

some pain, the profane and filthy protests uttered showed that the patient was suffering from the less dangerous of the two conditions. This was made still more certain when, an hour later, he lay in bed with flushed face, snoring peacefully, and with a pulse which had risen to eighty-four beats a minute.

Alcoholics suffering from concussion present a different picture. Most noticeable is the slowing of the pulse. Respiration is not snoring, more commonly superficial and inaudible, the face remains pale for a longer period, the facial expression is plaintive, and, as a rule, no answer can be elicited. Moans or sighs indicate the more serious nature of the injury.

A man who had fallen to the ground from a high ladder was brought to the clinic. The patient had remained unconscious for some time, but after he arrived at the hospital he gave his name and an account of the accident. He vomited several times in our presence. The pulse was only forty-six beats a minute. It was noticed that the patient bled from the right ear, and also from the nose. The bleeding from the ear was quite profuse. Both lids of the right eye were suffused with blood; there was no subconjunctival hemorrhage. The right side of the face was flattened and without its naso-labial fold, but the left retained the normal play of muscles. He was unable to close the right eye. On examination of the mouth, while the patient said "A" in a loud voice, the left half of the uvula was seen to wrinkle; the right did not.

We here had to deal first with concussion, for consciousness was lost, the pulse markedly slowed, and vomiting had occurred. In addition, a fracture of the base had also taken place. The bleeding from nose and ear, combined with paralysis of the right facial, permitted of no other interpretation. We were able to declare not only that the fracture extended through the right petrous bone, but also that it was situated at a level above the point where the great superficial petrosal nerve is given off, for the palate appeared para-

lyzed. The fracture may strike the facial at a lower part of its course and then reach the greater superficial petrosal nerve at some other point.

It was necessary in this case to find out whether the patient could hear with the affected ear. More careful examination showed that he was deaf on that side. Evidently the auditory nerve was compromised, and consequently auditory transmission interrupted. Therefore, the fracture passed through the internal auditory meatus.

If any subconjunctival hemorrhage, especially if actively progressive, had been present, we might have said that the fracture extended along the roof of the orbit. Hemorrhage from the bone would then have shown itself subconjunctivally.

A *Fracture of the Base* is present, beyond a shadow of doubt, if brain substance or cerebro-spinal fluid discharges from the nose or ear. Brain substance can be recognised as such by microscopical examination. If serum oozes from the ear, and we are in doubt whether it is cerebro-spinal fluid or merely blood serum expressed from a coagulum, or a serous fluid due to some ear disease, the course of the case will decide. Cerebro-spinal fluid—which is characterized by a low percentage of albumen and high percentage of sodium chloride—continues to run for days, and in large quantities. In a case reported by Kelly nearly 300 ounces were collected between the second and fourteenth days. After this the outflow ceased. From the outset certain signs which point to the nature of the fluid may be prominent. Cerebro-spinal fluid flows more rapidly when the head is inclined toward the injured drum membrane, or when the patient makes strong expiratory efforts.

If to the flow of cerebro-spinal fluid is added paralysis of a cranial nerve, we account for this paralysis by assuming a fracture of the base, especially if the affected nerve is either the facial or the auditory, which traverse the petrous bone. If bleeding occurs from ear, nose, or mouth, separately or together, and paralysis of a cranial nerve occurs at the same time, a fracture of the base is *highly probable*. This is especially true if the bleeding from the ear continues for any length of time. (Under the same conditions a fracture of the base is *fairly* probable even if the paralysis of a cranial nerve is not present.) If, however, signs of fracture of the base are wanting, though the signs of concussion and paralysis of a cranial nerve are to be seen, the possibility of a contusion of the brain is not excluded.

A brick fell upon the right frontal region of a man thirty-five years of age. Unconsciousness for ten minutes, followed by headache and dizziness. In four days these symptoms disappeared, but after the accident the left arm could not be properly moved. On the fourth day involuntary twitchings suddenly appeared in this arm. . . .

The rest of the history need not be quoted, but from what has been stated it is evident that a very moderate degree of concussion had been sustained. As paralysis of the left arm followed the injury, some local lesion of the right hemisphere must have occurred. It is probable that this was situated in the upper part of both ascending frontal and parietal convolutions. The spasms noticed on the fourth day were the result of reactive processes at the site of injury.

Finally, one more illustration. I will use a case of Tillaux:

A man, run over by a cab, was brought to the hospital without any skin wound, depressed fracture, or disturbance of general condition.

After six hours, paralysis, first of the left, next of the right extremities, supervened. This was followed by coma and death within three days. Autopsy showed an extravasation of blood between the left parietal bone and the dura. The blood-clot weighed 140 grammes and caused a flattening of the brain. The surface of the right hemisphere was bruised by *contre-coup*.

Let us analyze this case from the point of view of diagnosis. The symptoms of paralysis increased with such rapidity that but one cause could be assigned. This cause is arterial hemorrhage, which is always rapid. It has been proven that the middle meningeal artery can *rupture* even without injury to the cranial bones. This rupture may occur on the side opposite to the blow, merely as a result of the momentary change in the contour of the bones. A sinus may tear, with consequent hemorrhage, but the bleeding is never as extensive. Why did the paralytic symptoms not manifest themselves at once? This fact is characteristic of *injury to the middle meningeal artery*. The blood must first separate the dura from the bones before it can balloon out the membrane and thus exert pressure upon the brain. As soon as this is accomplished, pressure symptoms rapidly develop. But why did paralysis first appear in the *left* extremity when the *left* hemisphere was injured? With compression of the left hemisphere a right-sided hemiplegia was to be expected. Probably the contusion had previously impaired the circulation of the right hemisphere, and the pressure was therefore more readily felt in that region. Was the left hemiplegia not the result of the right-sided contusion of the brain? No; for if it had been, this hemiplegia would have appeared immediately after the injury.

