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REVIEW

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Comprehensive management evaluation of anaphylactic shock in dental clinics across developing countries

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Abstract

Anaphylaxis shock is defined as a sudden, severe allergic reaction that can be life-threatening and typically occurs within minutes to a few hours following exposure to a triggering substance. While anaphylaxis shock can be a rare side effect of dental treatments, including sedation and anesthesia, dentists must be prepared to respond promptly and appropriately to prevent complications such as airway obstruction and cardiac issues. In developing countries, managing anaphylactic shock presents challenges, often due to low awareness among dentists and a lack of necessary equipment. Immediate diagnosis and management are crucial in a dental setting when anaphylaxis shock occurs. Therefore, dental practitioners must be trained to diagnose and manage such situations effectively. A lack of comprehensive understanding of allergy testing, diagnosis, and management can have serious consequences.

Keywords Anaphylactic shock, Developing countries, Management

Introduction

Definition of anaphylactic shock and its significance in dentistry

Anaphylaxis shock is described as a sudden, severe allergic reaction that can be life-threatening, triggered by the release of mediators from mast cells, basophils, and inflammatory cells that have been recruited to the site [1]. Anaphylaxis shock is characterized by a variety of signs and symptoms, either individually or in combination, that manifest within minutes to a few hours following exposure to a triggering substance [1]. Per the 2020 World Allergy Organization (WAO) anaphylaxis shock guidance, anaphylaxis shock is a severe systemic hypersensitivity reaction that typically occurs quickly and can potentially be fatal. Severe anaphylaxis shock is identified by a critical compromise in the airway, breathing, and/or circulation that has the potential to be life-threatening. Also, anaphylaxis shock can occur even without typical skin manifestations or cardiovascular shock [2]. This reaction can range from mild to moderate to severe, with most cases being mild. However, it is important to note that any instance of anaphylaxis shock has the potential to escalate to a life-threatening situation [1]. The main pathogenesis of anaphylaxis shock involves an immediate allergic reaction mediated by immunoglobulin E (IgE). It is not feasible to measure IgE levels during real-time clinical diagnosis, making it challenging to definitively identify an IgE-mediated allergic response. As a result, the term anaphylaxis shock has historically been utilized

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as a general term that includes both IgE-mediated and non-IgE-mediated reactions. The world allergy organization and the European Academy of Allergy and Clinical Immunology (EAACI) have put forth a more inclusive definition by describing anaphylaxis shock as a severe, life-threatening, generalized, or systemic hypersensitivity reaction they recommend against using the term anaphylaxis shock [3–5]. Given that the signs and symptoms of anaphylaxis shock can escalate rapidly, prompt diagnosis and timely intervention are crucial in non-hospital settings [6]. In these scenarios, it is vital to suspect anaphylaxis shock, promptly contact emergency medical services (EMS), and provide of treatment protocols without delay if respiratory or cardiovascular symptoms are evident, regardless of the presence of skin symptoms. Furthermore, after managing the acute phase of an anaphylactic shock episode, it is crucial to confirm the diagnosis of anaphylaxis shock and determine the specific trigger that caused the reaction [6].

On the other hand, anaphylaxis shock can be a side effect of dental treatments, including sedation and anesthesia. That in this case requires a prompt and appropriate response to prevent complications such as airway obstruction and cardiac issues. Immediate diagnosis and management are essential in a dental setting when anaphylaxis shock occurs [6].

Once anaphylactic shock does happen, the symptoms progress rapidly and can result in airway obstruction, breathing difficulties, cardiovascular collapse, and cardiac arrest. Therefore, a quick and effective response is crucial for saving lives [6]. Factors that can lead to anaphylaxis shock in the dental office include antibiotics, chlorhexidine, local anesthetics, general anesthetics, latex, toothpaste, and iodoform [7]. Antibiotics are one of the medications that are most likely to trigger anaphylaxis shock [8]. Amoxicillin, phenoxymethylpenicillin, and metronidazole are three antibiotics commonly prescribed in dentistry [9]. Amoxicillin is likely the antibiotic most commonly linked to anaphylaxis shock. Fatalities resulting from anaphylactic shock reactions to amoxicillin have been documented [10]. However, anaphylaxis shock due to chlorhexidine too has been increasingly reported globally [7]. On the other hand, anaphylactic shock reactions to local anesthetics prescribed in the dental setting are extremely uncommon [11]. However, this reaction is potentially life-threatening in the context of any factor that may arise in the dental office, and the dental team must be prepared to respond effectively [7]. Therefore, this review aims to comprehensively evaluate the management of anaphylactic shock in dental practice, focusing on the importance of rapid diagnosis, timely intervention with epinephrine, and the identification of potential triggers associated with dental treatments. It also aims to enhance the preparedness of dental professionals to recognize and respond effectively to anaphylactic shock.

