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Risk of Adrenal Crisis in Dental Patients: A Narrative Review

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Abstract:

Adrenal crisis, a potentially life-threatening condition, poses significant risks in dental practice, particularly for patients with adrenal insufficiency. Dental interventions, especially those involving surgical stress or inadequate perioperative glucocorticoid management, can trigger adrenal crises. This narrative review explores the pathophysiology of adrenal insufficiency, highlights at-risk patient populations, and examines the triggers and management strategies for adrenal crises in dental settings. By addressing the gaps in current dental guidelines, the review aims to enhance practitioner awareness and emphasize the importance of preventive measures, timely intervention, and interdisciplinary collaboration for safe dental care. Future research directions include optimizing protocols and fostering clinician education.

Keywords:

Adrenal crisis, adrenal insufficiency, dental patients, glucocorticoid therapy, stress management, perioperative care, dental interventions, emergency protocols.

1. Introduction

Adrenal crisis, most commonly related to adrenal insufficiency, may cause a serious threat, especially in stressful situations, such as during surgical dental procedures. Risks associated with the occurrence of an adrenal crisis in dental patients depend on their current health condition or, above all, an unrecognized decreased glucocorticoid secretion. Substitution therapy is the basis of adrenal crisis prevention, but its effectiveness is determined by proper administration of glucocorticoids during dental procedures. (Woodcock et al.2020)(Bin et al.2021)Therefore, the recognition of the indicated population with the highest risk and raising awareness among the medical staff involved in dental treatment of new treatment options in the event of an adrenal crisis seem to be indispensable to provide safe care in dental settings. (Syed et al.2021)This narrative review aims to draw the attention of each dentist and dental specialist to the problem of adrenal crisis in patients suffering from adrenal insufficiency, enabling them to verify their knowledge and the current possibilities of dental treatment during the use of hormones inhibiting the hypothalamus-pituitary-adrenal axis. (Gaw et al., 2022)(Carmona and Ouanounou2021)

Up-to-date review rationale: A narrative review of the scientific literature is intended to present the available information on the issue of adrenal crisis with respect to dental practice. The first part of the narrative review focuses on the theoretical aspects related to the pathophysiology of HPA suppression. Consequently, the need for steroid coverage and the possibilities of carrying out qualification procedures within this area are emphasized. The second part of the manuscript is devoted to the search for the answer to the following research question: What are the effective management strategies in order to prevent the risk associated with the occurrence of adrenal crisis in patients suffering from adrenal insufficiency, taking into account various clinical conditions?

1.1. Background and Rationale

Adrenal insufficiency was first described in 1855 in patients with tuberculosis. The condition was recognized through the appearance of hyperpigmentation of the skin and mucous membrane and named 'Addison's disease'. After 1900, adrenal cortex extracts were used to treat adrenal insufficiency in humans for the first time. Some historical reports suggest that knowledge from this early era may already have found an entry into medical and dental treatment until the mid-twentieth century. For many practitioners, patients with adrenal insufficiency, a supposedly rare disorder, have remained an exotic population until recently. Now, guidelines and recommendations in the preoperative management and perioperative treatment of adrenal insufficiency have been issued by several societies in the last two decades. In contrast, present guidelines for the patient's risk-responsive management of an adrenal crisis in dental treatment are lacking. (Simpson et al., 2020)(Nowotny et al.2021)(Castro et al.2020)(Claessen et al.2021)

Patients with adrenal insufficiency may be vulnerable to an adrenal crisis in a variety of treatment situations, including those outside the hospital setting. Major or severe stress and dental interventions, particularly oral surgery, are well-established causes of biologically relevant and potentially dangerous adrenergic and cortisol counter-regulation. In dentistry, the number of regular systemically ill patients treated alongside pain and anxiety management has grown, suggesting an additional need for relevant management strategies. For the dental practitioner, the main aim is the prophylactic recognition of patients at risk of emotional and systemic crises, including patients with diseases that influence mental and physical state, as well as drug therapy that can impede the stress response or trigger acute or chronic illness. The clinical priority goal is to stop or treat acute dental pain and, if possible, any systemic distress that may affect dental care. Educational and management resources have become an essential part of other medical specialties for the successful management of patients. The development of oral medical platforms for the electronic identification and education of general and specialist dentists and practice personnel would help facilitate this step. (Claessen et al.2021)(Simpson et al., 2020)(Lentz et al., 2022)

