Published in final edited form as:

Minim Invasive Neurosurg. 2011 October ; 54(0): 243–246. doi:10.1055/s-0031-1297249.

“Colossal” Breakthrough: The Callosal Puncture as a Precursor to Third Ventriculostomy

D. A. Chesler^{1,2}, C. Pendleton¹, G. I. Jallo¹, and A. Quiñones-Hinojosa¹

¹The Johns Hopkins University School of Medicine, Department of Neurosurgery and Oncology, Baltimore, MD, USA

²The University of Maryland Medical Center, Department of Neurosurgery, Baltimore, MD, USA

Abstract

Background—In 1908, Anton and von Bramann proposed the Balkenstich method, a corpus callosum puncture which created a communication between the ventricle and subarachnoid space. This method offered the benefit of providing continuous CSF diversion without the implantation of cannula or other shunting devices, yet it received only slight reference in the literature of the time. It remained a novel and perhaps underutilized approach at the time Cushing began expanding his neurosurgical practice at the Johns Hopkins Hospital.

Materials and Methods—Following IRB approval, and through the courtesy of the Alan Mason Chesney Archives, the surgical records of the Johns Hopkins Hospital for the period 1896–1912 were reviewed. Patients operated upon by Harvey Cushing were selected.

Results—7 patients underwent puncture of the corpus callosum for treatment of hydrocephalus. 6 patients were treated for obstructive hydrocephalus secondary to presumed intracranial lesions. 1 patient was treated for congenital hydrocephalus.

Conclusion—The series reported here documents Cushing’s early use of the corpus callosum puncture to divert CSF in patients with obstructive hydrocephalus secondary to intracranial tumors, as well as an attempt to use the procedure in a pediatric patient with congenital hydrocephalus. Notably, 3 patients developed new onset left-sided weakness post-operatively, possibly due to retraction injury upon the supplementary motor intra-operative manipulations.

Keywords

callosal puncture; cushing; hydrocephalus

Introduction

At the turn of the twentieth century, the source and pathways of cerebrospinal fluid (CSF) remained a subject of active investigation and debate among physicians. Hydrocephalus and its treatment had been described from ancient times, with Hippocrates, Galen, and Vesalius

Correspondence A. Quiñones-Hinojosa, MD, 1550 Orleans Street, Cancer Research Building II, Room 253, Baltimore, MD 21231, USA, Tel.: +1/410/502 2906, Fax: +1/410/502 5559, aquinon2@jhmi.edu.

Conflict of Interest: None

proposing techniques for CSF drainage and diversion [1]. These descriptions culminated in a plethora of operative approaches devised by surgeons at the turn of the twentieth century [1 – 6].

Quincke proposed serial lumbar punctures [2, 5, 7], Mikulicz proposed subgaleal drainage [1, 5, 7], and Cushing advocated translumbar-peritoneal drainage [5 – 7]. As the CSF pathways were further elucidated, physicians began to differentiate between procedures with benefit in communicating or congenital hydrocephalus, versus those of benefit in obstructive hydrocephalus [1, 5, 7, 8]. In 1908, Anton and von Bramann proposed the Balkenstich method, a corpus callosum puncture which created a communication between the ventricular and subarachnoid space [9, 10]. Although they attempted this procedure in patients with congenital hydrocephalus, obstructive hydrocephalus from intracranial tumors, and patients with epilepsy, they concluded that its benefit was greatest in patients with hydrocephalus due to obstruction of the CSF pathways [9, 10]. This method offered the benefit of providing continuous CSF diversion without the implantation of cannula or other shunting devices, yet it received only slight reference in the literature of the time. A 1913 review of the method stated that other than Anton and von Bramann's own publications, only a single paper described the use of the Balkenstich method [10]. Therefore, while the callosal puncture was introduced as early as 1908, it remained a novel and perhaps underutilized approach at the time Cushing began expanding his neurosurgical practice at the Johns Hopkins Hospital.

Methods

Following IRB approval, and through the courtesy of the Alan Mason Chesney Archives, the surgical records of the Johns Hopkins Hospital for the period 1896–1912 were reviewed. Patients operated upon by Harvey Cushing were selected, and from this cohort, 7 patients treated with puncture of the corpus callosum for hydrocephalus were further analyzed.

Results

7 patients underwent puncture of the corpus callosum for treatment of hydrocephalus (Fig. 1). 6 patients were treated for obstructive hydrocephalus secondary to presumed intracranial lesions. 1 patient was treated for congenital hydrocephalus. The mean patient age was 26.2 years (range 0.67–47); the majority of patients were male (85.7 %) (Table 1). 3 patients developed new onset left-sided weakness post-operatively.

