DOI: https://doi.org/10.53350/pjmhs2023173836

ORIGINAL ARTICLE

Electrocardiographic Changes in patients with Acute Febrile Illness: A Cross-Sectional Study in a Tertiary Care Hospital

SAEED MAQSOOD[1], SADULLAH SHAH[2], NAIMAT ULLAH SHAH[3], SAMIULLAH KHAN[4], RADHIA KHAN[5], MUHAMMAD SAAD JIBRAN[6]
[1]*Assistant Professor of Cardiology, Medical Teaching Institution, Bannu*
[2]*Assistant Professor of Cardiology, Medical Teaching Institution, Bannu*
[3]*Assistant Professor of Medicine, Medical Teaching Institution, Bannu*
[4]*Assistant Professor of Medicine, Medical Teaching Institution, Bannu*
[5]*Associate Professor of Biochemistry Bannu Medical College*
[6]*Assistant Professor Cardiology District Head Quarter Teaching Hospital, Medical Teaching Institution Dera Ismail Khan*
Correspondence to: Dr. Samiullah Khan, Email: drsami88@gmail.com.

ABSTRACT

Background: Acute febrile illnesses (AFI) are frequent causes of hospitalization and can influence any body system, including the heart. Even in patients who do not have pre-existing cardiac disease, electrocardiographic (ECG) alterations can be an indication of systemic inflammation, autonomic imbalance, or myocardial involvement that is subclinical. Monitoring and control can be directed using early identification of these changes.

Objective: To identify the rate and trend of changes in electrocardiograph in patients who present with acute febrile illness at a tertiary care hospital.

Materials and methods: The study was a cross-sectional study carried out at Medical Teaching Institution Bannu and Medical Teaching institution DI Khan during the period between July 2022 and December 2022. Enrolment was restricted to adult patients who were found to be having fever 38C or lower of less than two weeks. The patients who had known cardiac disease or those on medications that affect ECG were excluded. Qualified clinicians recorded and interpreted standard 12-lead ECGs. The descriptive and inferential statistics were used to gather and analyze the demographic, clinical and ECG data.

Results: 180 patients were used (mean age 38.6 +14.2 years 60 men). In 96 (53.3) patients, the abnormalities of the ECG were observed. Sinus tachycardia (30, 11.7, and 10 percent of abnormalities respectively) was the most common and ST-segment alterations, T-wave inversion, and QT interval prolongation were the third, fourth, and fifth most common abnormalities respectively. Abnormalities in ECG were more apparent among the patients above 40 years old and a little more in males. Other less frequent discoveries were sinus bradycardia and conduction defects.

Conclusion: Electrocardiographic alterations are frequent in acute febrile disease, and the sinus tachycardia and repolarization changes are most frequent. Febrile patients may undergo periodic ECG examination, which could potentially aid in identifying subclinical cardiac involvement and manage the patient.

Keywords: Acute febrile disease, Electrocardiography, Cardiac abnormalities, Sinu tachycardia.

INTRODUCTION

One of the most frequent causes of hospital visits in developing countries and also a broad range of infectious etiologies such as viral, bacterial and parasitic diseases is acute febrile illness or AFI. These conditions are usually characterized by systemic inflammatory reactions that may be manifested in numerous organ systems other than the initial organ of infection. Among them, cardiovascular involvement is also beginning to be recognized as a significant source of morbidity, even in patients with no underlying heart disease[1].

Systemic inflammation and fever may affect the cardiac physiology in a variety of ways, including elevated sympathetic reactions, release of cytokines, metabolic imbalances, and direct myocardial injury. Such changes might be observed as changes in heart rate, conduction pathways and myocardial repolarization that could easily be observed in electrocardiography (ECG). Although most of these ECG alterations are temporary and reversible, there are those which could signal underlying myocardial stress, occult cardiac involvement that will need closer attention[2].

Electrocardiography is a non-invasive, easy and commonly used diagnostic method that offers important data concerning the cardiac rhythm, conduction abnormalities, ischemic or inflammatory pathology. Considering AFI, ECG assists in detecting the presence of sinus tachycardia, bradycardia, ST-segment and T-wave changes, QT interval increase, and other arrhythmias. These results can be the systemic consequences of fever, electrolytes disorder, or direct impact of the myocardium and pericardium[3].

There are a number of infectious diseases that are related to acute febrile conditions and have been reported to cause typical changes in the ECG, dengue, typhoid fever, malaria, and viral infections. The suggested mechanisms would be myocarditis, autonomic dysfunction, hypoxia, and inflammatory myocardial edema. This ECG abnormalities can also be associated with clinical deterioration in some instances and therefore early detection of ECG abnormality is clinically relevant with respect to risk stratification and management[4].

