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| RESEARCH ARTICLE

Myocardial Infarction Following Epinephrine Administration in Anaphylaxis: A Case Report

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| ABSTRACT

Anaphylaxis is a severe, acute hypersensitivity reaction that can lead to rapid deterioration and potentially fatal outcomes if untreated. Common symptoms include shortness of breath, angioedema, and hypotension. Despite the high incidence, mortality rates remain low due to the first-line treatment, epinephrine, and its well-established effectiveness in anaphylaxis management. Epinephrine acts as an alpha- and beta-adrenergic agonist, effectively increasing blood pressure and relieving airway obstruction. However, epinephrine can rarely induce cardiovascular events. Here, we present a case of a 55-year-old male with a known history of hypertension, ischemic heart disease, and smoking. Presented to the ED with a severe allergic reaction, he was given epinephrine, which resulted in the development of myocardial infarction. The literature suggests a small but significant risk of cardiotoxicity linked to epinephrine, with intramuscular (IM) administration being preferable over intravenous (IV) due to lower associated risks. While the risk of cardiovascular events exists, timely epinephrine administration is crucial for preventing severe anaphylactic outcomes. Clinicians must be mindful of the adverse effects of epinephrine and carefully assess and monitor the patients, particularly those at risk of cardiovascular events.

| KEYWORDS

STEMI; Shock; Epinephrine

| ARTICLE INFORMATION

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1. Introduction

Anaphylaxis is an acute medical condition involving systemic hypersensitivity reactions. Sign and symptoms onset is rapid with a variety of manifestations including but not limited to shortness of breath, angioedema, sudden, persistent cough, and hypotension (1). Without treatment, this allergic reaction could be fatal due to the rapid deterioration and respiratory collapse (2,3). According to the World Allergy Organization guidelines, anaphylaxis global incidence is between 50-112 episodes per 100 000 person-years while the lifetime provenance is 0.3–5.1%. Despite the high incident rate, the mortality rates remain low due to the improvement in the management approaches, mainly the effectiveness of the cornerstone treatment for anaphylaxis, which is epinephrine (4). Epinephrine is an alpha- and beta-adrenergic agonist that works by increasing the inotropic and chronotropic cardiac effects, leading to increasing blood pressure and counteracting anaphylaxis-mediated

hypotension. It also bronco dilates and reduces mucosal edema of the airway through vasodilation of its skeletal and smooth muscles, which improves respiration (1).

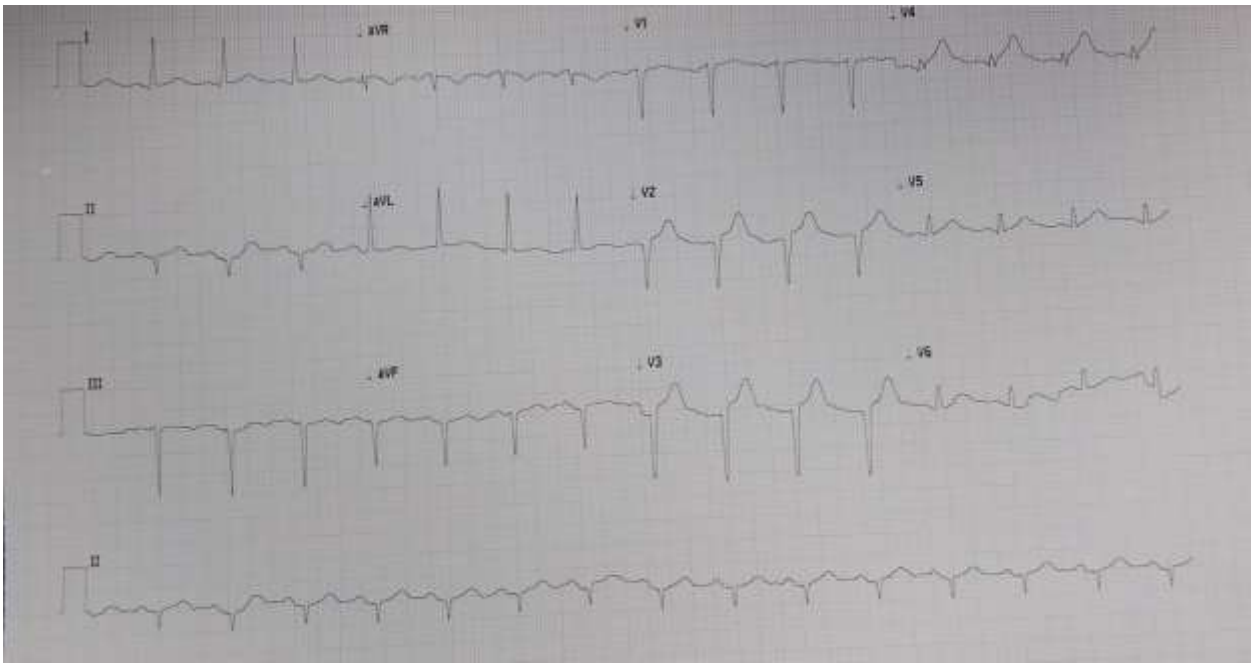
Myocardial infarction MI developing in the context of anaphylaxis can be several interrelated factors: the first one is Kounis syndrome, which is due to the release of anaphylaxis mediators causing coronary vasospasm and subsequent MI. The second factor is the systemic effects of anaphylaxis, including hypotension and shock, compromising the coronary perfusion, further increasing the risk of MI. Lastly, epinephrine administration increases the myocardial oxygen demand, leading to ischemic events and myocardial injury, particularly in suspectable individuals with pre-existing cardiovascular risks (5). Epinephrine, due to its inotropic and chronotropic properties, carries a risk of developing myocardial infarction, particularly in patients with underlying cardiovascular risk factors. However, this risk is relatively low (5,6). Here, we report a case of a 55-year-old male with pre-exciting cardiovascular risk factors, including ischemic heart disease, hypertension, dyslipidemia, and developing myocardial infarction following administration of epinephrine for anaphylaxis management.

