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Monitoring the Evolution of ST Elevation Myocardial Infarction (STEMI) Complicated by Total Atrioventricular (AV) Block: A Case Study

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ABSTRACT

Background: Myocardial infarction is the necrosis of heart muscle due to a lack of oxygen, often caused by impaired blood flow in the coronary arteries. ST Elevation Myocardial Infarction (STEMI) is characterized by ST-segment elevation, increased cardiac enzymes, and chest pain. Inferior STEMI can lead to arrhythmic complications, such as Atrioventricular (AV) Block, which requires close Electrocardiographic (ECG) and hemodynamic monitoring by nurses. This case report focuses on the ECG evolution of posteroinferior STEMI progressing from sinus rhythm to Total AV Block.

Purpose: To present the ECG monitoring of a STEMI patient with AV Block complications.

Methods: A case study was conducted on a 47-year-old male who experienced chest pain with an onset of more than 48 hours, demonstrating ECG evolution from sinus rhythm with posteroinferior STEMI to Total AV Block.

Results: The patient exhibited significant ECG changes from sinus rhythm with posteroinferior STEMI to total AV Block, necessitating several medical interventions for stabilization. Intensive monitoring and ongoing care were essential to support recovery.

Conclusion: Patients with STEMI show characteristic ECG evolution. In inferior STEMI, Total AV Block can occur due to occlusion of coronary arteries, particularly the Right Coronary Artery (RCA). The nurse's role in managing complication risks and ECG monitoring is vital for rapid and effective intervention. Multidisciplinary collaboration is necessary to enhance patient care outcomes.

Keywords: Myocardial Infarction; Electrocardiography; Atrio-Ventricular Block

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BACKGROUND

Myocardial Infarction (MI) is irreversible necrosis of the heart muscle, caused by a lack of oxygen supply to the myocardium due to impaired blood flow in one or more coronary arteries. (Anderson et al., 2022). In addition, MI can also be caused by inflammatory, metabolic, or toxic factors that affect the myocardium. (Anderson et al., 2022). In patients with ST Elevation Myocardial Infarction (STEMI), there are 3 typical symptoms, the first is the presence of point J elevation at V2-3 from at least two adjacent leads ≥ 2mm in men and ≥ 1.5 mm in women (Byrne et al., 2023). STEMI is also characterized by elevated levels of the cardiac enzyme, accompanied by typical chest pain in the left side of the chest that may radiate to the back, shoulder, neck, and down the left arm. (Byrne et al., 2023).

STEMI is mostly caused by smoking in men at 46.8%, and other risk factors such as diabetes mellitus, hypertension, and hypercholesterolemia also contribute to STEMI (Janjani et al., 2023). In STEMI, there is an evolution or change in the electrocardiogram (ECG) pattern that indicates an infarction episode, starting with hyperacute T waves, followed by ST-segment elevation, pathological Q waves, T wave inversion, and finally, normalization of the ST segment (Asatryan et al., 2019; Lippolis et al., 2019). Based on the location of STEMI, studies reported that 37-42% of cases are inferior STEMI (Abe et al., 2023).

Several studies indicate that inferior STEMI is frequently associated with arrhythmic complications, one of which is Atrio-Ventricular (AV) block (John et al., 2020; Velásquez-Rodríguez et al., 2023), which is about 7-8% of cases (Hashmi et al., 2018; Velásquez-Rodríguez et al., 2023). Factors contributing to the occurrence of AV block include ischemia of the AV node due to decreased perfusion from the previous infarction (Mahendra & Yuliani, 2022). Inferior STEMI is worsened when accompanied by RV infarction and posterior (Kurnia, 2021), thus, it requires proper evaluation and assessment of the ECG findings. Therefore, nurses, as the frontline in patient care, need to monitor the evolution of the ECG in STEMI patients and assess the patient's hemodynamic status to ensure adequate management and collaboration with other medical personnel, so that it can sustain the patient's life.

In this case report, we found that a patient with an ECG pattern of inferior-posterior STEMI developed AV block 1st degree that progressed to total AV block. Consequently, this report will discuss the monitoring of ECG evolution in STEMI patients with AV block.

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OBJECTIVE

The purpose of this study is to present the ECG monitoring of a STEMI patient with AV Block complications.

METHODS

This research was a case study that combined data collection methods, including archival research and observation. The observation was carried out for 5 days. We reported a 47-year-old male who experienced chest pain with an onset of more than 48 hours, demonstrating ECG evolution from sinus rhythm with posteroinferior STEMI to Total AV Block.