Although AFI poses a high burden in the low-income and middle-income populations, cardiovascular evaluation among febrile patients is often restricted to clinical observation and ECG is not widely used unless cardiac symptoms are evident. This leads to non-identification of subclinical or transient ECG abnormalities. Knowledge of the pattern and frequency of ECG changes in AFI can assist clinicians to recognize the patients who might require superior cardiac care (monitoring)[5].

Past research has indicated levels and types of ECG abnormalities in AFI patients which differ due to patient demographics, underlying etiologies, severity of illness and in healthcare settings. Nonetheless, the statistics of tertiary care hospitals in resource scarce areas are minimal. The local evidence is necessary to put international results into perspective and prescribe clinical practice where there is a high incidence of infectious diseases[6,7].

As the acute febrile diseases are a major burden and have the potential to cause cardiac involvement, the systematic assessment of ECG changes in such patients is a clinically important issue. Recognizing typical electrocardiographic patterns and clinical counterparts could help to detect cardiac complications and manage patients more effectively, as well as enhance the results of hospitalized febrile patients[8].

Objective: To establish the prevalence and trend of electrocardiographic variations in patients who have acute febrile illness at a tertiary care hospital.

MATERIALS AND METHODS

Study Design: This project was carried as a cross-sectional observational study and was a hospital-based study aimed at measuring the electrocardiographic variations in acutely presenting febrile patients. It was a cross-sectional design, which was

selected to determine the prevalence and pattern of the ECG abnormalities at the point of presentation throughout the research.

The research was conducted in Medical Teaching Institution Bannu and Medical Teaching institution DI Khan during the period between July 2022 and December 2022. The high number of patients with infectious diseases in the hospital makes the hospital an adequate place to assess the cardiovascular manifestations related to acute febrile diseases.

The sample population included the adult patients who reported to the medical wards and emergency department with acute febrile illness. Acute febrile illness was considered a recorded body temperature of 38 o C and above with a period of less than two weeks of fever and or without known focus of infection at the time of admission.

Sample Size and Sampling Technique: During the study, a consecutive non-probability method of sampling was employed to recruit patients who met the study inclusion criteria. It was felt that the sample size was sufficient to provide an estimate of the prevalence of the electrocardiographic changes in the patients with acute febrile illness taking into consideration the time and resources that were available at the study center.

Inclusion and Exclusion Criteria: The study included all adult patients aged 18 years and older who presented themselves with acute febrile illness and gave informed consent. Patients that have a known history of cardiomyopathy, ischemic heart disease, chronic heart failure, congenital heart disease, or any previously documented arrhythmias were not included to reduce confounding. Those patients who have been prescribed drugs that substantially affect ECG parameters (antiarrhythmic drugs), have electrolyte abnormalities recorded before ECG recording were also excluded.

Data Collection Procedure: The demographic information, clinical history, and the appropriate examination findings were documented on a structured proforma after informed consent has been obtained. Each patient was subjected to a standard 12-lead electrocardiogram in a resting position during the first phase of evaluation in the hospital. Qualified clinicians interpreted ECGs independently and results including heart rate abnormalities, conduction defects, ST-segment abnormalities, T-wave defects, and QT interval changes were recorded.

Outcome Measures: The existence and nature of electrocardiographic changes among patients with acute febrile illness was used as the primary outcome measure. The secondary outcomes were the distribution of ECG abnormalities by age and gender and the association between ECGs abnormalities and clinical presentation.

Data Analysis: The appropriate statistical software was used to input and analyze the data. Continuous variables were represented as mean and standard deviation whereas categorical variables were represented in form of frequencies and percentages. The findings were condensed to explain the trend and occurrence of Electrocardiographic changes in the participants in the study.

Ethical Considerations: The study got ethical approval of the Institutional Review Board of Medical Teaching Institution, Bannu. All participants had their informed consent written form before enrolment. The patient information was kept in confidence and the study was done in compliance with the code of ethics in the Declaration of Helsinki.

RESULTS

The final analysis involved 180 patients who came to the treatment with acute febrile illness. The age of the study population mean was 38.6 14.2 years, a range of 1875 years. The majority of the patients were males who made up 108 (60.0%) and the females 72 (40.0%). Majority of the patients were referred in the emergency department indicating the acute presentation. Table 1 summarises the baseline demographic and clinical features of the study population.

