Neurosurgical Forum

LETTERS TO THE EDITOR

Vitamin D supplementation in neurocritical patients

TO THE EDITOR: Vitamin D is a steroid hormone that is involved in multiple physiological and pathological events. In pathologies such as arterial hypertension, cancer, and infectious diseases, its protective role has been determined. Serum levels of vitamin D (particularly lower than normal values) have been explored to consider its role as a potential biomarker in clinical practice. Karsy et al.[1] provide an important insight into the supplementation of vitamin D and clinical outcomes in a neurocritical care unit (Karsy M, Guan J, Eli I, et al: The effect of supplementation of vitamin D in neurocritical care patients: RandomizEd Clinical TrIal oF hYpovitaminosis D (RECTIFY). *J Neurosurg* [epub ahead of print September 13, 2019. DOI: 10.3171/2018.11.JNS182713]). Although it is generally considered a trend in increased mortality when vitamin D levels are below 28 ng/mL, no supplementation strategy has proven to be optimal to achieve the best functional levels, since the pharmacokinetic profile of vitamin D supplementation remains not fully understood.[2] In conclusion, despite the physiological evidence of the potential benefits of vitamin D, multicenter clinical trials are urgently needed to establish the real benefit of vitamin D in subpopulations of neurocritical patients.

RECTIFY is a well-designed, randomized, double-blind controlled trial and intent-to-treat analysis. The major limitation of the study is that the role of only one factor (hypovitaminosis D and its supplementation) was determined to predict outcome in a very heterogeneous population. The primary outcome of hospital length of stay (LOS) might not be a good indicator to measure, as vitamin D deficiency reflects the long-term physiology of the body. In addition, hospital stay in cases of craniocerebral conditions (traumatic event vs aneurysms vs stroke) will be different from those of spinal disorders (traumatic vs degenerative). In addition, based on apparently small subsamples, it is difficult to draw the strong conclusion of "supplementation in vitamin D–deficient neurocritical care patients did not result in appreciable improvement in outcomes and likely does not play a role in acute clinical recovery." The choice of primary outcome as hospital LOS is less relevant than mortality, and the authors do not justify this weakness of the study. The representation of nonwhite patients is very low (vitamin D3, 6.6%; placebo, 8.4%), and race was unknown/not reported in many cases (vitamin D3, 13.4%; placebo, 17.3%), which is associated with limiting external validity. It has been established that lifestyle alterations, demographics, and sunlight exposure and modulators of this have an important role in vitamin D levels on a population and individual basis.[3] How do authors interpret their data based on this information?

Another important aspect is that critically ill patients with sepsis are usually screened with random biomarkers to evaluate when to start and stop antibiotics, and supplementation with vitamin D may interfere with procalcitonin levels; however, it is not clear whether this is a correlation or a causation.[5] Hypomagnesemia is frequently observed in the majority of sepsis patients, probably because magnesium is an important cofactor for the activation of vitamin D.[4]

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Response

We thank Dr. Moscote-Salazar et al. for their insightful comments regarding the RECTIFY trial. To address their first point, we agree that some of the external validity of this study may be limited by our population as with any single-center clinical trial; however, a predominantly Caucasian population in a northern latitude, such as Utah, would be the predicted group where vitamin D levels would be endemically low and where supplementation could be most helpful.[4–7] It is likely that if vitamin D supplementation for neurosurgical clinical outcomes is not helpful here, it may not be in most other North American centers as well.

Second, regarding patient outcomes, certainly LOS is affected by the number of factors involved in discharge disposition. We anticipated this clinical heterogeneity would be balanced in treatment and placebo groups because of the design of a randomized clinical trial. Our underlying subgroups did include different subspecialties (e.g., tumor, spine, trauma); however, this would be expected in a typical neurocritical care population, and thus reflects a real-world scenario. Our subgroup analysis did not show a benefit for vitamin D supplementation in specific disease categories or clinical subgroups. Our previous pilot data suggested improvement in LOS and 3-month Glasgow Outcome Scale scores depending on vitamin D level, regardless of specific subspeciality.[2,3] Similarly, other studies included heterogeneous populations to study the role of vitamin D,[1] because vitamin D levels have been shown to be involved in multiple diseases.[8] This prior literature suggested to us that vitamin D could be useful in a variety of diseases, but this does not eliminate the possibility that vitamin D may work better in a more homogeneous population.

We did not specifically evaluate vitamin D in the context of other clinical biomarkers (e.g., procalcitonin) in neurosurgical patients, but this is an active area of interest in our group. Whether interventions could improve clinical outcomes and biomarkers could serve as a surrogate of risk stratification in neurosurgery remains to be seen.

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Dr. Dwight Parkinson's legacy

TO THE EDITOR: We read with great interest the article by Ajisebutu et al.[1] on Dr. Dwight Parkinson's profound contributions to neurological surgery (Ajisebutu A, Del Bigio MR, Kazina CJ, et al. Dr. Dwight Parkinson: a Canadian neurosurgical pioneer [published online September 27, 2019]. *J Neurosurg*. doi:10.3171/2019.6.JNS19262). The paper brilliantly covered the Canadian surgeon's legacy from his early years to his appointment as the department head and his work even after his retirement. In our opinion, the intimate details of Parkinson's biography (that only his close colleagues would be able to contribute) made the paper truly exceptional. To conclude, the paper related Parkinson's lifetime achievements to Dr. Harvey Cushing, considered the father of neurological surgery. As in our previous letter on Dr. Cushing's legacy, we would like to highlight some of the pearls and patterns of ingenuity that physicians can strive to incorporate into their own medical practice today so that his history remains relevant.[2] In this letter, we explore our perspective of how Parkinson's life exemplified the role of the physician that extends beyond the technical trade and why he might have placed a stringent importance on linguistic integrity in academia.