Case Reports

Case 2: repeated callosal punctures for treatment of hydrocephalus secondary to suspected pineal tumor

On February 24, 1912, a 20 year-old man presented with complaints of “blindness and stupor.” Cushing suspected a pineal gland tumor, and brought the patient to the operating room first for a ventricle puncture and decompression, and then for a callosal puncture on March 5: “The usual incision was farther enlarged [at Kocher's point] and the bone opening increased to the size of possibly a 50-cent piece. The dura was opened, disclosing a network of large venous radicals. It seemed for a time that it would foolhardy to attempt to pass

between the falx and the hemisphere at this situation. A ventricle puncture was therefore done, and about 30 cc. of fluid withdrawn from the ventricle. This measure diminished tension considerably and lessened the distension of the fore-mentioned vessels. It was finally found possible to get between 2 of the vessels by depressing the edge of the hemisphere, and to see the falx. Along the exposed falx a curved ventricular [sic] needle was introduced to a depth of 5 cm. There was a sudden escape of fluid through and alongside of the needle, making it seem possible that the callosum had been punctured. The tension diminished greatly.”

Post-operatively, he developed left-sided weakness. He returned on April 16, 1912 for a second corpus callosum puncture: “In attempting to disclose the margins of the longitudinal sinus and falx there was considerable laceration of the adherent brain with more or less bleeding. However, it was finally possible to pass through the tissue as far as the falx with blunt dissection and in the line of this blunt perforation the curved ventricle needle was introduced alongside of the falx a distance of about 7 cm. before entering the third ventricle. There was an escape of fluid, very free. The needle was moved backwards and forwards for a distance of 1 cm. so as to insure [sic] an opening into the corpus callosum and the needle was withdrawn.”

Post-operatively, he had no change in his left-sided weakness, and his “general health remains good.” Follow-up letters document that he remained in good spirits, with “an interest in current events” until his death from unspecified causes on March 31, 1913.

Case 4: congenital hydrocephalus

On August 9, 1911 a 6 month-old boy presented with hydrocephalus. He was discharged without operative intervention, and returned at the age of 8 months, in October of the same year for further treatment. The history taken at this admission documented that the child was born full-term, and the labor and delivery did not require the use of instruments. The mother noted that she was “threatened with miscarriage at 5 mo.” The child’s history was remarkable only for croup at 3 months of age, after which the parents noticed his head gradually enlarged. The size of the child’s head was 53.2 cm in circumference. The physical examination noted a constant horizontal nystagmus, “more marked to the right.” Serial lumbar and ventricular punctures were performed at the bedside with little effect; on February 1, 1912 Cushing noted the head had increased in size to 56 cm in circumference. On March 23, 1912 Cushing brought the child to the operating room for a “Callosal Puncture.” His operative note and accompanying illustration (Fig. 2) document the procedure: “A small omega-shaped incision was made with its open arc pointing toward the median line and its curve extending over the right parietal bone. In correspondence with this skin incision an omega-shaped flap was made in the parietal bone, the bone arc being toward the median line. This flap was opened upward and a corresponding flap of dura was made.

The brain was bulging and a ventricular puncture was performed. This permitted the cortex to settle away sufficiently to make it possible to follow down and freely expose the falx with the curved ventricular needle. 3 or 4 punctures were made before the operator felt reasonably certain that he had found and punctured the corpus callosum. The first 3 punctures were dry. At the last, which was made somewhat farther forward than the operator

had thought the corpus callosum lay, fluid in abundance was secured. The small flap of bone and scalp was replaced and closed as usual in layers.”

Post-operatively, the patient developed an elevated temperature and nuchal rigidity, as well as left arm weakness. However, he was discharged on April 23, 1912, following a 180 day hospital stay. An autopsy was conducted at the time of death, February 1916, although the brief examination of the brain provided no details regarding the patency of the callosal puncture site.

Case 5: puncture to temporize hydrocephalus

On April 27, 1912 a 23-year-old man presented complaining of headaches, vomiting, and “partial blindness.” He received a diagnosis of presumed fourth ventricle tumor, which was subsequently amended to “cerebellar tumor.” Cushing brought him to the operating room on April 29, 1912 for an “attempted callosal puncture,” in an attempt to temporize his hydrocephalus, and allow time to plan and perform an exploration for the presumed tumor:

“Patient is [in] serious condition and although it seems probable that there is a cerebral tumor the hope of gaining time by doing a callosal puncture lead to the following procedure. A primary opening with perforator and burr and puncture of the right ventricle disclosed the ventricle distended with fluid under great tension. The opening was then enlarged to about the size of a 25 ct piece and the exposed dura was reflected toward the median line. Large venous radicles were exposed and it was almost impossible to get between them and the longitudinal sinus so as to expose the falx. Finally the needle was introduced and on the first puncture no fluid was encountered. An attempt was made to enlarge the opening but the operation was not satisfactory. It may be said that the lateral ventricle was aspirated four times in the course of the operation.”

