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Original Research Paper

Endodontics

SODIUM HYPOCHLORITE ACCIDENTS: A REVIEW ARTICLE

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INTRODUCTION

Endodontic failure is caused by microorganisms that colonize necrotic tissue in the root canal system (Mohammadi & Yazd, 2008), the microflora of which is dominated by obligate anaerobes (Zehnder, 2006). Organisms must be removed from the entire canal in order for endodontic treatment to be successful (Mohammadi & Yazd, 2008). Mechanical preparation is supplemented with irrigant to disinfect the entire canal space (Baser Can, Karapinar Kazandag, & Kaptan, 2015), and the ideal irrigant should dissolve necrotic tissue, inactivate endotoxin, prevent smear layer formation, and be antimicrobial all at the same time (Zehnder, 2006). These conditions are met by sodium hypochlorite, the most extensively used and widely available irrigant (Chaudhry, Wildan, Popat, Anand, & Dhariwal, 2011). However, it is a solution that is not without risk.{4}

Sodium hypoclorite possesses strong tissue dissolving and general antibacterial properties. It includes a number of the ideal characteristics of a perfect root canal irrigant. By oxidizing and hydrolyzing cell proteins, it also has a broad spectrum of antibacterial activity against endodontic pathogens. Its value as an endodontic irrigant solution is increased by its tissue solvent capacity, low surface tension, and lubricating action in the canal. Sodium hypochlorite is a pale, clear, yellowish- green liquid which is extremely alkaline with a strong chlorine smell that suggests an alkaline ph (11.6) in varying concentrations of 0.5%to 5.25%. Cytotoxicity increases with higher concentrations. {2} The major disadvantage of sodium hypochlorite is the noxious effects when it comes in direct contact with the soft tissues and also result in the corrosion of metal instruments.{3}

Hypochlorite accidents, in which the irrigant reaches periapical tissues or an allergic reaction occurs as a result of contact with soft tissues, can result in pain, severe inflammation, necrosis, and nerve damage as hypochlorite is caustic to vital tissues and has allergic potential (Chaudhry et al., 2011; Farook et al., 2014; Zehnder, 2006).Becker et al reported the first instance of hypochlorite accident in the literature in 1974 (Becker, Cohen, & Borer, 1974), and since then several studies have documented cases, including one by Kleier et al in 2008 who discovered that around 42% of surveyed practitioners reported having encountered hypochlorite accidents, with more women than men being affected, a higher risk of maxillary teeth over mandibular teeth, and more posterior teeth over anterior. Clinicians must therefore be able to recognize, identify, manage, and, more importantly, prevent this undesired complication by changing their techniques accordingly.{4}

Sodium Hypochlorite Properties {1}

Sodium hypochlorite has the following basic properties:

1. The ability to dissolve organic tissues
2. Antibacterial activity
3. Deodorant activity
4. Alkaline pH
5. Reduced surface tension
6. The effectiveness

Interactions Of Sodium Hypochlorite With Other Irrigants {1}

1) Chlorhexidine :

When sodium hypochlorite is mixed with liquid chlorhexidine, an immediate flocculate or precipitate forms. The combination of NaOCl with CHX has a negative effect on NaOCl efficacy.

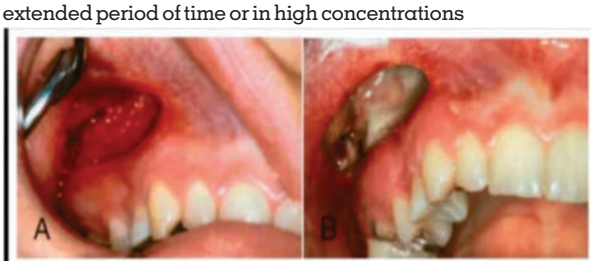
2) Chelating agents :

When EDTA is introduced to NaOCl, the chemical interactions between the chelating agents and the NaOCl result in a loss of free readily available chlorine. Since the degradation of EDTA following its interaction with NaOCl is exceedingly gradual, it does not impair its clinical function

What Are Sodium Hypochlorite Accidents?

Despite the widespread use of sodium hypochlorite in dentistry, accidents can still occur during its use, leading to various complications. However, sodium hypochlorite

accidents are rare. The most common accidents associated with sodium hypochlorite include skin and intraoral mucosa burns, laryngeal edema, upper airway obstruction, paresthesia, and bleeding. These accidents can happen when sodium hypochlorite is used inadvertently, such as when it comes into contact with the skin or oral mucosa for an extended period of time or in high concentrations



Causes

The causes of sodium hypochlorite accidents in dentistry can be attributed to several factors. These factors include a lack of proper training and education on the handling and use of sodium hypochlorite, inadequate protective measures such as gloves and eye protection, and the use of high concentrations of sodium hypochlorite without proper dilution or irrigation. Furthermore, accidents can also occur due to faulty irrigation technique or the presence of additional factors that contribute to sodium hypochlorite accidents (Singhal et al., n.d).

Hypochlorite Accidents

Extrusion at the Periapical Level

Problems from periapical hypochlorite extrusion include chemical burns, neurological problems, and airway obstruction. There is immediate intense pain and swelling, which may be accompanied by ecchymosis.(de Sermeno et al., 2009; Pelka & Petschelt, 2008; Zhu et al., 2013). Inflammation and tissue damage ensue, resulting in ulceration and local or widespread necrosis. If hypochlorite is extruded into the sinus, the patient may complain of chlorine odor in addition to acute sinusitis, throat irritation, and nasal bleeds (Chaudhry et al., 2011; Spencer et al., 2007). Bowden et colleagues reported an episode of airway blockage following extrusion that affected the floor of the mouth and adjacent tissues - a potentially fatal consequence (Bowden, Ethunandan, & Brennan, 2006). Intra-orally, the tooth may exhibit sensitivity to palpation and percussion, apical swelling, and swelling localized to the area around the tooth, with radiographic findings indicating increased periodontal ligament space suggestive of air emphysema due to hypochlorite extrusion (de Sermeno et al., 2009). Rarely hypochlorite accidents cause nerve damage manifesting as paraesthesia, anaesthesia or dysaesthesia.