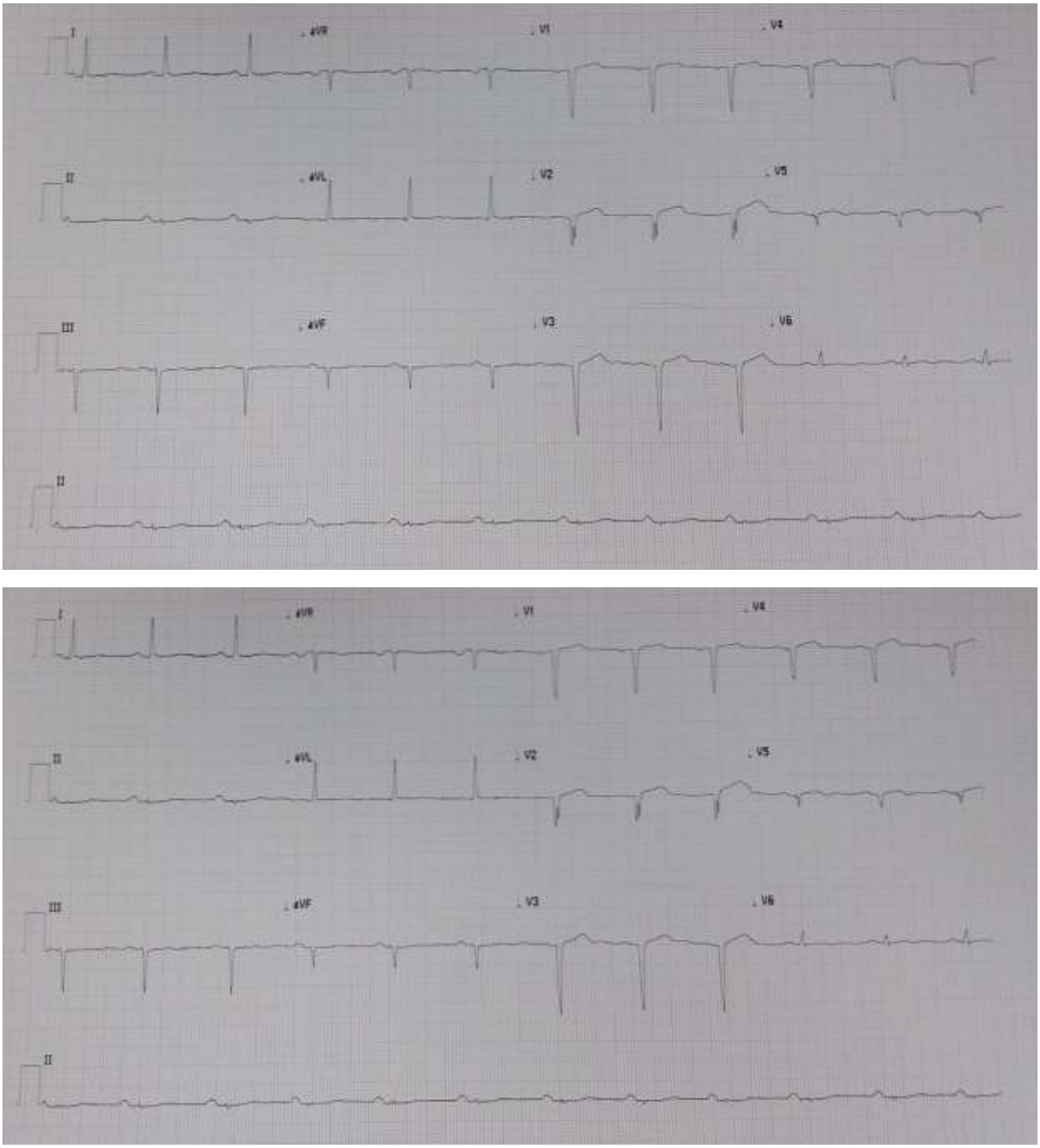
2. Case

A 55-year-old Middle Eastern Male presented to the emergency department with complaints of swelling of the lips and face associated with shortness of breath. The patient's relative also noted a skin rash that started to develop after the patient ingested an unknown dish in a restaurant. The patient reported having multiple allergies, including some types of fish, peanuts, and fruits. The patient also has a history of ischemic heart disease, where he had an ST-Segment Elevation Myocardial Infarction in 2020, Hypertension, Dyslipidemia, and Diabetes Mellitus. On examination, oxygen saturation was 88% on a 5L face mask, with a respiratory rate of 23, heart rate of 110, and blood pressure of 99\64. Facial swelling and bilateral wheezing were heard during the examination.

It was determined that the patient required a dose of epinephrine to stabilize the vital signs and the impending anaphylactic shock. The patient was attached to a cardiac monitor, and a STAT dose of epinephrine was given. The patient's vital signs started to pick up, with a saturation peaking at 96% and the blood pressure rising to 100\75. After an hour, the patient began to experience chest pain associated with radiation to the left arm and sweating. A serial electrocardiogram was taken within 10 minutes, as seen in Figure 1.

Figure One: Serial Electrocardiogram.





The electrocardiogram shows sinus rhythm with left axis deviation, Q waves in the inferior and anterior leads, and ST-segment elevation in the anterior leads (mainly V5 to V6) and was sent to a higher cardiac center in the region within the next thirty minutes. The patient underwent a coronary angiogram that showed normal coronary arteries with no noted thrombosis. The patient was treated with medical therapy, and it was regarded that the epinephrine was the most likely underlying cause of the infarction.

3. Discussion

