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## A Case of Fracture of the Cranium with Accumulation of Air in the Cranial Cavity

by

*N. Hansson*

(Tabula VIII)

In the early literature on this subject there is described a group of 30 cases of so-called *pneumatocele Cranii* collected by Mac. Arthur in the Annals of Surgery and Gynecology of 1905. These constitute all the cases published on the subject up to that time. As a curiosity, it may be mentioned that the one who discovered this disease, and differentiated it from the usual subcutaneous emphysema in the head, was the great Swedish surgeon, OLOF AV ACRELL, who, in his publication »Kirurgiska händelser», communicated the first case of the disease in question. The name pneumatocele was first given by the French physician, CHEVANCE DE VASSY, 1855. None of the cases in MAC ARTHUR'S publication have been Röntgen-diagnosed. Most of them refer to the region above processus mastoideus, and are therefore called pneumatocele-supra-mastoidea, and only very few to the frontal region. The accumulation of air has had an epidural location. Very few of these cases are of traumatic origin. But there are a few such described as traumatic cysts after fracture of the cranium with laceration of the brain. The majority of them have originated in patients with morbid changes in the bone in proc. mast., for instance, cellulæ or antrum, and the real, so to say, acute causal moment for their appearance is said to have been a sudden increase of the pressure in the nasopharyngeal cavity, such as a violent sneezing, or similar symptoms. The cases have been verified either through operation, or through post-mortem examination.

In the literature of the last few years there appears a case of this kind of pneumatocele cranii supra-mast. — not examined with the X-rays — published by Dr. T. PHEMISTER. It was one of the more rare cases with traumatic etiology and refers to a 12-year-old boy who, after a

knock against proc. mast., gradually developed headache and epileptic fits. Operation revealed an air- and fluid-filled cyst, which had arisen in a seat of contusion in the temporal lobe corresponding to the place for a fracture in proc. mast.

In 1913 M. LUCKET<sup>1</sup> describes in the *Annals of Surgery and Gynecol.* the first case of air in the ventricles of the brain which has been roentgen-diagnosed before operation. This refers to a 87-year-old man who had been run over in the street and got a fracture on the coronal bone, which went through sinus frontalis dx. and the right orbital roof. The first roentgen photo, which was taken some few days after the injury, certainly exhibited the fracture but no air within the cranial cavity. About 8 days after the trauma, when the pat. had considerably improved, he got a violent attack of sneezing, and instantaneously he felt a violent stinging pain in his head. At the same time, according to his statement, a large quantity (a coffee-cupful) of clear fluid is said to have run out through his nose. The patient afterwards became worse, and showed signs of increased intracranial pressure and meningitis. New roentgen plates were taken and exhibited air in the ventricles of the brain. The patient was operated upon, the right lateral ventricle was then punctured and an air-bubbling fluid came out. Death 4 days after operation from meningitis. On post-mortem examination a fracture was found through sinus frontalis on the right side, which extended further backwards through the orbital roof. The dura adhered to place of fracture and here showed a gap. The soft membranes were likewise adherent at the same place, and on detaching them a laceration in the brain substance was discovered, which showed a connection with the front corner in the lateral ventricle on the right side.

In M. LUCKET'S opinion the act of sneezing has pressed the air through the fracture and the injured dura, and further through the laceration in the brain up into the ventricle system. This brought about an acutely severe increase of intracranial pressure, and as an autodecompression from this the cerebrospinal fluid was emptied through the nose.

A. SKINNER<sup>2</sup> reports a similar case of fracture through sinus frontalis and air within the cranial cavity. With the aid of a roentgen examination it was ascertained that there was air before the operation which verified the finding and showed that the air lay subdurally. An analysis was made of the contents and showed 1.8 % oxygen and 98.2 % nitrogen, thus, practically speaking, ordinary air, out of which the oxygen had, for the most part, been resorbed. The patient died of meningitis 20 days after the operation.

