Comparison of Prognostic Performance between Fisher and Modified Fisher Scales for Patients with Aneurysmal Subarachnoid Hemorrhage

Abstract

Objective The present study aims to assess and compare the prognostic value of these two scales for predicting mortality.

Method We reviewed 172 patients with aneurysmal subarachnoid hemorrhage, who were followed-up for 6 months. The Fisher and modified Fisher scales were evaluated for the prediction of mortality using logistic regressions.

Results The Fisher scale was associated with mortality (odds ratio [OR]: 2; 95% confidence interval [CI]: 1.09–4.05) in the multivariate analysis. The modified Fisher scale was not associated with mortality in the multivariate analysis (OR: 1.39; 95% CI: 0.9–2.29), nor in the univariate analysis (OR: 1.24; 95% CI: 0.87–1.86). There was no significant association between Fisher score and unfavorable functional outcomes (mRS > 2) in the univariate analysis (OR: 1.39; 95% CI: 0.92–2.05), nor in the multivariate analysis (OR: 1.24; 95% CI: 0.87–1.86). There was also no significant association in the multivariate analysis (OR: 1.18; 95% CI: 0.88–1.57).

Conclusion Only the Fisher scale was associated with mortality. Neither of the two scales was associated with unfavorable functional outcomes (mRS > 2).
Introduction

Aneurysmal subarachnoid hemorrhage (aSAH) has serious consequences. One of the main causes of the problems is cerebral ischemia, and the presence of vasospasm, another clinical consequence, might make the ischemia worse. Vasospasm is characterized by a focal or diffuse artery constriction that can be noticed on vascular imaging. Due to its role in lowering cerebral blood flow, vasospasm is strongly associated with delayed ischemic neurologic impairments in patients.

There are a few approaches to classify vasospasm and to attempt to forecast its progression; the Fisher Scale is the best method for categorizing the magnitude of subarachnoid hemorrhage shown on computed tomography (CT) scans. It is very effective for predicting when and how severe cerebral vasospasm may occur.

Another method for grading subarachnoid hemorrhage is the modified Fisher Scale. This is a more logical tool than the original Fisher scale, because in this scale, the chance of developing vasospasm increases with each grade; in contrast, the risk in the original Fisher scale peaks at grade 3 and then decreases for grade 4.

The Fisher and modified Fisher scales were, therefore, developed for the classification of aSAH and to predict the occurrence of vasospasm. In the present study, we intend to evaluate a possible correlation between these scales and mortality.

Methods

Study
We performed a retrospective cohort study that reviewed 172 consecutive patients with aSAH between January 2018 and July 2019.

Eligibility Criteria
We included patients with aSAH whose CT scans, Fisher, and Modified Fisher scores were described by the attending neuroradiologist, with an adequate register of follow-up. Patients who did not have an aSAH, did not accept to participate, or were lost to follow-up were excluded.

Statistical analyses
Descriptive statistics are presented according to data type and normality checks (Shapiro-Wilk test). Logistic regressions evaluated covariates that could influence functional outcomes, and those significant in the univariate analyses (p < 0.1) were included in the multivariable models.

Logistic regression analyses were used to assess the prediction performance of the 2 scales for mortality within 6 months.

All tests were 2-tailed and statistical significance was pre-established at p < 0.05. Analyses were done using R software (R Foundation for Statistical Computing, Vienna, Austria). The local Ethics Committee approved the present study.

RESULTS

We reviewed the data of 172 patients who developed aSAH. The majority were female (114, or 75.5%), the mean age was 56.7 (±12.6) years old. The mean Glasgow Coma Scale (GCS) on admission was 11.62 (±4.5) and the Median Rankin T 6 months was 3 (5).

►Table 1 summarizes demographic and clinical patient characteristics. These patients were classified according to Fisher and Modified Fisher scores (►Table 2). ►Table 3 shows the classification of patients according to the Rankin Scale.

The second part of our study was the association between covariates and mortality. Covariates were evaluated in univariate regressions, including age, gender, hypertension,
diabetes, and smoking status. Covariates significant at $p < 0.1$ in the univariate analysis were included in the final multivariable model.

Logistic regression analysis about the association between patient score in the Fisher grading system and mortality (Table 4) showed that, in the multivariate analysis, the Fisher scale was associated with mortality (odds ratio [OR] 2; 95% confidence interval [CI]: 1.09–4.05). The modified Fisher scale was not associated with mortality in the multivariate analysis (OR: 1.39; 95%CI: 0.9–2.29), nor in the univariate analysis (OR: 1.24; 95%CI: 0.87–1.86) (Table 5).

