# Key Clinical Message

Cypermethrin poisoning can manifest with bradycardia, an uncommon but critical presentation requiring timely recognition and appropriate management. Clinicians should consider this toxicological cause in cases of unexplained bradycardia, especially in regions where pyrethroid exposure is common.

# Abstract

## Background

Cypermethrin, a synthetic pyrethroid insecticide, is widely used in agriculture and household pest control due to its high efficacy and relatively lower toxicity compared to organophosphates and carbamates. While gastrointestinal and neurological symptoms are common in cypermethrin poisoning, cardiovascular manifestations, particularly bradycardia, are rarely reported.

## Case Presentation

We report the case of a 47-year-old male who presented to the emergency department nine hours after ingesting 50 mL of cypermethrin (Tik-out 10%) with complaints of abdominal pain and dizziness. Initial assessment revealed sinus bradycardia (heart rate: 50 bpm), but no other systemic abnormalities. Laboratory findings, including serum cholinesterase levels, cardiac enzymes, and metabolic panel, were within normal limits. The patient experienced two recurrent episodes of bradycardia (heart rate: 40–45 bpm), both successfully managed with intravenous atropine (0.6 mg per episode). Supportive care included intravenous fluids, and thiamine due to his history of alcohol use disorder. The patient remained hemodynamically stable, and a repeat ECG at 72 hours showed normal sinus rhythm (76 bpm). He was discharged with psychiatric follow-up, and subsequent evaluations revealed an uneventful recovery.

## Discussion

This case highlights an atypical cardiovascular presentation of cypermethrin poisoning, with sinus bradycardia requiring atropine intervention. Pyrethroid toxicity primarily affects voltage-gated sodium channels and GABA-mediated chloride channels, leading to neurotoxic effects. However, its arrhythmogenic potential and impact on sinoatrial/atrioventricular nodes remain underrecognized. While most reported cases describe tachyarrhythmias, our case reinforces the need to monitor for bradycardia as a potential manifestation of cypermethrin toxicity.

## Conclusion

This case underscores the importance of early recognition and continuous cardiac monitoring in cypermethrin poisoning, even in patients with stable vital signs. The successful use of low-dose intravenous atropine highlights a key therapeutic approach for the associated bradycardia. Additionally, a multidisciplinary approach, including psychiatric evaluation, is crucial in cases of intentional poisoning.

## Keywords

cypermethrin, poisoning, pyrethrins, bradycardia, atropine, cardiac monitoring, insecticide, case report

# Graphical Abstract

(Figure 1)

# Introduction

Insecticide poisoning is a significant public health concern, particularly in regions where these chemicals are readily accessible and widely used in agricultural practices. Among the various insecticides, cypermethrin, a type II pyrethroid, is extensively used for its effectiveness against a broad range of pests. Cypermethrin is derived from natural pyrethrum extracted from chrysanthemum flowers and possesses insecticidal properties (1). As esters of chrysanthemic acid (ethyl 2,2-dimethyl-3-(1-isobutenyl) cyclopropane-1-carboxylate) (2) , cypermethrin is a synthetic organic insecticide that has been widely used globally since the 1980s due to its high efficacy and lower toxicity compared to organophosphate and carbamate pesticides (3,4). Due to its easy availability, accidental and occupational exposures to cypermethrin have been rising in Nepal and India. Cases of accidental pyrethroid poisoning at workplaces have been reported frequently, but poisoning with suicidal intention is rare.

It is classified as moderately toxic and when ingested, it leads to gastrointestinal symptoms (vomiting, throat and epigastric pain), neurological symptoms (coma, convulsions, tremors, and fasciculation) and can cause dermal irritation, itching, numbness, tingling, and a burning sensation (5). However, cardiotoxic manifestations like bradycardia are rare in cypermethrin poisoning (6,7) with only a few cases reported. Severe cases may present with an organophosphate-like toxidrome, complicating diagnosis (8). Management of cypermethrin poisoning is primarily supportive, focusing on decontamination, stabilization of vital signs, and symptomatic treatment. Gastric lavage is often performed if the patient presents early after ingestion.

