Neurosurgery and COVID-19: The International Guidelines, what Can be Done and what to Expect

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Abstract

It all started back in December 2019 from the wet market of Wuhan. Just before 31st December 2019, nobody could believe to be recalling and repeating the historical words of Marcus Terentius Varro (116 BC-27BC) as far back as 100BC for Sepsis who historically quoted as noting that “small creatures, invisible to the eye, fill the atmosphere, and breathed through the nose cause dangerous diseases” [1].

Combating with our shared invisible enemy has now challenged us to our limits. We are in it together as “one world”. We are now facing the reality of the limitations imposed by our resources, instead of directing our resources in terms of manpower and finances, now are resources are directing us to manage wisely and save as much lives as we can while no patient of ours suffer damage. but in the practical world we need a lot going on. The health sector has been an overlooked domain in several parts of the world as nobody ever predicted an unforeseen trouble in paradise.

On 31st December 2019, the World Health Organisation China office received the first reports of a previously-unknown virus behind a number of pneumonia cases in Wuhan, a city in Eastern China with a population of over 11 million [1]. What started as an epidemic mainly limited to China has now been declared a “pandemic”. Stirring the world with the immediate effect in terms of huge number of mortality and morbidity, the long term and indirect effects of this pandemic are yet to be determined.

One significant consequence of the rapid spread of the virus and the respiratory disease it causes is that hospitals have run out of resources to treat patients for which countries all around the world are deciding to practice “triage”. Hospital resources are shared and since Neurosurgery is also an Emergency field dealing with emergent and potentially emergent cases as well as patient requiring critical care, it has to take the impact and make major decisions in order to spare the shared resources in favor of the COVID 19 patients. In order to cope with this crisis, the American College of Surgeons (ACS), as well as Center for Medicare and Medicaid Services (CMS), have published guidelines for the triage, or ranking in order of priority, of surgical patients. The goal is to decrease the number of surgeries to preserve resources like doctors, operating rooms, ICU beds, etc. for the treatment of COVID-19 patients. The system has three Tiers of surgical acuity further subdividing each Tier into levels, depending on the overall health of the patient.

The ACS COVID-19: Guidance for triage of non-emergent surgical procedures and the CMS adult elective surgery and procedures recommendations

Are now available online. Elective, non-urgent spine surgery has a Tier 2 rating with a recommendation to postpone the procedure, if possible. Other neurosurgical procedures in general have a Tier 3 rating, which means hospitals and doctors should consider proceeding without delay as long as resources are available. While the degree of urgency remains a decision between a surgeon and his or her patient, it is very possible that a surgery might be rescheduled or delayed indefinitely. Some centers might continue to proceed with surgeries,
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while others might have to delay the same surgeries, depending on exactly how the epidemic is affecting their area and facility [2]. To address the conflicts and confusion of decision making and management of surgeries encompassing all the disciplines of surgery, the American College of Surgeons introduced their guidelines.

**Image 1: Tiered surgical response plan for COVID-19 (Courtesy: Journal of the American College of Surgeons).**

### Guiding principles

- The goal is to provide timely surgical care to patients presenting with urgent and emergent surgical conditions while optimizing patient care resources (e.g., hospital and intensive care unit beds, personal protective equipment, ventilators) and preserving the health of caregivers.
- There is no substitute for sound surgical judgement.
- Procedures and operations should be performed if delaying the procedure or operation is likely to prolong the hospital stay, increase the likelihood of later hospital admission, or cause harm to the patient.
- Patients who have failed attempts at medical management of a surgical condition should be considered for surgery to decrease the future use of resources
- Multidisciplinary shared decisions regarding surgical scheduling should be made in the context of available institutional resources that will be variable and rapidly evolving. https://www.facs.org/covid-19/clinical-guidance/review-committee [3].

The American College of Surgery guidelines presented a comprehensive set of instructions for management keeping in view the proper management of resources, "triage" to save as much lives as possible while providing the best possible for the patients inflicted with the ongoing Pandemic as well as breaking the chain of transmission by minimizing hospital trips by patients.

