Reflections on the Surgery of the Pineal Gland (A Glimpse Into the Past).

Gleanings from Medical History

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Probably the first attempt at a surgical approach to the pineal region was made by Sir Victor Horsley (10) but without any success.

As described by C. M. Hinds Howell (11) who presented a paper to the Royal Society of Medicine in 1910 on Tumours of the Pineal Gland, Sir Victor Horsley took part in the discussion. He did not mention that he had actually operated on any cases, although he implied that he had, and probably without any success. In the discussion it was reported . . . "With regard . . . to the possibility of doing anything surgically, he was bound to confess that the surgical results so far were far from favourable. He thought that this might be due to the fact that he had approached the lesion subtentorially. In the next case with which he had to deal he would certainly go supratentorially splitting the tentorium from the ventro-posterior position and exposing the tumour in that manner . . .".

Apparently the next attempt was the case, which Rorschach published in 1913 (20). The surgeon Brunner had apparently attacked two cases unsuccessfully. In the first case, a 27-year-old man had a long history of obesity and was in an asylum because of his hebephrenia, until however, he developed signs of an intracranial mass with disturbances of eye movements and cerebellar ataxia. Here, Brunner turned down a flap over the posterior fossa, but the patient died during the second stage of the surgical attempt. This was a walnut-sized well-encapsulated quadrigeminal tumour.

One year later a real cousin of this patient also in his 27th year was admitted to hospital and also diagnosed as a tumour of the quadrigeminal region (headache, choked disk, vertigo, disturbance of hearing, eye muscle paresis, ataxia, astereognosis).

In this case Brunner (2) chose to use the other known access to the quadrigeminal region, namely through the posterior corpus callosum.

In the second stage he opened the dura, ligated the sinus in two places and incised it in between. He then pushed aside the right hemisphere until the corpus callosum was visible. This, however, ruptured as the operation proceeded. The removal of the tumour was difficult because of the very narrow field of operation: later there was a severe venous haemorrhage but although the veins were ligated, any further approach toward the tumour was impossible and the operation was abandoned. The patient recovered soon and the general symptoms disappeared, but sensory defects remained.

Although removal of the tumour was not possible in this case, this approach through the corpus callosum has remained the usually favoured method since.

A very short report on an unsuccessful operation was made by Elschnig (6). Here an operation had been attempted by Schloffer on a patient of 21 years, where again, particularly because of the absence of any reaction in his dilated pupils and other signs in the eye muscles, a quadrigeminal tumour was diagnosed. The operation by Schloffer only led to a decompression which brought an early improvement in the symptoms, but the patient subsequently died. The posterior half of the third ventricle was replaced by a tumour the size of a hazle-nut, which apparently had its origin from the ependyma (see the ependymoma of the posterior part of the 3rd ventricle, Zülch (25), Fig. 57). A publication by Roman in 1913 (19) described this tumour more accurately as a "neuroepithelioma gliomatosum".

The *first report of a successful extirpation of a tumour from the pineal region* was published by Oppenheim and F. Krause in 1913 (16).

In their first case Oppenheim had diagnosed a tumour of the left hemisphere and its most likely location seemed to be in the thalamic region. This was approached by F. Krause through a left temporal flap. The first temporal convolution was incised and, at a depth of 5 cm a tumour of hard consistency was felt with the palpating finger. The tumour was

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removed from a depth of 8 cm, and measured 8 × 6 × 5.5 cm. According to the opinion expressed by Krause the lateral ventricle was not opened and he felt that the tumour must have been thalamic in origin.

The subsequent neurological deficits were considerable (paresis of the left oculomotor nerve, right hemianopia, hemiparesis), but there was no longer any evidence of increased intracranial pressure. Fedor Krause discussed in summarizing whether any operation was advisable on such a tumour, considering the extent of the residual deficit. However, he was moved to state that "in view of the operative success this case seems to be unique".

Their second case seems to be even more important for the further development of operative surgery in the pineal region. It was a ten-year-old boy in whom Oppenheim diagnosed a neoplasm in the quadrigeminal region.

Fedor Krause thought at first that only an operative decompression was indicated, but he later decided to turn a flap such as he had used since 1898 (see Krause (14), Fig. 57). This was a broad flap and he exposed both sides of the cerebellum. He then opened the dura, lifting the upper part with the spatula in order to gain access to the quadrigeminal region, as the patient was in the sitting position. As a result the cerebellar hemispheres and the whole contents of the posterior fossa "prolapsed posteriorly into the operation field". There was quite a large vein between the upper vermis and the lower tentorium, and this was divided between ligatures. By this means a tumour was exposed at the anterior portion of the upper vermis, which apparently corresponded to the neoplasm diagnosed by Oppenheim.

