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LETTER TO THE EDITOR

Risk factors for prolonged ventilation in patients undergoing endovascular treatment of unruptured intracranial aneurysm: a retrospective cohort study

Dear Editor,

The perioperative management of unruptured intracranial aneurysms represents a challenge for anesthesiologists. In recent years, endovascular treatment has emerged as a safe option for these patients, but the literature regarding intraoperative management is scarce.[1] Standard of care requires absolute immobility, which can be obtained with general anesthesia and muscle paralysis. However, general anesthesia is not free of complications as the hemodynamic alterations related to intubation and laryngoscopy can also represent a risk to aneurysm integrity.[1]

Recently, Hurtado et al.[1] suggested the use of a second generation Supraglottic Airway Device (SAD) for endovascular treatment of unruptured intracranial aneurysms, showing it could represent a feasible alternative to endotracheal intubation in selected patients. While SADs have been proposed for several endovascular scenarios[2–4] and may be associated with a reduced hemodynamic response compared to laryngoscopy,[2] their benefits should be weighed against potential risks associated with the prolonged use of these devices, which include oropharyngeal edema and pneumonia.[5,6] The identification of patients at risk for prolonged mechanical[7] ventilation may be useful when choosing the appropriate airway device. The aim of this study was to identify risk factors for prolonged ventilation in patients undergoing endovascular treatment of unruptured intracranial aneurysm.

A retrospective cohort study was conducted, and the study protocol was in accordance with the 1964 Declaration of Helsinki and its later amendments. The study was approved by the Ethics Committee for Clinical Research of the Padova University Hospital (Chairman: Dr. Sergi, reference: AOP/0042595;16/07/2020). Informed consent was waived due to the retrospective nature of the study.

A retrospective review of the records of patients admitted to our teaching Hospital (University Hospital of Padua, Italy) undergoing endovascular treatment of unruptured intracranial aneurysms from April 1st, 2014, to May 30th, 2020 was performed.

We included only adult patients and therefore we did not include patients under 18 years of age.

The following data was collected: demographic information such as age (years), sex, American Society of Anesthesiologists Physical Status (ASA-PS) and data related to the aneurysm (aneurysm size, aspect ratio, dome/neck ratio, aneurysm location and type: saccular vs. fusiform), data related to the procedure (duration and type: coiling, assisted coiling, vessel occlusion, flow diverter), and need for prolonged ventilation identified by Intensive Care Unit (ICU) admission.

An a priori sample size was not calculated. Data for each continuous variable was analyzed for normal distribution using the Shapiro-Wilk test. Results for continuous variables with normal distributions were expressed as mean and standard deviation values; those with non-normal distributions were expressed as median and interquartile range values. Analysis of data with a normal or a non-normal distribution was performed using the two-tailed Student's t-test and the Mann-Whitney U test, respectively. The results for analyses of categorical variables were reported as percentages and were compared among groups using the Chi-Square test or the Fisher's exact test as appropriate. To determine the relationships between the dependent categorical variable (need for prolonged ventilation) and one or more independent categorical variables (need for prolonged ventilation predictors), we performed a multiple logistic regression analysis to calculate Odds Ratios (ORs) with 95% Confidence Intervals (95% CIs); to avoid overfitting, only variables with a p-value lower than 0.05 on univariate regression analysis were included in the multivariable logistic regression.

The Receiving Operator Curve (ROC) was performed on identified variables to show their robustness, with best cutoff points for prediction determined using the Youden index.

A total of 102 consecutive patients were included in our analysis. Eight of these patients (7.8%) required prolonged mechanical ventilation and were admitted to the ICU, while all the others were discharged from the Post-Anesthesia Care Unit to the neurosurgical ward on the same day of the angiographic procedure.

Characteristics of included patients are shown in Table 1, there was no missing data. Univariate analysis identified aneurysm location and procedure duration as risk factors for prolonged ventilation. Multiple logistic regression then confirmed duration as a significant predictor (OR = 1.04, 95% CI 1.02—1.05, p-value = 0.004). The ROC for procedure

Table 1 Table showing characteristics of patients requiring prolonged ventilation (ICU admission group) and of patients not requiring prolonged ventilation (ward admission group).

