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

Comparação do desempenho prognóstico entre as escalas Fisher e Fisher modificada para pacientes com hemorragia subaracnóidea aneurismática

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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: 1.33; 95%CI: 0.92–1.92), nor 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).

Keywords
► fisher
► modified fisher
► subarachnoid hemorrhage
► intracranial aneurysm
► prognosis

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

Resumo

Objetivo   O presente estudo tem como objetivo avaliar e comparar o valor prognóstico dessas duas escalas para predizer mortalidade.

Método   Revisamos 172 pacientes com hemorragia subaracnóidea aneurismática, acompanhados por 6 meses. As escalas de Fisher e modificada de Fisher foram avaliadas para a previsão de mortalidade usando regressões logísticas.

Resultados   A escala de Fisher foi associada à mortalidade (odds ratio [OR]: 2; intervalo de confiança [IC] 95%: 1.09–4.05) na análise multivariada. A escala Fisher modificada não foi associada à mortalidade na análise multivariada (OR: 1.39; IC95%: 0.9–2.29), nem na análise univariada (OR: 1.24; IC95%: 0.87–1.86). Não houve associação significativa entre o escore de Fisher e resultados funcionais desfavoráveis (mRS > 2) na análise univariada (OR: 1.33; IC95%: 0.92–1.92), nem na análise multivariada (OR: 1.37; IC95%: 0.92–2.05). Não houve associação significativa entre os escores modificados de Fisher e resultados funcionais desfavoráveis na análise univariada (OR: 1.16; IC95%: 0.88–1.52). Também não houve associação significativa na análise multivariada (OR: 1.18; IC95%: 0.88–1.57).

Conclusão   Apenas a escala de Fisher foi associada à mortalidade. Nenhuma das duas escalas foi associada a resultados funcionais desfavoráveis (mRS > 2).

Palavras-chave
► escala fisher
► escala fisher modificada
► hemorragia subaracnóidea
► aneurismas intracranianos
► prognóstico

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.[1] Due to its role in lowering cerebral blood flow, vasospasm is strongly associated with delayed ischemic neurologic impairments in patients.[2–4]

There are a few approaches to classify vasospasm and to attempt to forecast its progression; the Fisher Scale is typically used for the latter.[5] 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.[6]

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 ($\pm$12.6) years old. The mean Glasgow Coma Scale (GCS) on admission was 11.62 ($\pm$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,

Table 1 Population characteristics

Mean age (years old)	56.7 (±12.6)
Female	114 (75.5%)
Hypertension	61 (79.2%)
DM	32 (41.6%)
Smoker	46 (59.7%)
Mean GCS on admission	11.62 (±4.5)
Median Rankin 6 months	3 (5)

Abbreviation: GCS, Glasgow Coma Scale.

Table 2 Classification of patients according to the Fisher and Modified Fisher scales

Grade	Fisher scale	Modified Fisher scale
0		7 patients
1	9 patients	25 patients
2	25 patients	4 patients
3	55 patients	55 patients
4	83 patients	81 patients

Table 3 Classification of patients according to the Rankin Scale

Grade	Rankin
1	47
3	20
4	6
5	1
6	33

Table 4 Association between patient score in the Fisher grading system and mortality

	OR	95%CI
Univariate		
Fisher	1.63	0.98–2.89
Multivariate		
Age	1.04	1.0–1.08
Fisher	2.00	1.09–4.05

Abbreviations: CI, confidence interval; OR, odds ratio.

diabetes, and smoking status. Covariates significant at $p < 0.1$ in the univariate analysis were included in the final multi-variable 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

Table 5 Association between patient score in the modified Fisher grading system and mortality

	OR	95%CI
Univariate		
Modified Fisher	1.24	0.87–1.86
Multivariate		
Age	1.04	1.00–1.09
Modified Fisher	1.39	0.9–2.29

Abbreviations: CI, confidence interval; OR, odds ratio.

Table 6 Association between Fisher scores and unfavorable functional outcomes (mRS > 2)

	OR	95%CI
Univariate		
Fisher	1.33	0.92–1.92
Multivariate		
Age	1.02	0.99–1.05
Fisher	1.37	0.92–2.05

Abbreviations: CI, confidence interval; OR, odds ratio.

Table 7 Association between modified Fisher scores and unfavorable functional outcomes (mRS > 2)

|	OR	95%CI
Univariate		
Modified Fisher	1.16	0.88–1.52
Multivariate		
Age	1.02	0.99–1.05
Modified Fisher	1.18	0.88–1.57

Abbreviations: CI, confidence interval; OR, odds ratio.

(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
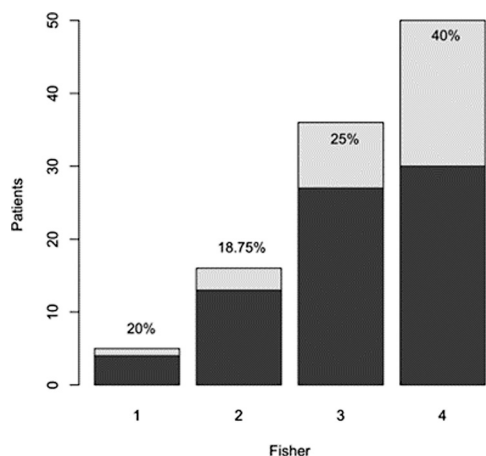
Fig. 1 Mortality per Fisher score.
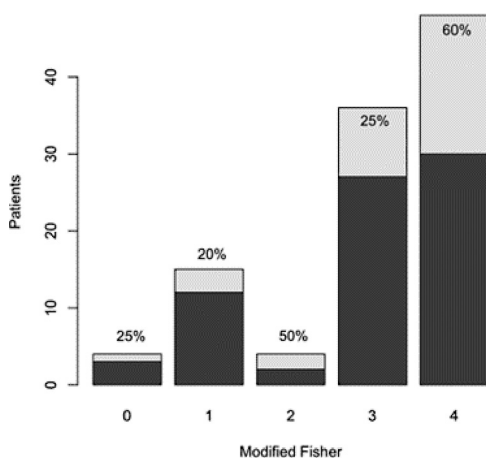
Fig. 2 Mortality per Modified Fisher Score.

Modified Fisher score the mortality was 25% in MFS-0, 20% in MFS-1, 50% in MFS-2, 25% in MFS-3, and 60% in MFS-4 (►**Fig. 2**).

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.,[7] 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.

The modified Fisher scale was proposed by Frontera et al.,[6] 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.[8] 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.[9] 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.[10] 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 a the initial clinical and morphological status of a patient may not always predict the outcome.

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).

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.

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Conflict of Interests

The authors have no conflict of interests to declare.

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