Abnormalities of electrocardiogram were also observed in a significant percent of patients with acute febrile illness. Of all 180 patients, 96 (53.3%), showed at least one abnormal ECG and 84 (46.7%) showed normal ECG. The most common abnormality was the sinus tachycardia, which was closely followed by the ST-segment and T-wave alterations. The general ECG findings are represented in Table 2.

Sinus tachycardia was the most common result as it was found in 54 (30.0) patients in the scenario whereby specific ECG patterns were analyzed. ST-segment depression or elevation was observed to indicate myocardial stress or inflammation in 21 (11.7) patients. In 18 (10.0%) cases, T-wave inversion was seen and 12 (6.7%) had a QT interval prolongation. Uncommon observations comprised sinus bradycardia and other conduction abnormalities like 1 st degree atrioventricular block. Table 3 gives the detailed frequencies of each ECG abnormality.

The analysis that compared the demographic variables to the electrocardiographic changes demonstrated that more males than females had ECG abnormalities but this was not significant. The frequency of the ECG changes was more frequently observed in patients aged above 40 years than in younger ones. Table 4 presents the relationship between age groups, gender, and the existence of ECG abnormalities.

To make the visual representation, a graphical comparison of most common ECG abnormalities was created. The graph shows that sinu tachycardia overtook the ST -T changes and the QT prolongation, which reinforce the range of cardiac electrical changes observed in acute febrile disease (Figure1).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n = 180)

Variable	Frequency (n)	Percentage (%)
Age (years), mean ± SD	38.6 ± 14.2	—
18–30 years	54	30.0
31–40 years	46	25.6
41–50 years	38	21.1
>50 years	42	23.3
Gender		
Male	108	60.0
Female	72	40.0

Table 2: Overall Frequency of Electrocardiographic Findings in Acute Febrile Illness

ECG Finding	Frequency (n)	Percentage (%)
Normal ECG	84	46.7
Any ECG abnormality	96	53.3
Total	180	100

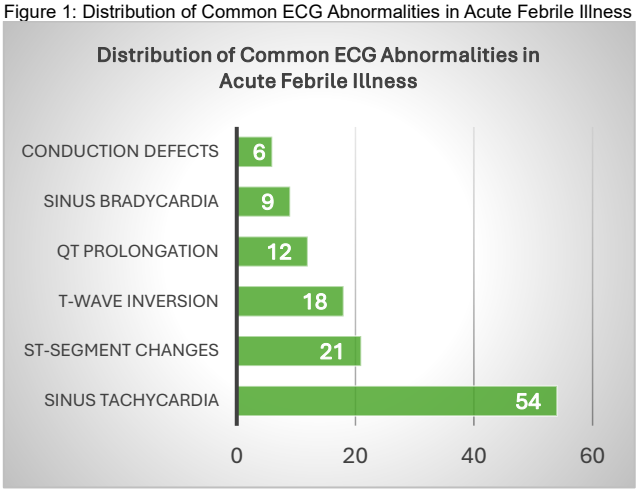
Table 3: Pattern of Electrocardiographic Abnormalities Observed (n = 96)

Type of ECG Abnormality	Frequency (n)	Percentage (%)
Sinus tachycardia	54	30.0
ST-segment changes	21	11.7
T-wave inversion	18	10.0
QT interval prolongation	12	6.7
Sinus bradycardia	9	5.0
Conduction abnormalities	6	3.3

Table 4: Association of ECG Abnormalities with Age and Gender

Variable	ECG Normal n (%)	ECG Abnormal n (%)	Total	p-value
Gender				
Male	46 (42.6)	62 (57.4)	108	0.18
Female	38 (52.8)	34 (47.2)	72	
Age group				
≤40 years	58 (53.2)	51 (46.8)	109	0.04
>40 years	26 (36.6)	45 (63.4)	71	

Figure 1: Distribution of Common ECG Abnormalities in Acute Febrile Illness



DISCUSSION

Greater than fifty percent of the participants in the current study showing electrocardiographic abnormalities had sinu tachycardia, which is the most common finding and the rest had ST-T segment change, T-wave inversion, and QT interval amplification. The results of these studies are that acute systemic infection may play a significant role in cardiac electrophysiology in the patient not having known cardiac disease. Sympathetic stimulation of fever, release of inflammatory cytokines, and metabolic stress are all well known (possibly) explanatory mechanisms of these non-persistent changes in ECG patterns[9].

