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Characteristics of BAT Score in intracerebral hemorrhage patients at Haji Adam Malik Hospital, Medan

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ABSTRACT

Background and objectives. BAT score can be used in predicting hematoma expansion if CT angiography is not available. The aim of this study was to determine the characteristics of BAT score and also the clinical features in intracerebral hemorrhage patients.

Materials and methods. It was a retrospective descriptive study using medical records on intracerebral hemorrhage patients admitted to Haji Adam Malik Hospital Medan in October 2022-October 2023 using a consecutive sampling method. The clinical features assessed in this study were demography characteristics, outcome, and comorbid disease. BAT score is a 5-point score, which are consist of: 1 point if there is a blend sign, 2 points if there are any hypodensities intrahematoma and 2 points if the initial head CT scan was performed < 2.5 hours of symptom onset. BAT score ≥ 3 correlated with the occurrence of hematoma expansion.

Results. A total of 56 subjects were enrolled in this study and the majority subjects were male with a mean age of 55.1 years old, graduated from senior high school, and had no occupations recently. The majority of patients died in the hospital (51.8%) and the most prevalent comorbidity was hypertension (78.6%). Subjects had less than 3 BAT (54%) scores with the lowest score from the time from onset to Head NCCT less than 2.5 hours (only 8%) and the other components such as the positive blending sign were 62% and any hypodense findings were 52%.

Conclusions. The majority of subjects were male with fatality rate was still high and hypertension as the main comorbid. Most of the subjects have BAT scores less than 3, with the least prevalent component being time from onset to head NCCT. Multidiscipline and teamwork must be coordinated to maximize the early diagnosis and management of stroke hemorrhagic in our settings.

Keywords: hematoma expansion, BAT, intracerebral hemorrhages, blending sign, hypodensities.

Abbreviations:

AVM - Arteriovenous Malformation
CAA - Cerebral Amyloid Angiopathy
CT - Computed Tomography
CTA - Computed Tomography Angiography
GBD - Global Burden of Disease
HE - Hematoma Expansion

HS - Hemorrhagic Stroke
ICH - Intracerebral Hemorrhage
NCCT - Non-contrast Computed Tomography Scan

INTRODUCTION

Hemorrhagic stroke (HS) or known as intracerebral hemorrhage (ICH) is one of the stroke pathologies due to rupture of intracerebral blood vessels [1]. Global burden of disease (GBD) in 2019 estimates that stroke is still the second cause of death and the third cause of disability in the world [2,3]. Based on World Fact Sheet data in 2022, there were nearly 21 million hemorrhagic stroke patients worldwide with 85% of sufferers aged <70 years and around 3 million people died each year [3]. Basic health research data from the Ministry of Health of the Republic of Indonesia showed that there was an increased prevalence of stroke from 2013 to 2018, from 7 to 10.9 per 1000 population per year [4].

Intracerebral hemorrhage can be primary and secondary causes. Primary causes occur in 78% to 88% of cases due to spontaneous rupture of small blood vessels, due to chronic hypertension and cerebral amyloid angiopathy (CAA). Secondary causes result from rupture of vascular abnormalities such as arteriovenous malformation (AVM), aneurysms and cavernomas, and anticoagulants consumption significantly increases the risk of intracerebral hemorrhage, hematoma expansion and mortality [1,5].

Initial hematoma volume and hematoma location are major non-modifiable predictors of 30-day mortality and functional outcomes. Hematoma expansion (HE) is a modifiable factor and has a high predictor value of clinical worsening in patients with ICH [6]. Hematoma expansion is an increase in hematoma above 33% or 12.5 ml on follow-up CT scans that is often found in patients with ICH. Hematoma expansion is reported to occur in 30% of patients with symptom onset of 6 hours and is an independent factor for poor functional outcome [5,6].

Hematoma expansion is a preventable condition, therefore early identification of patients with high risk of active bleeding is important in the management of hematoma expansion [7]. Recently, various neuroimaging markers along with clinical markers such as stroke onset and antiplatelet consumption can help predict hematoma expansion. Neuroimaging markers are found on non-contrast head CT scans, which is the most widely used modality in HS [8]. Spot sign features on CT angiography (CTA) are strong radiologic markers for HE, but most institutions do not routinely perform CTA in ICH [7].

Several tools have been studied to predict hematoma expansion, one of which is using the BAT score. The study from Morotti et al in 2018 developed and validated the BAT score in predicting hematoma expansion in ICH patients with a sensitivity of 0.50 and specificity of 0.89 at a BAT score ≥3 [7]. The BAT score is a 5-point score with score components: blend sign (1 point),

any hypodensities (2 points) and onset until head CT scan <2.5 hours (2 points) [7]. The study of Bakar et al. in 2020 concluded that BAT score, Glasgow Coma Scale (GCS) and intraventricular hemorrhage (IVH) can predict the occurrence of hematoma expansion and mortality in the early stages of ICH patients (p = 0.001) [9]. Yu et al in 2019 compared the BAT score and spot sign on CTA in ICH patients, the results of multivariate analysis showed that both BAT score ≥3 and the presence of spot sign correlated with the occurrence of hematoma expansion with a sensitivity of BAT score ≥3 was 0.41 and specificity 0.92. BAT score can be used in predicting hematoma expansion if CTA is not available [10]. Research on BAT score is still very limited, especially in Indonesia, so the aim of this study is to determine the BAT score and also the clinical features in ICH patients.

