The relationship between prolonged QT interval and acute stroke in Tikrit teaching hospital

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Abstract

The QT interval is closely related to ventricular action potential and is a good noninvasive measure of ventricular repolarization and myocardial homogeneity. Prolonged QT interval has been reported to be associated with higher mortality in stroke patients. The aim of this study is to asses whether QT interval is prolonged in patients with acute stroke, and whether this prolongation if present is related to the type, location, and size of stroke. The study included 60 patients with acute stroke admitted to Tikrit teaching hospital from July 2011 to February 2012 and 12 leads ECGs were recorded at the time of admission, to measure the corrected QTc interval (QTc manual and QTc automated). A 30 age matched individuals (control group) were included for comparison. The QTc interval measurement was significantly longer in patients with acute stroke than control group. The QTc interval was significantly higher with big infarct or large hemorrhage than small lesions. There was no significant difference between right and left sided stroke regarding QTc interval values. It was concluded that QT interval was prolonged in acute stroke and this prolongation was related to the size but not the type or location of stroke.

Introduction

Acute stroke is defined as rapidly onset of clinical signs of focal brain dysfunction lasting more than 24 hours or leading to death with no apparent cause(1,2).

There are number of electrocardiographic (ECG) changes that well known to appear during acute stroke like ST and T wave changes, which seem to be due to involvement of autonomic cardiac control centers. QT interval is closely related to ventricular action potential and is a good noninvasive measure of ventricular repolarization and myocardial homogeneity(3,4).

The rate related, corrected QT (QTc) interval can be calculated as $\frac{QT}{\sqrt{R-R}}$ (Bazzett's formula) and normally is ≤ 440 milliseconds(4). Prolonged QT interval is a predictor of serious ventricular tachyarrhythmias and sudden cardiac death in patients with ischemic heart disease(5,6), but some new studies showed that prolonged QT interval has been associated with higher mortality in stroke patients(7,8,9). The prognostic importance of QT interval in acute stroke is still underestimated in our locality. The aim of this study is to assess whether QT interval is prolonged in patients with acute stroke and whether this prolongation if present is related to the type, location and size of stroke.

Patients and methods:

Patients group: 60 patients, who were admitted to Tikrit teaching hospital within 24 hours of onset of stroke during the period from July/2011 to February/2012.

Control group: 30 age matched individuals who were free from cardiovascular or

neurological disease, were included for comparison.

Exclusion criteria: patients presenting with the following conditions were excluded from the study (10,11):

Transient ischemic attack.

Ischemic or valvular heart disease, heart failure, arrhythmias or cardiomyopathy.

Patient taking these medications: digoxin, antiarrhythmic drugs, phenothiazine, tricyclic antidepressant drugs and macrolides antibiotics.

ECG reveals a bundle branch block or left ventricular hypertrophy.

Abnormal serum potassium or calcium concentration.

ECG recording: A 12 leads ECGs were recorded to the patients at the time of admission to hospital by using ECG machine (FX-7102 version 2, Fukuda Denshi, Japan) at a speed of 25 mm/s and amplitude of 10 mm/mV. The QT interval was measured from the onset of QRS deflection to the end of the T wave, the point of the return of T wave to the isoelectrical line, or the nadir between T and U waves(12,13). QT interval was measured manually in milliseconds (ms). Three successive QT intervals were measured in each lead and the mean was accepted as the measurement for that lead. This QT interval was corrected (QTc) for heart rate by using Bazzett's formula (14)(QTc manual). Automated QT and corrected automated QT (QTc automated) intervals were obtained from ECG recorded data paper.

Neurological assessment: A complete neurological examination and brain imaging by CT scan or MRI were performed to all patients at the time of admission. In this study patients with ischemic stroke classified according to Oxford community stroke project classification as following (15):

Total anterior circulation infarct (TACI): A triad of hemiparesis (or hemisensory loss), dysphasia (or other higher cortical dysfunction) and homonymous hemianopia.

Partial anterior circulation infarct (PACI): Present with only two of the features of TACI or isolated dysphasia.

Posterior circulation infarct (PCI): Patients with brain stem or cerebellar signs and/or isolated homonymous hemianopia.

