

# IMPACT OF THE COVID-19 PANDEMIC ON PATIENTS WITH RUPTURE OF INTRACRANIAL ANEURYSM AT THE DOS DE MAYO NATIONAL HOSPITAL IN LIMA PERU

## *Impacto de la pandemia por COVID-19 en pacientes con ruptura de aneurisma intracraneal en el Hospital Nacional Dos de Mayo en Lima Perú*

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### ABSTRACT

**Objective:** To evaluate the impact on the outcome of patients with a ruptured aneurysm, who are admitted to the Dos de Mayo National Hospital in the context of the COVID-19 pandemic.

**Methods:** 42 operated for ruptured aneurysms were included in the context of the COVID-19 pandemic between March 1 and December 31, 2020 (group A), and a control group of 44 patients operated on between March 1 and December 31, 2019 (group B). Upon admission, the poor neurological status defined by the WFNS > 3, the Fisher IV high-grade tomographic status with intracerebral hematoma or acute hydrocephalus, which required external ventricular drainage (EVD), and the presence of vasospasm were evaluated. The Modified Rankin Scale was evaluated at discharge. Statistical analysis was performed to compare both groups.

**Results:** The rates of poor neurological presentation and complications during the presurgical evolution (intracerebral hemorrhage and acute hydrocephalus that required EVD) were higher in group A ( $p = 0.002$  and  $p < 0.05$ , respectively). The delay in the admission of the patient to the emergency room to receive treatment was 7.5 days in group A and 4.95 days for group B. All these factors contributed to a lower possibility of recovery in group A, which was correlated with higher Values on the Modified Rankin Scale at discharge for this group ( $p = 0.04$ ).

**Conclusion:** We did not find national reports on ruptured aneurysms treated in the context of the pandemic, this being one of the first studies that demonstrate the impact of the COVID-19 pandemic in patients with ruptured intracranial aneurysm. The population should be educated on how to act in case of specific symptoms such as sudden intense headache, neurological deficit, or acute chest pain, which should receive timely care, immediate referral, and priority of treatment in referral hospitals in order to reduce morbidity and mortality of complex neurological pathologies.

**Keywords:** Intracranial Aneurysm, Aneurysm, Ruptured, Cerebral Hemorrhage, Pandemics, COVID-19. (Source: MeSH NLM)

### RESUMEN

**Objetivo:** Evaluar el impacto en el resultado de los pacientes con ruptura de aneurisma, que ingresan al Hospital Nacional Dos de Mayo, en el contexto de la pandemia COVID-19.

**Métodos:** Se incluyó a 42 operados por aneurismas rotos en el contexto de la pandemia COVID-19 entre el 1 de marzo y 31 de diciembre del 2020 (grupo A) y un grupo control de 44 pacientes operados entre el 1 de marzo y 31 de diciembre del 2019 (grupo B). Al ingreso, se evaluó el mal estado neurológico definido por la escala WFNS >3, el estado tomográfico de alto grado Fisher IV con hematoma intracerebral o hidrocefalia aguda, que requirió drenaje ventricular externo (DVE) y la presencia de vasoespasmo. La escala de Rankin Modificada fue evaluada al alta. Se realizó un análisis estadístico para comparar ambos grupos.

**Resultados:** Las tasas de presentación neurológica deficiente y complicaciones durante la evolución quirúrgica (hemorragia intracerebral e hidrocefalia aguda que requirió DVE) fueron mayores en el grupo A ( $p=0.002$  y  $p<0.05$ , respectivamente). El retraso en el ingreso del paciente a emergencia, para recibir tratamiento fue de 7.5 días en el grupo A y de 4.95 días para el grupo B. Todos estos factores contribuyeron a una menor posibilidad de recuperación en el grupo A, que se correlacionó con mayores valores en la Escala de Rankin Modificada al alta para este grupo ( $p=0.04$ ).

