

**Case Report**
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## The “Depression and Elevation” of ST Segment Settle Down as Momentary “Up and Down” of Architect of Artefact: A Case Report of COVID-19 Patient

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### ABSTRACT

A young male was admitted with diagnosis of Covid-19 SARS infection and was having fever, cough & non-cardiac chest pain. There was no past history of cardiac symptoms and physical examination was unremarkable. His vitals were stable. His ECG showed ST elevation and Tall but notched T wave in V3 and ST depression in inferior and lateral leads. Carefully looking these manifestations, they seem the artifacts based on their ECG features and history of the patient. ECG was repeated removing all possible sources of technical errors for these ECG manifestations which showed normal ECG confirming the diagnosis of artifactual ECG. Patient was discharged uneventfully. Recognition of ECG artifact and their technical causes is necessary to avoid inappropriate management.

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### Background

ECG artifacts are common and can lead to erroneous diagnosis and management. The thorough knowledge of various causes of ECG artifacts and their ECG manifestations is must to get skillful ECG interpretation. Many technical and patient related factors may cause ECG artifacts. Each artifact has peculiar ECG manifestations which may mimic various arrhythmia, ischemic changes and electrolyte imbalance etc. Sometimes patient history and surroundings may indicate the possibility of artifacts. Careful observation of 12 lead ECG features may easily distinguish these artifacts from common as well as serious real ECG diagnosis such as myocardial infarction, ventricular tachycardia specially in scenario of current COVID-19 pandemic.

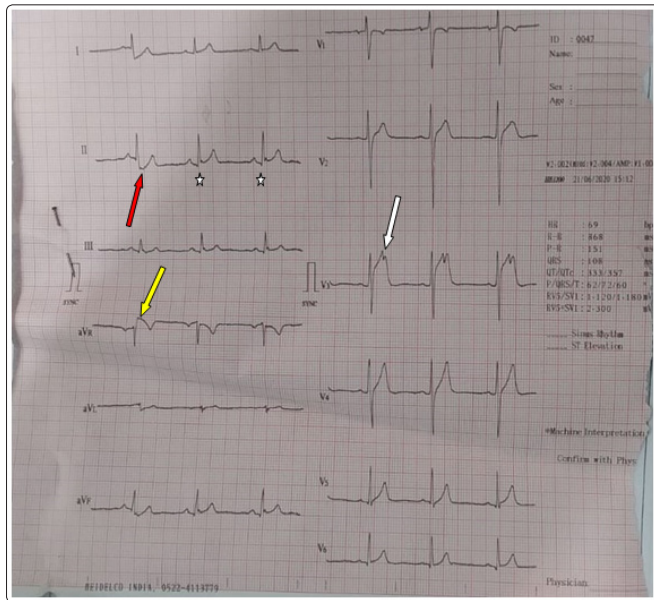
### Case presentation

A 21-year-old person, Covid-19 SARS positive, was admitted with diagnosis of complaints of fever, cough, chest pain with atypical features for 4 days. Patient is nonsmoker and there was no personal and family history of diabetes mellites, hypertension, asthma, coronary artery disease. On examination his BP was 128/86 mm of Hg in right arm, pulse rate was 68 beats/min, respiratory rate was 20/min, cardiovascular examination was unremarkable, SpO<sub>2</sub> was 98% on room air, temperature 100.4 F. A 12 lead ECG was done on admission which was showing sinus rhythm with tall T

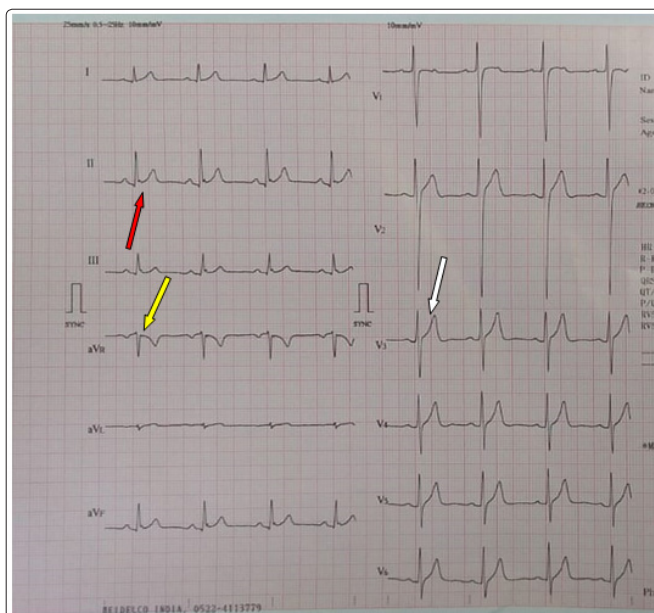
wave with “bifid” configuration with ST elevation in V3 and ST depression in II, III, aVF, I and aVL, ST elevation in aVR (Figure 1). On carefully asking, patient was telling site of pain on right side of chest which was localized, waxing and waning without known precipitating factors and not associated with dyspnea, palpitation. There was also no history of syncope, antiarrhythmic drug intake. Having carefully observed the ECG again, we noticed that ST depression was upsloping and elevation of ST segment with “bifid” T was primarily limited to V3. The configuration of ECG changes and patient history made us to repeat ECG keeping the possibility of artifact. We wiped out the sweating on the limbs and chest, ensured proper skin and electrode attachment, we also adjusted low frequency filter and asked the patient to do not move his limbs and hold breath for few seconds while recording of 12 lead ECG. Repeat 12 lead ECG showed normalization of ST segment and disappearance of abnormal “bifid” peak of T wave. The diagnosis of ECG artifact was made. Patient was discharged uneventfully 5 days after admission and after 1 month follow up, he was completely asymptomatic.