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The Society of British Neurosurgeons discussed the plan for carrying out surgeries, minimizing the number of surgeries to the ones that were urgently needed. They discussed the surgical procedures in light of the mode of transmission of COVID-19. It was discussed that since the mode of transmission does not involve blood so most neurosurgical procedures to the spine and head should be considered safe with routine face and eye protection. This includes cranial and spinal drilling, though there should be more rigorous irrigation of drills when stationary to prevent "aerosol". Care would clearly be needed with anterior skull base procedures which might breach a sinus. Endonasal procedures were of course carried a very significant risk. Use of debriders and drills within the nasal cavity cause production of droplet aerosol which is highly dangerous. This is based on the fact that in Wuhan, the ENT surgeons were amongst the worst affected victims and it should be noted here that N95 masks did not prevent infection. While the majority of pituitary patients present subacutely and surgery maybe deferred but it would be unforgivable to allow a patient to go blind during this period. With patients for whom surgery cannot be deferred, consideration should be given to alternatives to endoscopic surgery: 1. Craniotomy 2. Microscope based trans-sphenoidal surgery, with a submucosal approach and entry to the sella using non-drill techniques. Available PPE should be employed BY ALL THEATRE STAFF and care taken with.

**Image 2: The "tiered system" for surgical prioritization by the society of the British neurosurgeons.**

Thus, there has been concern about transmission nasal secretions of Covid-19 during some routine neurosurgical operations, particularly those involving drills or endoscopes [4].

**The chinese experience: How did they manage to control transmission among the healthcare providers to ‘zero’ in the largest department of neurosurgery in Tongji Hospital and Medical College, Huazhong University in Wuhan?**

In a webinar conducted by the GlobalNeuro, Prof. Dr. Ting Lei, Director of the Tongji Hospital and Medical College, Huazhing University, Wuhan shared their prompt reaction to the “first report of atypical pneumonia”. He added that since they have already struggled with an epidemic of SARS before, they had an idea of management and how serious this epidemic may be later. So their plan of action was prompt and wise that ultimately saved a disaster to be taking place in the hospital.

![Image 3: Attention of Neurosurgeons for COVID-19 Respiratory Findings (Courtesy: GlobalNeuro Webinar on Neurosurgical Response to COVID-19).](image)

The government directed designated 2 hospitals the Sino-French Friendship and the Sino-German Frendship hospital as COVID-19 patients only. The Sino-French Friendship hospital was established on 26th January 2020 and consisted of 1150 beds. It has 23 national teams to look after the patients. The Sino-German Friendship Hospital was established on 6th February 2020, consisting of 830 beds and 17 national teams were appointed for it. To deal with Neurosurgical emergencies 40 doctors and 86 nurses were appointed and the following plan was given.

The level of PPE are described as follows.

While the incidence is declining and Wuhan has been reopened with return of surgeries to be back to normal, there is another threat of causing the re-emergence of infection.

The experience of Lombardy, the epicentre of COVID-19 in Italy

Prof. Marco Maria Fontanella shared his impeccable management while the province was undergoing the worst emergency of receiving COVID-19 patients. It is to be mentioned that the mortality rate in Italy from COVID-19 has been the highest among all the countries
**Personal Protective Management (Tongji Hospital Standard)**

**Protection Level** | **Scope of Application** | **PPEs**
--- | --- | ---
**LEVEL I** | In low exposure risk zones (Clean zones):  
- Health care workers without direct contact with the COVID patients, such as: sample delivering workers, administrative officers | · Disposable surgical cap  
· Disposable surgical mask  
· Work uniform  
· Disposable latex gloves  
· Disposable isolation clothing if necessary

**LEVEL II** | Contaminant zones: including fever clinic, isolation ward area including ICU  
- All the staff who possibly direct contact with the suspected/confirmed COVID-19 patients and their body fluid  
- Sanitary workers in contaminant zones including ones for surgical instruments cleaning | · Disposable surgical cap  
· Medical protective mask (N95)  
· Work uniform  
· Disposable medical protective uniform  
· Disposable latex gloves  
· Goggles  
· Face protective screen sometimes

**LEVEL III** | For all the invasive procedures:  
- Tracheal intubation, tracheotomy, bronchoscopy, gastroenterological endoscope, etc., during which, the suspected/confirmed patients may spray or splash respiratory secretions or body fluids/blood  
- When the staff performs surgery and autopsy for confirmed/suspected patients  
- When the staff carries out NAT for COVID-19 | · Disposable surgical cap  
· Medical protective mask (N95)  
· Work uniform  
· Disposable medical protective uniform  
· Disposable latex gloves (Doubled)  
· Full-face respiratory protective devices or powered air-purifying respirator