2. Anatomy and Physiology of the Adrenal Glands

The adrenal glands are a pair of small endocrine glands located on top of each kidney. Each adrenal gland can be separated into the cortex and the medulla. The adrenal cortex is the largest part of the gland and is further separated into three zones from the exterior to the interior: the zona glomerulosa, the zona fasciculata, and the zona reticularis. The adrenal medulla is found at the center of the gland and is divided into two parts: the chromaffin cells and the neural cells. The main function of the adrenal glands is to secrete hormones, in particular those that are released during stress, known as the stress hormones, and the sex hormones. As such, the adrenal glands are often referred to as the "glands of stress". (Bigzad2022)(Knight, 2021)(Robinson-Weiss et al.2022)

The adrenal glands are responsible for the synthesis of over 50 hormones. The main hormones of the adrenal cortex are the corticosteroids, which can be further divided into: glucocorticoids, mineralocorticoids, androgens. There are some other biologically active substances that reside in the adrenal gland, like adrenaline and noradrenaline that are released into the bloodstream from the adrenal medulla. Cortisol is secreted in response to physical, physiological, endocrine, and emotional stress. In each case, the stressor triggers the release of corticotropin-releasing hormone from the hypothalamus. The hormone stimulates the anterior pituitary gland to secrete adrenocorticotropic hormone into the systemic circulation. The hormone then acts on the adrenal cortex, mainly on the zona fasciculata, and stimulates the production of cortisol, which in turn provides the body with the hormones needed to cope with stress and undergo the normal circadian rhythm. In health, cortisol levels are highest in the early morning and at their lowest at night. (Kim & Choi, 2020)(Martin et al.2020)(Megha et al., 2022)

3. Adrenal Insufficiency: Causes and Types

A sudden life-threatening situation called adrenal crisis can occur in patients with adrenal insufficiency, during or after stressful or potentially harmful medical procedures. Adrenal insufficiency can be primary due to destruction of the adrenal gland or related to its genetic enzyme defect. The causes of primary adrenal insufficiency include an autoimmune disorder that affects a significant percentage of patients, infection, metastasis, drugs, genetic factors, and unknown causes. The common etiologies of secondary adrenal insufficiency involve dysfunction in either the pituitary or hypothalamus, but the responsible area is hard to distinguish. (Karunarathna et al.)(Karunarathna et al.)(Karunarathna et al.)

The adrenal cortex secretes glucocorticoids, which are essential for our body to survive. While performing medical and dental procedures, patients who are unable to secrete the hormone may need additional glucocorticoids to help maintain normal blood pressure, blood glucose levels, and immune responses. Prolonged stress outside the body, such as physical injury, surgery, fever, dental infection, and emotional disturbances, constricts blood vessels and releases glucocorticoids from the adrenal gland. In dental clinics, knowledge of the causes of adrenal insufficiency and recognition is important for early identification of at-risk patients. The detection of adrenal hormones or adrenocorticotropic hormone can be helpful to diagnose the types of adrenal insufficiency and to design an appropriate treatment plan. (Dineen et al.2020)(Bain et al., 2023)(Woodcock et al.2020)

Chronic stress conditions may increase the secretion of cortisol, which may lead to secondary adrenal insufficiency. To exclude overmedication, other reasons such as physical stress, infection, trauma, surgery, or emotional issues should be ruled out. Adrenal insufficiency should be confirmed if the symptoms persist. It is important to decrease the glucocorticoid dose gradually after confirming that functional adrenal recovery has been reached. (Téblick et al.2022)(Agorastos & Chrousos, 2022)

