prove negative; whereas in nerve deafness the static labyrinth usually remains intact and the same tests would prove positive. From a forensic point of view, this differentiation is of great importance in case of malingering. Moreover, in malingering

ing, we can bring to our aid, in addition to the above tests for the reactions of the static labyrinth, the functional hearing tests by means of tuning forks. Malingering of one-sided deafness is readily detected by the Stinger test with the Bezold-a forks.

DR. C. R. C. BORDEN, Boston: I know of nothing in the entire field of medicine or surgery that offers such spectacular cases as fractures of the base or the skull. We get them in all degrees of severity, and in many the injury does not seem at all in proportion to the symptoms that follow. Among the records I have studied was that of a boy struck by an express train traveling at a high rate of speed. He was thrown many feet, picked up and brought into the hospital in an unconscious condition, and one would naturally suppose that he would not recover, but in two or three days he was in fairly good condition.

In regard to the hemorrhage from the ear, in the average case it is usually fairly easy to find the bleeding point within the canal. It may be in any portion of the meatus, or in the drum membrane, appearing as a ragged tear. Some patients bleed so profusely that it is impossible to find the point of hemorrhage. In the majority of cases there is a fracture, and it is unwise to assume that there is not a fracture of the base, because the symptoms are not profound. In these 408 cases there are a number in which the first treatment was given by a family physician who failed to realize the importance of the injury and treated it lightly, allowing the patients to go about, and within a few days the patients were brought to the hospital with very grave symptoms, and in certain cases died later.

The blow on the chin that has been referred to, we have seen often, as a result of fist fights. Dr. Holinger spoke of thinking he had found brain mass in the bottom of the ear; it has been found several times in the hospital, and in one of the cases there was recovery following it.

As to decompression, these cases are in the hands of the general surgeon and we see them only as a matter of courtesy. Judging from what I have been able to gather, unless the symptoms are aggravated and urgent, it is a safer plan to depend on quiet and rest. The operation for decompression has resulted many times in hernia of the brain, which is often difficult to control. Nothing except tumor causes greater pressure than trauma of this kind. Of course, certain symptoms demand operation, but usually only as a last resort. The ear should always be kept clean, and I am inclined to think that more infection comes from the nose than from the ear.

TUBERCULOSIS OF THE LARYNX

THE TYPE WHICH IS CAPABLE OF RECOVERY OR ARREST AND THE PRINCIPLES OF TREATMENT *

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I. THE NON-RESISTANT TYPE

On the principle that an overpowering, though often erroneous, impression is produced by tragic events, our common conception of tuberculosis of the larynx is drawn from its harrowing course in about two-fifths of the cases which, collectively, for contrast, I designate the non-resistant type and which is characterized by a speedy development, persistent progress and rapidly fatal termination. Out of a total of 60 cases of private record, these qualities pertained to a group of 24, or 40 per cent., in all of which death ensued in less than an average of one year from first observation and in less than two years from the first remembered symptom of

the laryngeal complication. A classical laryngeal image of the disease is presented in Figure 1, sketched from nature in the person of one of this group.

It will not, therefore, seem inappropriate as the argument proceeds that tuberculosis of the larynx which has proved capable of healing or arrest should be designated as a type, for, while Heryng, Krause and Lake have dwelt on its surgical curability in isolated instances, I seek to establish for laryngeal tuberculosis what is now well known with respect to the pulmonary affection, the fact that in certain patients Nature develops an adequate resistance, sufficient of itself to arrest the disease, and that in certain other patients Nature develops an almost but not quite adequate resistance which, when persistently reinforced by the best methods of our art, then suffices to arrest the disease.

II. THE HOPEFULLY RESISTANT TYPE

Twenty-two cases, or two-fifths of the total series, compose a second group in which the laryngeal tuberculosis ran a much slower course, the natural resistance of the patient having been sufficient to effect temporary

Fig. 1.—A classical image of tuberculosis of the larynx; case of Miss A. C., non-resistant type.

amelioration and arrest, but usually in the end having fallen short of permanent arrest. Of this number, 8 are accurately known to have succumbed, but only after from three to seven years, and 12, when last observed, were obviously doomed, also having survived through their own inherent resistance, with but desultory aid, for from three to seven years. This brings the mortality of the entire series to 80 per cent., but the cloud is not without its silver lining, for, in addition to the third group, that of permanent arrests which will take up the other 20 per cent., there remain two cases of this second group which by aid of modern methods and suitable habits of life have now almost, if not quite, reached a state of permanent arrest.

CASE 1.—The condition of the larynx in one of these as sketched at its worst nearly three years ago, is shown in Figure 2, in which, bearing on the diagnosis, it should be observed by comparison that, aside from a unilateral predominance, the lesions are identical in kind with those in Figure 1, which in turn was selected from the non-resistant type to represent the classical aspect of tuberculosis of the larynx. The pyriform

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