T. HOLMES gives an account<sup>3</sup> of a case of fracture through sinus frontalis with air within the cranial cavity — also in this case subdurally situated — death, after operation, from meningitis. And further two similar cases are reported, the one by H. POTTER<sup>4</sup> and the other by J. MAY.<sup>5</sup>

Some time ago I had the opportunity to observe a case of fracture of the cranium with accumulation of air in the cranial cavity.

<sup>1</sup> Chicago surgical clinics 1919.

<sup>2</sup> Journ. of Am. Med. Ass. 1914.

<sup>3</sup> Journ. of Am. Med. Ass. 1914.

<sup>4</sup> Am. Journ. of Röntgenology 1918.

<sup>5</sup> " " " " "

The patient was a 36-year-old cavalry officer who, at the beginning of last June, was brought to the military hospital in Stockholm. According to statement, he is said to have always been healthy previously, with the exception of a shorter period of influenza in August, 1918. On the 15th April, 1919, he took part in competitive horse-riding, and during same rode at a great pace right against a corner-post. The patient got a blow on the forehead and was thrown from his horse several yards and fell head over heels to the ground. He at once lost consciousness and for the next two hours remained unconscious. According to information from Dr O. GERTZÉN at Skövde, who first took care of the patient, he had, in addition to several scratches on his face and contusions on his body, a gaping bruise over the right eye, showing the bare bone. The wound was sutured and was healed per primam. The pulse was normal and no sign of intracranial pressure was to be found. No hemorrhage from pharynx and ears. The first three or four days the patient had slight fever, which was thought to be a resorption fever, and afterwards completely disappeared. He had no vomiting but intensive headache. After violent sneezing some hours after the injury he got a hemorrhage in the upper palpebrae and a ptosis of the right upper eyelid. He was nursed at home from the  $15/4$ — $3/5$ . From the  $8/5$  in service again. During this time he was troubled partly with headache and tenderness in the muscles of the neck and shoulders, and partly with vertigo which he had felt the whole time when raising himself up from a recumbent or downward-bent position, likewise difficulty in keeping his balance.

In the middle of May, thus about a month after the trauma, the patient in raising himself up in bed one morning noticed a splashing in his head. He could easily produce this splashing when he made slight, quick movements of the head. He himself located the sensation to the nape of his neck. The vertigo and headache still continued, although both had diminished somewhat in intensity. At the beginning of June the patient visited Dr O. ALEMAN on account of this sensation of splashing. He was received for further examination at the medical department of the military hospital on the  $5/6$ .

From the status (Head physician, Docent F. Lindstedt) the following was recorded: The patient's subjective trouble consists of the abovementioned sensation of splashing and a slight vertigo. A right-angled cicatrice exists over the right eye, well-healed and without a trace of irritation. On percussion of cranium no soreness anywhere. On auscultation over the cranium, when pat. makes slight, quick movements, the splashing is distinctly heard and sometimes appears more distinct in the nape of the neck, sometimes in the region of the temples. A slight ptosis of the right eyelid was found. Keeness of sight normal on both eyes. The reaction of the pupils to light as well as to accommodation without remark. Nothing pathological in the eye-grounds. On glancing to the extreme right the pat. states double pictures from right eye. The hearing, which has formerly been normal, is now distinctly reduced on the left ear, also on the right, although in a lesser degree. Smell and taste without remark. Facialis everywhere without remark. No deviation of or tremor in the tongue. Sense of temperature, pain and touch everywhere normal. No decline anywhere in the muscular strength. All reflexes normal. Babinski negative. Gait without remark. Romberg negative. Internal organs show no changes. The white corpuscles were counted and showed an amount of 8,500 per cubic mm. Lumbar puncture was made, and the pressure was 140 mm. The fluid was quite clear and had about one cell per range of sight.