3.1. Primary Adrenal Insufficiency

Primary adrenal insufficiency (PAI), also known as Addison's disease, is a rare disease characterized by a low production of adrenal hormones. The major cause of PAI in developed countries is autoimmunity associated with 21-hydroxylase, which can be isolated or associated with other autoimmune diseases such as autoimmune thyroiditis or type I diabetes. Progressive impoverishment of the adrenal cortex due to an autoimmune response, with simultaneous damage to mineralocorticoid and glucocorticoid areas, is the leading cause of the disease. In developed countries, approximately 90% of cases are due to the primary form, with tubercular and fungal etiology being rare. (Percik et al.2020)(Pignatti & Flück, 2021)

The typical signs and symptoms of PAI are fatigue, malaise, decreased resistance to stress and infections, hypotension, weight loss, and reactive hypoglycemia, with the possibility of selective involvement of mineralocorticoid secretion. Nausea, vomiting, and diarrhea are frequent gastroenteric signs. However, the disease can present with other rare symptoms such as orthostatic hypotension, hyponatremia, and hyperglycemic crises. Due to the nonspecific signs and symptoms of adrenal insufficiency, it is often a challenge to diagnose this condition correctly. If left untreated, this can result in an adrenal crisis with a mortality rate that ranges from 0 to 26.2%, but this rate will increase to 10%–20% in patients with treatment delay, so the development of the adrenal crisis needs to be prevented. In the advanced stages of PAI, the management strategy is hormone replacement therapy. A comprehensive understanding of the mechanisms and symptoms involved in the pathophysiology of chronic adrenocortical insufficiency is necessary for the management of these conditions in a dental clinic. (Taniguchi et al.2020)(Buergy et al.2021)

3.2. Secondary Adrenal Insufficiency

Most commonly, the insufficiency of the adrenal cortex hormones is due to disorders in the pituitary gland or in the hypothalamus. The most important stimulus for the adrenal cortex is the adrenocorticotropic hormone (ACTH) secreted by the pituitary gland. So, if there is any disorder from the pituitary gland or from the base of the brain, then signals for the production of adrenal cortex hormones are not given in the required quantities, which leads to symptoms of insufficiency of these hormones. There are many causes behind impairment of the connection between the hypothalamus, pituitary, and the adrenal cortex, finally leading to insufficient adrenal hormone production. (Percik et al.2020)(Hasenmajer et al.2021)

The main cause of secondary adrenal insufficiency is the suppression of the hypothalamus-pituitary-adrenal axis due to the production of exogenous glucocorticoids. Only a very little ACTH is released, which is not sufficient for the production of cortisol. Long-term low-dose therapy with glucocorticoids is more likely to cause suppression of the HPA than a short-term high dose. Basically, it is necessary to remember that a number of corticosteroid drugs injected into the body finally reach the adrenal gland, and such medications have an action that suppresses the normal function of the adrenal cortex. Tumors in the pituitary gland or the production of an excess quantity of certain hormones are considered to be one of the main causes. Tumors of the pituitary gland that may affect ACTH production are classified as microadenoma and macroadenoma. It has been shown that the main cause of adrenal insufficiency syndrome is iatrogenic. The anatomy and physiology of the hypothalamic-pituitary-adrenal axis are mandatory to understand. Signs and symptoms may range from cardinal symptoms to multiple other symptoms of chronic insufficiency. The hyperpigmentation of gums and skin, especially in pressure-bearing parts of the skin, has been considered to be one of the pathognomonic features, signifying this type of insufficiency. Secondary adrenal insufficiency remains challenging to diagnose on the basis of clinical findings only, as symptoms are usually subtle and often occur suddenly and multifactorially. The mainstay therapies for this insufficiency are addressing the cause or underlying diseases. Optimal therapy directs towards hormone replacement for the insufficiency only. The description of the secondary adrenal insufficiency syndrome is important for dental practice to minimize the risk of adrenal crisis imposed by stressful procedures on the patients. (Gruber & Bancos, 2022)(Li et al.2023)