Anaphylaxis is a medical emergency due to a severe allergic reaction. Intramuscular Epinephrine is the first-line treatment. IM epinephrin is superior to IV administration even if intravenous access is available. A single dose of IM epinephrine is well-tolerated and has minimal adverse risks. Delayed epinephrin administration is associated with an increased risk of biphasic reaction, which is the recurrence of anaphylaxis symptoms after the resolution of the initial episode (7). While

epinephrin administration is crucial in anaphylaxis management, its potent sympathomimetic effects can lead to significant cardiovascular events, particularly in patients with underlying risk factors (8).

Myocardial Infarction (MI) occurring in the context of anaphylaxis represents a complex interplay between immunological, cardiovascular response and possible pharmacological reaction with the main treatment epinephrine. One primary factor was first described by Kounis and Zavras in 1991, Kounis syndrome, which is characterized by coronary vasospasms secondary to the release of cytokines through mast cell activation during an allergic reaction(1,9). This syndrome has three distinct types, each reflecting different underlying pathophysiological mechanisms. Type I involves coronary artery spasm in normal artery, Type II involves coronary artery spasm or plaque erosion in a vessel with pre-existing atheromatous disease, while Type III is associated with stent thrombosis, often characterized by the presence of eosinophils or mast cells in the thrombus (10). There have been several cases of patients with allergic reactions developing MI before receiving epinephrine(11)(12). Kounis N.G. estimated the prevalence of Kounis syndrome patients hospitalized for allergic reactions to be 1.1% (13). Most reported cases of MI development in the background of allergic reaction were before receiving epinephrine, which is suggestive of Kounis syndrome (5).