Allergic reactivity

Hypochlorite, first reported by Sulzberger in 1940, can also produce allergy, characterized by urticaria, bronchospasm, shortness of breath, and hypotension (Chaudhry et al., 2011; Spencer et al., 2007; Sulzberger, 1940). Severe consequences have been recorded at concentrations as low as 1% (Mohammadi & Yazd,2008). However, it is not only apical extrusion that can cause allergy; spillage of hypochlorite and any contact with the patient's mucosa can cause erythema, sublingual or submandibular swelling, or oesophageal erythema, which can lead to airway obstruction requiring immediate hospital admission (Chaudhry et al., 2011). {4}

Prevention

Given the potential risks associated with the use of sodium hypochlorite in dentistry, it is imperative for dental professionals to be aware of preventive measures that can minimize the occurrence of accidents.

These measures include:

1. Proper handling and storage of sodium hypochlorite solutions to prevent accidental spills or leaks.
2. Correct identification and labelling of sodium hypochlorite solutions to avoid confusion with other substances.
3. Clear communication and documentation of the concentration and volume of sodium hypochlorite being used during dental procedures.
4. Use of appropriate protective equipment, such as goggles, gloves, and masks, patient drape when handling sodium hypochlorite solutions to minimize the risk of contact with the skin, eyes, or mucous membranes.(5)
5. Irrigation needle at least 2 mm short of operating length{5}
6. Avoiding inserting the needle into the root canal. Avoidance of excessive irrigation pressure.{5}
7. If there is obvious tissue damage, antibiotics to minimize the possibility of subsequent infection. {5}
8. Regular training and education of dental staff on the safe handling, use, and disposal of sodium hypochlorite.

Additionally, dentists should be aware of the signs and symptoms of sodium hypochlorite accidents, such as chemical burns or tissue damage, and should have a protocol in place to immediately address any accidents that may occur. Furthermore, it is crucial for dental professionals to establish an emergency management plan for sodium hypochlorite accidents, including appropriate first aid measures and access to emergency medical care if necessary.

The potential risks associated with sodium hypochlorite accidents in dentistry warrant the implementation of preventive measures to minimize their occurrence.

Patient Management After Sodium Hypochlorite Accident

After a sodium hypochlorite accident occurs in dentistry, proper patient management is crucial to ensure their safety and well-being. Immediate steps should be taken to alleviate pain, reduce inflammation, and prevent infection of the affected tissue. This may include providing additional local anesthesia to control acute pain, as well as administering nerve block anesthesia if necessary. Reassuring the patient is also important, as they may experience anxiety or distress following the accident. In addition, the toxic effects of sodium hypochlorite must be neutralized by rinsing the affected area with water or saline solution. Ice packs can be applied in the first and second day after the accident to minimize edema, followed by warm compresses to promote the liquefaction of the hematoma.

It is important to communicate to the patient that symptoms will likely resolve within a few days or weeks, and that complete relief is expected in most cases. During the first week after the accident, daily monitoring is recommended to identify any worsening of signs and symptoms (Psimma &

Boutsioukis, n.d). In cases where there is extensive tissue damage and a high risk of spreading infection, more aggressive interventions such as extraction or surgical treatment of the involved tooth may be necessary.

However, it is important to note that the decision for these interventions should be made on a case-by-case basis, taking into consideration the severity of the accident and the individual patient's circumstances. Management of sodium hypochlorite accidents in dentistry requires careful consideration and implementation of appropriate measures to ensure patient safety and promote optimal healing.

CONCLUSION

We can conclude that for the use of sodium hypochlorite it is necessary to previously know its qualities and risks; either by not carrying out a correct handling, as well as not. Take into account possible complications due to the intervention of different factors either in terms of dental morphology, instrumentation or systemic variations of the patient. The actions that tend to generate accidents with hypochlorite are: diseases that cause periapical resorption, inadequate selection of the type of syringe and needle with which irrigation is performed and the lack of adequate determination of root length. The best option for the management of these accidents is through the use of corticosteroids and analgesia since they reduce the aggressiveness of the symptoms presented by the patient, as well as antibiotic prophylaxis, decreases the risk of plastic damage.{2}

Future Research Directions In Sodium Hypochlorite Safety

Further research is needed to establish standardized protocols for the management of sodium hypochlorite accidents in dentistry. In addition, more comprehensive studies are needed to determine the optimal interventions for different severities of accidents and to assess the long-term outcomes of these interventions. Moreover, it would be beneficial to investigate the effectiveness of alternative solutions or techniques that can minimize the risk of sodium hypochlorite accidents in the first place. This could include exploring the use of alternative irrigation solutions, modifying irrigation techniques, or implementing additional safety . Overall, sodium hypochlorite accidents in dentistry can have significant consequences for patient well-being. Therefore, it is imperative for dental professionals to stay updated on the latest research and recommendations regarding the management and prevention of these accidents measures in dental practices. By addressing these research gaps, dental professionals can enhance patient safety and improve the management of sodium hypochlorite accidents. Additionally, it is important to note that proper training and education of dental professionals regarding the safe use and handling of sodium hypochlorite can play a critical role in preventing accidents and ensuring patient safety. In light of the potential risks associated with sodium hypochlorite accidents in dentistry, it is crucial for dental professionals to prioritize patient safety and implement appropriate measures to prevent and manage these accidents.