**Conclusión:** No encontramos reportes a nivel nacional sobre aneurismas rotos tratados en contexto de la pandemia, siendo este uno de los primeros estudios que muestra el impacto de la pandemia COVID-19 en pacientes con ruptura de aneurisma intracraneal. Se debe educar a la población sobre cómo actuar en caso de síntomas específicos como cefalea intensa súbita, déficit neurológico o dolor torácico agudo, los cuales deben recibir una atención oportuna, referencia inmediata y prioridad de tratamiento en los hospitales de referencia para así disminuir la morbimortalidad de patologías neurológicas complejas.

**Palabras clave:** Aneurisma intracraneal, Aneurisma Roto, Hemorragia cerebral, Pandemias, COVID-19. (Fuente: DeCS Bireme)

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The World Health Organization declares the coronavirus disease 2019 (COVID-19) as a pandemic, on March 11, 2020.<sup>1</sup> As of May 20, 4,789,205 cases and the global death toll of 318,789 patients were reported in the world.<sup>2</sup> This disease was first discovered in Wuhan, Hubei Province, China on December 31, 2019.<sup>3</sup> As it spread, governments and their health systems applied measures with varying degrees of restriction.<sup>4</sup> The local consequences of this pandemic are complex, essentially because the demand for medical care exceeds the capacity of the health system.<sup>5</sup>

Reports on changes in surgical services during the pandemic are limited to retrospective evaluations, subjective questionnaires, and surveys.<sup>6,7</sup> Observations show increased rates of surgical cancellation, including elective surgeries. The emergency and intensive care units (ICU) are saturated by the massive influx of COVID-19 patients. All the world's health systems are focused on the pandemic,<sup>8</sup> but neglect other urgent and serious life-threatening diseases.<sup>9</sup> More patients with ruptured aneurysms are observed, with greater neurological deterioration on admission due to a longer delay in referral and more complications. The Dos de Mayo National Hospital suffered a collapse due to the large number of patients who came to the emergency for reasons of COVID-19, which caused other diseases to be neglected. Added to this, patients with non-COVID-19 diseases did not go to health facilities promptly, for fear of getting infected when leaving their homes or due to difficulties in being referred to a more complex healthcare center.

The present study aims to evaluate the impact of the COVID-19 pandemic on the neurological outcome of patients with a ruptured brain aneurysm, treated at the Dos de Mayo National Hospital in Lima, Peru.

## METHODS

A non-concurrent, observational, and analytical cohort study was carried out. Data from the medical records of patients with ruptured aneurysms who underwent surgery are reviewed, during the period from March to December 2019 and March to December 2020, in the Neurosurgery Service of the Dos de Mayo National Hospital. We separated the patients into two groups according to time; group A treated during the COVID-19 pandemic between March to December 2020, and group B attended during pre-pandemic COVID-19 between March to December 2019.

The variables were analyzed: age, sex, medical history (arterial hypertension, obesity, diabetes, COVID pneumonia, cancer, alcoholism), days of delay in admission to the emergency and treatment (days of bleeding until the intervention), type and location of the aneurysm, neurological complications before surgery (intracerebral hemorrhage, vasospasm, hydrocephalus, seizures, intracranial hypertension), the Glasgow scale,<sup>10</sup> the scale of the world federation of neurosurgeons (WFNS)<sup>11</sup> and the Fisher scale<sup>12</sup> upon admission. Also, the functional neurological status with the Modified Rankin scale at discharge. A greater neurological deficit was defined with WFNS >3. Acute hydrocephalus required external ventricular drainage (EVD).

A descriptive analysis of the information was carried out through frequencies, percentages, and measures of central tendency. The difference between groups of patients treated during the pandemic (group A) and before the pandemic (group B) concerning a quantitative variable was evaluated with the Student's T-test, for independent groups (after evaluation of normality with the Kolmogorov test- Smirnov) and with the Mann-Whitney U test for variables that did not have a normal distribution. The association between two qualitative variables was evaluated with the  $\chi^2$  test. A p-value <0.05 was considered for a statistically significant difference or association.