Parkinson retired from neurological surgery in 1981 yet remained an active researcher at the University of Manitoba until his death in 2005.[3] It is worth mentioning that he made regular contributions to the prestigious *Journal of Neurosurgery*, even during his retirement, by writing letters on topics ranging from neuroanatomy, to oxygen metabolism, to portable angiography.[4–6] This exemplifies not only his continuous fascination with neuroscience but also his lifelong devotion to expanding the wealth of neurological knowledge. His legacy stands as a reminder that any physician is first and foremost a scientist; this philosophy harnesses intellectual curiosity and advances medicine for the betterment of patients. Today, as private practices hold a much greater financial incentive than academia, we encourage physicians to treat neurological surgery as Parkinson did, i.e., as a rich heritage a surgeon has the humble privilege of contributing to, and less as a business venture. The field of neurological surgery has experienced rapid advancement during Parkinson's era and we hope that today's physicians will carry the torch even further.[7]

Parkinson's insistence on referring to the "lateral sellar compartment" and not the "cavernous sinus" illustrates his devotion to linguistic integrity. While this may seem of minor importance, we affirm that upholding the precise academic terminology is critical to preserving the foundations of medicine. For example, many hospitals prefer to use the longer term "neurological surgery" instead of "neurosurgery" when officially naming their departments and programs. Perhaps this is because "neurological surgery" reminds physicians of the origins of the surgical profession as envisioned by Harvey Cushing and encourages them to view themselves not only as surgeons but also as extended scholars of neurology.[8]

We feel that critical patterns of ingenuity underlie the specifics of a great physician's achievements and drive success for the individual and for future patients. In the case of Dr. Dwight Parkinson, we feel that today's neurological surgeons should learn from his example by fulfilling lifelong roles as physician-scientists and upholding the importance of precise linguistics in scientific discourse.

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Response

We greatly appreciate the insightful comments by Szmuda et al., which have helped to further highlight several important features about Dr. Parkinson's life and legacy. We are in agreement that the pursuit of neuroscientific and other medical knowledge should remain at the forefront of the neurological surgeon-scientist's mission. Moreover, one cannot advance without also acknowledging and incorporating the many important lessons and experiences drawn from our predecessors, including stylistic features (such as linguistics) that permeated the surgical culture of Parkinson's era. We believe our paper has humbly captured the spirit of these elements that Szmuda et al. have nicely summarized in their letter.

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Clip, clip, pass: real-world data and middle cerebral artery aneurysms

TO THE EDITOR: We read with great interest the timely and provocative article by Berro et al.,[1] an exciting work that provides important and novel evidence in support of the conclusion that middle cerebral artery (MCA) aneurysms are and should remain surgical lesions (Berro DH, L'Allinec V, Pasco-Papon A, et al: Clip-first policy versus coil-first policy for the exclusion of middle cerebral artery aneurysms. *J Neurosurg* [epub ahead of print September 20, 2019. DOI: 10.3171/2019.5.JNS19373]).

By leveraging established "clip first" and "coil first" protocols at sister institutions, applied to paired series of consecutive patients, the authors have executed a clever study design that functions as a form of surrogate randomization. The benefits of this approach are apparent in the "intention-to-treat" analysis, which provides real-world data that allow practical conclusions to be drawn within a relatively rigorous statistical framework.

The authors have posed the question, "Does an institution that practices a clip-first policy achieve superior clinical outcomes to one that practices under a coil-first policy, allowing for clinically determined crossover between techniques in rare, appropriately selected circumstances?"

The answer is a compelling *yes*, supported in their study by evidence with a higher degree of reliability and certainty than essentially all preceding observational studies and in alignment with the highest-quality evidence from clinical trials in this space—including the Barrow Ruptured Aneurysm Trial (BRAT).[3–5]

The study also highlights two vulnerabilities of endovascular coiling as a primary modality for MCA aneurysms. First, the alarmingly low rate of complete radiographic occlusion in the endovascular group (31%) demonstrates that a large fraction of patients with coiled MCA aneurysms remain exposed to an unacceptable risk of rupture or rebleeding. Additionally, patients who underwent coiling were also significantly more likely to require retreatment and were therefore subject to the intrinsic risks of two procedures, the second of which was markedly higher risk, as a repeat intervention.

Although neurosurgery is evolving beyond rigid "clip/coil first" policies, we have learned that the safer default treatment for patients with MCA aneurysms is clipping. As such, the findings reported by Berro et al. provide a key ballast against the concerning trend we have noted—particularly in Europe—of centers adopting universal coil-first postures toward intracranial aneurysms, independent of location, morphology, or other predictive factors. This attitude is informed in part by a 2018 Cochrane review, which argued that patients with favorable hemorrhage grades should preferentially undergo coiling. Unfortunately, the evidence-based analysis reproduces the intrinsic limitations and biases of its component studies—namely, that the granularity between patient cohorts (e.g., MCA location) is inadequate.[2] This vulnerability is highlighted by numerous other analyses, such as single-center studies, clinical trials including the BRAT, and at least 2 other large-scale systematic reviews that appropriately stratified cases by aneurysm location, all of which highlighted key outcomes in clinical, radiographic, or durability domains that support the superiority of neurosurgical clipping for the treatment of MCA aneurysms.[3,5–7]

We congratulate the authors for their outstanding work, which demonstrates a creative and compelling mode for infusing clinical research in neurosurgery with additional rigor and reinforces the fundamental superiority of open clipping for MCA aneurysms.

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Response

We thank Drs. Graffeo and Lawton for their very positive comment dealing with our article. We fully agree with our colleagues' point of view: MCA aneurysms have to be preferentially treated with microsurgical clipping. This statement is not the fancy of "open" neurosurgery but is based on very robust data.[1,3] The revolution provoked by the publication of the International Subarachnoid Aneurysm Trial (ISAT) in 2005 has also had some side effects, especially in Europe. As reported by our Phoenix colleagues, the results of ISAT have been overinterpreted, and since then in many centers, only endovascular treatments are available.[2] In view of our results and those of the BRAT, this situation is not consistent and may not improve in the future: Microsurgical clipping is an excellent treatment of MCA aneurysms but only if performed by trained surgeons. It therefore seems necessary that neurosurgeons, particularly in Europe, reinvest in the practice of microsurgical clipping.

