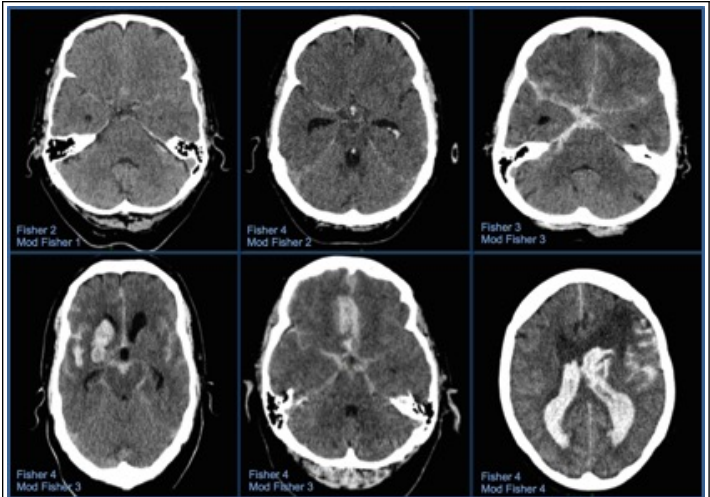


Introduction

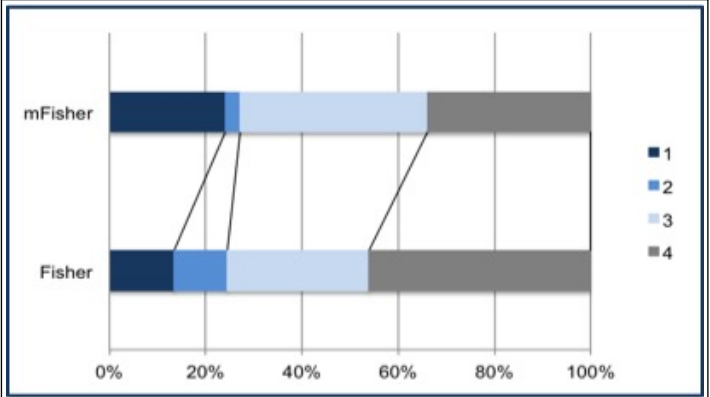
Fisher grade is a computerised tomography (CT) grade of subarachnoid hemorrhage (SAH) based on blood load on initial scan first proposed in 1980 [1]. This has been shown to be well correlated with increasing risk of developing delayed ischaemic neurological deficit (DIND) for increasing grades 1-3 then not correlating with grade 4. On this basis, the modified Fisher grading system was proposed and was thought to have a higher degree of correlation with risk of DIND [2]. DIND is also known as “symptomatic vasospasm”, or as delayed cerebral ischaemia. This is a serious complication that occurs in 20 to 40% of patients with SAH [3]. Cerebral infarction may occur as an immediate and direct result of the haemorrhage, but most often develops 4-12 days after the onset, hence the term DIND. Of the patients that develop DIND, one quarter die and a tenth of the survivors are permanently disabled [4]. The exact mechanism of cerebral arterial constriction seen on angiography is unclear, proposed mechanisms include an inflammatory reaction to the blood surround the arteries in the subarachnoid space. However, several vasoconstriction antagonists have failed to show any clinical improvement in vasospasm [4]; only oral nimodipine has shown any measurable clinical benefit and is now a standard of care in the United Kingdom. This was confirmed by the randomised placebo controlled British Aneurysm Nimodipine Trial [5], which proved a relative risk reduction of symptomatic vasospasm of one third, and improving outcome.



Unenhanced axial CT brain scans of patients with SAH that demonstrate how Fisher and modified Fisher grades can vary with the same scan.

Methods

Retrospective analysis was carried out on prospectively collected data for 609 consecutive patients referred to the West of Scotland regional neurosurgical service (population 2.7 million) with a diagnosis of SAH between August 2010 and August 2013. Each admission CT scan was independently graded for both Fisher and modified Fisher grades by two raters. Patients that were not accepted to the department of neurosurgery were then excluded, since data on whether or not these patients subsequently developed DIND was not available. Inter-rater agreement was calculated using Cohen’s kappa coefficient, and the rate of DIND assessed against increasing grade using the Chi-squared test.

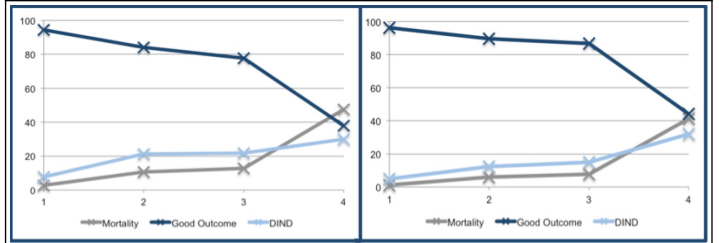


Frequency of each grade of Fisher and modified Fisher grade of presentation CT scan.

Results

609 patients with SAH were identified (61.9% were female). Average age at presentation was 54.8±13.5 (range 11-89 years). 526/609 (86.4%) patients were accepted for further investigation and treatment, the remainder refused on the grounds of fitness for intervention. The proportions of Fisher and modified Fisher grades were not significantly different. Fisher grade had a high level of inter-rater agreement (Kappa=0.946 ± 0.011; 95% CI 0.924–0.968), and showed positive correlation at all grades for DIND (Fisher 1: 4.9%, Fisher 2: 12.3%, Fisher 3: 14.9%, Fisher 4: 32%), contrary to the published literature (P < 0.00001). Furthermore, increasing Fisher grade was highly correlated with poor outcome and with mortality (P < 0.0001).

Modified Fisher grade (1-4) had a higher level of inter-rater agreement (Kappa=0.966 ± 0.009; 95% CI 0.949–0.984), and also showed positive correlation at all grades for DIND (7.6%, 21.1%, 21.8%, 30% respectively, P=0.00003). Increasing modified Fisher grade was highly correlated with poor outcome and with mortality (P < 0.0001).



Outcome related to modified Fisher grade (left) and Fisher grade (right).

Conclusions

Both Fisher and Modified Fisher grading systems for assessment of blood load on initial CT scan are well correlated with risk of development of delayed ischaemic neurological deficit. Furthermore, both grading systems are highly correlated with clinical outcome. However, the modified Fisher grading system has a higher index of inter-rater agreement.

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