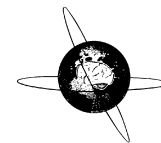




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## Letter to the Editor

### Lessons from the present: Intraoperative neurophysiological monitoring organization during the COVID-19 pandemic in Lombardy, northern Italy



Since February 21st, 2020, when the first case affected by Coronavirus Disease 2019 (COVID-19) was reported, Italy has been at the center of the global health crisis, exceeding soon thereafter the number of COVID-19 deaths in China, and the first country to lockdown in Europe.

Currently, on April 27th, 2020, 197.675 COVID-19 cases have been confirmed in Italy with 26.644 deaths (13.5% lethal rate, over 50% of the deaths occurred in Lombardy); 9.187 COVID-19 patients are currently hospitalized in Lombardy. This data makes Italy, at present, the third most affected country in the world by the SARS-Cov-2 pandemic, after the United States of America and Spain, and the second for deaths.

Within a few weeks, the pandemic has put massive strain on the national Health System, with unprecedented reorganization of hospitals; in this scenario the neurosurgical units were converted to the new COVID wards, and operating rooms were transformed into intensive care units.

Therefore, the neurosurgical network of Lombardy, that includes 26 neurosurgical departments in 21 hospitals, has been reorganized by the Regional Health System following the hub-and-spoke model. All urgent neurosurgical cases were conveyed to three hub hospitals chosen based on geographical criteria (west, central and east of Lombardy) and the capacity to guarantee 7/24 acceptance of neurosurgical emergency cases. Our neurological institute, Fondazione IRCCS Istituto Neurologico Besta in Milan was identified as a fourth hub hospital, the only one reserved for *nondeferrable* neurooncological patients coming from all the other departments of the region (Zoja et al., 2020).

For this reason, within very short time, our institute has become a strategic center for a specific type of neurosurgery that needs a highly integrated multifunctional equipment and personnel, including neuroanesthesiologists, neuroradiologists and the IntraOperative Neurophysiological Monitoring (IONM) team. Here, we outline our IONM set-up to ensure valuable and prompt support to the Neurooncological Hub activity, working both with local and guest neurosurgical teams, coming from other hospitals.

In Neuro-Oncology the role of IONM is well established. The goals include anatomical identification of neural structures especially when the lesion has caused significant distortion of landmarks and/or neuroplasticity of eloquent areas, and detection of possible damage of the nervous system while still reversible, under the purpose of maximizing tumor resection and minimizing neurological damage.

During the COVID-19 pandemic, our IONM team has been requested to be on duty supporting the neurosurgical teams coming from other hospitals, in which different experiences, methodological techniques and equipment were present. We rapidly adapted our experience to the current situation, and we think this hands-on experience should be shared as an example of possible reorganization of the IONM activities also in other countries.

We organized our activity as detailed in the flowchart (Fig. 1). The patients' waiting list was created by an *ad hoc* web-based platform, and the level of urgency categorized into 3 classes, A++, A+ and A based on level of urgency (Cenzato et al., 2020). This means a high rate of volatility in surgical schedule and plans, related to the arrivals of new cases classified as A++, or to the rapid change of clinical condition also due to possible new COVID-19 infection. In this peculiar everyday emergency state, this new organization was made operational only by an experienced IONM technician coordinator, who was full-time responsible for re-organization of the technicians and medical staff, the neurophysiological devices and instrument availability. The IONM set-up and flow-chart can be summarized in 3 steps.

The first step was the IONM plans. Every week, the surgical plan (operation room (OR) week plan) for the incoming week was created by a multidisciplinary team including the IONM coordinator, neurosurgeons, neuroanesthesiologists, administrative staff and OR coordinator. The IONM coordinator organized the IONM technicians work shift, the instrument availability related to the planned kind of IONM and the relationship with the surgical center coordinators.

The second step was the choice of IONM plan for each single case together with the local or guest neurosurgical team. Usually, IONM planning depends on the location of the lesion and the surgical approach. But different techniques are available, requiring increasingly tailored multimodality IONM plans to support the particular expectations and habits of the different neurosurgical teams. For this, a comprehensive discussion of the case between neurosurgeons and the neurophysiologist was essential, regarding the clinical history, clinical evaluation, risk of seizures and pharmacological treatments, neuroimaging evaluation and neurosurgery approach and target. We created soon a case discussion by telemedicine, which was also useful for neuroimaging sharing.

The third step was the introduction of daily video-meetings for all members of the IONM team to ensure sharing clinical cases, technical information including problems with instruments or devices, and experiences with the different neurosurgical teams in order to improve communication and management during surgery. Due the high rate of plan changes, all the team members needed to be continuously informed and ready for shift changes and case changes.