MATERIALS AND METHODS

This study was descriptive observational with a retrospective study using secondary data sources from medical records on ICH patients admitted to Haji Adam Malik Hospital Medan in October 2022-October 2023. The ethic approval has been obtained from the Faculty of Medicine, North of Sumatera University before starting collect the data. Informed consent was waived due to the retrospective nature of the study. The inclusion criteria in this study include subjects aged ≥18 years and have been diagnosed with intracerebral hemorrhage based on a non-contrast head CT scan performed at Haji Adam Malik General Hospital Medan. Exclusion criteria in this study were: head injury, tumor, and hemorrhagic transformation of ischemic stroke. The sampling was done by consecutive sampling method.

The clinical features assessed in this study were age, sex, education, occupation, outcome, and comorbid disease. Imaging data in this study include BAT score using Radiant Dicom Viewer 64-bit software. BAT score is a 5-point score, which consists of: 1 point if there is a blend sign, 2 points if there are any hypodensities and 2 points if the initial head CT scan was performed <2.5 hours of symptom onset. Blend sign is a hypodense area adjacent to a hyperdense area which is a hematoma and a clear boundary between the 2 areas with a density difference of at least 18 Hounsfield units (HU). Intrahematoma hypodensities were defined as a hypodense region inside the hemorrhage with any shape and dimension and lack of connection with the surrounding brain parenchyma [7].

The research data were analyzed statistically using SPSS software and will be presented in the form of frequency tables, percentages and standard deviations using descriptive statistics.

RESULTS

The total of 56 subjects were enrolled in this study. The majority of intracerebral hemorrhage patients were male with a mean age of 55.1 years old, graduated from senior high school, and had no occupations recently (Table 1). The majority of patients died in the hospital (51.8%) and the most prevalent comorbidity was hypertension (78.6%) (Table 2).

Table 3 shows that the majority of subjects had less than 3 BAT (54%) scores with the lowest score from the time from onset to Head NCCT less than 2.5 hours (only 8%). The other components such as the positive blending sign were 62% and any hypodense findings were 52%.

DISCUSSION

Becoming one of the highest causes of mortality among non-communicable diseases, the diagnostics and management of hemorrhagic stroke (HS) must be considered among all neurologists and neurosurgeons [11]. However, a study in Korea showed a decreasing trend of mortality among HS [12] while the Singapore data showed an increasing trend among Malay and Chinese ethnicities and a fluctuating trend in Indian ethnic [13]. This study showed 51.8% mortality rate which is higher compared to the Singapore study that showed only 25.7% of HS patients died in 30 days of admissions day [13]. The data from another study in Surabaya also showed that the mortality among intracerebral hemorrhage as the most common subtype of HS was around 42% with the main causes related to mortality were duration of hospitalizations and the bleeding volume [14].

Few factors were identified as risk factors for HS. This study showed the male predominant gender in HS incidence (51,8%) and it was in line with the recent studies that showed males have a higher incidence of HS compared to females [11,13]. Age also has a significant impact on developing HS and is predisposed as the significant factor of mortality [11-13]. This study showed that the mean age of HS was 55.1 years old. This was younger than the mean age in Singapore (64.4 years)[3] and Canada (71.3 years) [11]. Yet, the Korean data showed that the age group of 50-69 years old showed the highest mortality amongst all groups in male patients, while in female patients, it was over 70 years old [12]. Comorbidities have been discussed as a significant contributor to the incidence of HS and related to higher mortality [15-17]. Along with this study, hypertension was the main risk factor for developing HS and significantly related to mortality [11,17]. Other factors such as smoking, coronary artery disease, diabetes mellitus, atrial fibrillation, dyslipidemia, previous stroke, cancers, and infections might contribute to the incidence of HS [11,15-18].

Spontaneous intracerebral hemorrhage (ICH) is the second most common subtype of stroke with an estimated incidence was 2 million people around the world [1]. ICH itself accounted for 10-20% of total stroke incidence and this number varied depending on the countries. Data showed

that the incidence of ICH was twice as high in low-middle countries compared with high-income countries [19].