## RESULTS

Between March to December 2019, and March to December 2020, 86 patients with ruptured brain aneurysms were treated, of which 44 were treated during March to December 2019 (group B) and 42 during March to December 2020 (group A). No significant differences were found between groups A and B regarding the variables of age, history, type, and location of the aneurysm (Table 1). Both groups were homogeneous based on these variables. There was a significant sex difference, group A patients were mostly women (88.1%) compared to group B (65.9%). The mean age of groups A and B was  $54.29 \pm 13.83$  years, and  $50.86 \pm 13.74$ , respectively ( $p = 0.253$ ). In both groups the predominant sex was female. The most frequent antecedent was arterial hypertension (AHT), followed by obesity, with two patients with COVID-19 pneumonia. In both groups, the most frequent location of the aneurysm was the carotid segment of the posterior communicator, followed by the middle cerebral artery (MCA). The most frequent type of cerebral aneurysm for both groups was the saccular type.

The mean bleeding time of the ruptured aneurysm until its intervention was  $7.55 \pm 10.82$  days in group A patients (during the pandemic), and  $4.95 \pm 6$  days in group B patients (pre-pandemic); Although the delay of days for a patient's intervention during the COVID-19 pandemic was greater than that of a patient before it, the results are not statistically significant ( $p = 0.289$ ).

The state of the level of consciousness through the Glasgow (GCS) at admission, had a mean of  $12.74 \pm 2.77$  points in patients during the COVID-19 pandemic (group A) and of  $13.52 \pm 2.44$  points in patients before the COVID-pandemic. 19 (group B); a slightly better state of consciousness is evidenced in patients who presented to the emergency before the COVID-19 pandemic (group B); however, the results of this variable are not statistically significant either ( $p = 0.107$ ).

On admission, a bad neurological state was considered when the WFNS scale was greater than 3. Of the total, 33.3% of patients with a ruptured aneurysm during the COVID-19 pandemic (group A) presented a bad neurological state, compared with 6.8% of those evaluated before the COVID-19 pandemic (group B). There is a greater number of patients with ruptured aneurysms with poor neurological status during the period of the COVID-19 pandemic (Table 2), being statistically significant ( $p = 0.002$ ). Additionally, it

Tabla 1: Características de los pacientes con aneurisma roto según grupo pandemia y pre pandemia (A y B)

	Grupo A		Grupo B		Valor p
	Media	DS	Media	DS	
Edad	54.29	±13.83	50.86	±13.74	0.253
	n (42)	%	n (44)	%	
Sexo					0.015
Masculino	5	11.9	15	34.1	
Femenino	37	88.1	29	65.9	
Antecedentes					NS
HTA	22		23		
Obesidad	8		3		
Neumonía COVID-19	2		0		
Cáncer	0		3		
Otros*	4		12		
Ubicación del aneurisma					0.065
AcomP	11	26.6	20	45.5	
ACM	8	19	10	22.7	
AcomA	7	16.7	8	18.2	
ACA	4	9.5	0	0	
Otros <sup>§</sup>	12	28.6	6	13.6	
Tipo de aneurisma					0.071
Sacular	39	92.9	44	100	
Fusiforme	3	7.1	0	0	

NS: No significativo; Otros\*: asma, arritmia, absceso, alcoholismo, hipotiroidismo; Otros<sup>§</sup>: paraclinoideo, coroideo, ACI, PICA, hipofisiario. p < 0.05 estadísticamente significativo.

was observed that 5 patients in group A and 6 patients in group B had seizures as part of the clinical course. No patient in group A had active COVID (IgM +), but 12 patients had reactive IgG plus a negative molecular test.