4. Signs and Symptoms of Adrenal Crisis

An adrenal crisis is a life-threatening disorder that results from inadequate production or release of endogenous glucocorticoids by the adrenal glands. This acute adrenal insufficiency can present with one or more nonspecific symptoms such as severe hypotension, altered mental status, and abdominal pain. The onset of symptoms is rapid, and a patient can deteriorate quickly. In each dental patient, the presentation and course can be unique. A sign that we in the dental office should watch for is the sudden dramatic change in a patient's status. An intriguing aspect of acute adrenal insufficiency is that some patients will respond with immediate signs and symptoms, some within hours, and some within a day or more. These patients have a degree of preserved hypothalamic-pituitary axis function. They are at risk for acute adrenal insufficiency and may benefit from preventive treatment before a corticosensitive procedure is performed. Signs and symptoms pertaining to insufficiency arise when the levels of glucocorticoids drop. (Martel-Duguech et al.2024)(Dineen et al.2020)

Medical conditions or stressors that can give rise to acute adrenal insufficiency include diseases of the adrenal gland, destruction of the adrenal gland, suppressive therapy with long-term administration of glucocorticoids, and rarely, anticoagulation, severe infections, and surgery, especially with general anesthesia. The physiological processes governing the production and regulation of glucocorticoids in the human body are complex. However, the association between stress and patients with adrenal insufficiency potentially makes them unique and at a higher risk for illness. They are exposed to additional risk when undergoing dental procedures. If stress is ongoing or has not been recognized or managed as it progresses, this may push the body to its limits in responding. (Rushworth et al.2022)(Simpson et al., 2020)(Claessen et al.2021)

5. Triggers of Adrenal Crisis in Dental Patients

Perioperative guidance for stress steroid therapy aims to shed light on the individual perioperative risk of developing an adrenal crisis. The risk of acute, life-threatening adrenal crisis is elevated in cases of surgical stress, concurrent infections, febrile illnesses, or considerable morbidity. In dental medicine and oral surgery, a number of triggers for the emergence of an adrenal crisis have been anticipated. Any surgical-traumatic interventions in the region of the Gasserian ganglion may potentially lead to an increased bone turnover with higher steroid release and may consequently also have an influence on the perioperative necessity of additional stress steroids. (Prete et al.2020)(Woodcock et al.2020)(Simpson et al., 2020)(Cusack & Buggy, 2020)(Claessen et al.2021)

A chronological and clinically relevant differentiation of the term “surgical stress” is recommended, namely a surgical stress that is limited to the periprocedural period and an intercurrent risk trigger primarily related to the therapy or medication that must be possible to anticipate and reliably avoided. The underlying pathomechanism in these patients is based on various triggers for the adrenal orifice, including the intensity and extent of periprocedural trauma, modifications of the medication and/or therapy, sudden stop of steroid replacement therapy, and also immediate or considerably delayed emotional and physical stress. Treatment planning should be strictly aligned with the possible determination of individual medical history, including emotional and environmental stress occurrences and already experienced clinical pictures of adrenal crisis precipitation, if possible. (Kodvavi et al.2023)(Ramasamy & Madhan, 2023)

6. Management of Dental Patients at Risk of Adrenal Crisis

Clinical management not only begins with a comprehensive medical history, which serves to identify and assess adrenal insufficiency, but also specific dental anamnesis is mandatory. Based on the information that can be gathered, at-risk patients need to be identified and preventive measures need to be initiated to provide for safe dental treatment. A medically indicated preoperative dose of 25–50 mg hydrocortisone and a regimen that allows the continuation of intercurrent replacement dosing is recommended. Moderate surgical stress is assumed, and thus only a physiological regimen is recommended. Medication adjustments are made individually, and an increasing dose can be considered for long and major interventions. Irrespective of an established treatment regimen, to prevent adrenal crisis, the increased intake of therapy to rule out symptoms of adrenal insufficiency is recommended on the day of the surgery. (Woodcock et al.2020)(Arafah2020)(Prete et al.2020)