These are the types most commonly seen in ordinary practice.

Let us now turn to the *local examination* of injuries to the skull. There is naturally a considerable difference between subcutaneous and compound injuries. The outcome of simple fractures of the skull resemble the result of similar injuries of the ribs or pelvis.

When the force has not fatally injured the inclosed organs the fracture heals with or without disturbance of certain functions. If the injury to the intracranial contents (or to the contents of thorax or pelvis) is of itself fatal, it is of no importance whether the fracture was simple or compound. We may therefore say that in the case of severe simple fractures of the skull there is good hope of recovery, while in case of even an insignificant compound fracture the danger of a fatal termination must never be lost sight of. If the internal injury is not fatal, the subsequent course depends primarily upon the asepsis observed. This is the A to Z of the whole matter. Therefore, every examination must be conducted with strictest asepsis or antisepsis.

What should be looked for in examining the wound? In practice this really reduces itself to finding out whether there is a circumscribed depression or not. If it is present, we trephine or elevate the fragments. A foreign body, if present, should be removed. During the whole examination only these two points need be borne in mind. In many cases the examination is part of the treatment.

If the splintering is circumscribed, we remove all the movable fragments and smooth the circumference of the wound. If the fracture is of considerable extent, we content ourselves with removing the loose splinters,

but refrain from excessive elevation, resection, or extraction. If it is a fissure, pure and simple, an antiseptic dressing will suffice.

In case of subcutaneous injuries our local examination should be directed chiefly to determine the following points:

In the first place we must decide in what layer a hæmatoma is situated; in the second, provided the hæmatoma is deep-seated, whether the bone has been depressed or not.

The following signs are of value: A hæmatoma which is directly under the skin is prominent and tense, and moves readily with the skin. A subaponeurotic or subperiosteal hæmatoma is, first of all, greater in extent, because the aponeurosis of the occipito-frontalis does not yield to pressure. It is therefore flattened, under low tension, and firmly attached. We might ask how a subaponeurotic extravasation could be distinguished from a subperiosteal. By introducing a needle this question may be satisfactorily answered; for if the needle strike a rough surface, the bone has been laid bare and the extravasation is consequently subperiosteal.

An inexperienced man may be readily led astray by the second query, whether the bone below a hæmatoma has been depressed or not, owing to the fact that a deep, especially a subperiosteal, extravasation often, or regularly, is bounded by a harder wall. The examining finger discovers this ridge and sweeps over it; the finger then sinks into the hæmatoma, so that the false diagnosis of a depressed fracture of the bone may be made. The impression is uncanny, but after examining a few cases this feeling of uncertainty is lost. The ridge

about the extravasation is caused by a bloody infiltration of the tissues at the edge of the hæmatoma. Consequently the finger can make an impression in the ridge, in some cases even flatten it completely here and there. A feeling of very delicate crepitation, due to the friction of the blood coagula in the tissue spaces, may be obtained. No hesitation need be felt about making this examination, as the patient suffers no harm by it.

If a sabre wound extends along a markedly curved segment of the skull, and if the wound is long, we may generally suspect that at least the centre of the wound communicates with the cranial cavity. This assumption has more or less of a geometrical basis.

If, in an incised wound of the scalp, the edges of the wound do not gape, the injury has been confined to the skin; if the edges separate, the galea has been severed. Anatomical facts explain this, for the aponeurosis is drawn upon by its muscles, and thus separated. As the skin is closely connected with it, the wound gapes.

If a hæmatoma, or swelling, appears at a point opposite to the point of entrance of a shot, the projectile may be situated under this spot. Larrey found a bullet by cutting down upon the suggillation.

If the unharmed dura, exposed by some defect in the skull bones, shows no brain pulsation, one of several conditions may be present. The part of the brain situated beneath this point may be anæmic, or contused; or there may be an extravasation of blood under the dura. The anæmia may be caused by a splinter of bone wedged in between the dura and the skull. Contusion interferes with pulsation, because the contused parts have their circulation disturbed through destruction of the vessels. A blood extravasation situated beneath the dura will impart a bluish colour to the affected area.

CHAPTER III

INFLAMMATORY COMPLICATIONS FOLLOWING INJURIES TO THE SKULL

IN many cases, carefully executed antisepsis will determine whether a penetrating injury to the skull will be followed by suppurative inflammation of the intracranial contents. Frequently, however, reliable antisepsis is out of the question. For instance, in fractures of the base, which involve the tympanum or nasopharynx, and consequently tear the mucous membrane, the pyogenic cocci find a point of entrance in spite of all possible precautions.

The most frequent complications to be considered are meningitis, brain abscess, and phlebitis of the sinuses. Other causes in surgical practice may, however, occasion these diseases. Thus, tuberculosis of the petrous bone or a suppurative otitis media may readily lead to an abscess in the neighbouring parts of the brain, or to inflammation of the meninges. A phosphorus necrosis may spread to the sphenoid bone and cause a meningitis. Erysipelas of the scalp may travel along the emissary veins and give rise to purulent meningitis, often with sinus thrombosis. Analogous complications may arise from a furuncle of the face. Following a resection of a cranial nerve infection has been known to travel along the nerve-sheath and enter the skull. I