This case of cypermethrin ingestion highlights the importance of recognizing and managing the cardiovascular complications associated with such poisonings. The patient's history of alcohol use disorder and the need for psychiatric follow-up underscore the importance of a multidisciplinary approach in managing these cases. Future research should focus on the long-term outcomes and potential preventive strategies for such types of poisoning, particularly in high-risk populations. This case report follows the CARE guidelines (9).

# Case Presentation

## History/Examination

A 47-year-old male was referred to our emergency department from nearby Primary Health Center (PHC) with an alleged history of ingestion of 50 ml of locally available insecticide named Tik-out (i.e. cypermethrin 10%) around 9 hours ago. Initially he was taken to Primary Health Center (PHC) an hour after ingesting cypermethrin where gastric lavage was performed. Later he was referred to our hospital for further management where we received him in our emergency department. Upon arrival at the emergency department, he complained of abdominal pain and dizziness. There was no history of loss of consciousness, difficulty breathing, palpitations, or seizures. His medical history was notable for alcohol use disorder, but he had no other known chronic illnesses (Figure 2).

During the primary assessment, we found his airway was intact, respiratory rate was 18 breaths/minute, chest movement was symmetric with normal breath sounds. Blood pressure was 120/70 mmHg, pulse rate ranged between 50 and 55 beats per minute and Glasgow Coma Scale (GCS) was 15/15, with both pupils measuring 3 mm, round, regular, and reactive to light. His systemic examination revealed no abnormality. The patient was placed on continuous cardiac monitoring. An ECG revealed sinus bradycardia with a heart rate of 50 bpm (Figure 3).

## Methodology (Investigations, differential diagnosis and management)

His laboratory values showed normal Renal Function Tests, Liver Function Tests, Complete blood count (CBC) and random blood glucose (RBG) levels. His serum cholinesterase level was 6.62 KU/L (4.6-11.5 KU/L), serum calcium was 2.5 mmol/L (2.20-2.65 mmol/L), CPK MB was 20 U/L (<25 U/L) and troponin I was negative. With this history, examinations and investigations, the patient was diagnosed with cypermethrin poisoning. The other differentials we should think of in such scenarios are organophosphate poisoning, beta‐blocker overdose, calcium channel blocker toxicity or inferior wall myocardial infarction. Although organophosphate poisoning can present with bradycardia, it was ruled out because the patient’s serum cholinesterase levels were within normal limits and he lacked other cholinergic features like miosis, excessive salivation, and fasciculations. Similarly, history of ingestion of cypermithrin with evidence of a bottle of poison brought to the hospital by patient party, normal electrolytes and metabolic investigations, normal cardiac enzyme levels, unremarkable echocardiogram, and overall ECG findings (aside from isolated bradycardia) ruled out other differential diagnosis.

The patient was transferred to the observation ward for continuous cardiac monitoring. While the patient initially remained stable in the observation ward, he experienced an episode of dizziness approximately one hour later, coinciding with bradycardia (heart rate: 40–45 bpm). A bedside random blood glucose test performed at the same time showed a level of 93 mg/dL. Immediately intravenous atropine (0.6 mg) was administered, which increased the heart rate above 80 bpm. Three hours later, a similar bradycardic episode occurred, with a heart rate dropping below 42 bpm. Another dose of intravenous atropine (0.6 mg) was given, leading to a heart rate correction to 75–80 bpm. Along with atropine, additional supportive measures included Pantoprazole (40 mg IV) for gastrointestinal symptoms, Thiamine (100 mg IV) due to his history of alcohol use, and maintenance intravenous fluids for hydration. His stay in the observation ward was uneventful for the next 72 hours. An echocardiogram was performed, which showed no abnormalities. Over the next 72 hours, the patient remained asymptomatic, and a repeat ECG showed a normal sinus rhythm with a heart rate of 76 bpm (Figure 4). He was evaluated by the psychiatry team and discharged with advice for psychiatric follow-up in seven days. Subsequent follow-ups revealed an uneventful recovery.

# Discussion

This was a case of cypermethrin poisoning with suicidal intent with an atypical cardiac manifestation—bradycardia—which was successfully managed conservatively. The widespread use of insecticides in agriculture has led to increased cases of poisoning, including both accidental and suicidal ingestions. Organophosphates and organochlorines are the most common culprits, but synthetic pyrethroids like cypermethrin are also becoming more prevalent. These are widely available as Rakshak, Shooter or Tik-out. Cases of cypermethrin poisoning with typical gastrointestinal or neurological manifestation have been reported frequently. However, the atypical presentation like bradycardia is rare.