The general rate and trend of ECG abnormalities that we observed in our research is similar to those in the recent literature on acute infectious diseases. Some reports have reported case of sinu tachycardia as the most frequent change in ECG of febrile patients, a condition that has mainly been attributed to high metabolic load, and imbalance in the autonomic system during the time of infection[10,11]. The ST-segment and T-wave changes that were observed in our cohort are also reported in other literature and are believed to represent the myocardial strain or a subclinical inflammatory process and not overt ischemic heart disease[12].

The lengthening of QT interval which is observed in some of our patients has been observed to be gradually reported in the circumstances of systemic infections and in febrile states. Recent results indicate that fever and inflammatory mediators can directly influence the ventricular repolarization, which results in temporary QT variation even without cardiotoxic substances[13]. These types of findings can be clinically applicable, with the long period of QT being a factor that can predispose vulnerable patients to malignant arrhythmias especially in the presence of electrolyte imbalances that are characteristic in acute disorders.

There is evidence in the literature of a particular type of febrile infection, e.i. dengue and other viral infections, that exhibit similar ECG patterns, with repolarization abnormalities and rhythm disturbances. Autonomic dysfunction, direct myocardial involvement, or capillary leak-induced myocardial edema has been blamed as the cause of such changes[14,15]. Even though we have not stratified ECG results by a particular etiological agent, patterns of observation have been similar, which leads to the idea that various infections can have a similar effect on the cardiac electric activity.

Nonspecific ECG abnormalities and conduction defects have also been common in the presence of bacterial and parasitic febrile diseases. The studies have pointed out that these changes can be reversible and do not need clinical recovery and therefore implies the existence of a functional as opposed to structural myocardial basis in most instances[16]. These findings and the heterogeneity of the cardiac involvement in acute febrile states are consistent with the presence of conduction abnormalities and bradyarrhythmias in a minority of our patients and further highlight the heterogeneity of cardiac involvement in acute febrile states.

Age variations in ECG abnormalities that were found in our study are in line with results by other studies, whereby older patients showed higher prevalence of ECG changes. This can be an indication of decreased physiological reserve, increased burden of the subclinical cardiovascular disease, or an overreacting in the inflammatory responses among older age groups[17,18]. There were not as high gender-based differences and this is also in agreement with recent research results that showed no significant sex-specific variation in ECG changes during acute infections[19].

In general, the data presented in this research paper support the available literature that electrocardiographic changes are frequent among patients with acute febrile illness and represent a continuum of physiological and pathological reactions to the systemic infection. Regular ECG evaluation could thus be an effective source of information to be used in the early detection of patients who might need extra attention at the acute stage of the disease[20].

Limitations: There are some limitations of this study that one should take into account when interpreting the results. The cross-sectional design does not provide the opportunities to determine causal relationship and to evaluate the time progression and reversibility of changes in the ECG. The study is a single center study and it might not be applicable to all healthcare settings or populations having different disease profiles. Etiological classification of acute febrile diseases had not been done and this limited the analysis of ECG changes specific to the pathogen. Moreover, there was no assessment of biochemical indicators of myocardial necrosis and clinical long-term results, which might have helped to get some understanding of the prognostic value of the detected alterations in the electrocardiographic patterns.

CONCLUSION

Electrocardiographic aberrations are very common in patients who arrive with acute febrile illness with the most common finding being sinus tachycardia and repolarization changes. Such changes are probably due to systemic inflammatory and autonomic consequences of fever and not due to underlying cardiac disease but provides evidence that in acute infections cardiac changes may occur in the absence of clinical symptoms. Regular ECG cardiac monitoring in febrile patients, especially older and clinically unstable ones, can help to identify cardiac electrical anomalies in an early stage and assist in reaching a timely clinical decision to enhance patient monitoring and care.

REFERENCES

1. Furlan DF, Santos LF, Geleilete T, Bestetti RB. Abnormalities in electrocardiographic ventricular repolarization in patients with dengue virus infection. *J Infect Dev Ctries.* 2019;13(5):374–379
2. Jesrani G, Gupta S, Gaba S, Gupta M. Electrocardiographic abnormalities in prevalent infections in tropical regions: A scoping review. *J Acute Dis.* 2022;11(2):45–51.
3. Chan XH, *et al.* Factors affecting the electrocardiographic QT interval in malaria: A systematic review and meta-analysis of individual patient data. *PLoS Med.* 2020;17(3):e1003040.
4. Choi SW, Yun NR, Choi DH, Ki YJ, Kim SW, Kim CM, Kim DM. Scrub typhus and abnormal electrocardiography. The American Journal of Tropical Medicine and Hygiene. 2018 Dec 10;100(2):399.
5. dos Santos VM, dos Santos UM, Gebrim DG, Santos AM, Cançado AC. Anicteric leptospirosis with pneumonitis, pericarditis and acalculous cholecystitis. Le infezioni in medicina. 2014 Sep;22(3):236-40.
6. Rahim A, Hameed A, Ishaq U, Malik J, Zaidi SM, Khurshid H, Malik A, Satti DI, Naz H. Cardiovascular sequelae of dengue fever: a systematic review. Expert review of cardiovascular therapy. 2022 Jun 3;20(6):465-79.
7. Santos JP, Ribeiro AL, Andrade-Junior D, Marcolino MS. Prevalence of electrocardiographic abnormalities in primary care patients according to sex and age group. A retrospective observational study. Sao Paulo Medical Journal. 2017 Dec 18;136(01):20-8.
8. Talreja S, Ram B, Kumar N. To study the cardiac manifestations of dengue fever and its correlation with warning signs in tertiary care