Lacunar infarction did not include in this study. Patients with hemorrhagic stroke were classified according to Afsar *et al* and Chung *et al* (11,16) into:

Large hemorrhage: > 33 mm in diameter, with or without ventricular extension or subarachnoid hemorrhage.

Small hemorrhage: ≤ 33 mm in diameter.

Statistical analysis: analysis was performed using SPSS version 12.0 software program. The data were reported as mean ± SD and frequencies expressed as percent. The unpaired and paired t tests were used to compare two groups of variables. ANOV test was used to compare QTc interval values among subtypes of ischemic stroke. The probability value($P < 0.05$) was considered to be statistically significant.

Results

There were 60 patients with acute stroke (patients group) with mean age of 63.6 ± 10.2 years and 28 (46.7%) patients were males. There were 47(78.3%) patients had ischemic and 13(21.7%) patients had hemorrhagic stroke.

The control group included 30 individuals with mean age of 60.5 ± 9.7 and 12 (40%) of them were males. The QTc interval measurements (QTc manual and QTc automated) were significantly longer in patients group than

control group (Table 1). However there was no significant difference between manual and automated assessment of QTc interval in both groups (Table 2).

The QTc interval measurements were found to be significantly higher in TACI and PACI than PCI in comparison subtypes of ischemic stroke (Table 3), and being significantly greater with large rather than small hemorrhagic stroke (Table 4). There was no significant difference between the location of stroke (right or left side) diagnosed by CT scan or MRI and different values of QTc interval (Table 5).

Discussion

The present study revealed a high agreement between machine and manual QTc interval measurement, therefore Bazzett's formula is still a useful method for evaluation of this interval(13,14,17). The QTc interval of patients with acute stroke was significantly higher than control group, considering exclusion of concomitant cardiac disease, that prolongation may reflect the acute disturbances of central nervous system function (11,17), which may leads to increase catecholamines secretion and sympathetic over activation (18,19). However, the QTc interval prolongation is also related to the size of lesion in the brain, being significantly longer with big infarct or large hemorrhage than small lesions, which might be due to wide involvement of cardiovascular autonomic control centers in the brain(3).

Other previous studies showed a greater QTc interval prolongation with insular involvement. Insula is the cortex of the brain that lies at the base of Sylvian fissure, it affected by proximal middle cerebral artery occlusion and associated with greater stroke severity(20,21). Moreover, the present study revealed no significant correlation between the location of stroke (right or left side) and QTc interval measurements, which seems to be due to that cardiovascular autonomic innervation come from the two cerebral hemispheres(3,19,22).

It was concluded that QT interval was prolonged in acute stroke and this prolongation was related to the size but not to the type and location of stroke. Therefore, more studies and follow up are recommended to explore if the prolonged QT interval worsen the prognosis of stroke patients.

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Table 1. The basic characteristics of patients studied

Variables		Patients group (n:60)	Control group (n:30)	P value
Age		63.6 ± 10.2	60.5 ± 9.7	>0.05
Sex		M 28(46.7%) : F 32(53.3%)	M 12(40%) : F 18(60%)	>0.05
Ischemic stroke: n:47(78.3%)	TACI	16(34%)	----------	-------
	PACI	28(59.6%)	----------	-------
	PCI	3(6.4%)	----------	-------
Hemorrhagicstroke: n:13(21.7%)	Large	9(69.2%)	----------	-------
	Small	4(30.8%)	----------	-------
QTc manual(ms)		467.2 ± 47.8	426.03 ± 28.5	<0.05
QTc automated (ms)		462.5 ± 37.9	422.2 ± 29.7	<0.05
Fasting blood sugar (mmol/L)		8.4 ± 3.1	6.1 ± 2.3	>0.05
Blood urea (mmol/L)		7.5 ± 2.4	6.2 ± 3.1	>0.05
Serum creatinine (µmol/L)		88.5 ± 17.9	75.3 ± 3.2	>0.05
Serum sodium (mmol/L)		140.1 ± 7.6	142.3 ± 4.3	>0.05
Serum potassium (mmol/L)		4.2 ± 0.4	4.7 ± 0.6	>0.05
Serum calcium (mmol/L)		2.2 ± 0.1	2.3 ± 0.2	>0.05

