Neuroendoscopy
Spyros Sgouros
Editor

Neuroendoscopy

Current Status and Future Trends
In June 2009, I had the pleasure and honor of hosting the 5th World Congress of Neuroendoscopy in Athens, Greece, under the auspices of the International Federation of Neuroendoscopy (IFNE). The luxurious surroundings and the classical elegance of Hotel “Grande Bretagne,” a place synonymous with the history of modern Greece, provided the perfect setting for a rich scientific program, full of innovative ideas, which covered all the aspects of neuroendoscopy. Colleagues from all over the world brought their best work and their most spectacular endoscopy videos and shared them with us all. The social program included a fantastic classical guitar concert by the neurosurgeon Dr. Alvaro Cordoba, who is in fact an accomplished classical guitarist giving concerts in some of the biggest music halls worldwide. Under the heavy shadow of the Acropolis monument, in the courtyard of the first building of the University of Athens, circa 1837, Dr. Cordoba held our breath with his amazing sounds. The Congress was closed with the gala dinner, which was held at the Zappeion Megaron, the place where the ascension treaty of Greece joining the European Community was signed.
This book contains the keynote lectures of the Congress. Each main topic was covered conclusively by a renowned neurosurgeon considered a world authority on the subject. Having listened to these lectures during the meeting, I considered appropriate that they should be collected in a book, which will identify the state-of-the-art standard in neuroendoscopy, at the end of the first decade of the twenty-first century.

I hope that the reader will enjoy reading this book, as much as I enjoyed compiling and editing it.

Athens, Greece

Spyros Sgouros
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It is a great honour for me to give the laudation on Professor Axel Perneczky, laureate on occasion of the Vth World Congress of IFNE. I hope to succeed in conveying his human and professional dimension. I am well aware that such attempt will fall short of a true reflection.

Professor Axel Perneczky was born November 1, 1945, in Krasnogorsk, Russia, near Moscow (Fig. 1.1). From 1946 to 1965, he lived in Budapest and started studying medicine at the University Medical School of Budapest in 1964. In 1965, he left for Austria and continued his medical studies at the University of Vienna. After graduation from medical school at the University of Vienna in 1971, he spent 2 years at the departments of general surgery and traumatology. In 1973, he started training in neurosurgery at the Neurosurgical University Department in Vienna with Professor Kraus. Because of his very early interest in microsurgery and surgical anatomy, he spent 1 year with Professor G. Yasargil as assistant surgeon in Zürich. In 1980, he became Associate Professor for neurosurgery in Vienna under Professor Koos. In October 1988, he was elected and appointed Professor of Neurosurgery and Chairman of the Neurosurgical Department of the Medical School, University of Mainz, Germany.

His main fields of activity were microsurgical anatomy and the implicating surgical strategies in neurosurgery, aneurysm and angiooma surgery and skull base surgery with special consideration of the cavernous sinus. The development of microsurgical strategies resulted in a further refinement of surgical technique, and so since 1989, he was working on the application of endoscopy in neurosurgery. A special technique has been developed for the extended use of the keyhole strategy. He organised the “First International Congress on Minimally Invasive Techniques in Neurosurgery” (Wiesbaden, June 1993), and he was the Editor in Chief of the International Journal of Minimally Invasive Neurosurgery (MIN). Hands-on courses on microsurgical planning and neuroendoscopy were held six times per year in Mainz and Tuttlingen. He has been the President of the 1st International Congress on Endoscope-Assisted Microsurgery in June 1998 in Frankfurt. During the last year, his interest was focused on the intraoperative imaging modalities used for surgical planning and navigation.

His published scientific contributions count more than 250 papers. He is co-author of the Colour Atlas of Microneurosurgery (Thieme, 1984 and 1993) and Endoscopic Anatomy for Neurosurgery (Thieme 1993); he is also the author of the book Keyhole Concept in Neurosurgery including Endoscope-Assisted Microsurgery (Thieme 1999).

A new centre for “Minimally Invasive Neurosurgery” at the University of Mainz is now
under construction, including a special concept for development and application of new concepts and technologies in the neurosurgical operating unit with special innovation in intraoperative visualisation and imaging.

We remember his passion and brilliance as member of the “Skull-Base-All-Stars” band playing jazz guitar. Gifted with talent beyond neurosurgery, we remember him as a painter and last but not least as a sportsman on the tennis court, in the swimming pool and skiing snowy mountains.