Fisher's tomographic scale was used to assess all patients with ruptured aneurysms and assess the risk of vasospasm. Fisher IV was considered a serious presentation. 54.8% of the patients in group A presented Fisher IV, slightly higher than 43.2% of the patients in group B; the result was not statistically significant ( $p = 0.283$ ). Additionally, the presence of acute complications before surgery was evaluated, such as intracerebral hemorrhage (ICH), acute hydrocephalus treated with EVD, and vasospasm. 40.5% of group A patients presented ICH, and almost twice as many of group B patients (20.5%), this difference being statistically significant ( $p = 0.043$ ). Acute hydrocephalus treated with EVD was greater in group A (33.3%) than in group B (11.4%), a statistically significant difference ( $p = 0.014$ ). On the other hand, vasospasm was also, a little more than double in group A (26.2%) compared to group B (11.4%) but it was not statistically significant ( $p = 0.077$ ).

## DISCUSSION

The objective of the study is to evaluate the impact on the outcome of patients with ruptured brain aneurysms in the context of the COVID-19 pandemic. We found statistically significant differences when evaluating the severity of the neurological status at admission, the neurological complications before surgery, and the functional status of the patients at discharge. Thus, the severity of the neurological state on admission was greater during the pandemic (about four times more). Aboukais et al. (2009), showed in their study of 121 patients with subarachnoid hemorrhage (SAH) due to cerebral aneurysm, that only 24% had a poor neurological status upon admission.<sup>13</sup> On the other hand, Natarajan et al., Reported in their study of 195 In patients with aneurysmal SAH, 38% presented a WFNS on admission to the emergency room greater than three.<sup>14</sup>

Various hypotheses can be put forward that would explain this difference between groups A and B of the study. Group A patients, with ruptured aneurysms during the pandemic (with social confinement) may not have attended hospital

Tabla 2: Características asociados a mal estado neurológico de los pacientes con aneurisma roto según grupo A y B

	Grupo A		Grupo B		Valor p
	Media	DS	Media	DS	
Días de retraso al ingreso a EMG	7.55	±10.82	4.95	±6	0.289
Escala de coma de Glasgow	12.74	±2.77	13.52	±2.44	0.107
Escala de Rankin Modificada	2.67	±1.92	1.9	±1.63	0.04
	n (42)	%	n (44)	%	
<b>Estado neurológico al ingreso a emergencia</b>					<b>0.002</b>
WFNS ≤ 3	28	66.7	41	93.2	
WFNS > 3	14	33.3	3	6.8	
<b>Escala de Fisher</b>					<b>0.283</b>
I - II - III	19	45.2	25	56.8	
IV	23	54.8	19	43.2	
<b>Hemorragia Intracerebral* (HIC)</b>					<b>0.043</b>
Si	17	40.5	9	20.5	
No	25	59.5	35	79.5	
<b>Hidrocefalia* con drenaje ventricular externo</b>					<b>0.014</b>
Si	14	33.3	5	11.4	
No	28	66.7	39	88.6	
<b>Vasoespasmo*</b>					<b>0.077</b>
Si	11	26.2	5	11.4	
No	31	73.8	39	88.6	

WFNS: World Federation of Neurological Surgeons; \*: complicación aguda pre quirúrgica. p < 0.05 estadísticamente significativo.

emergency services for fear of being exposed and infected with COVID-19. This could have caused a delay in the arrival to the emergency, which in the time before the pandemic would not have happened. This hypothesis is supported by the findings of the present study regarding the worst neurological state with which patients arrived at the emergency room, together with the variable "time it took to arrive" after the onset of the condition. Likewise, the saturation of emergency services by COVID-19 and its exclusive use to treat this disease reduced attention to other diseases. Bernat et al., Described a decrease in the admission of patients with SAH to neurosurgery services during the COVID-19 pandemic.<sup>17</sup>