Post-operatively, the patient developed a new onset left-arm weakness, and was unable to swallow; on May 6, a week postoperatively, he developed a fever of 108, and died. A post-mortem demonstrated “the callosal puncture has passed through the corpus callosum about at its centre and into the cavity of the ventricle, just to the left of the centre. It is quite evident that the track is insufficient. A lateral or an antero-posterior movement of the needle might have made the outlet more likely to have availed.”

Discussion

Most methods for establishing CSF drainage or diversion at the turn of the twentieth century met with limited success, patients succumbed to operative complications or increased intracranial pressure from incompletely treated hydrocephalus. While the corpus callosum puncture proposed by Anton and von Bramann was intended to provide permanent CSF diversion, it was often complicated by closure of the fenestration and redevelopment of hydrocephalus [9, 10]. Despite this shortcoming, the Balkenstich method, as it was known, became popular among neurosurgeons in the early twentieth century, until it was replaced by the third ventriculostomy in the 1920 s, as initially described by Mixter and popularized by Dandy [11, 12].

The concept of the Balkenstich was to create a communication between the ventricular system and the subarachnoid space, by way of a fenestration of the corpus callosum. A controversy exists in the literature regarding the precise anatomy of this communication. Anatomically, access to the lateral ventricle through this approach offers a significantly easier and safer trajectory compared with access to the third ventricle, which would require traversing the potential space of the septum pellucidum, and risking injury to the internal cerebral veins. In the original manuscript, Anton and von Bramann recommended puncture of the callosum anteriorly, at the transition between the genu and the body of the corpus callosum, providing easy access to the lateral ventricle; moreover, they cautioned against more posterior callosal punctures because of the risk of getting between the ventricles and the “four hills” region, suggesting the cisternal spaces around the colliculi. Contemporaries of Anton and von Bramann, in the years subsequent to the cases presented here, reported that the Balkenstich provided entry to the lateral ventricle [13], or failed to specify which ventricle was accessed [10]. In the literature today, descriptions of early neurosurgery have disparate accountings of the Balkenstich method, alternately describing access to the lateral [14] or third [15] ventricle. Interestingly, Cushing himself refers to this procedure as a means to access the third ventricle in his operative notes (Case 2), and expresses disappointment when only the lateral ventricle was accessed (Case 5).

The series reported here documents Cushing’s early use of the corpus callosum puncture to divert CSF in patients with obstructive hydrocephalus secondary to intracranial tumors, as well as an attempt to use the procedure in a pediatric patient with congenital hydrocephalus. 3 of these patients (42.9 %) were discharged from the hospital in “improved” condition, while 3 were reported as having no improvement. Notably, 3 patients developed new onset left-sided weakness post-operatively. Cushing’s notes offer little insight into the potential etiology of this complication, but it may have been caused by cortical damage from retraction of the right hemisphere, possibly upon the supplementary motor area, or damage to white matter tracts secondary to errant needle placement. Interestingly, despite multiple punctures of the corpus callosum to access the third ventricle, as well as manipulation of the corpus callosum to generate a larger fenestration, no mention is made in the charts of symptoms consistent with the sequelae of disconnect syndromes. Cushing continued to perform corpus callosum punctures throughout his career at the Peter Bent Brigham Hospital, and attempted to circumvent the primary drawback of the operation by placing a tube into the fenestration through the corpus callosum, to prevent its subsequent closure [7].

In 1842, Magendie roundly condemned physicians for accepting the layman’s view of hydrocephalus as “water on the brain” without pursuing an explanation rooted in physiology. He exhorted future physicians to define the pathophysiology of this condition, “mais quelle est cette eau? D’ou vient-elle? Voila ce don’t les medecins auraient du s’occuper” (But what is this water? Where did it come from? This is what the physicians will have to occupy themselves with) [16] (referenced in [7]). At the turn of the twentieth century, physicians reaped the rewards of heeding Magendie’s advice; newfound understanding of the CSF pathways allowed the development of novel techniques for CSF diversion and drainage, and offered the possibility of improving quality of life for patients with hydrocephalus of various etiologies.

Conclusion

The case series presented here represents the utilization of a novel technique which was widely embraced, albeit with limited success, in its time.

