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Correlation between National Institute Health Stroke Scale and QT Dispersion In Acute Ischemic Stroke

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ABSTRACT

Introduction: Stroke is a global health problemwhose incidence is increasing every year throughout the world. Stroke can cause disorders of the autonomic system in sufferers including cardiovascular disorders. Several studies examining cardiovascular disorders after acute stroke using electrocardiography (ECG), one of which is the QT Dispersion. The aim of this study was to examine the relationship between the National Institute of Health Stroke Scale and the QT Dispersion.

Method: This research is analytic correlation with cross-sectional design. The study sample consisted of 50 acute ischemic stroke patients. QT Dispersion were assessed based on the results of the ECG examination on the first day of treatment. Stroke outcome assessment using the NIHSS score was assessed on the first day of treatment.

Results: The mean age of the 50 subjects is 57,28±12,216. The majority were male (64%), the majority were Batak (72%), 58% Subjects graduated fromsenior high school and the majority works as housewives 32%. The mean NIHSS value obtained was 8,74±6,599.81 and the mean QTd value was 142,40±73,250 ms. The most common infarct site in this study were basal ganglia (21%). There was a significant correlation between NIHSS scores and QTd in acute ischemic stroke patients ($r= 0,668$, $p<0.05$).

Conclusion: There was a significant relationship between NIHSS scores and QT dispersion in acute ischemic stroke patients ($p<0.05$).

Keywords

QT Dispersion, NIHSS, Acute Stroke, ECG

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INTRODUCTION

Stroke is a neurological syndrome causing global health problems with high mortality and comorbidity rates.[1] Data from the World Health Organization (WHO) in 2017 showed that stroke is the number one cause of death in Indonesia, it was estimated that around 19.79% of deaths in Indonesia were caused by stroke.[2] Various autonomic complications can occur after a stroke, including cardiovascular, respiratory, sudomotor and sexual dysfunction complications.[3] Cardiovascular complications are the second leading cause of death in stroke patients.[4] Lesions in the central nervous system (CNS) can cause changes in cardiovascular system and autonomic system which will later manifest in changes in the patient's heart rate and electrocardiography (ECG). [5-7] ECG changes that can be recorded in patients suffering from acute cerebrovascular events include lengthening of the QT interval, QT dispersion (QTd), wave inversion T, pathological Q, ST Segment Deviation, AV Block and T segment changes.[5-9] QTd is defined as the difference between the maximum QT interval minus the minimum QT Interval on a 12 lead ECG. QTd can describe cardiac repolarization abnormalities and can be used as one of the prognostic markers in ischemic and hemorrhagic stroke patients.[9,10] Research by Ozturk et al in 2019 stated that there was a relationship between NIHSS and QTd. Acute ischemic stroke can cause changes in repolarization parameters such as QTc and QTd. QTd is believed

to be a marker of depolarization homogeneity and serves as a predictor of sudden cardiac death and death in acute ischemic stroke patients.[11] QTd is a marker that can be easily measured on an ECG and has clinical value that can help in the daily management of acute stroke, however the use of QTd is still controversial and research is still relatively small. based on this issue, hence the reason researchers want to know the correlation of QT Dispersion with the National Institute of Health Stroke value. Scale (NIHSS).

METHOD

It was analytic observational study with cross-sectional design using primary data source on hospitalized patients at H.Adam Malik General Hospital Medan and North Sumatra University Hospital in March 2022-November 2022. This study got agreement from Committee Local Health Ethics and Research.

Patients were included if aged ≥18 years old and diagnosed with acute stroke within 48 hours of symptom onset. The diagnosis of stroke was based on persistent neurological deficits and confirmation by computed tomography (CT) and old and willing to participate in study by informed consent. Exclusion criteria were as follows: (1) Patients with a history of previous heart disease (coronary heart disease, heart valve disease, bundle branch block, atrioventricular block, arrhythmia and cardiomyopathy); (2) recurrent stroke patients (3) Patients who were taken medication known to affect repolarisation parameter on the ECG, i.e., digoxin, antiarrythmic drugs, phenothiazines, tricyclic antidepressant, lithium carbonate, erythromycin, theophylline, levodopa, etc; (4) Subjects with T waves on the ECG results cannot be assessed; (5) Patients with electrolyte imbalance (calcium and potassium). Sampling was carried out by consecutive sampling method on 50 acute stroke patients with 48 hours onset.

Acute Ischemic stroke patients within at least 48 hours of onset confirmed by the CT Scan and underwent through blood examination, ECG and NIHSS Score was calculated at the time patient admited to hospital. The QT dispersion was calculated at the time of the admission of patients on a 12 lead ECG. QT dispersion is the difference between maximum and minimum QT interval on the 12 lead ECG. The routine hematological, biochemistry and electrolytes tests were checked. National Institute of Health Stroke Score (NIHSS) was calculated at the time of the admission. Data study were analyzed by using SPSS software and will served in form table frequency. To evaluate association between NIHSS score with QT Dispersion, Pearson test was used.