Cypermethrin toxicity primarily affects the nervous system by delaying the closure of voltage-gated sodium channels in axonal membranes. Additionally, its inhibition of gamma-aminobutyric acid (GABA)-mediated chloride channels contributes to neurotoxic effects such as tremors and convulsions (11). In mammals, it binds to the anionic substrate binding site of acetylcholinesterase, thus inhibiting the enzyme and leading to cholinergic crisis (12). Moreover, the dermal absorption is slower while the metabolism and excretion is rapid (10). This poison is categorized as a moderately hazardous insecticide by the WHO. The toxic dose in mammals ranges from 100 to 1000 mg/kg body weight. The lethal dose (LD50) is 1 - 10gm (10,11). The toxic dose and lethal dose vary according to the type of isomer, body weight and species.

The clinical manifestations vary according to the route of exposure. Dermal exposure leads to paresthesia, pruritus, blisters and burning sensation. Dermal symptoms usually start 30 min to 2 hours after exposure, peaks at around 6 hrs and recovers in around 24 hours (10). Oral ingestion leads to systemic toxicity presenting mainly as gastrointestinal and neurological symptoms. Immediately after ingestion nausea, vomiting, dizziness, headache, burning sensation of throat, oral and throat ulcerations are usually seen. Upper GI endoscopy findings in previous cases have demonstrated esophagitis, gastritis, and gastric and duodenal ulcers (8). Patient can also present with features of cholinergic crisis like salivation, increased urination, fasciculation, tremor due to inactivation of acetylcholinesterase (13). Paresthesia, retropulsion, lateral head movements has also been reported. Cardiac symptoms are rare in cypermethrin poisoning with cases reporting of sinus tachycardia, ventricular premature beats and ST-T changes in ECG and rarely sinus bradycardia (10). The cardiac manifestations are attributed to the blockage of sodium channels in sinoatrial or atrioventricular node. The pyrethroid group of compounds are arrhythmogenic in nature.

The management of cypermethrin toxicity is primarily symptomatic and supportive. In the emergency department, airway, breathing, and circulation should be stabilized first through oxygen supplementation and intravenous fluid resuscitation. It may be followed by dermal decontamination by changing the exposed clothes and washing the body with soap and water, however there is no conclusive evidence that this step reduces toxicity. Gastric lavage is avoided due to the heightened risk of aspiration pneumonia associated with the solvent. The use of activated charcoal may be considered within one hour of ingestion but it has limited supporting evidence (14). For neurological symptoms such as prolonged seizure, intravenous diazepam or lorazepam can be given. Low dose intravenous atropine sulphate (0.6 - 1.2 mg) is found to be effective for cholinergic crisis. Our patient who happened to ingest 50 ml of cypermethrin presented with atypical features of bradycardia in emergency department. He was managed with two doses of atropine (0.6 mg each) along with supportive care.

Our case presents unique features rarely reported in the literature. Firstly, the patient's history of alcohol use disorder adds a layer of complexity to the management, as it necessitates additional supportive care such as Thiamine administration. Secondly, the recurrent episodes of bradycardia highlight the cardiovascular complications associated with cypermethrin poisoning, which are not commonly reported in the literature. This emphasizes the importance of continuous cardiac monitoring and prompt intervention with atropine. Furthermore, the patient's uneventful recovery and the subsequent psychiatric follow-up highlight the need for a multidisciplinary approach in managing such cases.

Previous studies have reported cases of cypermethrin poisoning with varying clinical presentations and outcomes. For instance, a case report described a 30-year-old male who presented with symptoms resembling organophosphate poisoning, including increased salivation and bronchospasm (11). In contrast, our patient did not exhibit these symptoms, but had significant cardiovascular complications. Another study highlighted the long-term and severe nature of delayed peripheral neuropathy, persisting at two years of follow-up in case of ingestion of mixed pesticide, consisting of 50% chlorpyrifos with 5% cypermethrin (15). While our case did not involve organophosphates, long-term considerations with monitoring and follow-up in patients with any insecticide poisoning should be prioritized to look for long term outcomes. Singh et al. reported a case of syncope due to transient complete heart block after an accidental exposure to bed bug repellent spray containing pyrethroid (16). Bhaskar et al. reported a case of sinus arrest with escape junctional rhythm that persisted for three days after suicidal consumption of a pyrethroid compound (Prallethrin) (17). Another case reported a death attributed to poisoning from ingestion of pyrethroids in combination with mirtazapine (18).