**Image 4:** PPE Levels as proposed by the Tongji Hospital Standard (Courtesy Global Neuro Webinar).

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hit by the virus while the healthcare system of Lombardy is considered one of the best in Europe. The first COVID-19 patient was reported on 21st February 2020, in 3 days the cases rose to 221 and by 1st March the cases were 1337 and rose to 115,242 on 2nd April with an unfortunate 13,915 number of fatalities. The Lombardy Regional Council called an emergency task force in order to reprogram. Lombardy has 26 neurosurgical departments in 21 hospitals with > 200 neurosurgeons and 40 residents in training. All urgent outpatient activities had to be suspended. It has been decided to remodel the hospital treatment system by identifying three neurosurgical hub hospitals where to concentrate on all the neurosurgical activities that could not be postponed, three hub hospitals guarantee 24/7 acceptance of emergency cases. The three hospitals have been chosen on geographical basis covering roughly 1/3 of Lombardy directory divided in western, central and eastern all of the other departments have been assigned to one of the three hubs as “spokes”. The hub hospitals for emergencies must have neurosurgical team, trauma team, ICU beds dedicated to neurosurgery, stroke unit and endovascular unit with 24/7 coverage allowing to handle all the urgent pathologies. The on duty neurosurgeons were doubled. The on call service for specialist in spinal surgery and one in vascular surgery has been set up. Two emergency rooms for covid positive and covid negative should be always available. The 4th hub hospital, the regional neuro oncological center has been disposed off for urgent on oncological patients coming from all other departments of the region. The following clinical situations have been defined as neurosurgical emergencies 1. Cerebral subarachnoid and intraparenchymal 2. Acute hydrocephalus 3. Spinal cord compressions with neurological deficit or at risk of 4. Traumatic cranial and spinal trauma emergencies tumors at risk of intra cranial hypertension.

Patients may access the hub in two ways by primary or secondary transport.

Primary transport configures when the access is direct into the hub from the territory the patient is evaluated by the neurosurgeon on duty a COVID-19 swab and a chest xray is routinely carried out.

*Image 5: Dealing with oncological pathology=The priority criteria practiced in Lombardy (Courtesy GlobalNeuro Webinar).*

Secondary transport: The patient is evaluated at the “spoke” department if considered an urgent case he/she is is centralized to the hub hospital after the execution of a swab and a chest xray for COVID-19.

Prof. Fontanella concluded that as we are practicing in weak economical regions, we need to know the importance of epidemiological measures in order to decrease the possibility of health resources exhaustion especially PPE for emergency surgery and ICU equipment for postoperative care. We, as Neurosurgeons, need to understand very well that we are a “team players” inside the pandemic dynamics and we can be confronted by many situations with our regular status of practice. We need to activate our brains in disaster medicine mode. We are not in an ideal world of infinite availability of tests for everybody. That situation makes our practice more dangerous and we need to consider a possible postove case every one of our emergency surgery cases (trauma, vascular, oncology...).

The Mount Sinai strategy
As the neurosurgery community grieves at the untimely demise of the Ace Neurosurgeon Prof. James T Goodrich, the New York city suffers from the worst ever nightmare that can only be found in one of the fictional novels and a few Hollywood movies. The surgical strategy remains the same as discussed above. The following few points were added for COVID-19 positive patients by Prof. Joshua Bederson, Professor and Chairman of Neurosurgery at the Mount Sinai Health System in the New York city.

The tiered staffing strategy was described. The neurosurgeons have adopted the role of ICU APP.

The Korean strategy
They introduced the following strategical methods of visit control and procedure protection.

Image 7: The vitals and settings are all noted on the glass walls of the designated ICUs in Mount Sinai, New York (Courtesy: GlobalNeuro Webinar).

Image 8: Negative ventilation is applied in the neurosurgical department to suck air for neurosurgeons, keeping track of the ICU patients vitals and settings and the ingenious use of extra long tubing at Mount Sinai New York (Courtesy: GlobalNeuro Webinar).

Everyone who enters the hospital should have
In visit control:
1. Temperature recorded
2. History taken

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3. Given a mask
4. Restrict movement (close certain passages)
5. Minimize contact.

Procedure protection:
1. Intubation (Risk if aerosol) that should be by the most skilled physician with videoscope assisted level D + PAPR.
2. Invasive procedures: Central line insertion, chest tube insertion, cricothyroidotomy, ICP monitoring probe insertion. These should be done wearing personal protective equipment + surgical gowns.

Image 11: The Korean Experience Based Suggestions (Courtesy: Global Neuro).

The Cambridge plan
Prof. Peter Hutchinson discussed the categorization for the management of neurotrauma.

Image 12: Categories of Neurotrauma patient attendance to be considered as per Cambridge to be in recent circumstances (Courtesy: Global Neuro).
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He described the patients that will benefit from admission to major trauma centre/neurosurgical centre as the ones having “easily reversible conditions” such as extra-axial hematoma (extradural/subdural) with mass/clinical effect. He further added the referral of diffuse injuries to an MTC neurosciences centre for advanced monitoring as normally done will be considered “relatively limited” if the resources are “extremely limited”.