Professor Axel Perneczky had a brilliant career in academic neurosurgery, devoting himself to solving many of the problems that existed with microsurgery and neuroendoscopy. He took a truly intellectual approach to these problems, starting with basic laboratory work, devising ingenious surgical methods, carefully applying new concepts and a new technique to previously unmanageable neurosurgical problems in patients and doing all of this with the kindness, compassion and consummate skill of a great physician and surgeon. No one who has met him and has read his writings could not fail to feel a growing respect for his wide knowledge, his directness and his broad cultural background.

He devoted himself to the education of young neurosurgeons; in large numbers, they are his scholars and reside worldwide.

His proposal to reconcile microsurgery and neuroendoscopy as the minimal invasive and tissue-saving procedure called “keyhole surgery” shall be connected forever with his name. He has moulded modern-day neurosurgical practice.

The minor and major setbacks and sad moments in his life did not manage to hinder this man’s work and did not influence his character negatively. He was able to control the situation and continue onward both externally as well as with his spirit.

He has given neuroendoscopy worldwide a solid reputation. We, his colleagues and the great family of former scholars are thankful and indebted. His name and his work occupy a worthy and honourable place in the annals of IFNE and a special place in our heart. World Neurosurgery has lost an invaluable teacher and a great master of neurosurgery.

**Remembrance of Dr. Philipp Bozzini**

Inventor of the Endoscopy 200th Anniversary

Before the end of the last century, there has been little interest in the endoscopic visualisation of the cerebrospinal fluid-filled cavities. CT and MRI scanning had made endoscopy almost obsolete in neurosurgery. Only very special studies on evaluating the nature and degree in intracranial hydrocephalus by neuroendoscopy were reported. Shunting procedures had overgrown surgical endoscopic technique and procedures. It would seem that endoscopy was about to follow pneumoencephalography, ventriculography and some other techniques to vanish from clinical practice.

When I started neuroendoscopy in 1985, I was convinced that it had a significant potential. The ultimate promise of the technique was the potential of the endoscope to provide a change of paradigms in certain fields of neurosurgical practice. Future applications of neuroendoscopy have the greatest potential to combine both microsurgery and endoscopy. Additionally, the use of virtual reality as a teaching tool promises a revolution in medical education techniques. The virtual clinic trains physicians to perform less invasive surgery.
without having to practise on animal models or assist other surgeons.

M.L. Apuzzo [1] wrote in 1977: “These technologies will include electronics like neuronavigation, ultrasound, robotics, lasers, and other technologies. So we can approximately attain a precise discipline which can best exploit techniques such as the endoscope. Computer systems coupled to endoscopic surgical instrumentation will make significant future advances possible. Use and incorporation of these techniques into neurosurgical procedures will depend on having access to the know-how necessary to bring these applications into the neurosurgical theatre. Problem is only a few neurosurgeons will have the time and/or the technical knowledge to be truly effective in this area. Therefore, instrument designers and computer scientists must become part with a close affiliation with neurosurgical departments involved in neuroendoscopy. Together they will provide the tools for the future of neuroendoscopy. Surgeons will provide the guidance necessary by telling instrument makers what we need and what is useful”.

We must take care not to overwhelm the surgeon with highly sophisticated surroundings which hinder his concentration. Free the neurosurgeon to his true scope to operate on. New instruments like the endo-spatula will offer access to transfrontal, pterional and posterior fossa space-occupying lesions and vascular processes.

Philipp Bozzini [2] a German-Italian physician demonstrating the “Lichtleiter” in 1806 to the Academy of Medicine in Vienna wrote: “Although our eyes can deceive us more than other senses, optical deception rarely prevents real proof of a matter. The eyes lead all the other senses, and guide their impressions to the point of conviction. Rarely do the eyes need their cooperation, and rarely can the other senses do without the eyes help. Even when the other sense of touch has already informed us sufficiently, the sense of sight is more reliable, and the more senses are focused on one object the less the latter is able to deceive us. Until now, we have completely lacked the ability to see into the inner cavities and spaces of the living body; in anatomy the scalpel taught us only about their shape, and conclusions about their functions could only be suspected. This is the main reason why our knowledge of the important laws of motion in the animal organisation is still so retarded, since no change can take place in all of nature other than by increased or decreased motion!”