By a further prolapse of the cerebellum and upper vermis the tumour could be palpated with the finger and it was felt to be considerably harder than the brain substance. Partly by using his finger and partly with a medium-sharp curette (spoon) Krause succeeded in removing the neoplasm completely. The venous haemorrhage from the tumour bed was successfully controlled by compression with a pack. At this stage the internal cerebral veins on the right and left side were seen. The dura was then sutured, and this restored the prolapsed cerebellum to its normal position. The bone-flap was removed and the skin sutured without drainage.

The tumour was apparently completely removed and seemed to be a well-encapsulated sarcoma, microscopically a "fibrosarcoma" of mixed origin (meningioma? as seen in Zülch (25), Fig. 208).

Six weeks later the boy was free of all complaints and was presented at that time to the Berliner Medizinische Gesellschaft on the 26th November, 1913. He had no diplopia, no paralysis of upward gaze and although the pupils were at that time still not reacting to light they reacted to convergence. The fundi and the visual fields were normal, there were no signs in the cranial nerves and no ataxia in the hands, but there was dysdiadochokinesis in the left hand. He had good movement in the lower extremities and his gait was normal. There was no ataxia when walking, stopping or turning.

Fedor Krause came to the conclusion that tumours in the pineal gland could be attacked in a manner similar to that already discussed by H. Rorschach (20).

A further attempt at operating on a quadrigeminal tumour was reported by Puusep (18). This had been an operation on a 10-year-old boy in November 22, 1910. Because of the typical syndrome the tumour was surgically attacked through a temporal flap by ligating the occipital sinus and splitting the tentorium. A cystic mass containing reddish-fluid was visible in the quadrigeminal region. The fluid was removed but only a part of the cystic sac could be removed. However, the patient died on the third post-operative day.

Dandy made his first attempts on an experimental operation upon the pineal body and published his experience in 1915 (3).

In a series of experiments on dogs during his studies on hydrocephalus he showed the feasibility of exposing and clipping the great vein of Galen. Having in mind an approach to the pineal gland he subsequently extended his exposure and by painstaking dissection exposed the corpora quadrigemina and the pineal body. The pineal was then caught in a small (pituitary) rongeur and removed. In a series of twelve dogs none of the animals survived the operation and at the post-mortem examination all showed ventricles full of blood. The extirpation of the pineal necessitated opening the third ventricle because of the incorporation of this structure in its posterior wall . . . At this time he had not operated successfully in man, but he concluded that a comparable operation should be possible in the human subject.

Dandy reported in 1921 (4) on his three further attempts to operate in the pineal region: "Tumours of the pineal body have rarely been diagnosed and substantiated . . . But it is now possible to make a correct diagnosis of this lesion; at times the exact diagnosis cannot be made but the lesion can be restricted to the mesencephalon with the pineal growth the highest probability . . . Several years ago I evolved an operative procedure by which it was possible to remove the pineal body in dogs. The operation as finally developed could be conducted without mortality and without any noticeable after-effect upon the well-being of the animal and resulted

in no apparent mental or physical change. The operation which is presented here for patients suffering with pineal tumours is very similar to this canine operation.

The operation has been performed on three patients . . . The operation, therefore, which I am about to propose is designed to remove the tumour directly . . . The approach to the tumor is made possible by a very large parieto-occipital bone flap, the mesial margin of which extends to the superior longitudinal sinus. The exposure of this sinus is frequently a relatively bloody procedure because of the venous lakes, which are usually both large and numerous and the control of haemorrhage must be quick and effective. If the bone flap does not extend to the mid-line a secondary defect must be rongeured away from the mesial margin of bone until the sinus is reached. The dura is then opened and reflected over the inferior longitudinal sinus.