# Conclusion

This case report highlights the importance of recognizing cardiovascular manifestations, particularly bradycardia, in cases of pyrethroid poisoning. Given the arrhythmogenic potential of cypermethrin, continuous cardiac monitoring is crucial, and prompt intervention with atropine should be considered when necessary. Additionally, this case underscores the significance of a multidisciplinary approach, including psychiatric evaluation, in the management of intentional poisoning. Future research should explore the long-term cardiovascular effects of cypermethrin toxicity and the development of standardized treatment protocols to optimize patient outcomes.

**Author Contributions**

**Manish Acharya:** Conceptualization, Data curation, Investigation, Methodology, Resources, Supervision, Visualization, Writing - original draft, Writing - review & editing; **Kapil Khanal:** Conceptualization, Writing - original draft, Writing - review & editing**; Devansh Upadhyay:** Conceptualization, Methodology, Resources; **Sagar Thapa:** Investigation, Methodology, Visualization, Writing - review & editing**; Archana Dhakal:** Conceptualization, Methodology, Writing - original draft; **Santosh Bastola:** Conceptualization, Investigation, Methodology, Supervision, Writing - original draft**; Ramesh Maharjan:** Conceptualization, Investigation, Methodology, Supervision

**Ethical approval**

This case report did not intervene with the patient’s treatment plans and hence it did not require ethical approval.

**Consent**

Written informed consent was obtained from the patient for the publication of this case report and accompanying images. A copy of written consent is available for review by the editor in chief of this journal on request.

**Conflicts of Interest**

The authors declare no conflicts of interest regarding the publication of this case report.