From the beginning, ventriculoscopy and treatment of hydrocephalus was a domain of intraventricular endoscopy. V.D. L’Espinasse [3, 4] (1878–1946) from Chicago succeeded in carrying out ventriculoscopy with coagulation of the choroid plexus in two infants. One of the patients died 5 years after the operation. The second patient did not survive the operation for reasons that were not clarified. L’Espinasse performed the procedure with a rigid Uroscope. The lens system he used was developed in 1878 by M. Nitze [5] (1849–1906) in collaboration with the instrument builder Josef Leiter [6] (1830–1892) in Vienna, Austria. This system consisted of a metal tube and an appropriate obturator. The incandescent platinum wire light known since 1845 served for illumination. After the discovery of the electric light bulb by T.A. Edison, it could be replaced by the more effective mignon lamp at the distal tip of the endoscope.

On April 3, 1922, Walter Dandy [7] from the Johns Hopkins Hospital reported on occasion of the session of the Medical Society on two diagnostic ventriculoscopies he had carried out. Dandy described the topographic conditions in the lateral ventricles, the location of the interventricular foramen, the pellucid septum and the choroid plexus. His comment was given with discretion: “How useful operating ventriculoscopy will be can scarcely be predicted”.

Fay and Grant from the Neurosurgery Division in Philadelphia were the first to combine ventriculoscopy with intraventricular photography. Their case report from 1923 [8] showed that the suggestion to use ventriculoscopy as a means of imaging pathological lesions was already made in September 1921. Unfortunately, only line drawings of the photographs are preserved.

Fay and Grant concluded from their investigations that intraventricular photography is feasible when the ventricles are enlarged. This operation
has few complications when it is carried out according to the rules of the medical art. The diagnostic value consists in direct inspection of the ventricles and determination of the location and size of lesions in and surrounding the ventricles.

On February 6, 1923, W.J. Mixter [9] from Boston performed the first ventriculostomy in a baby with congenital hydrocephalus. The floor of the third ventricle was observed and located with a urethroscope and afterwards perforated with a flexible probe. Mixter reported that the operation was not associated with any complications. He recommended therefore ventriculostomy with perforation of the floor of the third ventricle as a means of treating noncommunicating hydrocephalus.

In his paper presented in front of the Society of Neurology and Psychiatry on May 17, 1934, Tracy J. Putnam [10] suggested that this method should be used. He concluded that characteristics such as the focal length of the lens system, the restricted visual field and the size of the endoscopes used at that time were an impediment to plexus coagulation. The coagulation manoeuvre lasted between 5 and 20 min. In one session, the plexus of both lateral ventricles were obliterated as far as possible. In 1938, Putnam presented the results of surgery with communicating hydrocephalus which had been treated by endoscopic plexus coagulation. He rated the outcome as being “overall encouraging”.

In 1935 and later, John E. Scarff [11–14] from the Department of Neurological Surgery at the Columbia University Hospital, NY, published his experiences with endoscopic cauterisation of the choroid plexus. The essential feature of his surgical technique was the permanent direct communication between the ventricle and a lavage system with physiological saline attached to the endoscope. This enabled a constant intraventricular pressure to be maintained during the operation so as to prevent a collapse of the ventricle and a potential postoperative complication associated with it. As with Putnam, the duration of the coagulation process was about 15 min. According to Putnam’s experience, the most radical cauterization had the most prognostically favourable outcome.

Of 20 babies that were operated endoscopically by Scarff, 3 babies died immediately after the procedure; 7 survived without sustained elimination of the intracranial pressure symptoms. A lasting reduction of intracranial pressure could be achieved by the operation in 10 babies. In his series from 1966, Scarff reported of a further 19 babies that he had operated on in the period from 1946 to 1951. In these cases, the results of surgery were very much better than in the first series from 1936. In 1952, Scarff concluded that this was owed to a greater routine in the application on the new method. What we call “learning by doing” or “learning curve” is coincident with Putnam and Scarff which were involved towards the problems of hydrocephalus. At the same time J.L. Pool [15] focused his whole interest into the spinal endoscope and he succeeded in the endoscopic demonstration of the cauda equina and its roots.

During the time of the Second World War and a long time after, any development in this special field of neuroendosurgery was suspended. The development of the rod lens system by Harold H. Hopkins in 1959 [16] and its installation in a Karl Storz (1911–1996) Endoscope (1965) resulted in a revolution in the field of endoscopy. The introduction of the cold light (1960) and bipolar cutting and coagulation technologies led to a renaissance of endoscopy in neurosurgery in the subsequent years.