Almost 30% of Spontaneous ICH patients had hematoma expansions (HE) that strongly related to unfavorable outcomes. Therefore, identifying the higher risk for HE is substantial to reduce the mortality among ICH. Several indicators of HE can be identified based on the non-contrast Head CT Scan. BAT Score was composed of blend sign, any hypodensity, and time of onset to NCCT. A recent study showed that a score of more than 3 points was significantly predicted of HE [10]. This study showed that 46% of subjects had a BAT score ≥3 with configurations such as: 31% of subjects had a positive blending sign, 26% of subjects had any hypodense, and 4% of subjects had time from onset to NCCT less than 2.5 hours.

Morotti's study explained this score further. HE is defined as hematoma growth >6 mL or >33%. The study showed that each variable has a reliable prediction score of HE with a p-value <0.05. The odds ratio of each variable mentioned; 3.09 (95%CI: 1.49-6.40) for blend sign; 4.54 (95%CI: 2.44-8.43) for any/absence of hypodense; 3.73 (95% CI: 1.86-7.51) for time admissions to NCCT. The univariate analysis showed that the percentage of subjects who had blend signs was 27.4%, heterogenous density was 40.3%, and less than 2.5 hours of time admissions to NCCT were 58.1% [7]. Unfortunately, it is far different from our data. In developing countries, there is a lack of facilities and low citizen awareness of ICH contribute to this phenomenon.

The recent journal also showed the same findings that the BAT score is a reliable score for predicting HE and mortality risk [9]. Further, other studies calculate the component of BAT score separately. Li et al showed that the Blend sign had 39.3% of sensitivity and 95.5% of specificity in predicting HE [6]. Boulouis et al. also showed that hypodensities have 62% sensitivity and 77% specificities of HE [20]. Generally, Bakar et al stated that imaging has a substantial role in predicting HE as the crucial factor for determining outcomes in ICH patients [9].

CONCLUSION

Epidemiology data of intracerebral hemorrhage in Haji Adam Malik General Hospital showed that the majority of subjects were male with a mean age of 55 years old. The case fatality rate is still 51.8% which is categorized as higher than other countries in Southeast Asia. The more prevalent comorbid is hypertension. The majority of patients have BAT scores less than 3, with the least prevalent component being time from onset to head NCCT. Multidiscipline and teamwork must be coordinated to maximize the early diagnosis and management of stroke hemorrhagic in our settings.

Conflict of interestl: The authors declare no conflict of interest

Authors' contributions:

Conceptualization, C.A.A; methodology, C.A.A.; software, S.O.S; validation, C.A.A. and S.O.S; formal analysis, C.A.A and S.O.S; investigation, S.O.S; resources, C.A.A. and S.O.S; data curation, S.O.S; writing-original draft preparation, S.O.S.; writing-review and editing, C.A.A.; visualization, C.A.A.; supervision, C.A.A.; project administration, S.O.S; funding acquisition, S.O.S. All authors have read and agreed to the published version of the manuscript.

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TABLES

Table 1. Demographic characteristics of haemorrhagic stroke patients in Haji Adam Malik Hospital Medan

Demographic Characteristics	n = 56 (%)
Gender, n (%)	
Female	27 (48,2)
Male	29 (51,8)
Age, years	
Mean (SD)	55,1 (14,5)
Median (Min-Max)	57,5 (19 – 82)
Educations, n (%)	
Junior High School	3 (5,4)
Senior High School	42 (75,0)
Universities	11 (19,6)
Occupations, n (%)	
Officer	7 (12,5)
Enterpreneur	19 (33,9)
No occupations	30 (53,6)
Outcomes in hospital discharge, n (%)	
Dead	29 (51,8)
Alive	27 (48,2)

SD : standard deviation; Min-max : minimum and maximum; n : number of subjects

Table 2. Comorbidities related to hemorrhagic stroke in Haji Adam Malik General Hospital

Comorbidities	n = 56
Hypertension n (%)	
Yes	44 (78,6)
No	12 (21,4)
Diabetes Mellitus, n (%)	
Yes	4 (7,1)
No	52 (92,9)
Cardiac Disease, n (%)	
Yes	5 (9,1)
No	51 (90,9)
Dyslipidemia, n (%)	
Yes	1 (1,8)
No	55 (98,2)
Smoking, n (%)	
Yes	12 (21,4)
No	44 (78,6)
Renal Disease	
Yes	2 (3,6)
No	54 (96,4)
Hemostatic Disease	
Yes	9 (16,1)

Comorbidities	n = 56
No	47 (83,9)

n : number of subjects

Table 3. BAT score characteristics in Haemorrhagic stroke in Haji Adam Malik General Hospital

NCCT characteristics	n = 50
BAT Score, n (%)	
≥3	23 (46,0)
<3	27 (54,0)
Blending Sign, n (%)	
Yes	31 (62,0)
No	19 (38,0)
Any Hypodense, n (%)	
Yes	26 (52,0)
No	24 (48,0)
Time from Onset to Head NCCT, n (%)	4 (8,0)
Less than 2.5 hours	46 (92,0)
More than 2.5 hours	

NCCT : non-contrast Head CT scan; n : number of subjects