Prevalence of anaphylactic shock in dental clinics

The most common systemic complications during dental treatment in dental clinics include vasovagal syncope (62–63%), angina (12%), hypoglycemia (10%), and seizure (7–10%); anaphylaxis shock with an incidence rate of only 0.4–2.1%, is considered [12–15]. Dentists are estimated to encounter approximately 0.004 to 0.013 cases of anaphylaxis shock during dental treatment per year, suggesting that a dentist is likely to come across a case of anaphylaxis shock once every 77 to 250 years [14, 15]. The occurrence of perioperative anaphylaxis shock differs by region and study. The highest estimated occurrence is 0.01% (1 in 10,000 cases of general anesthesia), with a mortality rate of 3.8–4.8%, as indicated by studies conducted in the United Kingdom and France [16–18].

However, a study conducted in a developing country regarding the prevalence of common reactions in a dental clinic showed that the prevalence of anaphylactic shock in a dental clinic is very low [19]. Therefore, according to the studies, the prevalence of anaphylactic shock is very rare, but, dental practitioners, especially those specializing in areas such as oral and maxillofacial surgery, endodontics, and periodontics, should receive proper training to diagnose and handle such occurrences [20–23]. Lack of a thorough understanding of allergy testing, diagnosis, and management can lead to serious consequences [23].

Diagnosis and assessment of anaphylactic shock

Signs and symptoms of anaphylactic shock

One of the challenges faced in dental clinics is the potential for panic attacks, vasovagal attacks, or syncope to be misidentified as anaphylactic shock. Consequently, it is imperative to adhere to established diagnostic guidelines [7]. Anyway, anaphylaxis shock can develop rapidly and is typically an immediate life-threatening condition primarily due to respiratory compromise. Early signs and symptoms may include a warm sensation, itching (especially in the armpits and groin), and feelings of anxiety and panic. These initial symptoms can progress to a red or hives-like rash, swelling of the face and neck, bronchospasm, and laryngeal edema [24]. Identifying the causative agent can help prevent future episodes and guide appropriate management strategies. For instance, studies have identified low vitamin D levels as a risk factor for anaphylaxis and food allergies [25]. The relationship between this vitamin and immune system function, as well as airway health, supports the hypothesis that vitamin D may be directly related to asthma and allergic diseases. This connection is particularly relevant because vitamin D plays a crucial role in the development and maintenance of lung

structure and function [26]. Also, in individuals with ischemic heart disease and dilated cardiomyopathies, the quantity and density of cardiac mast cells are elevated. This finding may help clarify why these conditions significantly increase the risk of fatal anaphylaxis [27]. Table 1 briefly shows the related risk factors for developing anaphylactic shock [28].

Diagnostic methods for anaphylactic shock in dental clinics

The timely diagnosis of anaphylaxis shock is crucial in dental clinics due to the potential for rapid deterioration. Immediate administration of adrenaline (epinephrine) is the first-line treatment, and dental professionals must be trained to recognize symptoms and respond effectively. Studies indicate a significant lack of awareness among dental practitioners regarding the recognition and management of anaphylaxis, highlighting the need for improved training and preparedness in dental settings [6, 29].

- Clinical diagnosis: Anaphylaxis shock is primarily diagnosed based on clinical findings. Rapid onset of symptoms such as respiratory distress, cardiovascular instability, and skin reactions are critical indicators. Recognizing these signs is crucial for immediate management, especially in a dental setting where such reactions may be life-threatening [6].
- Serum tryptase measurement: Serum mast cell tryptase (MCT) levels can be a valuable diagnostic tool. Elevated levels of tryptase in the blood can indicate an anaphylactic shock, particularly when measured within a few hours of symptom onset. This method helps confirm anaphylaxis shock post-event and identify the causative agent for future avoidance [6, 24]. Of course, the ideal time to measure serum tryptase is considered within three hours but significant elevations can be found up to six hours or longer [30].
- Skin testing: Skin tests may be conducted to identify specific allergens that triggered the anaphylactic shock. These tests can help in the long-term management of patients by avoiding known allergens during dental procedures [6, 24].
- Basophil activation test: This test can assess the functional response of basophils to specific allergens. It is not routinely used test in acute settings but can provide insights into the patient's allergic profile for future dental treatments [6].
- Allergy tests/ local anesthetics: An allergy to local anesthetics is thought to be a type IV reaction at rates of between 80 and 90%. This means that the majority of allergic reactions occur as allergic contact dermatitis. Hence, allergy tests of local anesthetics should be performed on patients in whom it is uncertain if they are allergic, and patients should undergo dental treatment only after it has been confirmed that a local anesthetic can be used safely [31, 32].