## Roentgen examination on the 7th of June, 1919

On r-grams (Tab. VIII Fig. 1—4) in upright position there is to be noticed on the lateral photo (Fig. 1) the contour of a *semicircular, gas-filled cavity situated within the upper part of the frontal lobe of the brain*, and on r-grams in saggittal direction with the forehead against the plate (Fig. 2) a similar, curved outline encircling gaseous cavity situated on the right side close to the median line. The gaseous cavity is *downwards* limited by a *straight, horizontal* outline, which is formed by a substance of the same density as the surrounding cerebral substance.

This cavity reaches downwards to the base of the skull and from hence about 6 cm. upwards. Forwards it reaches close to the lamina interna ossis frontalis and from hence 5 cm. backwards. Its breadth in the frontal position is 4 cm.

Now some *lateral photos* were taken in a prone position (Fig. 3) with the front against the plate as well as in supine position with the neck against the plate (Fig. 4). In these photos it turned out that the gaseous contents showed off against a surface with a smooth curved outline in the posterior as well as in the frontal part of the cavity. Downwards the gaseous cavity is limited by a plane surface keeping horizontal in all positions of the body, which is evidently caused by a *fluid* that filled up about  $\frac{2}{3}$  of the cavity. *The cavity, which had a diameter of about 5 cm., was thus well defined and kept its site within the brain in the different positions of the body.*

No gas was to be noticed in the space of the lateral ventricles.

On all the photos a *fracture through the coronal bone passing through the right frontal sinus* was distinguished and a bone fragment of the size of  $\frac{1}{2} \times 1\frac{1}{2}$  cm. is fractured off the frontal wall and dislocated backwards into the right frontal sinus. The latter is also highly condensed and dimly outlined.

Thus there is evidently a *rounded, well limited cavity in the area of the right frontal lobe of the brain, containing gaseous and fluid contents.*

The patient left the hospital after a few days. On the 20<sup>th</sup> of July, about 3 months after the injury, the patient notified that the splashing sensation had completely disappeared some days ago. This had happened gradually without the patient being able to give the fixed time for the disappearance. A renewed roentgen examination was then made, and *no trace of air could now be observed within the cranial cavity.*

At the same time the patient was subjected to a renewed examination at the military hospital. With the exception of a slight vertigo, when he raises himself up from a recumbent or downward-bent position, no subjective or objective symptoms whatever were to be found. The patient is still in active service and feels quite well.

No surgical treatment nor post-mortem examination having been performed, it is not possible in the present case to decide with surety the anatomical character of the cavity in the frontal lobe of the brain. I venture, indeed, to designate this injury as a traumatic cyst, well-known from injuries of the brain as well as of the spine. Their origin is explained by the fact that the trauma causes a hemorrhage in the membranes. The blood acts as a foreign body and consequently irritates the soft membranes. This causes a slight sclerosis of same and the adhesive formations, rendering the normal renewal of the cerebro-spinal fluid more difficult. As a further consequence of this hemorrhage the secretion of the cerebro-spinal fluid on the wounded place is increased and, on account of the deficient absorption, the surplus cerebro-spinal fluid cannot be removed, and a retention-cyst is formed here.

As all signs of infection are lacking, it seems very improbable that the gaseous contents of the cavity should have been caused by gas-producing bacterias. As in the other similar cases, where a chemical analysis has been made, I suppose that also in this case *air* has been pressed into the cavity via the fracture crossing the frontal sinus, possibly on the occasion of the sneezing, as in the case of LUCKET.

The sensation of splashing may have made itself felt when fluid became present in the air-filled cavity. When the air was completely resorbed, the sensation disappeared.

The case here described is also of interest because, excepting the case published by POTTER, it is the only one which has resulted in recovery.

These two patients have not been subjected to operative treatment, whilst all the others have been operated upon and have died. The question now arises how to proceed with these injuries in therapeutic respect. HOLMES opines that the correct treatment is a prompt surgical intervention and, as the majority of other writers, he holds that the air draws bacteria along with it, which cause the purulent meningitis that is the cause of death in nearly every case. If this explanation should be correct, it appears very strange that just these two cases, which have not been subjected to operative treatment, are the only ones which have recovered.

