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Historical Review

John Edwin Scarff (1898-1978) and endoscopic choroid plexus coagulation: A historical vignette

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Abstract

John Edwin Scarff (1898-1978) was one of the pioneers of neuroendoscopy and the head of the Department of Neurological Surgery at Columbia University in New York from 1947 to 1949. In this article, we highlight the pioneering and longstanding efforts of John E. Scarff in support of endoscopic choroid plexus coagulation. These efforts represent an important part of the rich history of neuroendoscopy and a legacy to which the current procedure owes a great credit.

Key Words: Choroid plexus, coagulation, endoscopic, hydrocephalus, Scarff

History of neuroendoscopy is the history of ingenious neurosurgeons and the innovative procedures and tools they developed.[7] John Edwin Scarff (1898-1978) [Figure 1] was one of the pioneers of neuroendoscopy and the head of the Department of Neurological Surgery at Columbia University in New York from 1947 to 1949.[16] His work on endoscopic choroid plexus coagulation[17-24] played a fundamental role in fostering neuroendoscopy during its infancy and paved the way for an endoscopic procedure that still proves effective and sometimes indispensable in some subcategories of hydrocephalus.

Treatment of hydrocephalus during the early 20th century was an extremely difficult problem to solve. In 1918, Dandy pointed out that all operations previously described for that purpose were unsuccessful. Such futile attempts included, for instance, ligating one or both carotid arteries, injecting of irritants into the ventricles, and head compression.[2] Torkildsen's original description of ventriculo-cisternal shunt was published in 1939. He subsequently published reports of 35 cases in 1947 and 1948 in which eight operative deaths occurred. It was not until 1952 when Nulsen and Spitz described ventriculo-atrial shunting for the treatment of obstructive or non-obstructive hydrocephalus using a plastic tube and a Holter valve. This was followed by the description of ventriculo-pleural shunting by Ransohoff in 1954 and the ventriculo-peritoneal shunting by Scott, Wycis, Murtagh, and Reyes in 1955.[21]

Ever since the first endoscopic brain surgery was performed by Lespinasse in 1910,[9] neuroendoscopy never gained favor in general neurosurgical practice until its resurgence in the 1970s.[11,12] Dandy was the first to describe choroid plexus extirpation through open surgery for treatment of communicating hydrocephalus in 1918. In Dandy's original technique, a nasal speculum was used to maintain the opening in the cortex and gain access to the lateral ventricle. The entire choroid plexus of the lateral ventricle was transected and stripped from its ventricular attachment after ligating its vessels by silver clips. The choroid plexus was then removed in toto.[2]

Figure 1: John Edwin Scarff (1898-1978)

He subsequently used a Kelly cystoscope to remove the choroid plexus of both lateral ventricles[4] and later modified the device in 1938 to improve the results of the procedure.[5] In 1945, however, Dandy ultimately expressed his overall frustration with the endoscope as a surgical tool,[6,11] almost after three decades of numerous attempts at neuroendoscopy by himself and other neurosurgeons.[3,13,15,17]

Scarff was an example of persistence in following what he was convinced with, namely, the potential benefit of the endoscope in the treatment of hydrocephalic children. He continued to use the ventriculoscope he devised and improve the results of endoscopic choroid plexus coagulation despite the prevailing atmosphere of discouragement. Endoscopic choroid plexus coagulation was first introduced by Putnam[15] in 1934 and shortly thereafter by Scarff[17] who had already been working on the same problem for several months by the time Putnam published his work. Putnam was indeed convinced with the validity of the principle of Dandy's open surgical choroid plexus extirpation for treatment of communicating hydrocephalus and carried out the procedure endoscopically.[15] The surgical rationale was based on destroying the choroid plexus without removing the cerebrospinal fluid (CSF) from the ventricles,[15,19] unlike all of Dandy's procedures in which the CSF was completely evacuated from both lateral ventricles before avulsion or cauterization of the choroid plexus was undertaken.[2,4,5]

In Scarff's first publication of 1936, he described his "ventriculoscope" [Figure 2] and reported the first results of choroid plexus cauterization. He argued that the ventriculoscope enabled "rational surgical procedure with a minimum of shock which was impossible with the earlier forms of surgical intervention,"[17] referring to Dandy's intraoperative finding of "immediate operative collapse" which began with evacuation of the ventricular fluid and was later followed by death in three out of

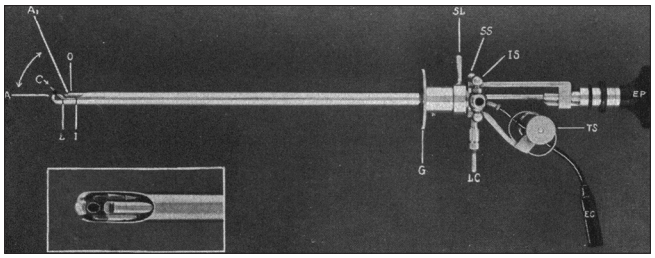

Figure 2: Scarff's ventriculoscope developed in 1935 (from [17], reprinted with permission)

four cases treated by open surgical extirpation of the choroid plexus.[2] Scarff's "ventriculoscope"[17] had somewhat different features from Putnam's "coagulating ventriculoscope"[15] which also was primarily designed to coagulate the choroid plexus. In collaboration with Frederick C. Wappler of the American Cystoscope Makers, Inc., New York, Scarff developed his original device in 1935 which featured (1) a telescope allowing for lateral and forward views; (2) a movable electrode and probe to respectively enable a wider range in the cauterization of the choroid plexus and a visually controlled puncture of the third ventricular floor; and (3) a system for continuous irrigation which enables a clear vision and a constant intraventricular pressure that prevents collapse of t he ventricular walls.[17] Scarff later developed a newer version in 1963 that was identical to the original model except that the lighting system used in the original ventriculoscope had been replaced by a fiberoptic lighting system.[24] In Putnam's device, a tiny bronchoscope light bulb at the tip of the instrument is described as the light source.[15] However, in Scarff's description of his original ventriculoscope, no full detail of the light source is provided and only a mention of connections leading from the instrument to the source of illumination can be found.[17] On the other hand, in his description of the newer version of the ventriculoscope, the light source for illuminating the ventricles was a pair of interchangeable 150-W light bulbs with integrated reflectors housed in a separate light supply unit placed a short distance from the operating table. The beam of light was conducted to the ventriculoscope by optical glass fibers. The light delivered into the ventricles was cold light with an intensity 10 times greater than that of the original ventriculoscope.[24]