The external diameters of the rigid endoscopes were reduced to less than 3 mm with a larger visual angle up to 70° and a ten times greater light conduction. With the introduction of the “cold light source” also by Karl Storz which replaced the Nitze system that had been used up to that time, the new endoscopic system could be optimised. This enabled an extension of the indication spectrum usual up to that time. Until today, the Hopkins lens system has served as a basis for the development and manufacturing of rigid endoscopes.

Ogata et al. [17] from Kyoto presented in 1964 a rigid “encephaloscope”. The new details of the system consisted of two components: a glass-fibre light bush and a camera system.

The external diameter of the endoscope was 3.1 mm; the length was 220 mm. The outer trocar
had a diameter of 3.6 mm. As a light conductor, 10,000 glass fibres with a diameter of 18 mm were arranged circularly around the lens. For that time, this ultrathin instrument was an excellent construction, but it was to my knowledge tested only in animal experiments.

The next step of importance in the development of the endoscopic technique and indications we owe to G. Guiot [18] from the “Centre National de la Recherche Scientifique” in Paris. He is recognised to have used the endoscope in transphenoidal approach likely for the first time. Guiot used also an external light source adapted to the endoscope and a bi-ventricular approach to the third ventricle in hydrocephalus surgery. In his series from 1973, he successfully operated on nine patients with Mixter’s technique and had no serious complications and no deaths. We should remember also the very early (1978) endeavours from Bushe and Halfes [19] to use the endoscope in para- and suprasellar pituitary space-occupying lesions.

In a technical note “Ventriculofiberscope: a new technique for endoscopic diagnosis and operation”, T. Fukushima [20] from Tokyo University (1973) described for the first time the prototype for a flexible ventriculofibrescope of which the specifications correspond to those of the flexible endoscopes used today in neuroendoscopy. The photographic documentation of ventriculoscopic operations as well as operations on cystic and solid intracerebral space-occupying lesions in 37 cases published in the Journal of Neurosurgery was of excellent quality and was a milestone in the development of minimally invasive endoscopic neurosurgery.

Very early in 1977, M.L. Apuzzo contributed to neuroendoscopy in various fields. He recognised the endoscope as a helpful complement to microneurosurgery and practised the combination of endoscopic and stereotaxic neurosurgery for the first time. L.M. Auer [21, 22] from Graz, Austria, extended the spectrum of indications using endoscopic treatment of intracranial haemorrhages and cystic brain lesions and bestowed much care upon the use of the ultrasound in neuroendoscopy.

F. Oppel and G. Mulch [23] in 1979 reported for the first time on endoscopic interventions in the cerebellopontine angle for selective trigeminal root section and endoscopic section of the vestibular nerve by transpyramidal retro labyrinthine approach in Meniere’s disease.

The utilisation of ultrathin flexible-steerable endoscopes and the miniaturisation of instruments as well as the application of laser were introduced in 1980 from DiMagno et al. [24] and Stephen K. Powers [25] from Chapel Hill, University of North Carolina.

Upon this fundament, further development could take place. So the time has come for the first synopsis in minimally endoscopic neurosurgery. H.B. Griffith [26, 27] from Bristol, UK, impresses in his overview “Endoscopic Intracranial Neurosurgery” the term endoneurosurgery.

Robert F.C. Jones [28] from the Prince of Wales Children’s Hospital Sydney, Australia, readopted the endoscopic “third ventriculostomy” in treatment of obstructive hydrocephalus. Between 1979 and 1990, he operated on 59 patients with this method. He presented the method of third ventriculostomy in detail in his paper in 1992 on occasion of MIEN II in Marburg, Germany. He specifies the indications for the procedure in detail. His description of the preoperative workup and the surgical technique, as well as the possible complications, is to be regarded as an important contribution to the state of the art in minimal endoscopic neurosurgery.

Alan R. Cohen [29, 30] performed in the years between 1989 and 1990 in Boston endoscopic fenestrations of ventricular cysts and in eight babies with obstructive hydrocephalus pellucid septum fenestration. A flexible endoscope was his instrument. For dissection of the cyst walls and for coagulation of small blood vessels, he used a monopolar dissection needle.

Kim H. Manwaring [31] from the Phoenix Children’s Hospital gave with his technical inventions and advices of the “saline torch” (monopolar RF endoscopic dissector) and the “peel-away introducer” new impetus in the development of neuroendoscopy. Besides the content of the publications (1992) mentioned above, Manwaring has also investigated the endoscopic fenestration and dissection of ventricular lesions resulting in compartmentation and septation of