International Journal of Advances in Medicine
Gawali PS et al. Int J Adv Med. 2018 Oct;5(5):1116-1119
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20183856

Original Research Article

Prevalence of prolonged corrected QT interval and its impact on outcomes in patients admitted in medical intensive care unit

Pandharinath S. Gawali, Sachin N. Solanke*, Sudhir L. Tungikar

Department of General Medicine, Indian Institute of Medical Science and Research Medical College, Badnapur, Jalna, Maharashtra, India

Received: 28 August 2018
Accepted: 04 September 2018

***Correspondence:**
Dr. Sachin N. Solanke,
E-mail: drsachinnsolanke@gmail.com

ABSTRACT

Background: The long QT syndrome (LQTS) is a disorder of myocardial repolarization characterized by a prolonged QT interval on the electrocardiogram (ECG). Hence the present study was aimed to determine prevalence of QT prolongation of the ECG and to assess its impact on outcomes in patients admitted in medical ICU of Noor Hospital of IIMSR Medical College, Badnapur, Jalna, Maharashtra, India.
Methods: This prospective observational study was carried out during the period of October 2016 to March 2018, for assessment of prevalence of prolonged QTc at admission and its impact on outcomes in medical ICU. QTc calculated by bazett's formula of >440 ms for males and >460 ms for females was considered as prolonged. Details of illness, clinical observations and laboratory parameters were also monitored.
Results: The total 150 patients were studied and there was a high prevalence (32%) of prolonged QTc at admission to the ICU which reduced to 20.5% on day 3. Patients with prolonged QTc were found to be at high risk for adverse outcomes and their ICU and hospital stay was more.
Conclusions: The study concluded that prolonged QTc is common in authors' medical ICU at admission (32%). Patients with QTc prolongation were at higher risk for adverse outcomes and their ICU and hospital stay was more.

Keywords: Corrected QT interval, Intensive Care Unit (ICU), Prevalence

INTRODUCTION

Patients of different diseases with varying severity of illnesses and complications are admitted in medical intensive care unit (ICU). These patients have high morbidity, significant mortality and a guarded prognosis.[1] A thorough clinical examination and relevant laboratory assessment has to be made at admission for diagnosis, severity of illness in order to provide necessary supportive and specific therapy. This also helps to prognosticate the course and outcome. There are different scoring systems like acute physiology and chronic health evaluation (APACHE), Sequential organ failure assessment (SOFA) which are routinely employed.[2-4] ECG taken for all patients in ICU is important tool which can provide valuable information. The ECG represents the electrical activity of the Heart. The QT interval related to ventricular function, if prolonged has been shown to have association with poor ICU outcomes.[5] It is observed that the prevalence of prolonged QT interval is very high in acutely ill patients.[6]

Long QT interval syndrome (LQTS) may be either congenital or acquired. These two primary syndromes (congenital and acquired LQTS) may be related, as some patients who develop acquired LQTS may have an inherited predisposition with abnormalities in repolarization that represent the forme fruste of LQTS. This may be due to correctable underlying causes like Hypokalaemia, Hypomagnesaemia, Hypocalcaemia,

Hypothermia, Myocardial ischemia, Post-cardiac arrest, Raised intracranial pressure, and myocarditis. Those diagnosed with LQTS are usually advised to avoid drugs that would prolong the QT interval further or lower the threshold for TDP. In addition to this, two intervention options are known for individuals with LQTS: arrhythmia prevention and arrhythmia termination.[7] Hence the aim of the present study was to determine the prevalence of prolonged QTc at admission and evaluate associated outcomes regarding morbidity, mortality, hospital stay in patients admitted in medical ICU of Noor Hospital of IIMSR Medical College, Badnapur, Jalna, Maharashtra, India.

METHODS

A prospective observational study was carried out amongst 150 patients admitted in Medical ICU of Noor Hospital of IIMSR Medical College, Badnapur, Jalna, Maharashtra during the period of October 2016 to March 2018.

Inclusion criteria

- Patients above the age of 18 years of both sexes of different illnesses admitted in medical ICU
- All patients were thoroughly examined and evaluated at admission and followed till discharge.

Exclusion criteria

- Patients on temporary or permanent pacemakers
- those with WPW pattern on ECG and patients referred from other ICU.

Study tool

The primary outcome to be evaluated was the prevalence of prolonged QTc at admission. Secondary outcomes were association of prolonged QTc and duration of ICU and hospital stay, favorable or unfavorable outcomes from ICU and hospital. Favorable event was successful discharge from ICU/hospital and unfavorable was death or discharge against medical advice. The other outcomes assessed were association of prolonged QTc and arrhythmias, hypotension, cardiac arrest, acute coronary syndrome, intubation and death.

Patients were admitted in medical ICU from emergency departments or wards. After stabilization, ECG was taken within 4 hours of admission. A data collection proforma containing details of diagnosis, medications, co-morbidities and need for ICU admission was filled up. The necessary blood investigations and other relevant investigations were documented. In ICU patients underwent continuous monitoring of Heart rate, blood pressure, respiratory rate, oxygen saturation and temperature. A repeat ECG and blood parameters were repeated on day 3. The collected ECG of day 1 and day 3 were analyzed for QT, RR and QTc manually. The formula used for calculation of corrected QT was bazett's formula i.e. $QTc=QT/\sqrt{RR}$. The medication list on day 1 and day 3 was documented and it was checked for potential QT prolonging drugs. At discharge the final diagnosis, duration of ICU and hospital stay, and outcomes were noted. Prolonged QT was taken as >440 ms for males and >460 ms for females.

Statistical analysis

QTc intervals were compared between gender, different age groups and other variables. Data was entered in Microsoft Excel and results were analyzed in the form of percentage and proportions whenever appropriate.

