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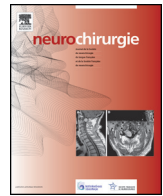


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## Letter to the Editor

### Intracranial hemorrhage related to brain vascular disease and COVID-19 containment: Where are the patients?



Dear Editor,

Aneurysmal subarachnoid hemorrhage (aSAH), ruptured arteriovenous malformation (AVM) and dural arteriovenous fistula (AVF) are significant causes of morbidity and mortality, particularly in young patients [1]. While the French Government introduced containment measures on March 17th 2020 to drastically limit social interactions and consequently virus COVID-19 diffusion, we noted a surprising decrease of subarachnoid hemorrhage in several centers.

The study was reviewed and approved by the Institutional Ethics Committee of Caen University Hospital (Caen, France). We conducted a retrospective cohort study based on data provided from six tertiary neurosurgical units (University Hospital of Paris Lariboisière, Paris La Pitié-Salpêtrière, Paris Foch, Marseille, Brest, Caen; France). We retrospectively determined the number of patients admitted to each centers every month for spontaneous hemorrhage related to brain vascular diseases that we divided in two types: subarachnoid hemorrhage related to intracranial aneurysm rupture (aSAH) and intracranial hemorrhage related to arteriovenous malformation (AVM) or to dural arteriovenous fistula (AVF). We have compared the number of patients admitted during the first month of containment to the number of patients admitted during the 12 previous months (no containment). Results are the mean  $\pm$  SD. Statistical analyses were performed using the Mann-Whitney *U* test. Statistical significance was set at the 0.05 level.

We found that the number of patients admitted for aSAH dropped from 6.9 patients per month per center before the containment to 4.3 during the containment, corresponding to a decrease of 37.7% ( $P=0.03$ , [Supplementary Figure 1A](#)). The number of patients admitted for intracranial hemorrhage related to AVM or to dural AVF dropped from 1.6 patients per month per center before the containment to 0.8 during the containment, corresponding to a decrease of 50%. However this difference is not significant because of an important variability ([Supplementary Figure 1B](#)).

Possible explanations to such uncommon epidemiological situation could be:

- decrease of people seeking for medical help, because they fear to get infected, or underestimating their symptoms, or do not want to disturb health physicians;
- excessive pressure on healthcare system that may lead to misdiagnosis, especially for patients presenting headache which can

be also one of initial symptoms of COVID -19 infection. These patients could finally die before coming to the hospital;

- decrease of usual daily activities reducing the stress level and finally the risk of rupture [2];
- some still unknown deaths of quarantined people;
- a seasonal phenomenon [3,4].

We are concerned that the two first hypothesis, leading to restrictions of appropriate medical care, are partially true. Then we fear that there is currently a cohort of patients that experienced low grade aneurysm's or AVM/AVF rupture and who are exposed to a high risk of rebleeding over the upcoming weeks [5].

This fragile population of patients may be part of "collateral damages" of COVID-19. We would like to raise awareness of Emergency Departments about this issue and to encourage patients who need it to ask for physical examination. Further studies will probably clarify the epidemiology and consequences of intracranial hemorrhage related to vascular malformation rupture during this critical period.

#### Disclosure of interest

The authors declare that they have no competing interest.

#### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.neuchi.2020.06.127>.

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