The threshold for intervention should change with the availability of resources. Many cranial and spinal injuries can be managed conservatively. It should be noted that the condition should still be managed and may require joint working between local non-specialist and MTC specialists. The communication maybe done using telephone or by telemedicine.

**Image 13: Management plan for cranial and spinal injuries as per Cambridge guidelines (Courtesy: GlobalNeuro).**

Prof. Hutchinson summarized the challenges as provision of safe surgery with a need of PPE, testing, maintaining core surgical practice and re-deployment

**The role of COVID NeuroOnc COVIDSURG and lotus**

Prof. Hutchinson discussed the important roles being played by the following programs.

**The ace of neurosurgery we lost, a void that cannot be filled**

COVID-19 has cast an irreplaceable loss of several Neurosurgical mentors. Losing a mentor is a multidimensional loss that affects the patients, the future neurosurgeons and the ongoing research and education that leads to the growth of Neurosurgery. The sad demise of Prof. James T Goodrich has left a void that is hard to be filled. We have lost Prof. Li Wenliang, Prof. Robin Paul Humphrey, Prof. Hugo Diez Perez, Prof. Jorge Chica and Prof. Jeanne Winakto to COVID-19 as well.

What we have learnt?

As Prof. Franco Servadei has stated, it is the beauty of Neurosurgery that we can help out the other specialties suspending our own work for some time. We have learnt to manage our cases in the hour of crisis and we have explored our potential to transform ourselves to deal with non-neurosurgical cases. We have learnt that we need to be prepared for any unforeseen disaster and we should work in unity. We should always take proper precautions and train the team members to deal according to the ongoing crisis and manage according to the available resources.

To err is human

We may have taken a delay to take the proper steps to avoid what we are facing now following the epidemiological principle of “nipping the evil at the bud”. Even the, we have enough to learn from the mistake and should now create a strategy to deal with such crises. Still there is lack of supply of proper PPE to the healthcare professionals and their ignorance in part of the management in the proper care of the selfless healthcare staff serving day and night delivering that best possible they can to the patients.

Leading under crisis

The un-predicted crisis might have shaken us all but we need not to be stirred but assume our roles and lead our communities. People do have lots of questions, and we all need to let go of our egos of not knowing the answers as of course it is the truth, nobody has got answers to most of the questions related with this new global condition. The only solution to get over this amalgamated state of despair, confusion, apprehension, anxiety and helplessness is to follow a few basic rules of the implementation of crisis management policy and plans.

The Harvard Extension School for Developmental Studies declared it a state none of us is really prepared for so it’s assumed to be a deeply frightening, potentially traumatizing psychological and highly disruptive economic event. While it is expected to be dealt with as a single “Integrated Problem”, we actually have to deal with “two contagions”, the virus itself and the psychological impact he has caused. To deal with this, you have to step up the right way and make a position and identity to be recognized to lead your people. You need to identify the chaos and analyze your given conditions. Try to explore the capabilities of the people around you while you allay their anxiety and stress.

For the leadership to be effective you need to have people in your team that understand your key values people and your goals.

The downstream impacts

The crisis communication

Image 21: Crisis communication (Harvard extension school guidelines).

Image 22: Crisis communication framework continued (Harvard extension school guidelines).

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Welcome to the new world, time to recalibrate your strategy

A special reference to the viability of virus on surfaces

A matter of great concern for the neurosurgeons since several items being used in practice are made up of steel, copper and plastic. Plus the WHO declaration of aerosolized spread requires the healthcare providers to take extra precautions for aerosol transmission. The idea of Negative Pressure Ventilation is very impressive in such conditions.

Conclusion

In this given article we have explained all the possible guidelines by the leading institutions of the world regarding the management of neurosurgical cases during this COVID-19 pandemic. We strongly emphasize in the provision of proper PPE for health care providers and we want to enlighten the proper diversion of resources in a way we are certain we are true to our Oath of “do no harm” while saving
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as many lives as we can. These guidelines are still evolving and it is too early to say what is the most important point and which one is the best. The beauty of medicine is its dynamic, fluid, ever evolving nature:

- “Like a river that gives water to the thirsty and takes people where they want to go”.
- “Like a river which understands that it must learn to flow differently over waterfalls and to rest in the shallows” (Paulo Coelho “Aleph”).
- “All you have to do is to pay attention; lessons always arrive when you are ready, and if you can read the signs, you will learn everything you need to know in order to take the next step” (Paulo Coelho “The Zahir”).

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