Tables 6 and 7 show logistic regression analyses demonstrating the correlation between Fisher and modified Fisher scores with unfavorable functional outcomes (mRS > 2).

There was no significant association between Fisher score and unfavorable functional outcomes in the univariate analysis (OR: 1.33; 95%CI: 0.92–1.92). There was also no significant association in the multivariate analysis (OR: 1.37; 95%CI: 0.92–2.05).

There was no significant association between modified Fisher scores and unfavorable functional outcomes in the univariate analysis (OR: 1.16; 95%CI: 0.88–1.52). There was also no significant association in the multivariate analysis (OR: 1.18; 95%CI: 0.88–1.57).

The mortality per Fisher score was 20% in FS-1, 18.75% in FS-2, 25% in FS-3 and 40% in FS-4 (Fig. 1), whereas in the
The modified Fisher scale was proposed by Frontera et al., who concluded that it predicts symptomatic vasospasm following subarachnoid hemorrhage more accurately than the original Fisher scale. In our study, only the Fisher scale could predict mortality.

Lindvall et al. analyzed the receiver operating characteristic (ROC) curve and demonstrated the significance of the Fisher scale grade as an outcome predictor. This result agrees with the results obtained in our study. Additionally, they suggest that the Fisher scale may need to be reevaluated because of the possibility that the increased resolution of modern CT scanners has altered the significance of the scale in predicting vasospasm and outcome. In one study about outcomes for surgical and endovascular management of intracranial aneurysms, Ogilvy et al. demonstrated that, for both the endovascular and surgical categories, there is a strong association between outcome and density of hemorrhage graded by the Fisher scale.

Cedzich et al. suggest that Fisher grade is very good for describing initial state of patients, but it is not a good tool for predicting the outcome of patients with ruptured intracranial aneurysms, highlighting the fact that initial clinical and morphological status of a patient may not always predict the outcome.

**DISCUSSION**

Logistic regression data showed that the Fisher scale was associated with mortality in the multivariate analysis. On the other hand, the modified Fisher scale was not associated with mortality in any analysis. In our study, the mortality rate assessed by the Fisher scale increases as the grades of this scale increase, reaching a maximum at grade 4 (Fig. 1). The mortality rate assessed by the modified Fisher scale showed a greater variation, being minimal in grade 1 and maximum in grade 4 (Fig. 2).

According to Fisher et al., enough blood at specific regions in the subarachnoid space might be the only important etiological factor in vasospasm, being superior to age, sex, severity of the original illness, blood pressure, and headache. Therefore, the Fisher scale was devised to predict the occurrence of vasospasm. In our study, we aimed to compare the prognostic performance between the Fisher and modified Fisher scales for patients with aSAH.

**Strengths and limitations of the study**

There are some limitations to our study. First, this is a retrospective study, limiting the obtaining of the sample and variable measuring. Second, in some patients, data about the Fisher and Modified Fisher scale could not be found. Third, the follow-up was lost in some patients, which may interfere with the clinical trial.

Conversely, there are also some strengths. First, we reviewed the data of 172 patients, which is a significant sample. Second, this is an original work. Third, the original description of these scales is for the prediction of vasospasm, and, in our study, we showed the correlation between these scales and mortality. This will help the clinic to be more confident in using the scales as a prognostic index as well.

**Conclusion**

The Fisher scale was associated with mortality. The modified Fisher scale was not associated with mortality. Neither of the two scales was associated with unfavorable functional outcomes (mRS > 2).

**Ethical Standards**

The present research project was approved by the Ethics and Research Committee of the Hospital das Clínicas of FMUSP. Online registration CAPPeq: 15226 approved 06/20/2016. Approved on the Brazil platform CAAE number: 61719416.6.0000.0068

**Disclosure**

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in the present article.
Originality
I, Nícollas Nunes Rabelo, certify that this manuscript is a unique submission and is not being considered for publication with any other source in any medium.

Financial Support
None to declare.

Conflict of Interests
The authors have no conflict of interests to declare.

References
2 Fang YJ, Mei SH, Lu JN, et al. New risk score of the early period after spontaneous subarachnoid hemorrhage: For the prediction of delayed cerebral ischemia. CNS Neurosci Ther 2019;25(10):1173–1181