Acknowledgements

DAC was supported by an NIH T32 grant (T32CA009574). CP was supported by an HHMI-Ivy Student Research Training Grant. AQH is funded by an NIH R01 grant (RO1NS070024). Figures provided courtesy of the Alan Mason Chesney Archives.

References

1. Davidoff L. Treatment of hydrocephalus: historical review and description of a new method. *Arch Surg.* 1929; 18:1737.
2. Quincke H. Die lumbarpuncture des hydrocephalus. *J Mol Med.* 1891; 28
3. Payr. Drainage der Hirnventrikel Mittels Frei Transplantirten Blutgefassen. *Zentralbl f Chir.* 1908
4. McClure RD. Hydrocephalus treated by drainage into a vein of the neck. *Johns Hopkins Hosp Bull.* 1909
5. Fowler RS. The surgical treatment of internal hydrocephalus. *Ann Surg.* 1909; 49:374. [PubMed: 17862317]
6. Cushing, H. *Surgery of the Head.* Philadelphia: WB: Saunders Co; 1908.
7. Cushing, H. *Studies in Intracranial Physiology & Surgery.* London: Oxford University Press; 1928. The Third Circulation.
8. Keen WW. *Surgery of the Lateral Ventricles.* Verhandlungen, des Zehnte Internatt Medicinischen Congress. 1891
9. Anton, Bramann v. Balkenstich bei Hydrozephalien, tumoren und bei Epilepsie. *Medizinische Wochenschrift.* 1908; 55:1673.
10. Archibald E. Puncture of the corpus callosum. *Can Med Ass J.* 1913; 3:451. [PubMed: 20310392]
11. Mixer W. Ventriculotomy and puncture of the floor of the third ventricle – preliminary report of a case. *Boston Med Surg J.* 1923; 188:277.
12. Dandy WE. An operative procedure for hydrocephalus. *Johns Hopkins Hosp Bull.* 1922; 33:189.
13. Elsberg CA. Puncture of the corpus callosum with special reference to its value as a decompressive measure. *J Nervous Mental Dis.* 1915; 42:140.
14. Greenblatt, SH. *A History of Neurosurgery: In its Scientific and Professional Contexts.* New York: Thieme; 1997. p. 625
15. Wilkins, RH.; Wilkins, GK. *Neurosurgical classics II.* Park Ridge, Ill.: American Association of Neurological Surgeons; 2000. American Association of Neurological Surgeons; p. xii
16. Magendie F. *Recherches Physiologiques et Cliniques sur le Liquide Cephalo-Rachidien.* Paris. 1842

October 9, 1911.

Operation,

Dr. Cushing,

Ether (Davis)

Ventricular Punctures. Attempted Colossal
Puncture.

It had been intended in view of the puncture of October 7th which disclosed a slightly distended right ventricle to do a cerebellar decompression on the view that the ventricular hydrops was brought about by some subtentorial lesion. It was determined on talking the matter over with Professor Pfeiffer to attempt a colossal puncture. Under ether anaesthesia a small opening was made to the left of the median line near the longitudinal sinus. The opening was enlarged to about 3 X 2 cm. The dura was opened and the brain was slightly drawn away from the falx and a straight ventricular needle introduced to a distance of 6 cm. where it met with a slight amount of blood stained fluid. It very possibly did not enter the third ventricle.

Fig. 1.

Cushing's typed operative note, describing the "Colossal Puncture" performed in case 1.

Fig. 2.
Cushing's original illustration documenting the operative approach in case 4.

Table 1

Demographics, operative description, and post-operative outcomes for 7 patients with hydrocephalus treated with puncture of the corpus callosum by Dr. Harvey Cushing, at the Johns Hopkins Hospital.

Case No.	Age	Sex	Diagnosis	Surgery Date	Procedure	Outcome	Cause of Death
1	20	M	rt cerebral hemisphere tumor	10/9/1911	"attempted colossal puncture"	unimproved	unknown
2	20	M	pineal gland tumor	3/5/1912	"callosal puncture, enlargement of the original opening made at Kocher's point of election for puncture of the right ventricle"	improved	unknown
3	39	M	cerebellopontine tumor	3/20/1912	"puncture of corpus callosum"	improved	unknown
4	8 mo	M	hydrocephalus (idiopathic)	3/23/1912	"callosal puncture"	unimproved	unknown
5	23	M	cerebellar tumor	4/29/1912	"attempted callosal puncture"	dead	possible sepsis
6	34	M	cerebral tumor	5/7/1912	"calossal puncture"	improved	no follow-up
7	47	F	cerebellar tumor	7/18/1912	"puncture of the corpus callosum, right"	not improved	no follow-up