RESULTS

The study included 50 patients (male/female = 32/18) with acute stroke who fulfilled inclusion criteria. The mean ± SD ages for the study group was 57.28 ± 12.216 years. Most of study participants were Batak (72%), housewives (32%) and had a high school education level (58%). The mean QTd was 142,40 ±73,250. The mean NIHSS Score was 8,74±6.599 (Table 1).

Characteristics of infarct locations can be seen in table 2. Among 50 patients who underwent CT Scan examinations, the infarction location were divided into 9 groups. The basal ganglia, parietal lobe, temporal lobe, frontal lobe, occipital, brainstem, cerebellum, internal capsule, and no lesion were found. The most common infarction lesion were found in basal ganglia 21 (42,0%).

Table 3. showed the relationship between the National Health Institute of Health Stroke Scale and QT Dispersion in acute ischemic stroke patients using the Pearson correlation test, this was because the normality test of the data was normally distributed. There is a significant relationship between NIHSS and QT Dispersion with a strong correlation strength between NIHSS and QT Dispersion and a positive direction of correlation ($r = 0.668$, $p = <0.001$).

DISCUSSION

Based on demographic data in this study, The mean ± SD ages for the study group was 57.28 ± 12.216 years. These results are relevant to a study by Nawaz et al in 2019 shown the largest group of this study aged 50 – 60 years old (55.8%).[12] The incidence of stroke increased within age. After the age 55 years old the incidence

doubled every decade. This was related to aging process causing the function declining, including the blood vessels in the brain. Blood vessel became inelastic, especially the intima. The blood vessel became narrow causing disrupton blood flow to the brain.[13]

The majority sex in this study were male (64,0%). These results are relevant to a study by Gultom et al in 2022 which reported that the sex male was the most common in acute ischemic stroke patients (60%).[14] This difference may be caused by differences in sex steroid hormones. Sex steroid hormones in cerebral vasculature have the ability to alter vascular reactivity and can modulate blood flow. Arteries in mend tend to constrict more in response to pressure compared to arteries in women.[15]

Table 1. Demographics Characteristics of Subjects

Characteristics Demographics	n = 50
Age Mean ±SD	57,28±12,216
Gender n, n (%)	
Male	32 (64,0)
Female	18 (36,0)
Tribe, n (%)	
Batak	36 (72,0)
Java	9 (18,0)
Malay	4 (8,0)
Tamil	3 (2,0)
Education, n (%)	
Junior High School	3 (6,0)
Senior High School	29 (58,0)
College	18 (36,0)
Occupation, n (%)	
Housewives	16 (32,0)
Private employees	11 (22,0)
Self-employed	3 (6,0)
Civil servants	4 (8,0)
Retiree	14 (28,0)
Farmer	2 (4,0)
QT dispersion (mean±SD)	142,40 ±73,250
NIHSS (mean±SD)	8,74±6.599
NIHSS Score Groups	
Mild (0-4)	16(32,0)
Moderate (5 – 15)	26 (52,0)
Severe (>15)	8 (16,0)

Table 2. Location Of Cerebral Infarction

Characteristics of CD4 Levels	n = 50
Basal Ganglia	21 (42,0%)
Parietal Lobe	7 (14,0%)
Temporal Lobe	3 (6,0%)
Frontal Lobe	3 (6,0%)
Occipital Lobe	2 (4,0%)
Brainstem	4 (8,0%)
Cerebellum	1 (2,0%)
Internal Capsule	6 (12,0%)
No Lession were found	1 (2,0%)

Table 3. Correlations of NIHSS Score and QTd

	QT Dispersion
Skor NIHSS	r = 0,668
	p = 0,0001
	n = 50

* Pearson Correlation test

The majority of subject tribe were batak (72%). These results relevant to Gultom et al in 2022 which reported 74.3% patients were batak tribe. Several factors were associated within the high incidence of stroke in the batak ethnic group . Research by Tambunan in 2019 stated that batak tribe has several risk factors that caused high stroke rates, including the daily food consumed by batak ethnic group was saltier, frequent consumption of fatty foods, and consumption of alcohol drink. These factors also triggers the high incidence of hypertension , hypercholesterolemia, and diabetes mellitus which was the risk factors of stroke.[16]

The most common infarct location in this study was the basal ganglia. A total of 21 subjects (42%) had the infarction location in the basal ganglia. This research is in line with research by Bhargava and Singh in 2019 which found that the location where most strokes occur is the basal ganglia around 62%.[17] Disorders of the basal ganglia causing disturbances in ECG changes. Features of ECG changes that can be found in Bhargava and Singh's research on basal ganglia stroke include T inversion and QTc prolongation.[17,18] Research by Cheng et al in 2017 found that infarcts in the basal ganglia had a higher incidence of paroxysmal atrial fibrillation. An increase in the sympathetic nervous system and vagus nerve due to infarction in the basal ganglia causes paroxysmal atrial fibrillation.[19] The theory showed the nervous system that regulates the heart involves the middle cerebral artery region or the anterior cingulate cortex. Damage to blood vessels in this area causes cardiac arrhythmias due to disinhibition of the insular cortex and leads to increased control of the sympathetic nervous system.[17]