Table 1 The related risk factors in developing anaphylactic shock [28]

Risk Factors
Known allergies.
Cardiovascular disease.
Substance abuse.
Asthma and other respiratory diseases.
Initial exposure to the allergen by injection (IV medication).
Frequent exposure to the allergen, particularly if exposure is followed by a long delay and then a re-exposure.
Low vitamin D levels.

IV: intravenous

Evaluation of anaphylactic shock in dental clinics in developing countries compared to developed countries

The evaluation of anaphylactic shock in dental clinics in less developed countries compared to developed countries reveals significant disparities in knowledge, preparedness, and response protocols. In developed nations, reports indicate anaphylactic shock to local anesthesia following dental procedures, with an incidence ranging from 1 in 3,500 to 1 in 13,000 [21]. Recent studies from Australia and Norway report incidences of 1 in 10,000 to 1 in 20,000 and 1 in 6,000, respectively [21]. Although these rates are low, the severe consequences of such reactions necessitate that dentists are well-equipped with the knowledge and tools to manage them effectively [21]. On the other hand, a study conducted in Chennai, India, highlighted a troubling lack of knowledge among dentists regarding anaphylaxis shock management [21]. While many dentists recognized the symptoms, only 62% possessed emergency kits, and knowledge of how to administer epinephrine was notably low [21]. This underscores a critical disparity when compared to their counterparts in developed countries, where dental practitioners receive more comprehensive training and resources [21]. Despite theoretical training in Indian dental colleges, dentists in Chennai demonstrated inadequate preparedness for handling anaphylactic shock emergencies, with most clinics lacking essential equipment [21]. This lack of experience could lead to adverse outcomes and potential legal repercussions, as dentists are responsible for managing emergencies within their clinics [33]. In another study that was done in developing countries like Turkey, the results showed that only 14% of dentists knew the appropriate doses of epinephrine for anaphylaxis, 40% understood how to administer it, and only 27% were familiar with the proper use of an epinephrine auto injector [34]. These