In doing so, the cerebral veins which bridge the subdural space between the brain and the longitudinal sinus are gradually elevated, doubly ligated with fine silk ligatures, and divided. The number of these veins in the necessary field of operation varies from one to six or even more. It is well if possible to avoid ligature of the Rolandic vein, for a transient hemiplegia will follow. Usually, however, it is necessary to ligate all the veins posterior to the Rolandic vein. It is hardly necessary to add that for this reason and because of possible speech disturbances, the craniotomy should be performed on the right side; and because tumors of the pineal body are always in a strictly central position, exposure of the growth is equally easy on either side. In the case in which the tuberculoma was removed, the tumor was approached from the left side because a deforming operation had been previously performed on the right. No speech disturbances followed in this case, although there was a weakness of the right side for several days.

After division of the cerebral veins the entire half of the cerebral hemisphere can be retracted and the falx exposed. The inferior longitudinal sinus is quickly passed and the corpus callosum brought into view as the brain is still further retracted. This part of the operation is bloodless and is quickly and easily accomplished. Until now there is no evidence of an underlying tumour. The posterior half of the corpus callosum is then carefully incised in the midline for a distance of 3 or 4 centimeters and the hemispheres still further retracted. The tumour will then be brought into full view. Under the splenium of the corpus callosum the vena magna Galeni will always be brought into full view at its entrance into the sinus rectus. In one of the cases here reported, the tumour lay anterior to the great vein of Galen and between it and the corpus callosum. In the other case about one-half centimeter of the great vein of Galen was free between the upper margin of the tumour and the beginning of the sinus rectus, an amount sufficient to permit double ligation and division of the vein between the ligatures . . .".

At this time Dandy could not report a longer survival than in a patient with a huge tuberculoma where death occurred eight months later, but later he was able to report the removal of twenty pineal tumours with a mortality of 20% and he had one patient still well after six years (see also Dandy (5) in 1936).

It was not until 1926 that Fedor Krause (15) reported again on his experiences with operations in the quadrigeminal region. He described a case of a 24-year-old student with a typical syndrome of a quadrigeminal tumour, which he also approached through the posterior fossa. He emphasized the importance of puncturing the posterior horn with a cannula, which remained *in situ* during the operation. However, on this occasion he was only able to do a decompression as the patient's state deteriorated during the operation. He noted that he had been able to attack the tumour this way three times, but only once with a successful removal. In all cases, however, the patient's state improved considerably.

As Kahn reports in 1937 (12), a large cystic tumour was removed by Sachs in 1926 from the region of the pineal gland, but its exact nature was not definitely determined. The tumour was considered by Sachs to be a form of cholesteatoma, but it is not established that it was actually of pineal origin.

O. Foerster (7) also embarked on the surgery of tumours of the quadrigeminal plate and *performed the second successful removal of a tumour.* ". . . Diagnosis: Tumour of the quadrigeminal area. Ventriculography shows greatly dilated lateral ventricles and a dilated third ventricle. Operation: Exposure of the right occipital lobe to the transverse sinus and longitudinal sinus. Ligation of all veins leading from the cerebrum into the latter. One advances along the falx, towards the tentorium and the splenium of the corpus callosum. Split tentorium antero-posteriorly along the sinus rectus. Division of splenium. This brings the tumour into view; it is exposed as much as possible on all sides and it has the size of a tangerine. It is resected piecemeal and completely; bleeding slight. After its removal, the vein of Galen comes into sight, displaced to the left. Transient respiratory paralysis is corrected promptly with lobelin. Nature of tumour: glioma. Healing per primam. Complete resolution of all symptoms except for blindness; even now six months after operation there is light perception only. Pupils react slowly but strongly. Hearing

normal, ocular movements show no restriction. Slight nystagmoid jerkings. No disturbances, no spontaneous choreiform movements".

A case of pineal tumour in which operation was performed by Dr. Max Peet in 1929 (17) was reported by Allen and Lovell (1) (see also Kahn (13), Fig. 129). "The patient was a boy aged 13, who entered the University Hospital complaining chiefly of severe headaches and blurring of vision. These symptoms had appeared four weeks before admission and had become progressively worse. Two weeks later the patient began to have projectile vomiting . . . At Operation an osteoplastic flap was turned down in the right parieto-occipital area. When the dura was opened close to the superior longitudinal sinus, the hemisphere was retracted laterally and the splenium of the corpus callosum exposed. An incision was made through this structure, exposing a firm fibrous tumour, approximately 1.5 cm in diameter. This was removed piecemeal. Convalescence was comparatively uneventful, but it was then noted for the first time that the eyeballs could not be elevated above the horizontal. A single course of X-ray therapy was given in 1929. The patient was still well and working in 1951 as a painter . . . This was probably the first total removal of a pinealoma" (13).