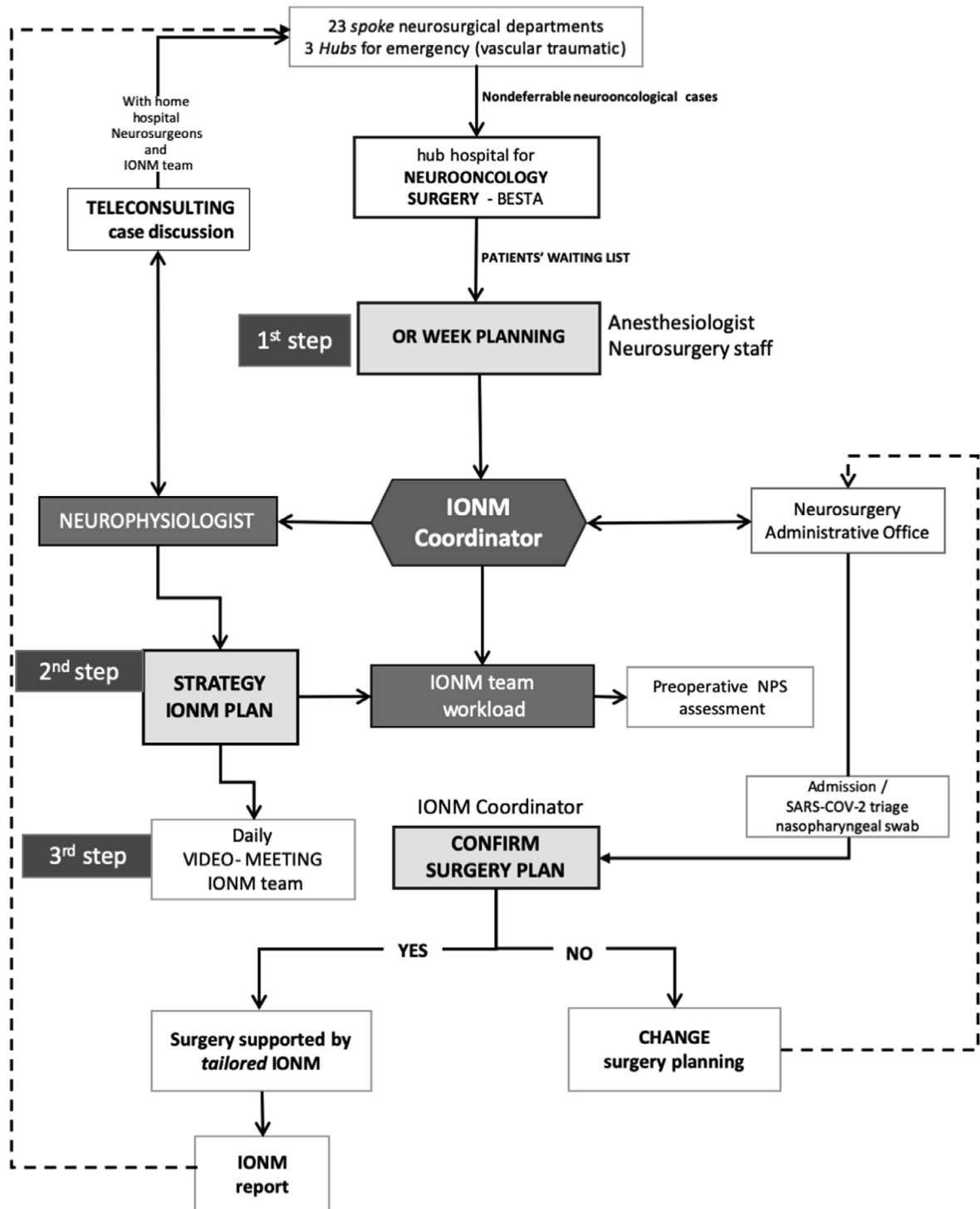


Fig. 1. IONM organization during COVID-19 emergency in Lombardy.

During the last 8 weeks, we carried out 70 IONM during surgery of A++, A+ or A cases. The described set-up allowed us to cover all the requests of IONM, despite the high rate of change in surgical plans (on average, 8 OR plan changes per week, with a total of 67 changes in 8 weeks).

The COVID-19 pandemic has created an opportunity for sharing and integration of different neurophysiological approaches, ultimately improving the overall quality of the IONM service, culture and its spread. Indeed, this experience has stimulated the idea of

a functional network set-up also for IONM activity in times when there is insufficient staff (at all levels) to provide IONM for all the neurosurgeries that may benefit from monitoring (Norton et al., 2015).

The Clinical Neurophysiological Society and the whole community of neurophysiologists are called on to play a major role in the validation of these novel approaches together with the implementation of new IONM platforms in which several neurophysiological teams can share their experience and interact in real time at a

worldwide level in the IONM field. There was a time before COVID-19 and there will be a time after COVID-19 when we should show that we have learned to share experiences and culture in a whole new way.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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