Based on the greater risk of dental interventions being potential stressors, clinical guidelines also recommend preventive treatment management of usual therapy in dental patients at the general dental level in the risk assessment of the adrenal crisis. The protocol for emergencies owing to an adrenal crisis is the administration of 50 mg hydrocortisone, whereas emergency medical services should be alerted. Since an increased awareness of the existence of adrenal insufficiency from patients cannot always be assumed, using concise and appropriate analogies would be beneficial. To further adjust the dental procedures and ensure dental treatment as an outpatient, surgery or interventions have to be considered an important point in the setting of a dental appointment. Dental patients at higher risk are referred to a general dentist for dental surgery. If the risks are further nuclear, these explorations should be considered as increased beyond dental surgery, and treatment will preferably be transferred to a train-related hospital dentist trained as a dental surgeon or oral and maxillofacial surgeon. An interdisciplinary exchange will be necessary to ensure the patient's safety. It is expected that the number of adrenal crises can be negated within the dental practice for patients at risk of optimal management.

6.1. Preventive Measures

Recognition of dental patients at risk for an onset of an adrenal crisis begins with preventive measures that are normally carried out in a dental setting to avoid the incidence of adrenal failure. First and foremost, preventive measures will begin with a pre-treatment assessment of dental patients by reviewing the patient's medical history. It is also important to include any adverse interactions between medications currently in use and those prescribed. Management of adrenal patients will also include the implementation of stress-reducing techniques used before any high-stress dental appointments in the dental office. The appointment time should be scheduled in the morning so that the patient will be in a post-medication state of peak cortisol level. They will also provide a light meal to the patient an hour before the planned dental appointment. It is beneficial when the dentist plans for a short duration of dental care in which the medical and dental history must be acquired. Prior to any major dental procedure requiring an increase in corticosteroids for dental patients, it is proposed to increase the usual corticosteroid dose by 25%–50% on the day of treatment. An additional corticosteroid as a supplemental dose is normally taken later in the evening on the day of the dental appointment. The signs of adrenal insufficiency at the dental office must be clearly communicated between the dentist and the patient, and they must comply with the treatment plan and take corticosteroids as instructed. The patient will also have information about the local hospital most convenient for admission and treatment. The dental professional will also be informed about other general health problems expected to be found in those with adrenal insufficiency. Whenever a dental professional asks a question about Addisonian or adrenal crises, the patient should have a plan on how to define them. Raising awareness among dental healthcare staff and personnel about this rare endocrine disorder might also be useful. The adrenal crisis box should be used in dental surgery to help dental professionals treat acute adrenal crises if they arise. The box should be sealed and closed with a list of the contents of the drugs, dosage, and route of administration used on the back. Dental healthcare personnel should not give panic and fear signs to the Addison patient. A threat that can trigger an Addisonian crisis is not providing pain-control medication as directed by the specialist team. The advice from the team is crucial, including that of the patient's physicians. They should also help the patient and/or the caregiver understand the warning signs of an Addisonian emergency and have the appointments rescheduled to more acceptable times when they suffer from other illnesses such as vomiting and/or diarrhea, prior to their dental appointment.

6.2. Emergency Protocols

Emergency protocols must be established in every dental practice to recognize the situation and aid immediate action. An adrenal crisis must be recognized as soon as possible. The patient may complain of an allergic reaction to local anesthesia; a metallic, unpleasant taste in the mouth; abdominal pain with nausea; perspiration; syncope; increased anxiety, or aggression. Dizziness, which is sometimes severe, is reported in a significant number of documented cases. Patients need to lie supine to aid venous return, and it is recommended to administer the injectable form of hydrocortisone immediately. It is extremely useful to provide front desk receptionists with a list of clinical symptoms and required immediate action, as they are not stymied by the notion of an emergency. The telephone must be free at all times. Guidelines recommend that patients with adrenal insufficiency be reviewed by an emergency protocol in approximately 15-30 minutes. There is an agreement on a maximum of a 10-minute response by the emergency team for this protocol.