This is somewhat outside the realm of evidence-based medicine, but it is interesting to note that the "clip-first policy" center (University Hospital of Caen) was a "coil-first policy" center before 2010, as it is often the case in France. It is by noting that most of the complications of endovascular treatments have occurred in patients with

MCA aneurysms that we decided to return to microsurgical treatment. We then observed good results, which led to a complete shift to a "clip-first policy." Of course, the resumption of a vascular microsurgery activity does not happen overnight, but it does not require exceptional skills either. It is important to note that most of the surgeries reported in our article were done by the senior author (T.G.) but who was at that time a young neurosurgeon starting his subspecialization in vascular neurosurgery and that our hospital was not equipped with a microscope incorporating infracyanine green (ICG) angiography. With training, but also with the contribution of ICG angiography, the results of our MCA aneurysm clipping improved again, and if we had continued the study after 2016, it is possible that the benefit of microsurgery on endovascular treatment could have been even more significant.

Like Drs. Graffeo and Lawton, we encourage our neurosurgeon colleagues to reinvest in the management of MCA aneurysms. Each patient with this type of aneurysm, regardless of the center in which he or she is being treated, must be able to benefit from microsurgical clipping by a trained vascular neurosurgeon or at least this therapeutic option should be discussed.

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Treatment of spontaneous anterior interosseous nerve palsy

TO THE EDITOR: With great pleasure, we read the recent article by Kodama and coauthors[1] (Kodama N, Ando K, Takemura Y, et al. Treatment of spontaneous anterior interosseous nerve palsy. *J Neurosurg*. 2020;132[4]:1243–1248). They retrospectively analyzed 27 patients with nontraumatic anterior interosseus nerve (AIN) palsy.[2,3] Thirteen patients underwent neurolysis, while the remaining 14 were treated conservatively only. All patients presented with a variable degree of motor impairment without sensory disturbance. Moreover, 21 of the 27 patients experienced preoperative pain around the elbow, the shoulder, or the upper limb. All patients were initially treated conservatively for 6 months, including nonsteroidal anti-inflammatory drug (NSAID) administration and physical therapy. In the case of satisfactory partial recovery, conservative treatment was prolonged for an additional 3–6 months. Otherwise, surgical treatment was proposed. The most common intraoperative finding was the hourglass-like fascicular constriction, which seems to be a predisposing factor of spontaneous nerve palsy.[4] This morphological feature and its histopathological correlate appear to be common characteristics of a spectrum of painful neuropathies determining amyotrophy, palsy, and sensory loss, identified as neuralgic amyotrophy (NA) or Parsonage-Turner syndrome.[5,6] Even though it has been described since the 1940s, its underlying pathophysiological mechanisms remain largely unknown. NA affects mainly the brachial plexus, concerning one or a few fascicules, although more extensive involvement can be present. Involvement of the AIN characterizes the idiopathic Kiloh-Nevin syndrome (KNS).[7] Although surgical treatment of all such manifestations can ameliorate the prognosis of all forms of NA, conservative treatment is considered the first therapeutic approach, which is often based on steroid administration and physical therapy. If and when to surgically treat these patients is still unclear. Recovery from NA can be greatly variable, alternating between the acute onset of pain with its remission and palsy; however, late spontaneous recovery has also been described after 1–2 years.[5] Because of the complexity of this condition, diagnosis and treatment are still matters of debate.

We seriously appreciated the work of Kodama and colleagues, which was based on a series of patients who in great part could be considered as KNS patients. The onset and distribution of the pain, along with the identification of hourglass-like fascicular compression (noted in 10 of 13 patients), led to the inclusion of such patients within the NA group.[4] The authors should be pleased about their attempts to describe a plausible scheme for therapeutic management. However, some issues should be clarified. For example, it is unclear if the pain in the majority of patients disappeared or was still present at the time of surgery, or if there was postoperative pain variation. Pain represents a pivotal symptom in NA conditions; therefore, a possible distinction among patients with or without preoperative pain could help to create a more homogeneous group (i.e., KNS or not). Moreover, conservative management was mainly based on NSAIDs, whereas steroids appear to be the primary treatment for conservative management. Did the patients receive steroids postoperatively? This could affect the disease entity and the rapidity of recovery. While we agree with the authors' conclusions, further prospective studies with larger and more homogeneous series could deepen our knowledge about the management of such complex conditions.

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Disclosures

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Response

No response was received from the authors of the original article.

Fornix infarction

TO THE EDITOR: I read with considerable interest the article in the April 2020 issue by Choi et al.[1] (Choi HH, Cho YD, Yoo DH, et al. Safety and efficacy of anterior communicating artery compromise during endovascular coil embolization of adjoining aneurysms. *J Neurosurg*. 2020;132[4]:1068–1076). The authors provide some reassurance to endovascular surgeons who may need to impede flow in the anterior communicating artery in the course of aneurysm surgery based on their low complication rate among their 71 patients. The authors point out that one limitation of their study is that formal neuropsychological testing was not performed, however.

Regarding their only case with symptomatic cerebral ischemia, it is worth noting the infarct seen in Fig. 4 of the paper involves not only the corpus callosum but also the bilateral columns of the fornix. Acute infarcts of the fornix would account for the patient's disorientation at the conclusion of the procedure, and it was gratifying to read that symptoms resolved after 1 month.

The same infarct pattern involving both the corpus callosum and the anterior fornix was illustrated in a paper that appeared in the journal *Stroke* in 2000.[2] In that patient it was due to an atherosclerotic perforator occlusion rather than cerebral intervention, but the resulting infarct was remarkably similar in appearance. The authors of that case report described in some detail their patient's impaired short-term memory in the acute phase of the infarct, but those symptoms also improved in the following month. It is worth noting that in both of these cases with infarcts of the bilateral columns of the fornix and anterior corpus callosum that it did not result in a lasting disability, which I found surprising considering the important role attributed to the fornix in memory function. While this represents scant clinical evidence, it is at least encouraging and provides additional support for the authors' suggestion that compromise of the anterior communicating artery during endovascular intervention has a low likelihood of causing significant morbidity. However, full neuropsychological testing would have been of interest in at least this one case since lasting postoperative cognitive difficulties can be easily underestimated in an outpatient clinic visit.

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Response

No response was received from the authors of the original article.

