

Clinical and Laboratory Predictors in Spontaneous Subarachnoid Hemorrhage

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ABSTRACT:
OBJECTIVE: To evaluate early prognostic variables in spontaneous subarachnoid hemorrhage (SAH).
DESIGN: Retrospective evaluation of the relation between the initial neurological condition (grading system of Hunt and Hess, Innsbruck Coma Scale), blood glucose level at the time of admission and final outcome.
PATIENTS: The study included 74 consecutive patients with spontaneous SAH, who had been admitted to our neurological intensive care unit between September, 1990, and August, 1991.
RESULTS: Blood glucose levels above 200 mg/dl as well as bad neurological condition on admission were associated with a poor prognosis.
CONCLUSION: In spontaneous SAH there is no difference in the prognostic significance of the Innsbruck Coma Scale (ICS) and the grading system of Hunt and Hess. Blood glucose measurement can be used as a further quick and objective tool for estimation of outcome in SAH.

INTRODUCTION

Unlike other forms of cerebrovascular disease, the incidence of spontaneous subarachnoid hemorrhage (SAH) has not declined during the past years (Garraway et al, 1983; Adams et al, 1984; Toole, Robinson, and Mercuri, 1989). SAH accounts for 6 to 8 percent of all strokes (Garraway et al, 1983). Despite advances in the diagnosis and treatment, the mortality and morbidity of SAH remain high (Locksley, 1966; Adams et al, 1984; Hijdra et al, 1988; Toole, Robinson, and Mercuri, 1989; Rinkel et al, 1991). Early prognostic assessment of patients with SAH is decisive in planning invasive diagnostic and therapeutic procedure. Although various prognostic parameters have been described in the literature (Neil-Dwyer and Cruickshank, 1974; Benedict, Phil, and Loach, 1978; Binder et al, 1979; Hijdra et al, 1988; Spitzer, Thie,

and Kunze, 1988; Rinkel et al, 1991), definitive, predictive parameters do not exist. The aim of our study was to evaluate early prognostic variables, which can be determined easily by clinicians or even by nurses and paramedics, who are not especially trained in neurology.

PATIENTS AND METHODS

We studied 74 patients (33 male, 41 female, mean age 47 years, range 19 to 83) with spontaneous SAH, who had been admitted to our neurological intensive care unit between September, 1990, and August, 1991. SAH was diagnosed by clinical examination and cerebral computerized tomography (CT scan), and spinal tap was not regularly done. Excluded patients were one known diabetic and four patients who had been given intravenous fluids containing dextrose before admission.

For the initial neurological evaluation, we used the grading system of Hunt and Hess (1968) as well as the Innsbruck Coma Scale (ICS), which is well established in the evaluation of traumatic brain injuries (Gerstenbrand et al, 1984; Benzer et al, 1991; Marosi et al, 1991). Blood glucose estimation was performed by glucoseoxidase-peroxydase reaction at the time of admission (2 to 12 hours after the bleeding event). The outcome of patients (at the time of discharge from the intensive care unit) with initial blood glucose levels below 150 mg/dl, between 150 and 200 mg/dl, and above 200 mg/dl, was compared.

RESULTS

Twenty-two out of 69 patients (32 percent) died, 19 of them had presented as Hunt and Hess IV or V and with less than 14 (in most cases below 10) out of 21 possible points in the Innsbruck Coma Scale (Figure 1), respectively. The three remaining patients who presented with a better clinical condition at the beginning died after a fatal rebleeding. All the survivors were Hunt and Hess I to III on admission, using the Innsbruck Coma Scale, as they presented with more than or equal to 14 points (Figure 2).