RESULT

Presentation Case

We reported a 47-year-old man admitted to the hospital with complaints of chest pain that felt like being crushed by a heavyweight two days before his arrival. The chest pain was felt through the back and radiated to the left arm, with a duration of more than 20 minutes. In addition, the patient also complained of cold sweat, nausea, and vomiting. The patient's cardiovascular risk factors included a history of uncontrolled hypertension for one year, diabetes mellitus, and a history of smoking for 30 years with a habit of consuming 1-2 packs per day. Laboratory results showed HS Troponin I levels of 40,239.20 ng/L.

The ECG features from the referring hospital showed a change from sinus rhythm with inferior STEMI to total AV block, so the patient was referred to Wahidin Sudirohusodo Hospital for further treatment. Subsequently, an ECG recording was performed, showing AV dissociation with an atrial rate of 100 beats per minute (bpm), a ventricular rate of 45 bpm, ST elevation in leads II, III, and aVF, along with reciprocal ST depression in leads I and aVL, and ST depression in leads V2-V4 (Figure 1). The ECG recording of the RV and posterior showed sinus bradycardia, with a heart rate of 45 bpm, regular rhythm, normal axis, an atrial rate of 100 bpm, a QRS rate of 45 bpm, a P/QRS ratio of 2:1, and ST elevation in II, III, and aVF (Figure 2). These results suggested an inferior wall Acute Myocardial Infarction with possible posterior wall infarction and Total AV block. In addition, the chest X-ray results showed cardiomegaly accompanied by signs of pulmonary congestion, and the patient's echocardiography revealed an Ejection Fraction of 45%.

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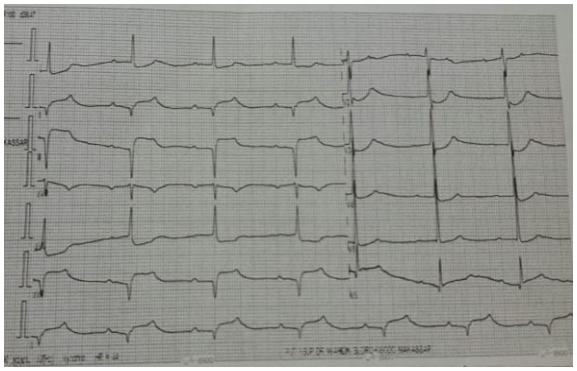

Figure 1. ECG upon admission to the referral

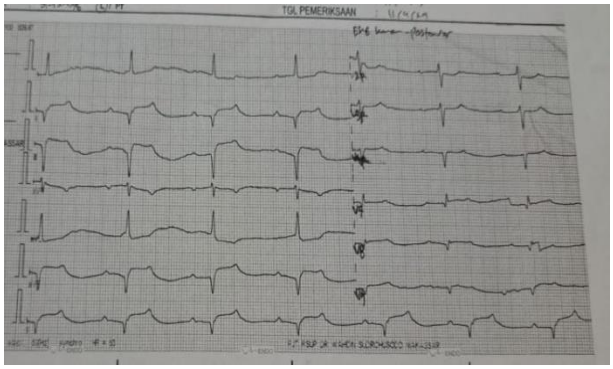

Figure 2. ECG of the RV and Posterior

Revascularization was performed immediately, and the results showed 100% total occlusion in the Right Coronary Artery (RCA) (Figure 3). The conclusion was Coronary Artery Disease 1 Vessel Disease Post Primary Percutaneous Transluminal Coronary Angiography (PTCA) with suboptimal outcome (Figure 4).