Barrow Ruptured Aneurysm Trial 10-year results

TO THE EDITOR: We would like to thank Spetzler et al.[1] for their continued contributions to the management of ruptured aneurysms with the publication of the BRAT 10-year results (Spetzler RF, McDougall CG, Zabramski JM, et al. Ten-year analysis of saccular aneurysms in the Barrow Ruptured Aneurysm Trial. *J Neurosurg*. 2020;132[3]: 771–776). The authors of the accompanying editorials[2–4] should also be thanked for critically discussing the pitfalls of the available evidence. We also wanted to comment on the statement that "it remains to be seen whether ISAT-2 can be successfully completed."[4]

BRAT and ISAT are based on 15- to 30-year-old interventions. The relevance of past evidence to contemporary practice remains a concern. Sometimes labeled the "moving target problem," this argument against trials, if true, would leave us without access to outcome-based medical care. How else can we determine whether our surgical practice is doing good or doing harm? The alternative, to rely on "a nuanced view of individualized care based on numerous factors," as suggested by some,[3] is actually an unregulated free-for-all that allows unreliable, unrepeatable "individualized" decisions to deceptively pass for "optimal care,"[5] while we sink into unverifiable, potentially harmful surgical practices. As Spetzler et al. remind us, "Randomized trials remain the gold standard to establish best practice."[6]

The difficulty is that we must repair the boat while it is at sea. How are we to practice while waiting for reliable evidence from ongoing trials? The answer would have been obvious, had we not been trained to conceive of research as an activity distinct from patient care, and to somehow think that good medical practice could systematically be defined even before anyone really knew what to do.[7]

We have come to understand that trials can play a more immediate goal than providing long-term answers regarding what best practice will eventually turn out to be. Trials can deliver best practice immediately, especially when care is to be provided in the presence of uncertainty (as it remains for many ruptured aneurysms). Trials must be designed in the best medical interest of the participating patient.[8] The focus is not on "will we successfully complete the trial?"[4] but rather on how to optimize practice under uncertainty *now*, when confronted with the question: "How should I manage this patient?" The secondary goal of obtaining reliable data remains important, but it's just like mountains are climbed not by consideration of the far-off peaks but rather by steadily placing one foot in front of the other.

In the meantime, we must continue to ethically and seamlessly integrate randomized trials into our day-to-day neurosurgical care, as they did at the Barrow during the BRAT, for progress is possible.[9] With trial participation, in the presence of uncertainty about "best management," not only will patients be offered a 50% chance of getting the treatment that will turn out to be best (whichever it is), but also the next generation of trainees and vascular surgeons will be given an opportunity to learn and refine clipping techniques. This may be the best way to ensure that the legacies of surgical giants do not disappear.

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Response

We appreciate the eloquence of Drs. Darsaut and Raymond. We are in complete agreement. We fully appreciate the problem and look forward to their finding a solution so that clinical research to define best practices becomes the standard of care.

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The COVID-19 pandemic in Singapore

TO THE EDITOR: We read with great interest the article by Lo et al.[1] (Lo YT, Teo NWY, Ang BT. Editorial. Endonasal neurosurgery during the COVID-19 pandemic: the Singapore perspective. *J Neurosurg*. 2020;133[1]:26–28) where the authors, in line with a current diffused thinking about the high viral load found in the nasopharynx,[2] shared the local advisories in terms of preoperative COVID-19 screening and healthcare worker protection during undeferrable transnasal (TN) surgeries.

In our country, the Italian Skull Base Society recently suggested that all patients who are candidates for surgery be tested for COVID-19 with at least 2 swab tests repeated at an interval of 2–4 days, to minimize false-negative results.[3] To further decrease the risk of SARS-CoV-2 positivity, we require a strict 2-week period of self-isolation before hospital admission to our institution. Nevertheless, the risk of infection due to possible false-negative swab tests, eventual infection development after surgery, or a longer period of incubation (around 1% of patients after 14 days)[4] remains.

In this context, patient safety appears to be understressed, which deserves to be protected along with the safety of healthcare workers. In fact, the decision to perform TN skull base surgery could preclude the eventual use of continuous positive airway pressure (CPAP) for COVID-19 treatment, if needed, due to the risk of pneumocephalus correlated to high intranasal pressures.[5,6] As a matter of fact, when respiratory insufficiency due to SARS-CoV-2 is refractory to simple O_2 administration and requires pulmonary assistance, the first step is represented by CPAP use, followed by endotracheal intubation.[7] In this emergency period, characterized by wide diffusion of the virus, hospitals are at risk of running out of ventilators, as has occurred in Lombardy, Italy. As a consequence, in the postoperative period, endotracheal intubation may be the best available option for these patients developing pulmonary insufficiency, given that CPAP carries an increased risk of pneumocephalus with possible brain injury, CSF leak, and infection. In particular, the association between CPAP and pneumocephalus has been studied in obstructive sleep apnea syndrome (OSAS) patients affected by pituitary tumors (prevalence up to 46% in individuals with acromegaly).[6] Although treatment of OSAS is based on positive airway pressure, there is no consensus on how and when reintroduce positive pressure therapy after TN surgery.[8]

Furthermore, preliminary work confirms the tropism of SARS-CoV-2 for the nervous system,[9] but the question of whether a skull base bone defect with or without a dura mater defect and its eventual dimension may facilitate local viral neuroinvasion remains without answer.

Hence, we strongly suggest suspending all deferrable transnasal surgeries, at the moment. Regarding this aspect, in cases that cannot be deferred, some authors have suggested considering the alternatives to purely endonasal transmucosal surgeries, such as craniotomies and microscope-based submucosal approaches with entry to the sella through nondrilling techniques.[10]

For example, the decision-making process for the treatment of a common pituitary macroadenoma affecting optic structures should reflect the careful balance of clinical aspects, considering those with rapid visual or campimetric deterioration as undeferrable cases, and anatomical characteristics, paying attention to prevalent tumor growth direction (e.g., intrasellar, suprasellar, infrasellar with eventual bony erosion).

In addition, in COVID-19 times we feel that the decision-making process should take into account all risk factors associated with possible CSF leak (BMI > 25 kg/m^2, older age, and diabetes mellitus) that have been proven to make the local healing process longer,[11,12] ruling out the possibility of using CPAP for an eventual COVID-19 treatment in the early postoperative period (and reasonably raising the risk of SARS-COV2 neuroinfection).