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**Figure 1:
Innsbruck Coma Scale**

Neurological assessment	Score
Reaction to acoustic stimuli	
Turning towards stimuli	3
Better-than-extension movements	2
Extension movements	1
None	0
Reaction to pain	
Defensive movements	3
Better-than-extension movements	2
Extension movements	1
None	0
Body posture	
Normal	3
Better-than-extension movements	2
Extension movements	1
Flaccid	0
Eye opening	
Spontaneous	3
To acoustic stimuli	2
To pain stimuli	1
None	0
Pupil size	
Normal	3
Narrow	2
Dilated	1
Completely dilated	0
Pupil response to light	
Sufficient	3
Reduced	2
Minimum	1
No response	0
Positive and movements of eyeballs	
Fixing with eyes	3
Sway of eyeballs	2
Divergent	1
Divergent fixed	0
Oral automatisms*	
Spontaneous	2
To external stimuli	1
None	0

* Since oral automatisms occur only in apallic syndrome (vegetative state), the maximum score for patients investigated in our study was 21.

All 13 patients with an initial blood glucose level above 200 mg/dl died. Four out of 10 patients with a blood glucose level between 150 and 200 mg/dl died and three survivors suffered from severe neurological sequelae. Forty-one of the 46 patients (89 percent) with normal initial blood glucose levels recovered completely. Five patients died later, three after a fatal rebleeding (Figure 2).

DISCUSSION

Various parameters were found to be of predictive value for the final outcome in SAH. The initial clinical condition, especially the level of consciousness (Botterell et al, 1956; Hunt and Hess, 1968; Hijdra et al, 1988), the amount of subarachnoid blood on an early computed tomogram (Fisher, Kistler, and Davis, 1988; Kistler et al, 1983; Gurusinghe and Richardson, 1984; Adams et al, 1987; Hijdra et al, 1988), the amount of intraventricular blood (Hijdra et al, 1988), the pattern of blood with angiogram-negative subarachnoid hemorrhage (Rinkel et al, 1991), the blood leucocyte count (Neil-Dwyer and Cruickshank, 1974), and electrocardiographic changes (Spitzer, Thie, and Kunze, 1988) are reported to be prognostic markers.

Hyperglycemia can be observed in various neurological and internal diseases, without diabetes mellitus being present (Hallpike et al, 1971; Knick and Knick, 1985). High blood glucose levels following acute brain injury (Pentelenyi and Kammerer, 1977; Michaud et al, 1991) and cardiac arrest (Longstreth, Diehr, and Inui, 1988) have been associated with poor neurologic recovery. Increased damage after ischemic stroke has been seen in patients with hyperglycemia with or without established diabetes mellitus (Gelmers et al, 1989), but there are only few reports about the relationship between hyperglycemia and the outcome in SAH (Spitzer, Thie, and Kunze, 1988; Berek et al, 1992).

Looking for an easy, quick, objective, and reproducible way of early prognostic assessment in SAH, we used the combination of the clinical condition and blood glucose level at the time of admission. For the clinical evaluation the grading system of Hunt and Hess (1968) has proved to be a useful tool, but a lot of neurological experience is necessary as it lacks clearly defined markers. In contrast, the Innsbruck Coma Scale is based on seven respectively, eight simple indices, which can be tested quickly (Figure 1).

In our study, we could demonstrate that there was no difference in the prognostic significance between the ICS and the grading system of Hunt and Hess. Adding blood glucose estimation to the clinical evaluation, we found a further way of improving the early prediction of prognosis. Our data show clearly that the blood glucose level at the time of admission is highly significant concerning the outcome in SAH ($p < 0.001$, chi-square test). No relationship between blood glucose level and clinical evaluation on admission and the development of complications such as vasospasm, ischemia, hydrocephalus, or rebleeding could be demonstrated.