Van Wagenen (23) in 1931 was the next to operate successfully in the pineal region. "A case is reported of a successful extirpation of a pineal gland tumor (spongioblastic type) by this means in a 34-year-old woman. She has remained entirely free from symptoms of hydrocephalus for 15 months following operation . . . Operation, first stage: On March 13, a right parieto-occipital bone flap was turned down under novocain and ether anaesthesia. The ventricles were tapped daily to relieve symptoms of intracranial pressure. Operation, second stage: On March 20, 1930, under local and ether anaesthesia, the wound was reopened. Inspection of the cortex revealed nothing of note except flattened convolutions. A reversed L-shaped incision 6 to 7 centimeters long was made in the cortex extending from the posterior end of the superior temporal lobe gyrus upward and slightly backward ending at the lobulus parietalis superior. With the aid of the electrocautery the incision was carried downward into the ventricle without difficulty. The point of entering the ventricle was at the juncture of the temporal and occipital horns with the lateral ventricle. Wet cotton pledgets were placed in the opening of the ventricles to prevent blood or tumour débris gravitating into them. A cotton pledget was placed over the exposed choroid plexus to prevent injury. This proved to have been ill-advised, as considerable bleeding was encountered in separating the cotton from the meshes of the plexus at the end of the operation. A distinct bluish bulge was to be made out in the depth of the wound. This was covered by the much thinned out medial wall of the lateral ventricle and was easily divided and removed with the electrocautery. The third ventricle was opened anterior to the tumour. The tumour lay between and above the large dilated venae vorticosae. It proved to be about 3 to 3.5 centimeters in diameter, was greyish-red in color, soft, smooth in outline and apparently not actually invading brain tissue at any point seen . . .. the tumour was entirely removed except for a small bit adherent to the large adjoining veins. This was left, inasmuch as the danger of uncontrollable bleeding from them was considerable . . . The procedure of choice in dealing with tumours of the pineal gland would seem to be first to perform a right subtemporal decompression. This should be followed by intensive deep X-ray therapy or radium radiation until the combination of these measures no longer seemed adequate to alleviate pressure symptoms. At this time an attempt at extirpation of the tumour might well be made. An approach of election would seem to be one trough the dilated right lateral ventricle".

In 1931 Foerster (8) reported again on his recent experiences in operating on tumours in the quadrigeminal region. He had operated for these lesions twelve times and on seven occasions a tumour had been found (and removed?).

After this, Harris and Cairns (9) reported the successful removal of a pinealoma. "This was a young man aged 20 who presented in March 1930 with headache, double vision and papilloedema.

On 26th April on the basis of the clinical findings his posterior fossa was explored. There was some degree of tonsillar herniation and he was decompressed. There was rapid subsidence of the papilloedema and in September 1930 – he was walking 2 miles/day. He was re-admitted in October – papilloedema was worse.

Ventriculography indicated a tumour in the pineal region. October 25th, 1930 – a right parietal flap was turned. The splenium was divided . . . they found a "smooth greyish-white tumour the size and shape of a walnut – it was quite circumscribed and was easily dissected away from the surrounding structures". The tumour weighed 8.75 g. It was reported by Dorothy Russell as a typical "pinealoma" (as described by Bailey). He was given X-ray treatment postoperatively and a further course of X-ray therapy in June 1931.

The most recent follow-up reported was December 7th, 1931 (shortly before the paper appeared), when he was said to be "well"."

Finally, Tönnis (22) was able to present two boys, 5 and 13 years old, from whom he had successfully removed teratomas of the pineal gland the size of a "walnut" or small "apple" respectively, at the Annual Meeting of the German Neurologists and Psychiatrists 1936. These cases were also reported by Weber in 1939 (24), when he described the teratomas of the pineal region.

This last report together with the descriptions of successful removals by Sachs (21), Peet (17), Cairns (9) and Van Wagenen (23) opened the era of routine removal of pineal and quadrigeminal tumours, whereas the cases of Oppenheim and Fedor Krause (16), and of Otfried Foerster (7) represented the pioneer work in this kind of operation.

Key words:
Pineal gland tumors – Removal of quadrigeminal tumours – Operative approach to the quadrigeminal region.

Schlüsselwörter:
Pinealistumoren - Entfernung von Vierhügeltumoren – Operative Zugänge zum Vierhügelgebiet.

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