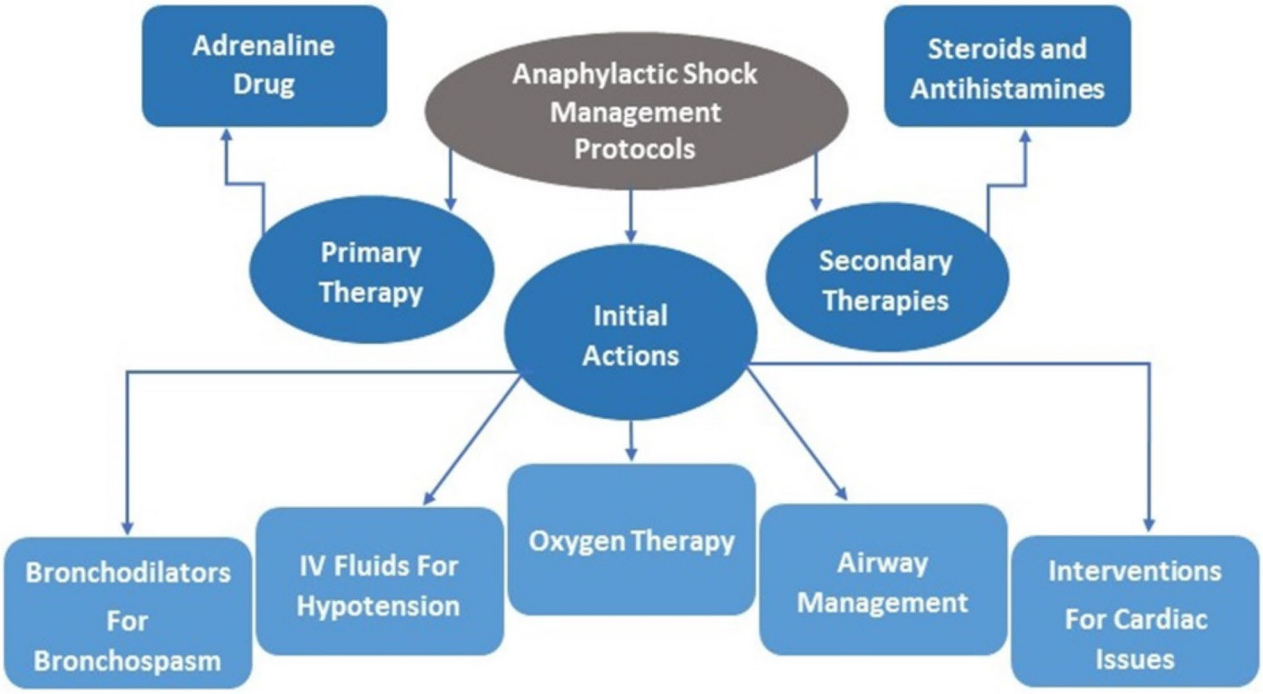

Fig. 1 Illustrates the fundamental and essential measures for managing a patient experiencing anaphylactic shock

findings indicate that healthcare workers' knowledge and skills regarding anaphylaxis shock management, particularly concerning the correct use of epinephrine auto injectors, are insufficient, with most errors occurring during the administration process [34]. On the other hand, must be acknowledged that there are regional variations in anaphylaxis shock management protocols [29]. Therefore, these studies highlight the considerable disparities in knowledge and resources that drive the focus on anaphylaxis shock in developing countries. While developed nations report low incidences of anaphylactic reactions due to better training and resources, developing countries like Turkey face critical gaps that require urgent attention. Addressing these issues is essential for enhancing patient safety and improving emergency management in dental practices.

Management and treatment

Anaphylactic shock management protocols

Given that anaphylaxis shock constitutes a medical emergency and individuals may develop hypersensitivity reactions to substances used in dental practice, dental professionals must stay updated on current management guidelines [35]. There is a pressing need for educational programs, both at undergraduate and post-graduate levels, to train dentists in anaphylaxis shock management. Additionally, dental facilities must be equipped with necessary emergency medications and equipment [36]. Hence, in facing a patient experiencing anaphylactic shock, dentists must prioritize their preparedness, knowledge, and equipment. The first step upon facing anaphylaxis is to activate emergency medical services (EMS). Following this, any potential allergens—such as drugs, dental materials, or latex-containing products—should be promptly removed from the area. A comprehensive evaluation of the patient's condition is crucial, focusing on the airway, breathing, circulation, mental status, and skin condition to confirm the diagnosis. The patient should be positioned supine, and epinephrine must be administered intramuscularly in the outer thigh as soon as possible. Continuous monitoring of vital signs is essential throughout the process [6]. On the other hand, prompt diagnosis and timely treatment are vital in out-of-hospital settings, with immediate administration of adrenaline also recommended upon suspicion of anaphylactic shock [6]. Standard life support procedures should be initiated as needed, including airway management, oxygen therapy, bronchodilators for bronchospasm, IV fluids for hypotension, and interventions for cardiac issues [29, 37]. Intramuscular adrenaline remains the primary treatment, while steroids and antihistamines are considered secondary therapies [37, 38]. In addition to these medical interventions, it is crucial to control and manage the anxiety experienced by the patient. Anxiety can interfere with adherence to treatment protocols and regular follow-up during the recovery process, ultimately affecting overall control of the condition [39]. Figure 1 depicts the management protocol for anaphylactic shock.

Essential drugs for the treatment of anaphylactic shock in dental clinics

Essential drugs for the treatment of anaphylactic shock in dental clinics are crucial for ensuring the safety of patients during dental procedures. The primary medication required is adrenaline (epinephrine), adrenaline is the first-line treatment for anaphylaxis shock and must be administered promptly to be effective. This drug causes vasoconstriction, increases heart rate, and improves airway patency. Dental professionals should be trained to administer it intramuscularly, especially given the current supply issues with adrenaline auto-injectors [7]. The Resuscitation Council UK and other health authorities recommend that all dental practices maintain a supply of adrenaline and ensure that staff are competent in its use. This includes being able to draw up adrenaline from an ampoule if auto-injectors are unavailable [7].

Training of dental staff on the management of anaphylactic shock

Anaphylaxis shock can occur in dental settings due to various allergens, including local anesthetics, latex, and medications. Dental professionals must be trained to recognize symptoms quickly and respond effectively, following established guidelines such as those from the Resuscitation Council UK. Immediate administration of adrenaline (epinephrine) is crucial for survival, and dental staff must be proficient in intramuscular injection techniques. Furthermore, it is essential to emphasize the importance of repeating intramuscular adrenaline doses if symptoms do not resolve [6, 7]. Also, regular simulation training is recommended to prepare dental staff for managing anaphylaxis shock. Studies have shown that simulation can significantly improve confidence and preparedness among dental professionals [6]. The General Dental Council (GDC) mandates that all dental professionals must be trained in managing medical emergencies, including anaphylaxis shock. This training should include up-to-date knowledge on the recognition and management of anaphylactic shock, ensuring that staff can act promptly in emergencies [7]. On the other hand, establishing clear emergency protocols tailored to individual dental practices is essential. These protocols should include steps for recognizing anaphylaxis shock, activating emergency services, and administering adrenaline [6].