In conclusion, the issue of TN surgery in the COVID-19 era involves both operator and patient safety. The "do-no-harm principle" must be followed to plan the safest surgery in patients in whom CSF leak, nasal airways and brain communication, and viral recrudescence may potentially result in harm to the patient. The right balance between the advantages and disadvantages of TN approaches and craniotomies for sellar/suprasellar and parasellar lesions must be revisited in the SARS-COV2 era, keeping in mind the potential for COVID-19 related complications.

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Response

We thank the authors of the letter for their thoughtful comments and important advice.

The primary thrust of our paper was to give some background to and recommendations for personal protective equipment (PPE) use in endonasal skull base surgery. The decision on whether to proceed with this surgery is complex and has to take into account many factors. The two main factors are the safety of the patient and safety of the medical personnel. Patient safety will entail weighing the benefits of surgery versus delaying surgery, and, if delaying surgery, defining what the possible endpoints might be, such as more ICU beds, more inpatient hospital beds, and availability of preoperative COVID-19 testing, among others, without compromising the patient's health. If we decide to continue with surgery at this point in time, what would the appropriate level of PPE be?

The considerations will include the following:

1. The local situation of COVID-19, whether it is controlled and contained, or whether it is widely prevalent. In Singapore, between February and March 2020, the situation was controlled and contained, the number of COVID-19 patients was low, and the risk assessment by the government of community prevalence, spread, and asymptomatic carriage was deemed to be low; hence, surgery was not deferred. Currently, with the explosion of numbers from foreign-worker dormitories and the presence of unlinked cases indicative of asymptomatic community spread, the risk of operating on an asymptomatic or presymptomatic COVID-19 patient is higher. In addition, hospital resources are now diverted to managing COVID-19 patients, so surgeries are still limited to emergency or semiurgent procedures only.
2. The availability of COVID-19 testing. We agree with the authors' hospital's policy of preoperative COVID-19 testing. However, this may not be available in every country due to a shortage of tests or priority given to screening symptomatic individuals rather than preoperative testing. As such, one would have to consider how to mitigate the risk of proceeding with emergency operations if COVID-19 testing is unavailable. Locally, we are indeed working toward effecting routine testing, much like what the authors report.
3. The availability of appropriate PPE. This is interlinked with preoperative COVID-19 testing and is mainly for the protection of the surgical team. However, one must be cognizant that operating on an asymptomatic or presymptomatic COVID-19 patient can place the rest of the hospital care team at risk, and not just the surgical team within the operating room.
4. The risks to patients are real and need to be weighed against the benefits of proceeding with surgery at this juncture, particularly if preoperative COVID-19 testing is not performed.

We look forward to the sharing of best practice from the international neurosurgical community as the pandemic evolves.

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Restraint is not the better part of valor

TO THE EDITOR: The helpful work of Linzey et al.[1] serves as a starting point for many of us in the neurosurgical community venturing into the social media world (Linzey JR, Graffeo CS, Wang JZ, et al. Neurosurgery and the rise of academic social media: what neurosurgeons should know. *J Neurosurg*. 2018;129[4]:1093–1097). In the section *A Cautionary Word*, the authors describe pitfalls to avoid for the prudent neurosurgeon engaging in social media, one of which is posting politically or socially divisive content. Although generally good advice, the framing of this warning is suspect. What could be interpreted as politically or socially divisive content may also be seen as the civic engagement on which our society's institutions depend.

Echo chambers are not theoretical. They affect the communities that we and our patients live in. Disease outbreaks related to vaccine avoidance promoted by online misinformation campaigns have demonstrable public health costs.[2] Misinformation arises when the voices of scientists and the medical community are diminished or self-censored in the interest of appearing "neutral" or rooted in a preference for avoiding contentious discussion. The effects of misinformation in online and broadcast media have been clearly documented in the current coronavirus pandemic,[3] a public health crisis of which the neurosurgical community is now very aware.

There is no reversing the trend of our civic lives moving increasingly online, and so too should the diverse ideas of the neurosurgical community. Many of us can offer salient and thoughtful perspectives on topics not directly related to neurosurgery. Ensuring that our public discourse is tethered to reality is a responsibility we all share. If a surgeon is willing to field the consequences, there need not be self-censorship on topics that may be difficult, yet important, to discuss.

Two American congressmen, Dr. Ami Bera and Gerald E. Connolly, wrote a letter in 2018 regarding a decision to disband the Global Health Security Agenda (GHSA) within the National Security Council (NSC).[4] They note:

> At this crucial juncture, forcing out some of our nation's most respected leaders on global health security and scaling back our investment in countering pandemic threats sends a dangerous message to our GHSA partner countries that the U.S. no longer considers global health security a priority. Given the fragmented organization of global health security responsibilities throughout the federal government, having a designated official at the White House coordinating the response is critical to an effective operation.… Saving lives from the next global pandemic starts with investing in preparedness before it strikes.

The prescience of this statement is striking. While we can only guess at alternative outcomes of a global pandemic, it would be hard to imagine a scenario where less engagement of physicians and surgeons in the civic arena, online or otherwise, would have led to a better outcome.

Dr. Sanjay Gupta's documentary *One Nation Under Stress* is an impactful example of what can be accomplished when neurosurgeons choose to engage and participate in media beyond the narrow scope of professional neurosurgical practice. Dr. Gupta addresses very politically and socially divisive topics, including ones that affect our mutual home state of Michigan, as he pries into the root causes of the falling American life expectancy, now shorter than all other major developed countries.

The neurosurgeon should contemplate the consequences of wading into controversial topics and should not be compelled to. Still, it is not a pitfall to participate in civic discourse. The idea that "restraint is the better part of valor" was originally used in jest by the vain, boastful, and cowardly knight Falstaff in Shakespeare's Henry IV, Part 1 (Fig. 1). His declaration stemmed from self-preservation and was primarily a justification for inaction. And while Falstaff was a likeable character, Shakespeare did not intend for him to be an example. Remaining inert can at times be considered a virtue, but as Voltaire observed in the 18th century, "what most persons consider as virtue, after the age of 40 is simply a loss of energy."