Concerning the etiology of hyperglycemia in SAH, elevated plasma catecholamines, plasmacortisol, and human growth hormone, possibly as a consequence of hypothalamic dysfunction, are discussed

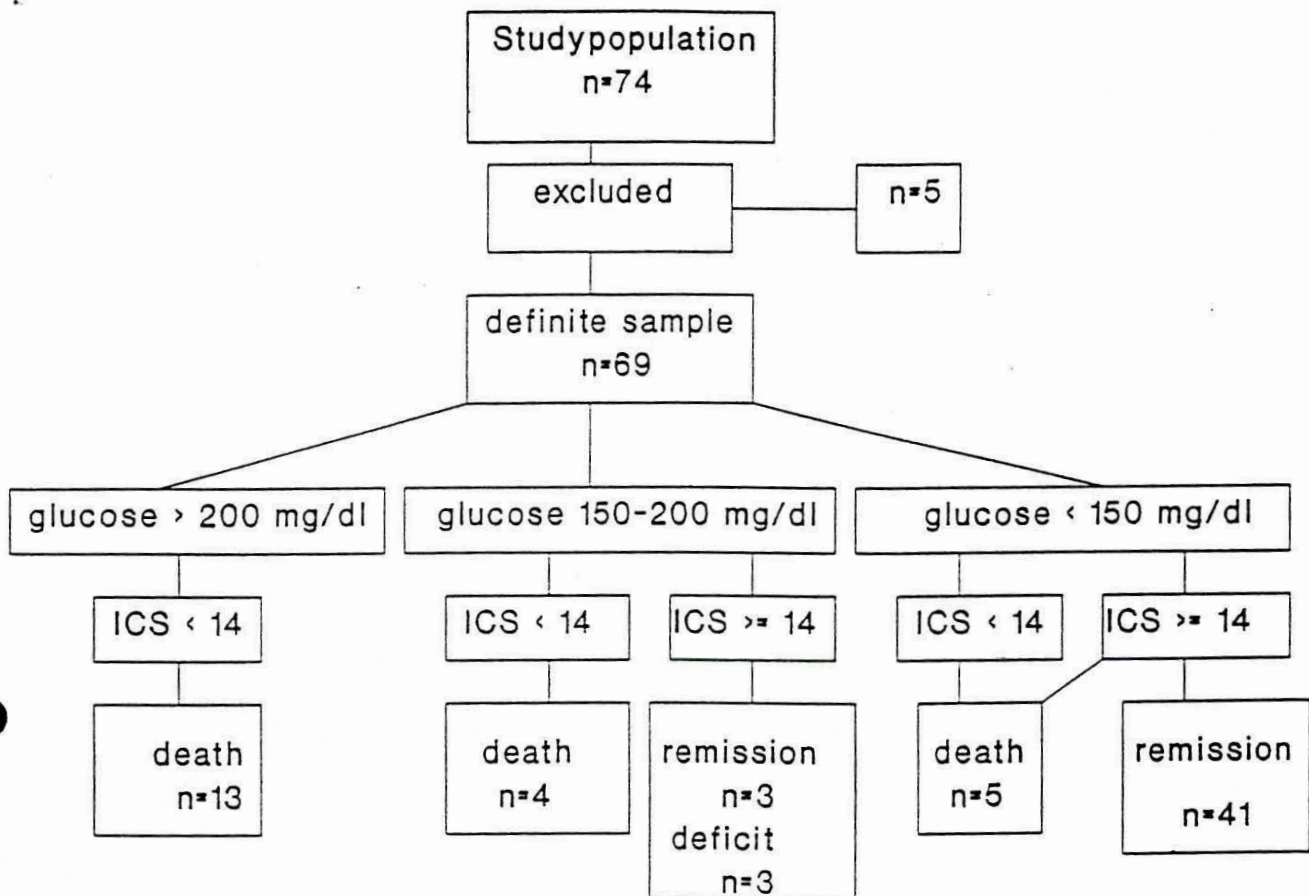


Figure 2:
Prediction of outcome in spontaneous SAH by blood glucose levels and Innsbruck Coma Scale (ICS)

(Hallpike et al, 1971; Neil-Dwyer and Cruickshank, 1974; Benedict, Phil, and Loach, 1978; Spitzer, Thie, and Kunze, 1988).

In conclusion, we think that the combined use of the Innsbruck Coma Scale and blood glucose measurement at the time of admission offers a useful tool of early prognostic estimation in spontaneous SAH.

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Abstract

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