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# Figures

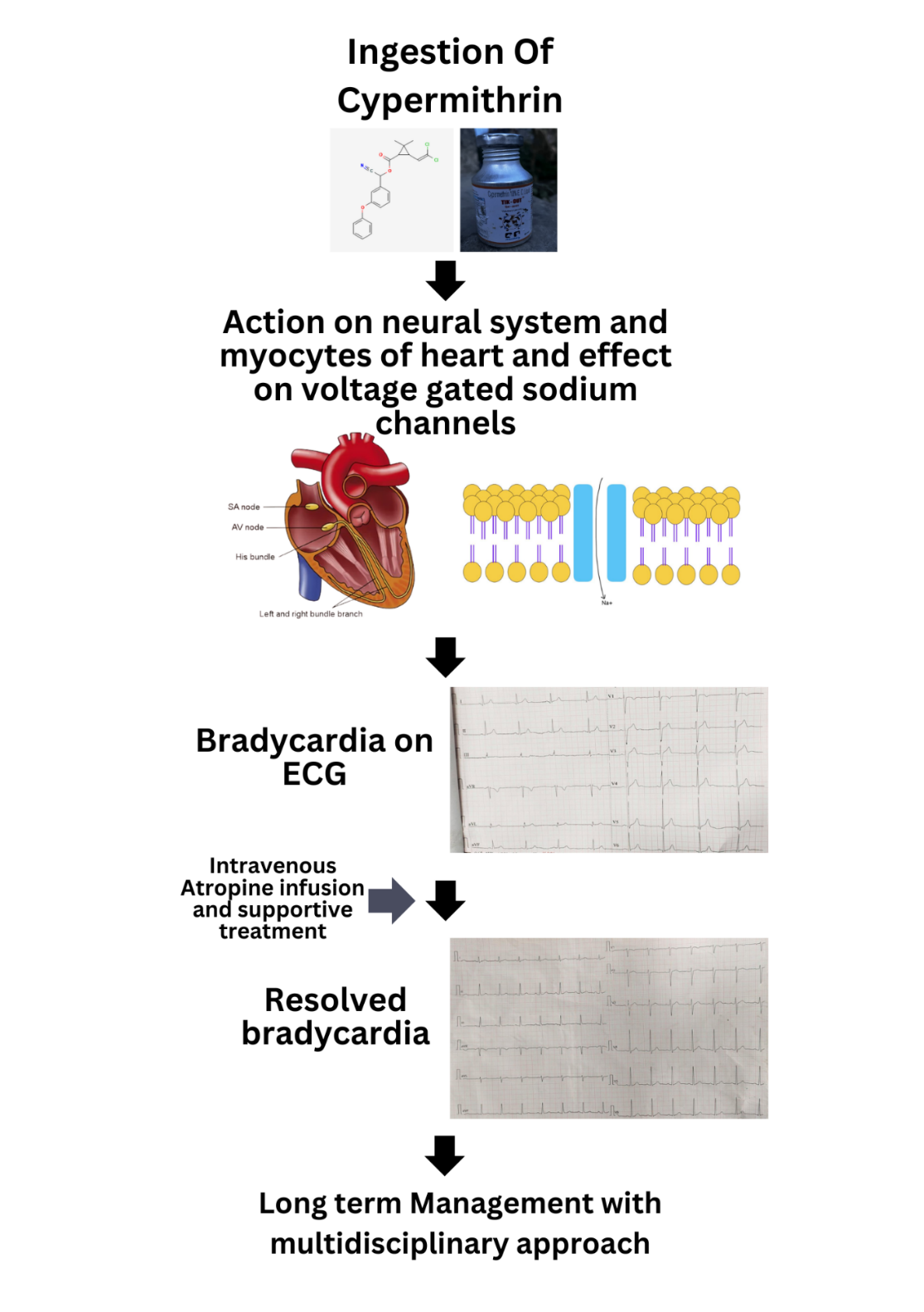


Figure 1: Graphical Abstract



Figure 2: The container containing the insecticide ingested by the patient