FIG. 1. A picture of the knight Falstaff, with his page. "Falstaff und sein Page," 1841, by Adolf Schrödter. Public domain. Downloaded from Wikipedia (https://en.wikipedia.org/wiki/Falstaff#/media/File:Adolf_Schr%C3%B6dter_Falstaff_und_sein_Page.jpg). Figure is available in color online only.

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Response

A witty quote proves nothing.

— *Voltaire*

If we shadows have offended,
Think but this, and all is mended,
That you have but slumbered here
While these visions did appear.

— *William Shakespeare*, A Midsummer Night's Dream

We were honored to learn that our recently published primer on social media for the practicing neurosurgeon has sparked debate among our most respected colleagues, and we are grateful to Dr. Cole and Dr. Spetzler for their thoughtful interpretation of the article. Indeed, we concur with their core message. As leaders in an ever-changing medical and civil landscape that extends not just online but far beyond the reaches of clinical practice, neurosurgeons should not excessively self-censor—even in public discussions of weighty topics that are beyond the scope of our professional expertise. Notwithstanding, we would also emphasize that our recommendation was neither "self-preservation" nor "inaction" but rather prudence and sound judgment, and that our cautionary tone was shaped to be mindful of an intended readership that is potentially unfamiliar with the inherent vulnerabilities of social media.

Expressed in the more playful, erudite, literary mood preferred by the authors, while we appreciate the good-natured equivocation between our attitudes and those of the baffoonish Falstaff, we would suggest that our recommendations more closely approximate those of Friedrich Nietzsche's Zarathustra, who spake, "I love the valiant; but it is not enough to wield a broadsword, one must also know against whom. And often there is more valor when one refrains and passes by, in order to save oneself for the worthier enemy."[1,2]

Candidly, no neurosurgeon should ever fear speaking up when confronted with unambiguous wrongdoing; and yet, in reality, many more conflicts inhabit gray spaces than ones that are black or white. If our primary calling is indeed to the service of neurosurgical patients, and if "The needs of the patient come first," to borrow from Dr. William Mayo, then we are obligated to consider the potential for adverse outcomes that may be associated with alienating patients, family members, colleagues, or other members of the healthcare team.[3] This possibility is particularly emphasized, given the relatively degenerate nature of most online discourse surrounding politically contentious issues in the contemporary moment. Although in spirit, we of course agree that "Many of us can offer salient and thoughtful perspectives on topics not directly related to neurosurgery," we also note that even the most reasonable voice breaking through the echo chamber is unlikely to disabuse the trolls of their ignorance. In such circumstances, the most resonant advice for the level-headed neurosurgeon comes from George Bernard Shaw: "Never wrestle with pigs. You both get dirty and the pig likes it."

These nuances notwithstanding, we are ultimately reassured by the fundamental compatibility of our views with those expressed by Dr. Cole and Dr. Spetzler. Taken together, they provide a valuable set of core principles for public life as a neurosurgeon, online or elsewhere, guided by the archetypal traits of our specialty: clarity and independence in our thoughts, steadfastness in our morals, and poise in our judgments.

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Management of petroclival meningioma

TO THE EDITOR: Petroclival meningioma continues to pose a challenge to neurosurgeons despite an abundance of published surgical studies accompanied by editorials from pioneers in skull base neurosurgery.[1–3] The dilemma remains constant: how to balance extent of resection with the risk of cranial nerve or vascular insult. We commend Kim et al.[4] on their recent study, in which the authors advocate for a multidisciplinary approach to petroclival meningioma (Kim JW, Jung HW, Kim YH, et al. Petroclival meningiomas: long-term outcomes of multimodal treatments and management strategies based on 30 years of experience at a single institution. *J Neurosurg*. 2020;132[6]:1675–1682). The authors performed intentional subtotal resection followed by adjuvant radiosurgery. They conclude that this strategy provides for optimal neurological outcomes and quality of life as supported by their long-term outcomes.

Early experiences prior to the advent of radiosurgery prioritized gross-total resections and thus were marred by a high incidence of cranial nerve or vascular injury.[1,5] The sentiments of Kim et al.[4] are echoed by many other skull base centers opting for intentional subtotal resection to minimize the destruction of adjacent neurovascular structures and relying on radiosurgery for tumor control.[3,6,7] However, there is still a wide variety of approaches to the management of residual tumor. Institutions differ in terms of the utilization of adjuvant radiosurgery, the timing of radiosurgery, and which type of radiation is most appropriate.

Our institution prefers a maximum safe resection strategy in conjunction with a "wait and scan" approach in al-most all cases of residual petroclival meningioma. In the event of subtotal resection, we routinely perform surveillance MRI starting at 3 months postoperatively, then every 6–12 months thereafter. Residual tumor is irradiated at the first evidence of tumor growth. Atypical or malignant subtypes are irradiated within the 1st postoperative year without waiting for tumor growth.

If adjuvant radiosurgery becomes necessary, a multitude of factors must be considered to determine whether CyberKnife treatment, Gamma Knife surgery, or intensity-modulated radiation therapy (IMRT) is most appropriate. Our institutional experience with radiation and the petroclival meningioma, as at many similar centers, has been shaped by machine availability and individual preferences (Table 1). Ever since we obtained Gamma Knife capabilities, we relied on the treatment as the primary means of

TABLE 1. Outcomes and radiosurgical data on cases of subtotal resection for petroclival meningioma over the last several decades