An emergency response team should be made up of a dentist, a nominated chairside assistant to list, observe, and act as scribe, and a timekeeper, supported by the team leader. It is of paramount importance for the team member who is responsible for activating the emergency protocol to understand the roles and responsibilities of their colleagues. Dental practice staff members need to attend emergency protocol training annually and practice mock adrenal crises at a minimum frequency of once every three months. A detailed set of emergency drugs and equipment should be present in each consulting room. It is helpful to keep one room set aside, equipped only with all the required emergency drugs and equipment. In the case of multidentist dental practices, the allocated emergency room is designated. All medications should have a good supply of backup stock with at least one emergency dose clear. Good communication with patients and their general physician is vital to prevent an adrenal crisis. A summary letter of an appointment is instantly sent and followed up with a postal hard copy to the caring general practitioner. A six-monthly audit is conducted to assess the delivery of emergencies by nominated team members, drugs in date and backup stock, and emergency training. Clinical emergencies are conducted to ensure a new treatment option has been included in the protocol. Emergency protocols are utmost in clinical governance and patient safety within a dental practice.

7. Case Studies and Clinical Examples

Two case studies will be described in this section: one case where the potential triggers were identified before treatment and the patient managed well, and a second case where no potential triggers were identified at assessment and the patient had a suboptimal outcome. While advice for the delivery of HBO at the time of surgical removal of a tooth or teeth for patients on high-dose steroids is sparse and describes how it may affect wound healing, it states that steroid dosages should not be adjusted unilaterally, as modifying the dose may exacerbate a pre-existing medical condition or trigger an adrenal crisis, as may the stress of surgery. (Sparling & Butler, 2024)(Téblick et al.2022)

The following two case studies are presented to illustrate the increasing details emerging about potential triggers that make carrying out a Dental Cumulative Stress Activity riskier for some individuals. While the potential triggers could be identified in the first case scenario, none were identified in this second case scenario. Where possible, the outcomes are discussed, and the discussions make recommendations on practical management solutions to improve patient care. Known adrenal crisis triggers should be elicited at risk assessment preoperatively. When managing any potential perioperative risks to prevent the risk of adrenal crisis, any associated delaying impact on clinical decision-making and limits of expertise should be included in shared decision-making. Whether a patient has steroids for the surgical procedure or not, they will initially need another stress dose of steroids when in an adrenal crisis to increase levels that are normally around 20 times the normal range. When a patient already on a high dose of steroids has a Dental Cumulative Stress Activity in primary care, a reminder that 100 mg hydrocortisone is likely to be insufficient in the above patient group, prefix questioning about the thiopurines/mercaptopurine derivative medication too, and decide if immediate transfer to secondary care, alongside steroids, is best. Guidelines in context for should be updated as new evidence emerges of this dental emergency, potential timely triggers, and outcomes resulting from the decisions taken. The case studies can act as an educational tool for use in, for example, an audit or as part of the new CPD system. (Ackerman et al.2022)(Dubow et al.2022)

8. Conclusion and Future Directions

The narrative review showed that the risk of adrenal crisis is an important issue for dental practice. Dental practitioners need to be familiar with the concept of adrenal crises, the underlying risk factors, and clinical signs, as such a severe condition may occur immediately after dental treatment. Awareness of the elevated risk of adrenal crisis in specific dentistry-patient populations has special relevance for routine outpatient dental practice.

Guidance for adrenal insufficiency is probably the best guidance concerning adrenal crises that is currently available. In the future, adrenal crisis management guidance may change due to advances in the treatment of adrenal insufficiency. Modern insights about the pharmacological and non-pharmacological interventions for prophylaxis of gastrointestinal harm could be a base for further research in identifying potential preventive strategies in the management of specific patient populations at risk of adrenal crisis. As there is a substantial risk of adrenal crisis occurrence, we also strongly recommend developing an effective protocol in the event of the development of adrenal crisis to ensure immediate patient safety. To advance our understanding of adrenal insufficiency in the field of dentistry, research is essential. Cooperation is essential to ensure the greatest possible protection for patients with adrenal insufficiency. In the future, it would be reasonable to provide further interdisciplinary education on adrenal crises. In the future, we aim to compel all practitioners, primarily dentists, to ensure that those patients who are unaware of their underlying adrenal insufficiency status undergo appropriate diagnostic procedures. Repeated, timely, and clearly documented communication among all members of the healthcare team is vital to ensuring patient security.

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