

Future Approaches to Neurological Diseases

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The incidence and prevalence of neurological diseases are constantly increasing, and their number will rise even more, due to the aging of the world population and the increased availability of diagnostic procedures.

Traumatic brain injury is one of the major causes of disability and death and requires specific prevention measures and treatment, that are out of the scope of this article [1,2].

At the same time, diagnosis of Central and Peripheral Nervous System pathologies will improve, thanks to the possibility to perform screening tests that integrated with an accurate clinical analysis will reveal the disease at the onset of symptoms. Moreover, in the future, biological tests may also become of aid in the diagnosis and follow-up of different pathological entities.

In the last 30 years, the revolution in diagnostic imaging modalities, has also contributed to a profound modification of the therapeutic approaches to brain disorders. Until the end of the last century, the localization doctrine, of Broca, according to which defined brain areas, composed mainly of gray matter, were responsible for a specific brain function, was considered to be true; however, later, recognizing the narrowness of the dichotomy between gray versus white matter brought to the conceptualization of neural networks, which were then confirmed by functional and morphological studies with fMRI [3,4].

Thanks to this discovery, neuromodulation (i.e. the activation or inhibition of different targets by specific electrical stimuli) gained increasing importance and it modified the understanding of how the brain works, subsequently leading to new therapeutic strategies for many neurological degenerative diseases, with the integration of different pharmaceutical approaches. This was particularly true for Parkinson disease in its different forms, for focal dystonia, spasticity and neuropathic pain. Furthermore, the experience of neuromodulation for mental disorders such as OCD, depression, craving, and recently, for cognitive disorders including Alzheimer disease, also showed positive results [5-8].

In the future, it is likely we will see an ever-increasing integration of treatments with combination of pharmacological and psychological therapies along with intra or extracranial neuromodulation.

Epileptic disorders treatment was also improved by imaging technological advances as well as by brain activity recording with EEG, video EEG, stereo EEG and MEG. These diagnostic improvements allowed a better selection of patients undergoing surgical resection of epileptic foci, disconnective surgery and cranial or peripheral nerves stimulation [9].

Brain tumors are a much more complex issue. For extra-axial tumors, such as pituitary region, skullbase and cerebral convexity neoplasms, new instruments such as endoscopes and exoscopes have been introduced and in the next future they will likely become routinely and successfully used in the majority of neurosurgical centers [10-14].

Although complete resection of these tumors remains the gold standard, in case of remnants or small recurrences, neuro radiosurgery is a valid option to complete the therapy. This selective or hybrid treatment has the advantage of not being limited by age or comorbidities, like surgery is.

On the other hand, for intra-axial tumors (e.g. gliomas and neuroepithelial lesions), the surgical procedure, either biopsy or partial/total removal still remains the pivotal element of the treatment, allowing for a biological characterization of the lesion. In fact, knowing the tumor genetic profile, gives more specific information about prognosis and progression free survival, leading to modifications of the overall strategy of surgery and subsequent complementary therapies. MRI spectroscopy gives some information on the metabolic asset of the tumor, but it does not allow to specify the genetic features. Fluorescence image-guided surgery helps in achieving maximal tumor resection, while intraoperative neurophysiological monitoring aids in preserving neural function during tumor removal, allowing for a better clinical outcome in patients harboring lesions in brain eloquent areas [15].

Furthermore, performing tumor resection in awake surgery is further improving the postoperative functional outcome of the patient, and it allows to widen some surgical indications.

Cerebrovascular diseases are the second cause of death in the so-called developed countries. Ischemic and hemorrhagic stroke, and arterial and venous malformations are the major challenges for these patients. The aging of the population will, again, bring more patients to the attention of the health system and ethical considerations will be the major issue when considering therapeutic options.

Neuroradiological interventional techniques are improving rapidly, modifying the course of the disease. Surgical re-vascularization procedures with simple or complex extra-intracranial or intracranial-only bypasses, are still considered a rescue therapy option, but with time and experience, they will probably become a routine and indispensable part of the therapeutic strategy for the prevention and treatment of cerebrovascular pathologies [16,17].

Finally, nowadays, non-invasive options, such as neuro radiosurgery (i.e. Gamma Knife, Cyber Knife) and focused U.S. lesioning are available: they are based on the well-established and proved knowledge that a treatment targeted with extreme precision on the pathological area may result in control of an invalidating symptom or of the growth of a small volume tumoral lesion [18-21].

In the next future, these procedures will become more and more used in patients in whom, for personal reasons or more frequently the coexistence of other severe pathologies, surgical or interventional procedures cannot be proposed for the higher morbidity and mortality risk.

In conclusion, the incidence of neurodegenerative, neurovascular and cerebral neoplastic diseases is bound to increase in an ever-aging world population, but instrumental technologies, guided by a thorough clinical analysis, may improve quality of life and therapeutic management.

“We know our birth date, we can postpone the date of our death...But this day will eventually come. Diseases may be treated, but not cancelled”.

Covid 19 is teaching us this lesson! [22].

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