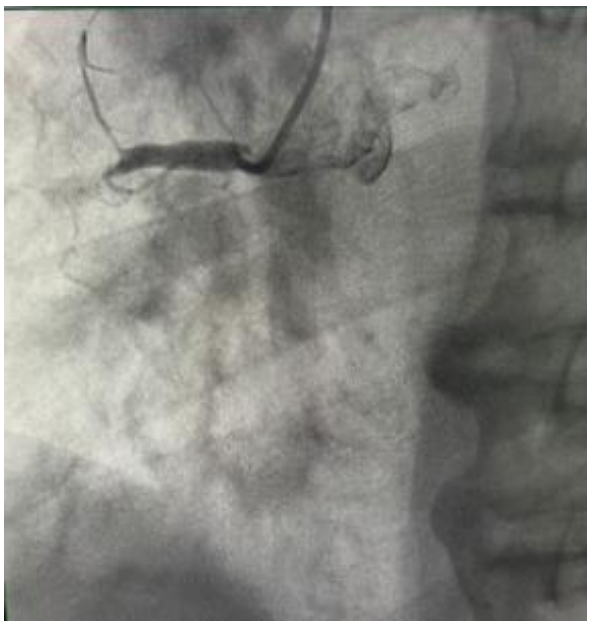

Figure 3. Total Occlusion in RCA

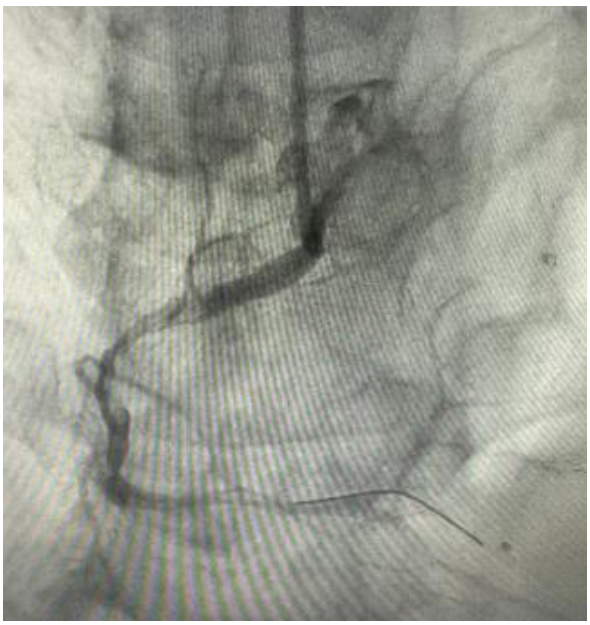

Figure 4. Post Primary PTCA with suboptimal outcome

After revascularisation, an ECG recording was performed on the patient. The recording showed AV dissociation, an Atrial Rate of 115 bpm, and Ventricular Rhythm of 38 bpm (Figure 5). The conclusion from these results was that there was a total AV block. Therefore, the doctor decided to implant a TPM with a rate of 70 bpm, sensitivity of 3.0 mV, and output of 3.0 mA.

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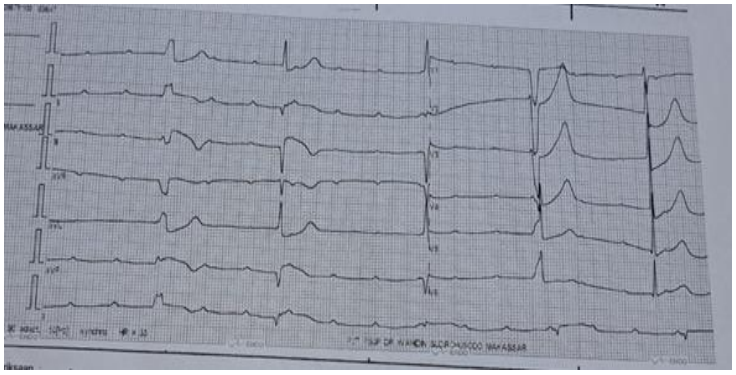

Figure 5. ECG Post Revascularization

ECG recording was performed while on TPM, revealing a pacing rhythm with Heart Rate 75 bpm, Regular, Left Axis Deviation (Figure 6). In contrast, the patient was off the TPM, the results showed AV dissociation, Atrial Rate 115 bpm, Ventricular Rhythm: 38 bpm (Figure 7).

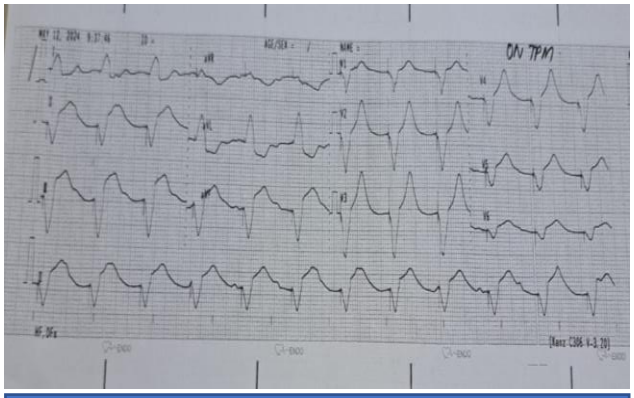

Figure 6. ECG On TPM

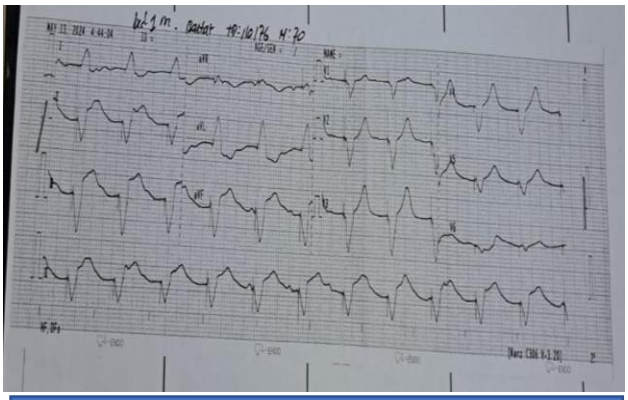

Figure 7. ECG Off TPM

For post-TPM evaluation, daily ECG recordings were performed to assess the patient's heart rhythm both in the off and on TPM conditions. After 4 days post-TPM, the patient's condition appeared unstable without the assistance of a pacemaker. Ultimately, the patient was implanted with a permanent pacemaker (PPM) with good results, showing a regular pacing rhythm on the post-PPM ECG at 70 beats per minute. The daily ECG monitoring provided clear guidance for further management of the patient.