center of Patna, Bihar. Journal of Indira Gandhi Institute Of Medical Science. 2020 Jul 1;6(2):149-52.
9. Rautaharju PM, Surawicz B, Gettes LS. AHA/ACCF/HRS recommendations for the standardization and interpretation of the electrocardiogram: part IV: the ST segment, T and U waves, and the QT interval a scientific statement from the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society Endorsed by the International Society for Computerized Electrocardiology. Journal of the American College of Cardiology. 2009 Mar 17;53(11):982-91.
10. Álvarez-García J, García-Zamora S, Liblik K, Guptad S. Electrocardiogram in Neglected Tropical. The NET-Heart Book: Neglected Tropical Diseases and other Infectious Diseases affecting the Heart. 2021 Oct 12:229.
11. Furlan-Daniel RA, Santos LF, Geleilete TJ, Restini CB, Bestetti RB. Abnormalities in electrocardiographic ventricular repolarization in patients with dengue virus infection. The Journal of Infection in Developing Countries. 2019 Aug 31;13(08):759-63.
12. Chan XH, Win YN, Haeusler IL, Tan JY, Loganathan S, Saralamba S, Chan SK, Ashley EA, Barnes KI, Baiden R, Bassi PU. Factors affecting the electrocardiographic QT interval in malaria: A systematic review and meta-analysis of individual patient data. PLoS medicine. 2020 Mar 5;17(3):e1003040.
13. Choi SW, Yun NR, Choi DH, Ki YJ, Kim SW, Kim CM, Kim DM. Scrub typhus and abnormal electrocardiography. The American Journal of Tropical Medicine and Hygiene. 2018 Dec 10;100(2):399.
14. Škerk V, Markotić A, Puljiz I, Kuzman I, Tošev EČ, Habuš J, Turk N, Begovac J. Electrocardiographic changes in hospitalized patients with leptospirosis over a 10-year period. Medical science monitor: international medical journal of experimental and clinical research. 2011 Jul 1;17(7):CR369.
15. Haeusler IL, Chan XH, Guérin PJ, White NJ. The arrhythmogenic cardiotoxicity of the quinoline and structurally related antimalarial drugs: a systematic review. BMC medicine. 2018 Nov 7;16(1):200.
16. Alvarez MF, Bolívar-Mejía A, Rodriguez-Morales AJ, Ramirez-Vallejo E. Cardiovascular involvement and manifestations of systemic Chikungunya virus infection: A systematic review. F1000Research. 2017 May 2;6:390.
17. Buttà C, Zappia L, Laterra G, Roberto M. Diagnostic and prognostic role of electrocardiogram in acute myocarditis: A comprehensive review. Annals of Noninvasive Electrocardiology. 2020 May;25(3):e12726.
18. Turakhia MP, Ullal AJ, Hoang DD, Than CT, Miller JD, Friday KJ, Perez MV, Freeman JV, Wang PJ, Heidenreich PA. Feasibility of extended ambulatory electrocardiogram monitoring to identify silent atrial fibrillation in high-risk patients: The Screening Study for Undiagnosed Atrial Fibrillation (STUDY-AF). Clinical cardiology. 2015 May;38(5):285-92.
19. Drew D, Baranchuk A, Hopman W, Brison RJ. The impact of fever on corrected QT interval. Journal of Electrocardiology. 2017 Sep 1;50(5):570-5.
20. Precoma DB, Oliveira GM, Simao AF, Dutra OP, Coelho OR, Izar MC, Póvoa RM, Giuliano ID, Alencar AC, Machado CA, Scherr C. Updated cardiovascular prevention guideline of the Brazilian Society of Cardiology-2019. Arquivos brasileiros de cardiologia. 2019 Nov 4;113:787-891.