Epinephrine-induced myocardial infarction following anaphylaxis has been reported a few times. As noted by Zakka et al. (2020), six cases have been documented in which therapeutic doses of epinephrine resulted in myocardial infarction. Of these reports, one was after intravenous infection, two involved intramuscular injection, and three followed subcutaneous injection. It has been proposed that patients with multiple risk factors for coronary artery disease (CAD) might be more vulnerable to complications from epinephrine administration. However, notably, the six reported cases involved relatively young individuals who did not have risk factors for CAD(14,15). Additionally, the case reported by Zakka et al. was on a young female with no major cardiac risk factors (14). Our patient, on the other hand, was a 55-year-old male with cardiovascular risk factors, including hypertension, ischemic heart disease, dyslipidemia, and smoking, all of which predisposed him to cardiovascular events. Notably, the cause of MI, in this case, would most likely be epinephrine and not anaphylaxis itself (Kounis syndrome), as the patient developed MI symptoms that include severe chest pain, shortness of breath, and sweating directly after epinephrine administration. However, kounis syndrome cannot be excluded. The suggested mechanism by which our patient and the similar discussed cases have developed MI is coronary vasospasm-induced epinephrine (5,14).

Epinephrine rapidly works to counteract the organs' response alongside the immune mediators of anaphylaxis. It prevents the degranulation of mast cells to limit the mediators' release. At the doses administered during anaphylaxis, the α-1-adrenergic effects of epinephrine lead to vasoconstriction, enhanced peripheral vascular resistance, and reduced mucosal edema. Meanwhile, the β-1-adrenergic effects boost myocardial contractility and enhance blood flow in the coronary arteries(16).

The development of epinephrine's adverse effects is highly impacted by the route of administration. In an observational cohort study conducted at Mayo Clinic Hospital, which included 573 patients, among those, 301 received at least one dose of epinephrine (57.6%). Leading to a total of 362 doses administered, with a majority given via intramuscular (IM) autoinjectors (67.7%). The study recorded eight adverse cardiovascular (CV) events and four cases of overdose, all associated with intravenous (IV) bolus administration. Importantly, adverse events were noted in 10% of IV bolus doses, compared to just 1.3% for IM doses, resulting in an odds ratio of 8.7 ($P = .006$). Additionally, all four overdose instances were related to IV bolus use, accounting for 13.3% of those doses, while no overdoses occurred with IM administration, yielding an odds ratio of 61.3 ($P < .001$) (17). This supports the current guidelines that emphasize intravascular administration of epinephrine rather than intravenous administration, even in hospital settings (3).

In a recent retrospective study assessing the frequency of the adverse cardiovascular effects after intramuscular administration of epinephrine for anaphylaxis in a Tennessee quaternary care academic ED from 2017 to 2021, which included 338 patients diagnosed with anaphylaxis who received at least one IM dose of epinephrine. The results indicated that 16 patients (4.7%) experienced cardiovascular events (4.7%), which included ischemic ECG changes (2.4%), elevated troponin (1.8%), and various arrhythmias. Notably, a patient who experienced those effects was older with more comorbidities and was more likely to have received multiple doses of epinephrine or an infusion (18), highlighting the need for careful monitoring for this population.

Although there is an approximately 5% risk of developing cardiovascular events, including MI, following epinephrine administration for anaphylaxis, epinephrine remains the mainstay treatment for anaphylaxis, and its administration should not be delayed, as delays can lead to worse outcomes and increased mortality rates. There are no absolute contraindications for using epinephrine in life-threatening anaphylaxis, and physicians should not hesitate to administer it promptly. However, they should be mindful of potential cardiovascular risk factors that may heighten the risk of adverse effects from epinephrine and ensure rapid management. Most cases of myocardial injury resulting from epinephrine have been effectively treated with nitrates, either through intravenous infusion or sublingual administration, as well as calcium channel blockers (5).

4. Conclusion

This case report describes a case of epinephrine-induced myocardial infarction in the context of anaphylaxis. While epinephrine is the cornerstone treatment for anaphylaxis, its administration can increase the risk of developing MI, particularly in individuals with underlying conditions such as ischemic heart disease and hypertension, which was the case with our patient. This aligns with the available literature that indicates a small but significant risk of cardiotoxicity associated with epinephrine. Intramuscular administration of epinephrine is superior to intravenous administration as it is associated with lower cardiotoxicity and risk of overdosing. Ultimately, while the risk exists, timely administration of epinephrine remains critical in preventing severe outcomes from anaphylaxis. Clinicians must be prepared to manage any complications that may arise. This includes close monitoring, regular patient assessment, and identifying potential risk factors. Areas requiring further exploration involve identifying patients who are susceptible to coronary artery spasms following epinephrine use. Important risk factors for epinephrine-induced myocardial ischemia include older age, pre-existing coronary artery disease, and the use of beta-blockers. Management of such cases often involves intravenous or sublingual nitrates in addition to calcium channel blockers.