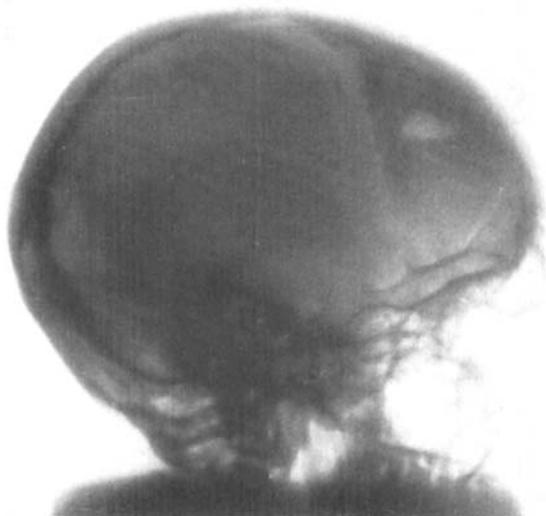


Fig. 1. Side-view: Upright pos.



Fig. 2. Frontal view: Upright pos.

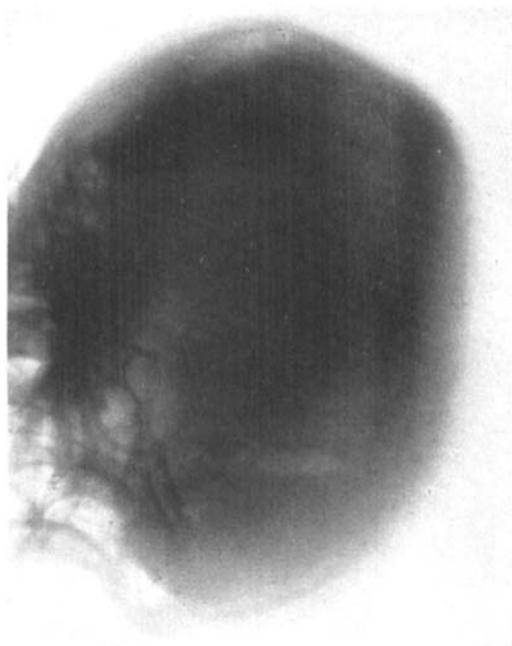


Fig. 3. Side-view: prone pos. Forehead against the plate.

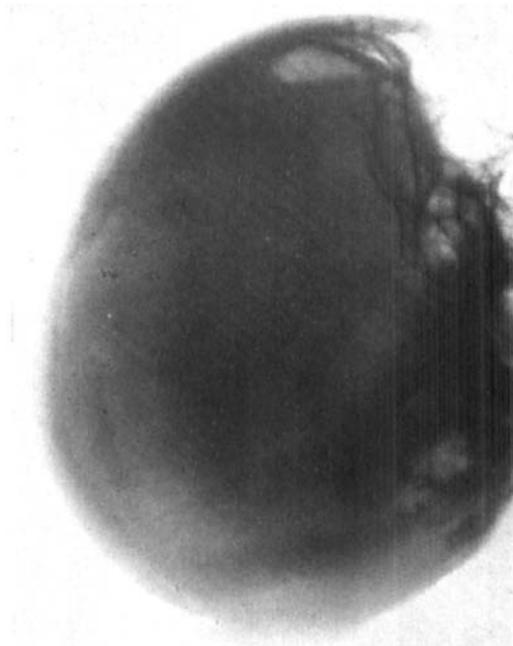


Fig. 4. Side-view: supine pos. Neck against the plate.

## Summary

The author gives an account of the cases of so-called »*pneumatocele cranii*» in the early and modern literature and describes a traumatic *cyst in the right frontal lobe of the brain*, observed and radiographically examined by him, and containing air and liquid, occurring in consequence of a fracture through the coronal bone, penetrating the frontal sinus.

The patient recovered without surgical treatment.