RESULTS

In this study, total 150 patients were studied. Out of these 78 were males and 72 were females. The mean QTc of total patients on day one of admission were 447.636. Mean QTc for males was 442.5 and that of females was 453.2.

Table 1: Baseline data of admitted patients.

Characteristics	Number
Age (Mean)	46.5 yrs
Males	78
Females	72
Admitting reasons	
Hemodynamic compromise	79
Respiratory diseases	67
Neurology	11
Poisoning	06
Mean duration of stay	
ICU	7.4 days
Hospital	11.7 days
Adverse outcome from ICU	49

It was seen from Table 1 that number of patients with prolonged QTc on day 1 was 48 (32%). Amongst those 23 males (29.4%) had prolonged QTc and 25 females (34.7%) had prolonged QTc. The mean age of patients was 46.5 yrs. analyzing the QTc in the various age groups it was found that mean QTc was longest in 46-60 yrs age group.

Table 2: Comparison of QT intervals of day 1 and day 3.

Characteristics	Day 1 (n=150)	Day 3 (n=141)
Prolonged QTc (%)	48/150 (32%)	29/41(20.5%)
Males	23/78 (29.4%)	13/68 (19.11%)
Females	25/72 (34.7%)	16/73(21.91%)
Mean QTc	447.636	442.539
Males	442.5	441.4
Females	453.2	443.6

It was observed from Table 2 that on day 3 of admission, the mean QTc interval of total patients was 442.539. The mean QTc for the males was 441.4 and that of females was 443.6. Percentage of patients with prolonged QTc was 20.5 (29/141). The percentage of males with prolonged QTc was 19.11% (13/68) and that of females was 21.91 % (16/73).

Table 3: Primary diagnosis and QTc interval.

Diagnosis	Number	Prolonged QTc
Cardiac	63	22
Respiratory	39	12
Neurological	11	04
Infections	17	05
Poisoning	06	02
Miscellaneous	14	03
Total	150	48

As seen from Table 3 that the patients had a wide range of primary diagnosis in the medical ICU. The most common was cardiac followed by respiratory problems. Quite often these patients had multiple organ involvements. The prevalence of QTc prolongation dropped from 32% on day 1 to 20.5% on day 3. There was a reduction in the mean QTc from 447.636 to 442.539. From the data it is seen that the mean QTc and the number of patients with prolonged QTc have reduced between day 1 and day 3.

Table 4: Comparison of outcomes based on QTc.

QTc	ICU outcomes		Hospital outcomes		Total
	Favorable	Adverse	Favorable	Adverse	
Normal	79	23 (22.54%)	76	26 (25.49%)	102
Prolonged	22	26 (54.16%)	23	25 (52.08%)	48
Total	101	49	99	51	150

It was seen from Table 4 that in the normal QTc group patients had adverse outcome of 22.5 and 25.5% in ICU and hospital respectively. However, in prolonged QTc patients had more adverse outcome of 54% and 52% in ICU and hospital respectively. The ICU and hospital stay were more in prolonged QTc group than in normal QTc group.

DISCUSSION

Patients admitted in medical ICU are of different illnesses and age groups who have chronic as well as acquired acute risk factors which are potentially correctable. In the present study, mean age of the patients was 46.5 yrs which is in contrast to ICU's in the west where patients of relatively higher age group are admitted in ICU.[7]

In our study, near about one third of ICU patients (32%) had prolonged QTc on day 1 of admission. Similarly, other studies also have shown similar trends in the prevalence of prolonged QTc in ICU's viz. in the studies of Kozik TM et al, it was 52%, George TK et al, it was 30%, Tisdale JE et al, it was 28%, and Pickham D et al, it was 24%.[5,6,8,9]

In the present study, it was seen that the mean QTc and the number of patients with prolonged QTc had reduced between day 1 and day 3 was 32 to 20.5%. The high prevalence is possibly due to the acquired, acute risk factors for QTc prolongation in newly admitted critically ill patients.[6] The resolution is possibly explained by the fact that in ICU, patient is stabilized after 2 days with less biochemical derangements and also control of the underlying acute illness. The present study found that patients with prolonged QTc had almost 3 times more risks of adverse outcomes in ICU as compared to normal QTc at admission. Similar results were noted in the studies by Pickham D et al, and Hangga KH et al.[9,10]

This study is basically observational and therefore does not contribute to causation effect of a prolonged QTc and adverse outcomes. But it definitely indicates a strong association between prevalence of prolonged QTc and adverse outcomes. Calculation of QTc interval from a simple ECG can be done very easily. Considering QTc as an index of severity of the underlying illness and a predictor of adverse outcomes it can be and should be incorporated into predictive diagnostic scores.

CONCLUSION

This study concluded the high prevalence (32%) of a prolonged QTc in patients admitted in medical ICU. It also shows that acutely ill patients with prolonged QTc intervals have very significantly high risk for adverse outcomes in ICU and require longer ICU and hospital stay. A simple ECG and a calculated QTc interval can be used to plan management strategy and can be a very useful tool for prognostification of patients in medical ICU.

ACKNOWLEDGEMENTS

Authors are especially thankful to Dr. Amarnath B. Solepure, Dean, for permitting to carry out this study. Authors are also thankful to Dr. Purushottam Giri, Professor and Head, Dept. of Community Medicine, IIMSR Medical College, Badnapur for his constant support and guidance. Last but not the least, authors are thankful to Mr. Parvez Tamboli and to all the patients enrolled for this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Gawali PS, Solanke SN, Tungikar SL. Prevalence of prolonged corrected QT interval and its impact on outcomes in patients admitted in medical intensive care unit. Int J Adv Med 2018;5:1116-9.