Table 2. The difference between manual and automated QTc interval measurements in patients studied

QTc interval / Groups	QTc manual (ms)	QTc automated (ms)	P value
Patients group (n: 60)	467.2 ± 47.8	462.5 ± 37.9	>0.05
Control group (n: 30)	426.03 ± 28.5	422.2 ± 29.7	>0.05

Table 3.QT interval measurements in subtypes of ischemic stroke

Ischemic stroke(47) / QTc interval	TACI n: 16(34%)	PACI n: 28 (59.6%)	PCI n: 3 (6.4%)	P value
QTc manual (ms)	474.25 ± 36.6	471.107 ± 46.1	415.67 ± 33.4	<0.05
QTc automated (ms)	469 ± 31.6	464.32 ± 32.7	405.66 ± 11.6	<0.05

Table 4. QTc interval measurements in subtypes of hemorrhagic stroke

Hemorrha. stroke(13) / QTc interval	Large n: 9 (69.2%)	Small n: 4 (30.8%)	P value
QTc manual (ms)	498.78 ± 46.1	445.25 ± 30.7	<0.05
QTc automated (ms)	492.67 ± 48.4	431.5 ± 38.9	<0.05

Table 5. QT interval measurements according to the location of stroke by CT or MRI

QTc interval (ms) / Location		Right side	Left side	P value
Ischemic stroke: 47 (78.3%)	QTc manual	n: 23 (48.9%) 468.82±51.6	n: 24 (51.1%) 465.08±41.2	>0.05
	QTc automated	457.82±36.8	460.317±33.7	>0.05
Hemorrhagic stroke: 13 (21.7%)	QTc manual	n: 6 (46.2%) 493.33±39.1	n: 7 (53.8%) 464.428±35.0	>0.05
	QTc automated	488±59.6	454.714±53.3	>0.05

العلاقة بين استطالة فاصل QT والسكتة الدماغية الحادة في مستشفى تكريت التعليمي

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خلاصة

فاصل QT ذو علاقة وثيقة مع عمل الجهد الكهربائي البطيني، وهو مقياس جيد غير اجتياحي لعودة الاستقطاب البطيني وتجانس عضلة القلب. وقد سجّل ترافق استطالة فاصل QT مع ارتفاع معدل الوفيات في مرضى السكتة الدماغية. ان الهدف من هذه الدراسة هو تقييم ما اذا كان هنالك استطالة في فاصل QT لدى المرضى المصابين بالسكتة الدماغية الحادة، وان كانت هذه الاستطالة موجودة هل لها ارتباط بنوع وموقع وحجم السكتة الدماغية. تضمنت هذه الدراسة ستين مريض مصابين بالسكتة الدماغية الحادة ادخلوا مستشفى تكريت التعليمي للفترة من تموز ٢٠١١ الى شباط ٢٠١٢ وسجّل لهم تخطيط القلب الكهربائي في وقت الدخول وذلك لقياس فاصل QT المصحح (فاصل QT المصحح اليدوي وفاصل QT المصحح الالي)، شملت الدراسة أيضا ثلاثين شخص (مجموعة مراقبة) وهي مطابقة للعمر من أجل المقارنة.في هذه الدراسة كانت قياسات فاصل QT المصحح أطول بشكل ملحوظ في المرضى الذين يعانون من السكتة الدماغية الحادة مقارنة بمجموعة المراقبة،وكانفاصل QT المصحح أعلى بكثير مع الاحتشاءالدماغي الضخم أو النزف الدماغي الكبير مقارنة بالآفات الصغيرة، وفي ما يتعلق بقيمفاصلQTالمصحح لم يكن هناك فرق ذو اهمية عندمقارنة السكتة الدماغية في الجانب الايمن مع الجانب الايسر.استنتج من هذه الدراسة انه توجد هنالك استطالة في فاصل QT لدى المرضى المصابين بالسكتة الدماغية الحادّة، وهذه الاستطالة لها علاقة بحجم لا بنوع او موقعالسكتة الدماغية.