### Investigations

Patient 12 lead ECG is shown in Figure 1 and figure 2. His troponin was 0.03 ng/ml (normal upper limit 0.04 ng/ml). Patient’s electrolytes were within normal limits. Transthoracic echocardiography was showing normal LV size and contractility without regional wall motion abnormality. There was no valvular regurgitation. aortic velocity 1.2 m/sec.



**Figure 1:** 12 lead ECG showing sinus rhythm with HR of 68 bpm, QTc interval of 358 msec, Notched T wave in V3 (white arrow) with ST segment elevation in V3 and aVR (yellow arrow) and upsloping ST depression in lead II (red arrow), III, aVF, I and aVL which is confined to first beat only (subsequent 2 beats are marked by white star showing no ST depression like in first beat).



**Figure 2:** 12 lead ECG showing sinus rhythm with HR of 72 bpm with resolution of notched T in V3 (white arrow) and ST segment elevation in V3 and aVR (yellow arrow) and ST depression in II (red arrow), III, aVF, I and aVL.

### Discussion

Bifid T wave or notched T wave in 12 lead ECG may be caused by long QT syndrome type 2 (LQTS type 2), acute ischemia, drugs like amiodarone and dofetilide and cerebrovascular accident [1-4]. Brugada syndrome which manifests ECG features classically in young male of Asian descent with fever (as our case was) may show J point elevation immediately followed by T wave mimicking bifid T wave but it is typically in V1, V2 and V3, not just limited to V3 only. QT interval was not prolonged (Figure 1 and figure 2) in our case as seen in LQTS type 2. Although there were ST depressions in inferior and lateral leads but this was

upsloping (in contrast to ischemic changes) and limited to first beat only of 12 lead ECG. Such kind of “pseudo-ST depression” may be caused by poor skin-electrode contact or wandering baseline. Hyperacute T wave of acute ischemia is associated with ST segment elevation which meets T wave and not form such kind of deep notch in T wave and it is not exclusively limited to one lead but involves contiguous leads (but magnitude may be more or less in contiguous leads) according to culprit artery. But peculiar ECG findings in our case (Figure 1) and also patient detailed history were not consistent with all above diagnosis but in the era of the COVID-19 pandemic, a high clinical suspicion should be maintained even in patients who present with atypical symptoms or signs.

ECG changes in COVID-19 illness may be caused by acute coronary syndrome, myocarditis, pericarditis and primary or drug induced QT prolongation. Covid-19 illness may unmask the underlying Brugada syndrome [5]. To clinch the diagnosis of ECG artifacts one must be knowledgeable about all the technical aspects of ECG recording thoroughly and distinguishing ECG manifestation of various artifacts.

ECG artifact may be caused by electrode misplacements, poor skin-electrode contact, patient limb movements, limb arterial tapping on electrode, chest movements (as during breathing, hiccups), muscle tremors, electric power line and electromagnetic interference [6]. In our case placement of electrodes was correct. There were no tremors. Band pass ECG Filter was 0.5-25 Hz. Before recording repeat ECG, we wiped out the sweating over limbs and chest, ensure good electrode-skin contact, asked patient to hold breath and remain still during recording. The repeat ECG was normal (figure 2). Probably the cause may be transient movement or poor skin-electrode contact. Sometimes band pass filter change may require to remove the high or low frequency artifact.

### Learning Points

1. Thorough knowledge of ECG artifacts may be crucial to interpret ECG correctly specially in emergency and ICU setting where rapid decision is crucial.
2. In COVID-19 pandemic era specially in developing countries, where resources are limited, simple removal of cause of artifact not only confirm the diagnosis but also avoid both delay in appropriate intervention (when the change in ECG is not artifactual) and utilization of resources for inappropriate intervention (when change in ECG is artifactual).
3. Not only cardiologist but also paramedics and primary care physician should be trained to identify these ECG artifacts.

### Notes

The manuscript has got ethical review exemption from Ethical Review Committee (ERC) of the authors’ institution (SGPGIMS) as case reports are exempted from review according to the institutional ethical review committee’s policy.

The written consent of patient was taken for publication of case report keeping his anonymity.

The authors declare that they have no competing interests.

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