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References

[1] Pflipsen MC, Colon KMV. Anaphylaxis: Recognition and Management. [cited 2024 Nov 1]; Available from: https://www.aafp.org/pubs/afp/issues/2020/0915/p355.html
[2] McLendon K, Sternard BT. Anaphylaxis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Nov 1]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK482124/
[3] Muraro A, Worm M, Alviani C, Cardona V, DunnGalvin A, Garvey LH, et al. EAACI guidelines: Anaphylaxis (2021 update). Allergy. 2022;77(2):357–77.
[4] Turner PJ, Campbell DE, Motosue MS, Campbell RL. Global Trends in Anaphylaxis Epidemiology and Clinical Implications. [cited 2024 Nov 1]; Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7152797/
[5] Jayamali WD, Herath HMMTB, Kulathunga A. Myocardial infarction during anaphylaxis in a young healthy male with normal coronary arteries- is epinephrine the culprit? BMC Cardiovasc Disord. 2017 Sep 4;17(1):237.
[6] Shankar A, Gurumurthy G, Sridharan L, Gupta D, Nicholson WJ, Jaber WA, et al. A Clinical Update on Vasoactive Medication in the Management of Cardiogenic Shock. [cited 2024 Nov 1]; Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8829716/
[7] Liu X, Lee S, Lohse CM, Hardy CT, Campbell RL. Biphasic Reactions in Emergency Department Anaphylaxis Patients: A Prospective Cohort Study. J Allergy Clin Immunol Pract. 2020 Apr 1;8(4):1230–8.
[8] Shrestha B, Kafle P, Thapa S, Dahal S, Gayam V, Dufresne A. Intramuscular Epinephrine-Induced Transient ST-Elevation Myocardial Infarction. [cited 2024 Nov 8]; Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6069038/
[9] Kounis NG, Zavras GM. Histamine-Induced Coronary Artery Spasm: The Concept of Allergic Angina. Int J Clin Pract. 1991;45(2):121–8.
[10] Cahuapaza-Gutierrez NL, Calderon-Hernandez CC, Chambergo-Michilot D, De Arruda-Chaves E, Zamora A, Runzer-Colmenares FM. Clinical characteristics, management, diagnostic findings, and various etiologies of patients with Kounis syndrome. A systematic review. Int J Cardiol. 2025 Jan 1;418:132606.
[11] Gangadharan V, Bhatheja S, Balbissi KA. Kounis syndrome - an atopic monster for the heart. [cited 2024 Nov 8]; Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3839223/
[12] Xu GZ, Wang G. Acute myocardial infarction due to Kounis syndrome: A case report. [cited 2024 Nov 8]; Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9649533/
[13] Kounis NG. Kounis syndrome: an update on epidemiology, pathogenesis, diagnosis and therapeutic management. 2016 Oct 1 [cited 2024 Nov 8]; Available from: https://www.degruyter.com/document/doi/10.1515/cclm-2016-0010/html
[14] Zakka K, Gadi S, Koshlelashvili N, Maleque NM. Acute myocardial injury after administration of intravenous epinephrine for allergic reaction. [cited 2024 Nov 10]; Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7301683/
[15] Rubio Caballero JA, Oteo Domínguez JF, Maicas Bellido C, Cantón T, Barciela R, García Moreno LM, et al. [An adrenaline-induced vasospasm as the form of presentation of variant angina]. Rev Esp Cardiol. 1999 Apr 1;52(4):273–6.
[16] Brown JC, Simons E, Rudders SA. Epinephrine in the Management of Anaphylaxis. J Allergy Clin Immunol Pract. 2020 Apr 1;8(4):1186–95.
[17] Campbell RL, Bellolio MF, Knutson BD, Bellamkonda VR, Fedko MG, Nestler DM, et al. Epinephrine in Anaphylaxis: Higher Risk of Cardiovascular Complications and Overdose After Administration of Intravenous Bolus Epinephrine Compared with Intramuscular Epinephrine. J Allergy Clin Immunol Pract. 2015 Jan 1;3(1):76–80.
[18] Pauw EK, Stubblefield WB, Wrenn JO, Brown SK, Cosse MS, Curry ZS, et al. Frequency of cardiotoxicity following intramuscular administration of epinephrine in emergency department patients with anaphylaxis. J Am Coll Emerg Physicians Open. 2024;5(1):e13095.