In addition to ECG monitoring, the patient's vital signs were also monitored. Below is the patient's vital signs chart.

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Table Vital Signs of Patient

Vital Signs	Day -				
	I	II	III	IV	V
SBP (mmHg)	100	110	110	104	104
DBP (mmHg)	70	76	69	70	67
MAP (mmHg)	78.7	87	82.7	81	79.3
Heart Rate (bpm)	70	70	61	60	61
Respiratory Rate (bpm)	20	20	22	22	22
Temperature (°C)	36.3	36.3	36.2	36.3	36.5
Peripheral Saturation (%)	98	98	98	97	99

**SBP : Systolic Blood Pressure; DBP: Dyastolic Blood Pressure; MAP: Mean Arterial Pressure*

Based on the table, it showed that the patient's hemodynamic were relatively stable, this is indicated by MAP above 65 mmHg, with saturation above 95%, no fever was found. There was increase in respiratory rate above normal limits, which is 22 bpm. The patient used 3 L per minute of binasal oxygen therapy modality.

DISCUSSION

The ECG findings in STEMI patients are characterized by an evolution that begins with a hyperacute T wave and culminates in ST-segment elevation (Gulati et al., 2021). This evolution of the ECG changes can happen rapidly following coronary artery occlusion (Munirwan & Pebriana, 2020). In this case study, the patient presented with an inferoposterior STEMI characterized by specific ECG changes. Notably, there was an evolution from sinus rhythm to total AV block. Subsequently, the ECG showed a return to grade I AV block before finally reverting to total AV block. Moras et al., (2024) explained that inferior STEMI can lead to bradyarrhythmia complications, such as AV block, caused by occlusion in the RCA. This is consistent with the primary Percutaneous Coronary Intervention (PCI) results which showed total occlusion in the RCA.

Anatomically, the inferior wall of the heart is primarily supplied by branches of the RCA (Ogobuiro et al., 2023). When hypoperfusion occurs in the RCA, the AV node arteries that should get supply from the RCA become necrotic, thus disrupting the cardiac conduction system and leading to AV block (John et al., 2020).

John et al. (2020) explained that the condition of AV block during a myocardial infarction can improve if perfusion to the heart muscle is restored. Rapid reperfusion is a priority and can normalize AV conduction, allowing the consideration for PPM implantation to be postponed. In this case, although the revascularization through primary PCI showed suboptimal success, reperfusion performed after more than 48 hours with ongoing chest

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pain was not sufficient to restore AV conduction. Therefore, it was decided to proceed with the placement of TPM. TPM was placed for 5 days, but AV conduction was not recovered, so it was decided to place PPM. The implantation of a PPM becomes the preferred option when bradycardia remains a persistent symptom (Glikson et al., 2021). During PPM implantation, the patient's hemodynamic condition was stable and the pacing rhythm was consistent with the ECG recording. Previous studies also have highlighted that PPM is a safe and effective procedure, demonstrating positive outcomes in patient care (Mulpuru et al., 2017; Thapa et al., 2019). Nevertheless, this must be supported by adequate monitoring of the potential complications that may arise following PPM implantation.

From a holistic perspective, the nursing implications of this case are that nurses play a crucial role in connecting each step of patient care, especially in the proper and professional management of STEMI patients. One of the nurses' main tasks in managing STEMI patients is complication risk management, which includes hemodynamic and ECG monitoring. ECG is a non-invasive diagnostic tool routinely used to assess the electrical and muscular function of the heart (Tahboub & Dal Yılmaz, 2019). Therefore, nurses need to understand and recognize ECG rhythms well. Proper interpretation of the ECG features is the basis for deciding on quick and effective interventions so that multidisciplinary collaboration can be carried out properly.

CONCLUSION

ECG images in patients with STEMI exhibit a typical evolution. In the case of inferoposterior STEMI, the progression from AV Block 1st degree to total AV Block occurred due to occlusion in the coronary arteries, particularly the RCA. Although reperfusion can restore AV conduction, the delay in initiating reperfusion for more than 48 hours led to the decision to place a TPM and ultimately a PPM due to the lack of recovery in AV conduction. From a holistic perspective, nurses play a crucial role in managing STEMI patients, including complication risk management and ECG monitoring, a vital diagnostic tool in determining rapid and effective interventions. Multidisciplinary collaboration in patient management is necessary to improve care outcomes.

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