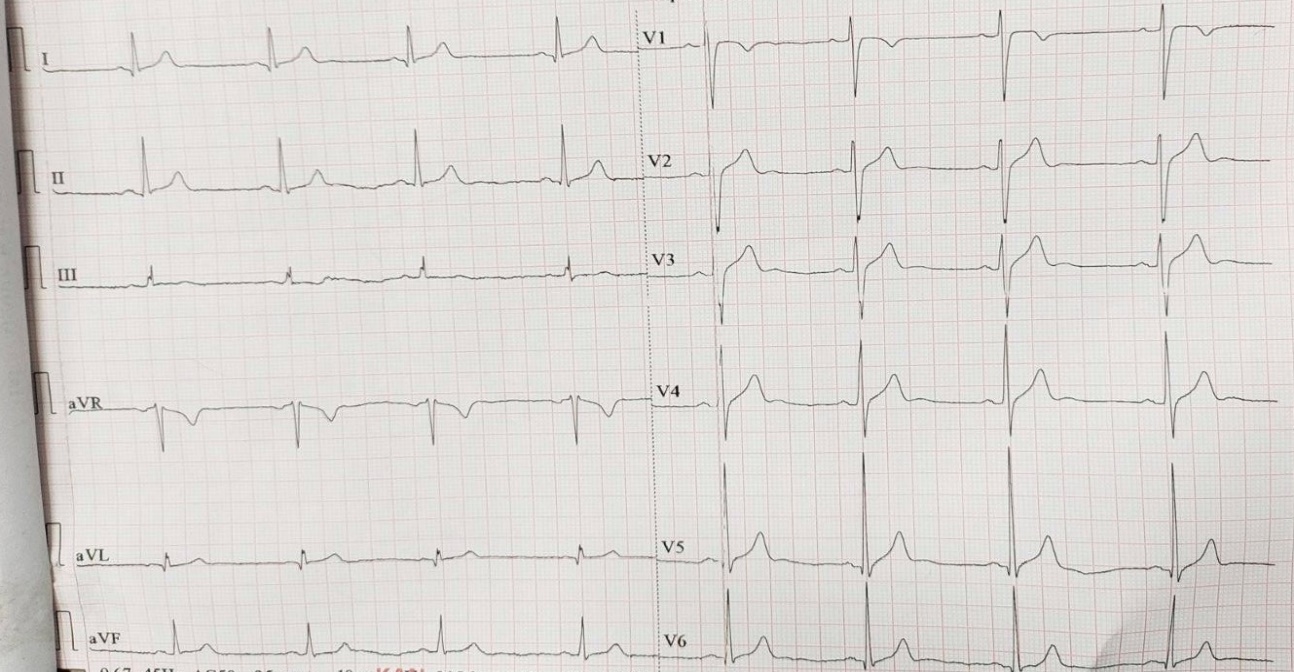
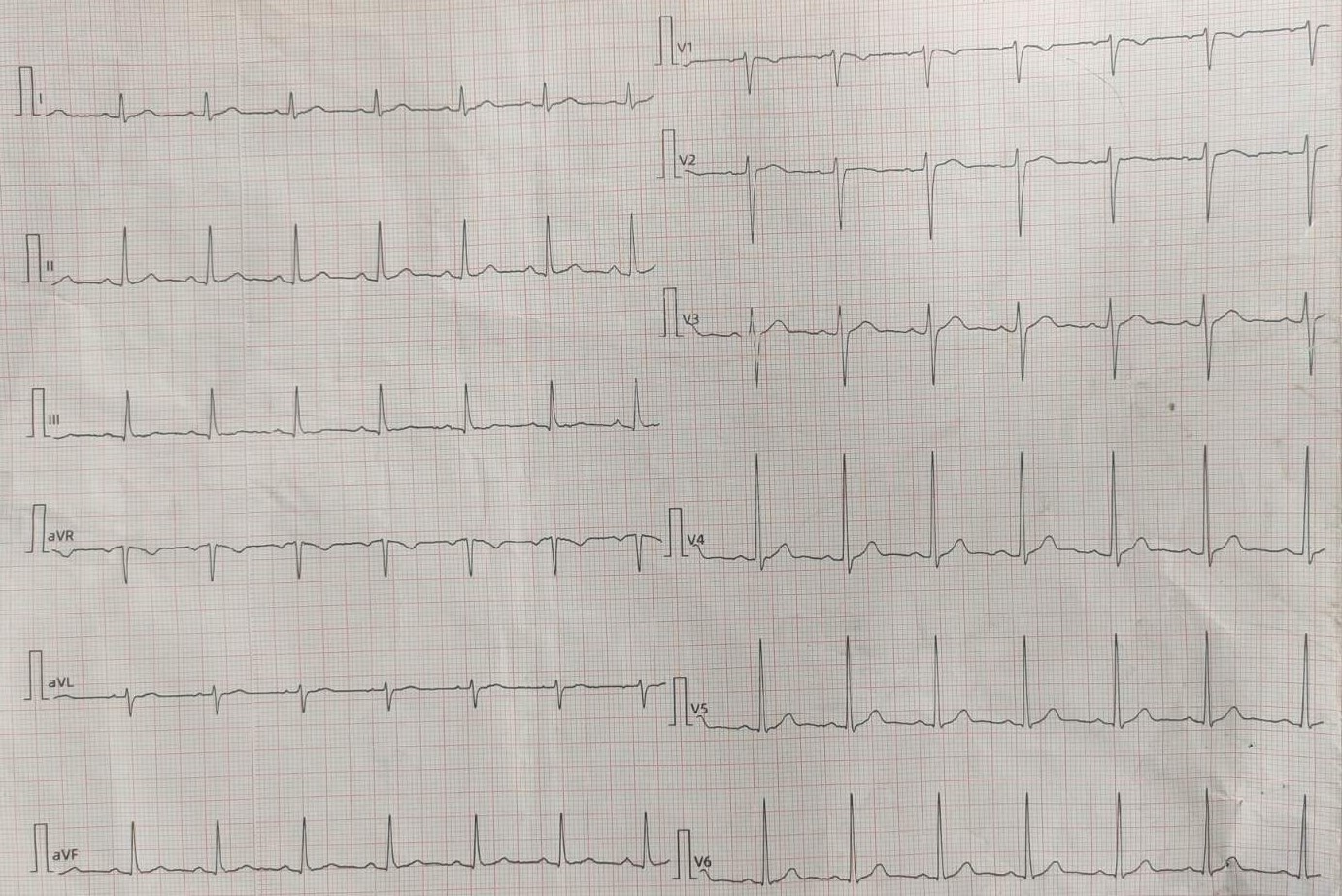


Figure 3: Initial ECG showing sinus bradycardia.

**** Figure 4: ECG showing sinus rhythm and rate after the treatment