Spontaneous Cerebellar Hematoma: Decision Making in Conscious Adults

Hazem M. Alkosha and Nabil Mansour Ali

■ OBJECTIVE: **To detect predictors of the clinical course and outcome of cerebellar hematoma in conscious patients that may help in decision making.**

■ METHODS: **This study entails retrospective and prospective review and collection of the demographic, clinical, and radiologic data of 92 patients with cerebellar hematoma presented conscious and initially treated conservatively. Primary outcome was deterioration lower than a Glasgow Coma Scale score of 14 and secondary outcome was Glasgow Outcome Scale score at discharge and 3 months later. Relevant data to primary outcome were used to create a prediction model and derive a risk score. The model was validated using a bootstrap technique and performance measures of the score were presented. Surgical interventions and secondary outcomes were correlated to the score to explore its use in future decision making.**

■ RESULTS: **Demographic and clinical data showed no relevance to outcome. The relevant initial computed tomography criteria were used to build up the prediction model. A score was derived after the model proved to be valid using internal validation with bootstrapping technique. The score (0–6) had a cutoff value of ≥2, with sensitivity of 93.3% and specificity of 88.0%. It was found to have a significant negative association with the onset of neurologic deterioration, end point Glasgow Coma Scale scores and the Glasgow Outcome Scale scores at discharge. The score was positively correlated to the aggressiveness of surgical interventions and the length of hospital stay.**

■ CONCLUSIONS: **Early definitive management is critical in conscious patients with cerebellar hematomas and can improve outcome. Our proposed score is a simple tool with high discrimination power that may help in timely decision making in those patients.**

INTRODUCTION

Cerebellar hematoma has witnessed a great improvement during the last century in terms of diagnosis and overall management. With the advent of computed tomography (CT), the radiologic criteria of patients became an integral part of diagnosing and defining the appropriate therapy.[1] Although several CT criteria such as hematoma size,[1-4] degree of fourth ventricular compression,[5] hematoma location,[3,6] and presence of hydrocephalus[7,8] were considered as strong indicators for surgical management of cerebellar hematomas, many investigators have become reluctant to conduct surgical intervention when patients present with a Glasgow Coma Scale (GCS) score of more than 13.[2,3,9] However, the clinical course of cerebellar hematoma is variable, and unexpected rapid deterioration in the conscious level can occur, especially within the first 72 hours.[4,7,10] On the other hand, a group of patients can pass through a favorable course.[1,3,6,9] The aim of this study was to develop a validated risk model for prediction of deterioration among conscious adults with

Key words
- Cerebellar
- Conscious
- Decision making
- Hematoma

Abbreviations and Acronyms
AUROC: Area under receiver operating characteristic
BFI: Bifrontal index
CI: Confidence interval
CSF: Cerebrospinal fluid
CT: Computed tomography
EPV: Events per variable
GCS: Glasgow Coma Scale
GOS: Glasgow Outcome Scale
ICC: Intraclass correlation
INR: International normalized ratio
ROC: Receiver operating characteristic
SCH: Spontaneous cerebellar hematoma
SE: Standard error

Department of Neurosurgery, Mansoura University Hospital, Mansoura, Egypt

To whom correspondence should be addressed: Hazem M. Alkosha, MD [E-mail: hazem_kosha@yahoo.com]

Citation: World Neurosurg. (2017) 102:123-138.
http://dx.doi.org/10.1016/j.wneu.2017.02.133

*Journal homepage: **www.WORLDNEUROSURGERY.org***

*Available online: **www.sciencedirect.com***

cerebellar hematomas and accordingly of a simple score for timely evaluation of patients and decision making.

METHODS

Study Design

This is an observational cohort study, performed through combined retrospective review and prospective data collection, of a 20-year cohort of conscious patients (GCS score 14 and 15) who presented with the diagnosis of cerebellar hematoma. According to the defined primary outcome, patients were divided into 2 groups. Group I included those who remained conscious (GCS score ≤14) until the end of conservative treatment, and group II included those who developed deterioration in the conscious level to a GCS score <14 during the same treatment protocol.