Case No.	Age (yrs)/ Sex	Reason for STR	RD (mm)	SRS Modality	Time to SRS (mos)	Outcome	FU (mos)
Max RD <3 cm							
1	38/F	Cavernous sinus component	22	GKRS, IMRT	10, 156	GKRS for cavernous sinus component, eventual IMRT for tumor growth	281
2	47/F	Fibrous tumor, abducens nerve encasement	15	—	—	Tumor controlled	45
3	60/M	No discernable plane from brainstem	28	GKRS	3	Tumor controlled	30
4	60/M	Carotid encasement	—	—	—	Died from stroke resulting from intraop vascular injury	—
5	46/F	No discernable plane from brainstem	24	GKRS	2	Tumor controlled following GKRS	21
6	55/F	No discernable plane from brainstem, basilar encasement	22	IMRT, GKRS	13, 75	IMRT for brainstem residue, eventual GKRS for tumor growth	94
7	34/M	No discernable plane from brainstem, cavernous sinus component	25	—	—	Tumor controlled	10
8	69/F	Cavernous sinus component, hemorrhagic clival component	17	CyberKnife	12	CyberKnife for optic nerve involvement, tumor controlled	127
9	56/F	Carotid encasement, optic chiasm encasement	25	CyberKnife	6	CyberKnife for optic chiasm involvement, tumor controlled	4
10	57/F	Trochlear & trigeminal nerve encasement, superior cerebellar artery encasement	23	CyberKnife	—	Lost to FU	35
11	60/M	Staged approach, tumor too scarred from initial resection	28	CyberKnife	18	Tumor controlled	20
12	45/F	Cavernous sinus component	20	CyberKnife, IMRT	33, 137	Delayed growth after CyberKnife w/ eventual need for IMRT	133
Max RD >3 cm							
13	71/F	No discernable plane from brainstem	40	CyberKnife	2	Tumor controlled	45
14	22/F	Cavernous sinus component, fibrous tumor	49	GKRS, IMRT	2, 118	GKRS followed by IMRT for tumor growth	217
15	51/F	No discernable plane from brainstem	38	IMRT	2	Tumor controlled after IMRT	150
16	50/F	No discernable plane from brainstem	30	GKRS	96	Tumor growth controlled after GKRS	93
17	68/M	No discernable plane from brainstem	60	—	—	Lost to FU	—
18	39/M	Abducens nerve encasement	38	CyberKnife	128	Initially lost to FU, then found to have growth w/ brainstem & cranial nerve involvement	157
19	60/M	Carotid & basilar artery encasement	43	IMRT	2	Tumor controlled	11
20	60/M	No discernable plane from brainstem	33	—	—	Tumor controlled	18
21	75/F	No discernable plane from brainstem	33	—	—	Tumor controlled	16
22	64/F	Carotid encasement, cranial nerve encasement	49	IMRT	3	Tumor controlled	26
23	47/F	Clival component too fibrous for resection, no discernable plane from brainstem	32	GKRS	9	Tumor controlled	230
24	43/F	Trigeminal & abducens nerve encasement	35	IMRT	4	Tumor controlled	17
25	39/F	No discernable plane from brainstem, trigeminal & abducens nerve encasement	43	IMRT	3	Tumor controlled	46

FU = follow-up; GKRS = Gamma Knife radiosurgery; SRS = stereotactic radiosurgery; STR = subtotal resection; RD = residual diameter.

radiation for residual tumor diameters suitable for targeting. Larger volumes were treated with IMRT. Given the preferences of our radiation oncology department, CyberKnife usage became increasingly common for larger residual volumes over the years. Currently, we continue to rely on IMRT over CyberKnife in the event of large residual tumor (> 3 cm), mostly because of machine availability, and Gamma Knife if residual tumor is < 2.5 cm or geometrically favorable for targeting (circular). We prefer IMRT in cases with a dural tail that we want to treat. We favor a fractionated approach if we are concerned about recovering cranial nerve function. The majority of our cases requiring radiosurgery would undergo only one form of radiation, most within the 1st postoperative year due to atypical or malignant subtype. Seldom do cases eventually require a second form of radiation because of continued tumor growth.

There is also emerging evidence for implementing radiosurgery as the sole intervention for petroclival meningioma. Because of considerations such as age or medical comorbidities, some patients are not suitable candidates even for a staged resection. Radiosurgery has led to suitable tumor control on long-term follow-up in some of these cases,[3] although not without consequences that must be considered by the neurosurgeon. Effective Gamma Knife doses to achieve tumor control are complicated by proximity to the brainstem. CyberKnife and IMRT can have logistical constraints requiring numerous treatments across time. Further, if tumor control is not achieved by radiosurgery alone, any future craniotomy for a previously radiated tumor poses a higher morbidity profile.[8]

In conclusion, we are largely in agreement with the described evolution in approach to petroclival meningioma. The intentional subtotal approach with the possibility of adjuvant radiosurgery provides sufficient tumor control with higher rates of maintaining neurological function. This is not to say that the neurosurgeon should approach all cases with the intention of subtotal resection; gross-total resection is still possible in a number of these cases, with favorable outcomes. If gross-total resection is not possible, then resection should continue until the residual tumor becomes targetable for single-fraction radiation. We continue to advocate for a "wait and scan" approach, as a meaningful number of these patients are capable of avoiding radiation to attain long-term tumor control, and we also highlight the importance of skull base neurosurgeons having a distinct knowledge of radiosurgical principles to help guide a subtotal resection before undertaking complex procedures.

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Response

First of all, we would like to acknowledge the thorough commentary by Dr. Strickland with regard to our article. As stated in their letter, after thorough consideration of the proximity of neurovascular structures such as the cranial nerves, vertebrobasilar artery, and brainstem with the tumor, neurosurgeons should consider gross-total resection of the tumor if possible. However, if such an approach could result in a prolonged operation time and in turn increase postoperative complications,[1–3] we believe intentional subtotal resection with adjuvant radiotherapy should be initially considered. Taking into account that most petroclival meningiomas are benign in nature,[4] we advise decreasing the immediate and long-term postoperative morbidity rates by planning the surgery within safe limits.

As mentioned in our article, comparing the gross-total resection rate and postoperative morbidity and mortality rates in the early period (before the introduction of Gamma Knife surgery) with those in the late period, we found that the morbidity and mortality rates decreased in the late period, although the gross-total resection rate decreased subsequently. With appropriate adjuvant radiosurgery, we believe that subtotal resection of the tumor is not inferior to gross-total resection.