Difficulties in contacting the emergency room due to telephone congestion may have discouraged patients with good neurological status from seeking health care.<sup>9</sup> By following the recommendations of the media, such as staying home in the absence of respiratory signs related to COVID-19, many suspected cases of ruptured aneurysm chose to stay at home. Other patients with a ruptured aneurysm could have considered that their symptoms, such as a headache that is also part of the COVID-19 picture, could have been due to COVID-19 and not related it to a cerebral vascular disease. When these symptoms persisted or worsened, such as headache, and were associated, in addition to the neurological deficit, with a WFNS > 3, they only came to the emergency room with a worse neurological

state. In a series of 509 patients with SAH, Goertz<sup>10</sup> reported a higher rate of neurological deterioration on admission in patients with delayed hospital admission. Another factor was the reluctance to refer a patient from a health center of less complexity to another of greater complexity, considering the mild clinical picture, not suspicious of SAH and thus avoid saturating the health centers for the treatment of COVID-19. This could be another cause of this increase in cases with greater neurological deterioration during the COVID-19 pandemic.

The neurological disorder of patients with SAH Fisher IV with intracerebral hematoma is more severe than those without hematoma.<sup>11</sup> In group A, a higher rate of patients with ICH (40.5%) was observed, which explains a greater neurological deficit. In one study, Wan<sup>12</sup> of 5362 aneurysmal SAH patients 21% had ICH, greater neurological injury, and a poorer outcome than those without ICH. In his series of 326 patients with aneurysmal SAH, Guo<sup>13</sup> reported rebleeding in 21.5% of those hospitalized up to 72 hours after the first symptom. Additionally, the incorrect management of hypertension and self-medication with aspirin for persistent headaches contributes to rebleeding of ruptured aneurysms.<sup>13-15</sup> Fisher IV SAH with ICH, acute hydrocephalus, and vasospasm on admission are predictive factors of poor neurological prognosis as described by multiple authors.<sup>16-18</sup>

The delay in diagnosis and treatment worsens the prognosis of severe cases that require immediate treatment.<sup>19</sup> Thus, the time between the aneurysm rupture and the start of treatment should be as short as possible due to the risk of rebleeding in the first hours,<sup>13</sup> the management of Vasospasm should be started immediately to avoid ischemic lesions.<sup>20</sup> Goertz reported a higher rate of infarction due to vasospasm in the group with delayed admission (41.5%) compared to those with early admission (22.6%).<sup>10</sup> On the other hand, other acute complications must be treated immediately to reduce morbidity and mortality, among them, acute hydrocephalus whose timely management improves the neurological outcome.<sup>21</sup> The EVD placement rate in group B was statistically like that of other studies, but in group A it is significantly higher.<sup>22</sup>

In the Neurosurgery Service of the Hospital Nacional Dos de Mayo and other national and international centers, all elective or non-urgent procedures were suspended, to support our anesthesia teams, neurosurgical intensive care, and hospital beds to other specialties for the management of COVID-19 patients. This could have also had an impact on the results shown in this article.

## CONCLUSION

After an exhaustive review of the medical literature, we have not found national reports of treatment of cerebral aneurysmal pathology concerning the pandemic, we believe, to our knowledge, that this is one of the first studies carried out in our country that demonstrate the impact of the COVID-19 pandemic in the prognosis of aneurysmal subarachnoid hemorrhage.

During the first phase of the pandemic, the total number of elective neurosurgical procedures decreased; At the same time, there was a progressive increase in morbidity due to emergency vascular pathology, due to multiple factors that impeded its management and treatment, such as confinement, fear of going to the emergency room due to the risk of contagion, the decrease in the acceptance of references for not having beds available. In case of recurrence of the pandemic, we must be emphatic in educating the population about specific symptoms such as sudden intense headache, neurological deficit, or even acute chest pain so that they can go to the hospital emergency room on time and receive specialized treatment if treated. of cerebral vascular pathology.

## ETHICAL CONSIDERATIONS

All procedures were carried out complying with the ethical standards of the institutional research committee and with the Declaration of Helsinki of 1964 and its subsequent modifications or comparable ethical standards.

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