Variables showing significant association with the primary outcome were collected and analyzed as potential predictors. A multivariable logistic regression model was then generated using the dichotomized primary outcome over these independent variables. Then, validation of our logistic regression model was performed by estimating apparent accuracy measurements, followed by internal validation using bootstrap resampling to correct for optimism in accuracy estimates. A simple score was developed for user-friendly bedside assessment. The score was then assessed in terms of interrater reliability, correlation to outcome, and surgical interventions.

Ethical Approval

The study was reviewed and approved by the local committee for medical research, MFM-IRB (code R/16.01.90). Informed written consent was provided by the families of all participants who underwent surgical interventions.

Study Population

Patients were selected from those admitted to the department of neurosurgery with the diagnosis of spontaneous cerebellar hematoma (SCH) between January 1996 and December 2015. Selected cases were adults of both sexes who were treated conservatively until discharge or clinical deterioration (GCS score <14). Among those patients who were eligible, we excluded cases presented in **Table 1**.

Table 1. Criteria of Eligibility to the Study

	n
Inclusion criteria (final patient sample in the study)	
Spontaneous cerebellar hematoma in adults	114
Glasgow Coma Scale score 14 and 15	
Exclusion criteria	
Neurologic deterioration shortly after presentation	2
Hemorrhagic metastasis	1
History of previous stroke with residual deficit	1
Early leave of hospital against medical advice	2
Cases with undocumented conscious level before surgery	9
Cases operated while still conscious (Glasgow Coma Scale score 15 or 14)	7
Final patient sample used for setting the risk model	92

Data Collection

The data were collected retrospectively until November 2010 and then prospectively afterward. The process of data collection passed through 2 parallel lines. The first included collection and assessment of demographic, clinical, and radiologic data in which assessors were blinded to outcome variables. The second included collection of the clinical course and outcome data while blinded to patient demographics, clinical, and radiologic data.

Demographic data included age, sex, residence (urban vs. rural), smoking status, education level (illiterate, ≤12 years, >12 years of education), occupation based on *International Standard Classification of Occupations 08* major groups[11] and marital status (married vs. unmarried). Clinical data included initial symptoms and signs, initial and end point GCS scores, blood pressure, presence of diabetes or any associated cardiac or hematologic health problems, onset of deterioration (for group II), and the length of hospital stay. Systemic hypertension was diagnosed for systolic blood pressure >140 mm Hg and/or diastolic blood pressure >90 mm Hg. End point GCS score was defined as GCS score at the end of conservative treatment in both groups (i.e., before discharge for group I and before surgery for group II). Onset of deterioration was calculated as the interval between the time of presentation to the emergency department and the time of the first recorded GCS score lower than 14 in the follow-up sheet. Clinical outcomes on discharge and 3 months later were assessed using the Glasgow Outcome Scale (GOS).

After initial CT imaging, patients underwent urgent admission to the surgical intensive care unit under strict observation of a neurosurgeon and an intensivist with a nearby ready-to-use mechanical ventilator. Those who remained conscious (group I) were transferred to the regular neurosurgical ward as indicated by the intensivist, whereas those who experienced neurologic deterioration (group II) stayed inside the intensive care unit after the appropriate surgical intervention was performed. All cases were nursed with the head elevated, under strict vital and neurologic monitoring, with the judicious use of brain dehydrating measures and painkillers. Associated medical conditions were treated under supervision of the corresponding specialists.

Features of CT imaging were thoroughly reviewed with evaluation of the different characteristics of hematoma and its mass effects. CT parameters such as hematoma maximum diameter (in millimeters), location (predominantly vermian or hemispheric), fourth ventricle status (normal, distorted, or obliterated), prepontine cistern status (normal or abnormal), bifrontal index (BFI), and the presence of intraventricular hemorrhage were collected for statistical analysis. Normal fourth ventricle was defined as being normal sized, central, and symmetrically patent, and distorted was defined as being effaced, shifted, and/or partially occluded by a clot with cerebrospinal fluid (CSF) density still visible. Occlusion of the fourth ventricle by hemorrhage or compression with absent CSF density was defined as obliterated ventricle (**Figure 1**). The prepontine cistern was evaluated as a 3-limb structure: a horizontal limb between the pons and the