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Significance of morphology and site of origin in surgical outcome of ruptured ACoA aneurysm

TO THE EDITOR: We read with great interest the article by Ivan et al.[1] (Ivan ME, Safaee MM, Martirosyan NL, et al. Anatomical triangles defining routes to anterior communicating artery aneurysms: the junctional and precommunicating triangles and the role of dome projection. *J Neurosurg*. 2020;132[5]:1517–1528). The authors have discussed their surgical experience and outcome of 400 anterior communicating artery (ACoA) aneurysms. They have introduced 2 surgical triangles in relation to the ACoA complex. According to the authors, these triangles allow optimal access and control to be achieved during surgical clipping of these aneurysms. The authors also categorized ACoA aneurysm projection into eight 3D octants and noted that the posterosuperiorly directed aneurysms have significantly higher chances of an unfavorable outcome.

We believe that the authors have described all these details to simplify the understanding of aneurysmal morphology and to ease the surgical clipping. To achieve a similar goal, we have proposed that ACoA aneurysms can be divided into 3 types according to morphology and site of origin: junctional, fusiform, and true ACoA aneurysms. In our clinical practice we observed that 80%–85% of ACoA aneurysms arise from the junction of A_1–A_2 with the ACoA (junctional); these are mostly flow-directed aneurysms with the fundus usually directed to the contralateral side, and they are most common on the left side. Fusiform aneurysms are detected often as large to giant aneurysms, and they tend to involve one or both A_2 or ACoA perforators.[2] The third type is a true ACoA aneurysm, truly arising from the ACoA—they are usually saccular in shape.

The surgical strategy for and outcome of ACoA aneurysms changes according to their morphological type; dissection and clipping of junctional aneurysms are relatively easy in comparison to the other types.[3,4] This is because of junctional aneurysms' saccular shape and narrow neck, albeit with a higher intraoperative rupture rate and a higher risk of postoperative vasospasm. In comparison to the junctional aneurysm, a fusiform aneurysm has a low intraoperative rupture rate, but clipping is difficult because of the involvement of perforators or the A_2 segment in the aneurysm fundus; thus, reconstruction and innovative clipping is required among these groups. The advantage of the fact that these aneurysms are less prone to intraoperative rupture is exploited to reconstruct the parent artery in the best possible way. The true ACoA aneurysm is relatively easy to clip in comparison to the other 2 types, because it is usually saccular and has a narrow neck.

Therefore, the authors' description of the junctional triangle, precommunicating triangle, and eight 3D octants may hold true for the so-called true ACoA aneurysm, but this not always the case, as our experience shows that the majority of aneurysms arise from the A_1–A_2–ACoA junction. It also appears from various illustrations that the authors have taken only aneurysms arising from the ACoA into consideration. Moreover, multilobed aneurysms with the lobules projecting in various directions may not fit into the classification proposed by the authors.[2]

As far as the operative nuances are concerned, the safest and the universal first step in these aneurysms is to follow the A_1 segment to the A_1–A_2 junction and proximal A_2 segment on the ipsilateral side. The next step depends on whether the aneurysm is placed anteroinferiorly or posterosuperiorly, the main idea being to expose all 5 relevant arteries here. In the anteroinferiorly directed lesions, as rightly described by the authors, a dissection in the precommunicating triangle in an effort to find the contralateral A_1 segment has the risk of a premature aneurysm rupture, and therefore it is better to look for the contralateral A_2 segment first by dissecting in what can be labeled as the "postcommunicating triangle." A retrograde navigation of the A_2 segment visualizes the contralateral A_1. In posterosuperiorly directed aneurysms, dissection of the precommunicating triangle can be performed safely to locate the contralateral A_1 segment. The most difficult part is to find the contralateral A_2, which, as the authors prudently mention, can be hidden by the aneurysm fundus. We agree completely that, more often than not, the contralateral A_2 is found more proximally due to rotation of the ACoA aneurysm complex by the dominant A_1 segment. We prefer to search for the contralateral A_2 distally, after removing a part of the gyrus rectus there. The most crucial step is separation of the aneurysm neck from the contralateral A_2 in a superiorly directed aneurysm. Coupled with the risk of perforator involvement, it is no wonder that the outcomes in posterosuperiorly directed aneurysms were found to be worse in this series.

At present, understanding and simulating the aneurysm in a 3D picture is mandatory to plan the surgical steps, and the authors' description is further adding to safety by describing the importance of triangles. We believe that the nuances we have added will further add to the ease of surgical clipping.

Finally, we congratulate the authors for sharing yet another experience from their leading center and detailing these triangles, which the neurosurgeons have so far used intuitively in clipping these challenging aneurysms.

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Response

We thank the authors for their interest in our paper and congratulate them on their own work. They categorized ACoA aneurysms into 3 types: true ACoA aneurysms, A_1–A_2 junctional aneurysms, and fusiform aneurysms. They found the A_1–A_2 junctional aneurysm to be much more prevalent than in our experience, accounting for 80%–85% of their cases as compared with approximately 10% of our cases. This low prevalence led us to group A_1–A_2 junctional aneurysms with true ACoA aneurysms in our paper. We did not find this anatomical nuance to be as important as dome projection in predicting outcome. Furthermore, we find A_1–A_2 junctional aneurysms to be more straightforward to clip than true ACoA aneurysms because the perforators are often less involved in these more eccentric junctional aneurysms. That said, we are in agreement that fusiform ACoA aneurysms are challenging to clip because of their nonsaccular necks, which can include perforators.

Our definitions of the A_1–A_1 precommunicating and A_1–A_2 junctional triangles were meant to identify safe corridors for aneurysm access and clipping. Our results direct attention to the more difficult superiorly and posteriorly projecting aneurysms that benefit from opening the junctional triangle for improved exposure. These triangle concepts have value in providing surgical awareness by informing the dissection steps intraoperatively, when it is easy to drift off course. The A_1–A_1 precommunicating triangle frames the anterior and inferior projecting aneurysms and leads to proximal aneurysm control. The A_1–A_2 junctional triangle frames the posteriorly and superiorly projecting aneurysms and leads to perforators, posterior neck anatomy, and the contralateral A_2 anterior cerebral artery. In the end, the transsylvian-subfrontal views into the interhemispheric fissure are imperfect and awkward, which makes it easy to miss a critical perforator that might have significant adverse effects on memory and cognition. Anatomical triangles are valuable in guiding our hands and eyes, in showing us where to widen corridors and improve visualization. We appreciate the authors' interest in these important microsurgical nuances.

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