Based on statistical analysis using the Pearson correlation test on 50 acute ischemic stroke subjects, the results showed a significant relationship between NIHSS and QT Dispersion $p = 0.001$ ($p<0.05$) and strong correlation strength with $r = 0.668$. The results of this study are relevant to Rahar et al in 2016 who compared QTd and QTc between acute onset stroke patients under 24 hours and healthy subjects. The results showed that QTd and QTc were higher when compared with the control group, namely (87.30 ± 24.42 vs. 49.60 ± 08.79 ms; $P < 0.001$) and (97.53 ± 27.36 vs. 56.28 ± 09.86 ms; $P < 0.001$).[5] Other research,

namely Hromadka et al's research in 2016 found QTc prolongation in acute ischemic stroke patients at 48 hours of onset with $p <0.0002.27$. Ozturk et al's research in 2019 found a relationship between QTd and NIHSS with $r = 0.257$ and $p < 0.042.28$ QT Dispersion defined as the difference between the maximum QT interval minus the minimum QT interval on a 12-lead ECG.[18] Increased QT is a marker of myocardial repolarization and can cause ventricular arrhythmias and cause sudden cardiac death.[11] QTd can describe cardiac repolarization abnormalities and can be used as a prognostic marker. in ischemic and hemorrhagic stroke patients.[9,10]

Changes in the autonomic system found in patients with acute ischemic stroke. The heart is influenced by the Central Autonomic Network (CAN) which consists of the insula, ventromedial prefrontal cortex, anterior cingulate cortex, amygdala, stria terminalis, paraventricular, hypothalamus, periaqueductal gray matter of the mesencephalon, lateral pons colliker-Fuse region, tractus solitaries nucleus, ventrolateral medulla and ambiguous nucleus. Cardiovagal impulses originate from parasympathetic preganglionic neurons located in the nucleus ambiguus and via the vagus nerve innervate the heart.[20] Ischemic stroke causing changes in the central autonomic nervous system which is responsible for the regulation of the autonomic system of the heart and causing an increase in catecholamines. A prolonged increase in serum catecholamines causing cardiotoxicity which will cause edema, transient fibrosis, inflammation and contraction necrosis bands.4 This will cause disruption of repolarization and will cause transient ECG changes, especially 12 to 48 hours after onset.[21] By Therefore, it can be concluded that there is a relationship between the central nervous system and the cardiovascular system during an acute stroke.[22]

The presence of ventricular arrhythmias is associated with prolongation of the QT interval.[23] Prolongation of the QT interval will affect QTd.[18] QTd is a popular marker currently used to assess the presence of heterogeneity in ventricular repolarization.[22] QTd is defined as the difference between the maximum QT interval minus the minimum QT interval in 12 ECG leads.[24] QTd can describe abnormalities in cardiac repolarization and can be used as a prognostic marker in ischemic and hemorrhagic stroke

patients.[9,10] This is supported by several studies which reveal that patients who experience acute cerebrovascular events show an increase in QTd.[5,24]

This study shows that in patients with acute ischemic stroke, there is a strong correlation between NIHSS and QTd values. This is in accordance with several theories above which stated that patients with acute ischemic stroke, especially those with severe stroke, have ECG disturbances. This disorder can be in the form of an imbalance of depolarization and repolarization of the heart ventricles. This is also an indication that there is an autonomic system disorder that occurs in acute ischemic stroke patients. Although several other tests are needed to confirm the presence of ventricular or atrial arrhythmias, the results of this study show that the QTd value can be a strong predictor to help clinicians predict the presence of heart rhythm disturbances in acute ischemic stroke patients, so that better treatment can be carried out.

CONCLUSION

This study has limitations, this study only analyzed several ECG components such as QT interval, QRS duration and heart rate and did not analyze other components such as ST segments, q waves, p waves. This study also, didn't do other examinations to rule out the presence of of other heart abnormalities that could be influenced by acute ischemic stroke.

DECLARATIONS

Ethics approval and consent to participate. Permission for this study was obtained from the Ethics Committee of Universitas Sumatera Utara and Haji Adam Malik General Hospital.

CONSENT FOR PUBLICATION

The Authors agree to publication in Journal of Society Medicine.

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COMPETING INTERESTS

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors significantly contribute to the work reported, whether in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas. Contribute to drafting, revising, or critically reviewing the article. Approved the final version to be published, agreed on the journal to be submitted, and agreed to be accountable for all aspects of the work.

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