Challenges and obstacles

Lack of resources\equipment and inadequate training

Studies indicate that individuals in developing nations are significantly affected by oral diseases, with periodontal disease being particularly prevalent. These issues are exacerbated by poverty, substandard living conditions, limited health education awareness, and inadequate government funding and policies to support an adequate number of oral healthcare professionals. The World Health Organization and the World Dental Federation (FDI) have recognized these challenges and have formulated strategies to address them [40].

In developed countries, clinics or hospitals often benefit from the collaboration of healthcare professionals from diverse specialties, enabling them to provide comprehensive patient care. These institutions are typically equipped with state-of-the-art technical facilities. However, in developing countries, health services primarily focus on offering emergency care or targeted interventions for specific age groups within the population [41]. Regrettably, in numerous countries, human resources, financial resources, and materials remain inadequate to adequately address the demand for oral healthcare services and ensure universal access, particularly in disadvantaged communities. This challenge is prevalent in both developing and developed countries [41].

On the other hand, there is limited information regarding the management and prevalence of anaphylactic shock in dental clinics within developing countries. The available data is sparse and primarily reported at local or regional levels, lacking integration [16]. However, these sparse reviews indicate that managing anaphylactic shock poses challenges, largely attributed to inadequate training among dentists in this area and a lack of necessary equipment [36]. Overall, many dentists seem unaware of proper anaphylaxis shock management protocols and lack essential medications and facilities for treatment in their clinics. Studies reveal that while around 72.9% of dentists recognize adrenaline as the primary treatment for anaphylactic shock, only 20% have emergency medications readily available in their offices [30]. This issue is exacerbated in developing countries due to limited access to automatic epinephrine injectors [42]. Additionally, a lack of experience and training in anaphylaxis shock can lead to unfavorable outcomes [29]. Therefore, there is a critical need for enhanced training and resources for dental professionals to better prepare them for emergency situations.

Conclusion

Managing anaphylactic shock in dental clinics requires increased awareness and the availability of essential medical equipment, particularly in developing countries where there is often less focus on these critical factors. Research indicates significant gaps in the knowledge and preparedness of dental practitioners in these regions, despite adherence to established management guidelines. Anaphylactic shock can escalate rapidly and is life-threatening, emphasizing the need for improved public education, healthcare access, and robust data collection systems to reduce its global burden. To enhance patient

safety, dental professionals must stay informed and ensure their clinics are equipped with necessary medications for prompt treatment. Collaboration between governments and dental associations is vital for developing training policies that integrate emergency management protocols into dental education curricula. By addressing these areas, we can improve the preparedness of dental professionals and ultimately enhance patient outcomes in cases of anaphylactic shock.

Limitations

This review acknowledges several limitations. Firstly, the studies cited vary in methodological quality, with differences in sample sizes and study designs that may affect the generalizability of the findings. Additionally, regional reporting biases may exist, as certain geographic areas may have different prevalence rates of anaphylactic shock related to dental treatments. Finally, it is important to recognize that studies with significant or positive results are often more likely to be published, which may lead to an overrepresentation of favorable outcomes in the literature.

Clinical relevance statement

Anaphylactic shock is a critical emergency in dental practice, requiring immediate recognition and intervention due to its rapid onset and potentially life-threatening consequences. Despite its rarity, many dental professionals lack adequate training and resources to manage anaphylaxis shock effectively, particularly in developing countries where emergency protocols are often insufficient. Previous studies reveal significant gaps in knowledge regarding the identification and treatment of anaphylaxis, especially concerning the administration of epinephrine. This study aims to evaluate current management practices and advocate for enhanced training and resource allocation, ultimately improving clinician preparedness and patient safety in dental settings.

Abbreviations

WAO	World allergy organization
IgE	immunoglobulin E
EAACI	European academy of allergy and clinical immunology
EMS	Emergency medical services
UN	United nations
HDI	Human development index
GNI	Gross national income
WHO	World health organization
FDI	World dental federation

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Data availability

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Declarations

Ethics approval and consent to participate

In accordance with the journal's guidelines, the authors declare that this review article does not involve original research requiring ethical approval, and all sources have been properly cited to ensure academic integrity.

Competing interests

The authors declare no competing interests.

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