	ICU admission (n = 8)	Ward admission (n = 94)	*p*-value
Patients' characteristics			
Age	49 (47−62.75)	55 (48−66)	0.525
Sex (Female) (%)	7 (87.5%)	72 (76.6%)	0.478
ASA-PS	2.5 (2−3)	2 (2−3)	0.381
Aneurysm characteristics			
Aneurysm dimension (mm)	7 (5.75−9)	7 (5−10.75)	0.940
Dome neck ratio	1.57 (1.19−1.68)	1.52 (1.22−1.85)	0.755
Aspect ratio	1.44 (1.41−1.60)	1.42 (1.16−2.05)	0.842
Sacciform (%)	7 (87.5%)	84 (89.4%)	0.870
Aneurysm location			
Anterior cerebral artery	0 (0.0%)	2 (2.1%)	0.038*
Middle cerebral artery	0 (0.0%)	5 (5.3%)	
Anterior communicating artery	1 (12.5%)	12 (12.8%)	
Posterior cerebral artery	1 (12.5%)	0 (0.0%)	
Basilar artery	0 (0.0%)	12 (12.8%)	
Internal carotid artery	6 (75.0%)	52 (55.3%)	
Pericallosal artery	0 (0.0%)	5 (5.3%)	
Vertebral artery	0 (0.0%)	6 (6.4%)	
Procedure characteristics			
Procedure length	185 (166.25−216.25)	120 (90−160)	0.002*
Procedure			
Assisted coiling	1 (12.5%)	21	0.717
Coiling	1 (12.5%)	16	
Flow diverter	6 (75.0%)	52	
Occlusion	0 (0.0%)	5 (5.3%)	

duration identified this variable as a good predictor for prolonged ventilation requiring ICU admission, with an area under the curve of 0.830 (95% CI 0.723−0.937) and best threshold identified at 137 minutes (Fig. 1).

Our study shows that endovascular treatment of unruptured aneurysms has a low rate of complications and confirms that a SAD approach is potentially feasible, considering the low percentage of patients requiring prolonged mechanical ventilation after the intervention.

Interestingly, the analyzed patient and aneurysm characteristics were not associated with prolonged ventilation requiring ICU admission, while procedure duration had a strong relationship. A possible explanation is that duration represents an indirect index of complexity and relates to the technical difficulty in completing the procedure. We identified 137 minutes as the best threshold, however, given the monocentric nature of the study, this threshold may be subject to variation across different centers.

As SAD in these procedures is conditional to the duration of the intervention, we suggest that technically complex procedures, potentially requiring longer operative times, may be safer to perform with endotracheal intubation. When the procedure is technically less complex and therefore duration is predicted to be short, SAD can be considered as an effective alternative.

Our study presents some limitations that need to be discussed. The first and main limitation is related to the retrospective and single center design of our study. Given the nature of the study, we cannot determine causality but only correlation among variables and future prospective studies are necessary to further investigate this topic. Secondly, we recognize that the sample size of our study is small and could
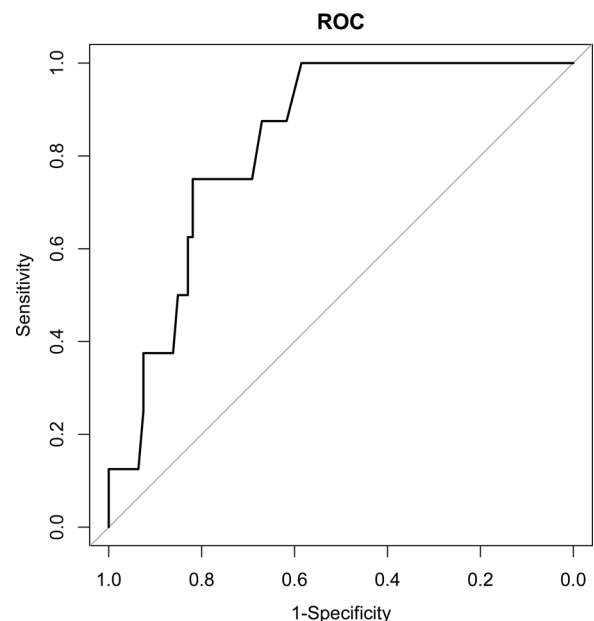

Figure 1 Need for ICU admission ROC curve (variable: procedure length). The ROC curve plots the true positive rate against the false positive rate at all procedure length values. The diagonal dotted line represents the reference line (AUC = 0.500).

be insufficient to detect all potentially relevant risk factors for prolonged mechanical ventilation.

We can conclude that procedure duration has a strong relationship with postoperative need for prolonged mechanical ventilation. In this framework, SADs could be considered as feasible for most patients undergoing endovascular treatment for unruptured intracranial aneurysms. However, for complex and time-consuming procedures, in our opinion endotracheal intubation has to be preferred given the risk of prolonged ventilation. Future prospective and multicentric studies are advisable to advance knowledge on this topic.

Fundings

Conflicts of interest

The authors declare no conflicts of interest.

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