Notably, in Scarff's publication of 1936 and indeed to his credit, perforation of the floor of the third ventricle for the relief of noncommunicating hydrocephalus was reported for one case using the instrument that he devised originally for choroid plexus coagulation.[17] This was the second report of endoscopic third ventriculostomy after the procedure was described for the first time by Mixter in 1923.[12] Although some neurosurgeons including Scarff and Putnam continued to perform neuroendoscopic procedures, the vast majority never attempted these

operations owing to the high mortality rates and technical difficulties, especially poor magnification and illumination. The advent of ventricular shunting in the 1950s further decreased the need for endoscopy. However, in 1978, Vries used a fiberoptic endoscope to perform endoscopic third ventriculostomy and was able to show that the procedure was technically feasible. A dramatic surge of using the procedure for treating hydrocephalus took place in the 1990s after Jones and colleagues published their results in the year 1990 and reported a 50% shunt-free success rate of endoscopic third ventriculostomy in 24 patients with various forms of hydrocephalus and the subsequent work in 1994 by the same group in which an improved success rate to 61% in a series of 103 patients was reported.[12]

The first series of endoscopic choroid plexus coagulation procedures by Scarff consisted of 20 cases operated before World War II between the years 1934 and 1942. These cases were reported initially in 1942, with subsequent progress reports in 1952, 1959, 1963, 1965, and 1966. His second series consisted of 19 children operated after World War II between 1946 and 1952. They were reported initially in 1952, with subsequent follow-up reports in 1959, 1963, 1965, and 1966.[18-23] In the first series, 50% of operated children survived 5 years or longer, with an average survival of 18 years. In the second series, 80% of children survived 8 years or longer, with an average survival of 13 years. In both series, long-term survival was achieved without revision surgeries once satisfactory bilateral cauterizations of the choroid plexuses had been accomplished. The intellectual development of the 19 long-term survivors in the two series varied widely. Ten children (50%) achieved good or at least satisfactory intellectual development with some going to college or finishing high school. On the other hand, three children were attractive and socially well-adjusted but moderately retarded, and could never get beyond the third grade in school. The remaining six were severely retarded.[24]

Analyzing his results in 1970, Scarff pointed out that the reduction in the operative mortality rate, from 15% in the first series to 5% in the second series, reflected an increased familiarity with the ventriculoscope, improved operating techniques, and a more critical selection of cases. For instance, he stressed that during cauterization of the choroid plexus, the cautery tip should always be moved repetitively while in contact with the superficial portion of choroid plexus and never be pushed into it to avoid plexus tearing and bleeding. In addition, the strength of the cauterizing current must be appropriate so that the plexus is whitened and not blackened and adherent to the cautery tip.[24]

The development of endoscopic choroid plexus coagulation by other neurosurgeons spans a large part of the 20th century. In 1957, Feld successfully treated 9 of 14 hydrocephalic children with endoscopic cauterization of the choroid plexus.[8] In 1986, Griffith[10] adopted the technique that he performed using a rigid endoscope and obtained a success rate of 49%. Bucholz and Pittman[1] cauterized the choroid plexus using a neodymium: YAG laser transmitted through a flexible quartz fiber. In 1995, Pople and Ettles[14] reported a large series of 156 choroid plexus coagulations in 116 patients with an overall long-term control of hydrocephalus in 35% of cases. During the late 1990s to early 2000s, advances in neurosurgical technology, anesthesia, and intensive care enabled safer endoscopic choroid plexus coagulation.[31] Combined with endoscopic third ventriculostomy, choroid plexus coagulation was revived by Warf and coworkers who reported their experience in African children through a large number of publications starting in 2005.[25-29] The success rate for combined ETV and CPC was 66% for those younger than age 1 year and 80% for those older than age 1 year.[25,30] The technique, therefore, was found to be an appealing alternative to shunting in children with hydrocephalus caused by various etiologies in developing countries with limited facilities and resources.[30] The broader impact of this technique in the developing world will rely on demonstrating its success when implemented by other surgeons in different patient populations and the extent to which this treatment paradigm is ultimately adopted.[30] In addition, choroid plexus coagulation is currently considered a well-established surgical treatment for hydrocephalus caused by CSF overproduction as in cases with choroid plexus hyperplasia.[31] With the well-known fact that CSF is not totally produced by the choroid plexus and is contributed by the ventricular lining as well as the interstitial space of the brain, it can be understood why choroid plexus ablation alone is not universally successful in treating many cases of hydrocephalus. Moreover, this has clearly allowed other surgical options like endoscopic third ventriculostomy and shunting to be utilized since they proved more effective in treating the vast majority of cases.

In this article, we highlighted the pioneering and longstanding efforts of John E. Scarff in support of endoscopic choroid plexus coagulation. These efforts actually represent an important part of the rich history of neuroendoscopy and a legacy to which the current procedure owes a great credit.

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