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The choice of the best surgical approach remains critical despite the technological revolution

La selección del mejor abordaje sigue siendo fundamental pese a la revolución tecnológica

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Resumen

Este trabajo describe brevemente la Neurocirugía a mediados del siglo XX, en cuanto a Instrumental disponible y a los elementos de apoyo diagnóstico entonces existentes. Luego evalúa el impacto progresivo que la neurocirugía ha experimentado durante este período como resultado de la revolución tecnológica, destacando el hecho de que a pesar de estas sucesivas innovaciones, la selección del mejor abordaje quirúrgico en cada caso individual, basado en la neuroanatomía relacionada ha retenido una gran importancia.

Palabras clave: Tecnología, progreso, abordaje quirúrgico.

Abstract

Following a brief description of the state of Neurosurgery in the mid XX Century, regarding both the instrumentation as well as the means of diagnosis existent at that time, an evaluation is made of the progressive impact that Neurosurgery has experienced as a consequence of the technological revolution, stressing the fact that, despite of the successive innovations experienced during this period, the selection of the surgical approach in each particular case has retained a great importance.

Key words: Technology, progress, surgical approach.

The technological explosion which has evolved during the past fifty years has clearly changed dramatically our specialty. These advances have emerged both based on the accumulating knowledge in neuroanatomy[21] and function as well as in the advent of imaging technologies which have permitted the application of that knowledge into practice.

At the dawn of this revolution, the neurosurgical instrumentation was rather rudimentary. It included the Hudson brace, with which burr holes were made in a way not much different than the way they were made in antiquity. If a craniotomy was required, a number of burr holes had to be made bordering the limits of the planned craniotomy and then each pair of these burr holes had to be interconnected by manually pulled saw wires which were used to cut the skull along a line connecting those burr holes. By repeating this procedure between each pair of burr holes the craniotomy flap could be completed. This cumbersome procedure was compounded by the poor head support provided to the patient's head by the horse-shoe head holder, practically the only head-support device existing at that time. Because the head support thus provided was insufficient, the patient´s head had to be manually steadied throughout the procedure by an assistant.

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Hemostasis, was controlled by irrigating the operative field with physiological solution and completed with the Bovie[5] electrosurgical unit which, which although effective for that purpose, it caused unnecessary tissue damage.

The operative field illumination was provided at that time by a rather small mobile electrical lamp, that also required operating room personnel to keep it focused at the area of interest for the length of procedure.

If the removal of a particular lesion required additional exposure, this was accomplished with a spoon-spatula retractor held by an assistant. Blood or any other liquid or semi-liquid material that blurred the operative field was removed by irrigating it with physiological solution which was later aspirated through cottonoids by suction provided by a small and noisy portable pump.

Together with this instrumentation, the diagnostic armamentarium at that time was equally limited and included the use of electroencephalography, cranial sonogram, isotopic brain scan, plain x-rays ,ventriculography, pneumoencephalography and angiography, all of which, provided some gross diagnostic data, but lacked anatomical detail.

To complicate the situation further, the rather limited scope of general anesthesia then existing, together with the few available elements for patient´s monitoring demanded the shortest possible operative time. With this objective in mind, the selection of the most direct surgical approach was of the outmost importance.

In a gradual fashion, better neurosurgical instrumentation was developed to facilitate the surgical procedure and made it faster and less traumatic[7].

Steading the patient´s head during surgery, beforehand a very problematic issue, was resolved with the invention of pin head- holder units[8] while the lengthy and cumbersome craniotomy became obsolete with the development of the pneumatic cranial drill, which transformed it into a simpler and faster surgical step.

The development of self-retaining brain retractors (Leyla and others)[7,8], which could be attached to the head holder unit, provided a steadier and more reliable retraction with less potential for tissue trauma.

Operative room illumination was also improved. A larger lamp, now attached to the ceiling at the center of the operating room and supplied with light-emitting diodes that produced a better illumination with no heat radiation became the norm. Nevertheless, and in spite of these lighting advances, the use of fiber optic individual head lamps has nowadays become commonplace.

Hemostasis, although the Bovie electrosurgical unit[5] is still in use nowadays, it has been largely replaced by the Malis[13,14] bipolar forceps because of its more delicate and precise application and the significant less tissue damage that it causes.

A better quality and more reliable suction system have become an integral part of the operating room, making another positive impact on the surgical procedure.

Debulking a mass lesion, which formerly required significant manipulation, prolonged the operative time and increased the blood loss, it became more expedient with the advent of the Cavitron ultrasonic aspirator[1].

Finally the incorporation of surgical magnification, through the use of loupes or and the operating microscope[6], has brought enormous progress to neurosurgery in general and to the area of vascular pathology in particular. This advance prompted the development of specialized microinstruments and microvascular clips (Yasargil[11], Sugita) that have enabled a much better handling of aneurysms and vascular malformations.

This instrumental development was accompanied by a similar progress in the diagnostic armamentarium. The technique for angiography experienced a dramatic expansion with the appearance on the scene of the Seldinger technique which not only resulted in an improved quality of the angiographic studies with a decrease in its complication rate, but it also propelled Neuroradiology into the interventional arena. The knowledge of neuroanatomy was furthered by the development of computerized axial tomography[10] and resulted in a mayor leap forward in the diagnostic capabilities both in scope and in the anatomical detail of intracranial as well as intraspinal pathology. It was augmented by the dawn of magnetic resonance imaging[9].

Both of these diagnostic modalities have been eventually adapted for its intraoperative use in order to provide real time images with the aim of detecting any potential brain shift during the surgical procedure and also allow for the differentiation between normal and abnormal tissue, in the area of interest thus increasing the possibilities for a more complete and safer resection of intra-axial mass lesions.

Side-by-side with these advances, the quality of anesthesia has also shown significant progress both in terms of the development of newer and better general and local anesthetic agents as well as by the currently more reliable monitoring systems that ensure the patient's hemodynamic stability and airway patency throughout the procedure. This has markedly improved the conditions for the performance of vigil craniotomies[16.17] which are indicated for the surgical resection of lesions in eloquent areas of the brain, for brain stimulation in cases of Parkinson disease or for the treatment of epileptic patients refractory to medical treatment, whose epileptic focus must be precisely located and resected.

While this evolution has resulted in a progressively more effective and safer specialty, the risk of postoperative neurological deficits remains present in certain circumstances, despite of the implementation of all these advances.

Diffusion tensor magnetic resonance imaging (DT-MRI) has been successful in delineating, in the "in vivo " brain, the course of different nerve fiber tracts[2.3.4], thus enabling a more accurate preoperative planning. Nevertheless, because these nerve tracts are not visible nor identifiable under the operating microscope, they remain in jeopardy, and their unintended injury can result in unexpected postoperative deficits. To prevent this, some variations to the classical surgical approaches have been recommended.

Examples of these are the one suggested by Mahaney and Abdulrauf[12] for tumors within the trigone of the lateral ventricle, the base of skull approaches devised by Rhoton[18] or the one recommended by Sincoff et al[19] for access to the temporal horn.

Currently diffusion tensor tractography is been incorporated into operative navigation systems[2,3,4,15], an advance that, if widely implemented, could make intracranial tumor removal, of for both intra and extra axial lesions, even more complete and safer, decreasing the possibility of damage to well defined nerve fiber tracts that may be running through their vicinity.

Conclusion

In spite of all these new advances, which are undoubtedly important and significant as well as others that may became implemented in the future, the relevance of a sound knowledge of the related neuroanatomy and, based on it, the selection of the best surgical approach cannot be underestimated in our ongoing endeavor for attaining the best possible surgical result.

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