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RESEARCH ARTICLE

MANAGING MISFORTUNES WITH SODIUM HYPOCHLORITE DURING ROOT CANAL TREATMENT

***[1]Saurav Paul, [1]Aakrati Raina, [2]Asheesh Sawhny and [2]Sridevi Nandamuri**

[1]Post Graduate Student, Department of Conservative Dentistry & Endodontics, Rama Dental College, Hospital & Research Centre, Kanpur
[2]Professor, Department of Conservative Dentistry & Endodontics, Rama Dental College, Hospital & Research Centre, Kanpur

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ABSTRACT

Sodium hypochlorite is a globally used irrigant in dental practice during root canal treatment. Although, generally regarded as being very safe, some potentially severe complications can arise when it comes in contact with soft tissues, skin or even clothing. Unintentional extrusion of sodium hypochlorite beyond the root apex results in widespread soft tissue or nerve damage. Its chief shortcomings in dentistry are the noxiousness of its action to vital tissues. In this article, we review the possible difficulties that can arise with sodium hypochlorite use during endodontic treatment, discuss the appropriate management and actions that can be taken to lessen danger, and provide specifics of suitable management in the rare cases of alleged tissue injury and damage.

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INTRODUCTION

Documented as an endodontic irrigant in 1920, and now in a consistent global use, Sodium hypochlorite (NaOCl) is an effective antimicrobial agent having tissue-dissolving capabilities, with an acceptable shelf life and low viscosity that permits an easy introduction into the canal architecture (Crane, 1920). On reaction with fatty acids and amino acids in the dental pulp, it leads to the liquefaction of organic tissue (Estrela, 2002). Its chief shortcomings in dentistry are the noxiousness of its action to vital tissues and corrosion of metals (O'Hoy, 2003). The efficacy and antibacterial and tissue dissolution action of hypochlorite amplifies with its concentration, but this goes together with an increase in its toxicity. Concentrations used vary down from 5.25% depending on the dilution and storage protocols of different practitioners. There is no universally accepted concentration of sodium hypochlorite for use as an endodontic irrigant. Increasing the temperature improves the bactericidal and pulp dissolution activity, although the effect of heat transfer to the adjacent tissues is uncertain. Solution warmers are available which help in increasing the temperature up to 60ºC (Sirtes, 2005).

***Corresponding author: Saurav Paul**
Post Graduate Student, Department of Conservative Dentistry & Endodontics, Rama Dental College, Hospital & Research Centre, Kanpur

Unintentional extrusion of sodium hypochlorite beyond the root apex results in widespread soft tissue or nerve damage, and even airway compromise.[5] In this article, we review the possible difficulties that can arise with sodium hypochlorite use during endodontic treatment, discuss actions that can be taken to lessen danger, and provide specifics of suitable management in the rare cases of alleged tissue injury and damage.

Problems arising due to unintentional spillage

Damage to clothing: Unintentional spilling of sodium hypochlorite is possibly the most common misfortune to befall during endodontic treatment. Even dropping of miniscule amounts on clothing leads to quick, permanent bleaching. Care should be taken by the practitioner while transporting hypochlorite filled syringes to the oral cavity and the patient should be given a protective plastic bib (Spencer, 2007).

Eye damage: The immediate symptoms of spilling of 5.25% sodium hypochlorite into the eye include severe pain and burning sensation, erythema and epiphora i.e. excessive watering. Being an alkali, sodium hypochlorite reacts with the lipid in the corneal epithelial cells, forming a soap bubble that penetrates the corneal stroma resulting in mild burns and injury.

Further injury to the tissues results in perforation, endophthalmitis and a permanent damage to the eye (Spencer, 2007). As a result of damage to the epithelial cells in the outer layer of cornea, blurring of vision and patchy coloration of the cornea may occur (Gatot, 1991). Washing of eyes with water or1litre of normal salinefor15 minutes, immediately, followed by an urgent referral to an ophthalmologist is critical (Hulsmann, 2000; Rutala, 1997 and Skinner, 1997). The use of appropriate eye protection during endodontic treatment can prevent the risk of occurrence of this accident.

Damage to skin: Alkalis combine with proteins or fats in the tissues and form soluble protein complexes or soaps. Therefore, skin injury with an alkaline substance entails prompt irrigation with water at low pressure to avoid further hypochlorite spread into the patient's or rescuer's eyes (Marx, 2006).

Damage to oral mucosa: It is also caused by the reaction of alkali with protein and fats. Swallowing of sodium hypochlorite requires immediate treatment followed by close monitoring of the patient.[5]

Allergy to sodium hypochlorite: Sulzberger first reported the allergic potential of sodium hypochlorite in 1940 and it was later testified by Cohen and Burns (Sulzberger, 1940 and Cohen, 1984). Kaufman and Keila proposed an allergy skin scratch test to be performed in suspected cases of sodium hypochlorite allergy (Kaufman, 1989). Although allergy to sodium hypochlorite is infrequent, it is important for clinicians to identify the symptoms. These include edema, wheezing (bronchospasm), urticaria, shortness of breath and hypotension. Quick referral to a hospital following first aid management is suggested (Kavanagh. 1998).

Hypochlorite extrusion beyond the apex and associated problems

Chemical burns and tissue necrosis: Although very rare, sodium hypochlorite extrusion beyond the root apex into the peri-radicular tissues leads to severe acute inflammatory reaction, chemical burns and localized or widespread tissue necrosis. The trademark of tissue damage is pain and may occur immediately or be delayed for several minutes or hours (Witton, 2005). There is rapid swelling both intra orally and extra orally within the skin and subcutaneous tissues (Spencer, 2007). Spread to the maxillary sinus leads to acute sinusitis, accompanying bleeding into the interstitial tissues and ecchymosis of the adjacent mucosa and possibly the facial skin and may consist of the development of a hematoma (Kavanagh, 1998; Mehra, 2000 and Gernhardt, 2004). Treatment of tissue necrosis is determined by the extent and speed of the soft tissue swelling but may require urgent hospitalization and administration of intravenous steroids and antibiotics. The use of antibiotics is subjective, secondary bacterial infection is a discrete possibility in areas of necrotic tissue and therefore they are often prescribed as part of the overall patient management. Surgical drainage or debridement may also be essential depending on the nature and extent of the swelling and necrosis (Gatot, 1991; Witton, 2005 and Kavanagh, 1998).

Neurological complications: "Paraesthesia and anaesthesia" (may take many months to resolve) affecting the mental, inferior dental and infraorbital branches of the trigeminal nerve following extrusion of sodium hypochlorite beyond the apex have been described. Facial nerve damage was first reported by Witton *et al.* in 2005.

Upper airway obstruction: The use leakage of the solution into the oral cavity and ingestion or inhalation by the patient could result in throat irritation and in severe cases, the upper airway could be compromised (Becking, 1991 and Serper, 2004). Fibre optic nasal tracheal intubation followed by surgical decompression might be required to manage compromised airway due to swelling arising in a few hours after accidental exposure to sodium hypochlorite during root canal treatment (Bowden, 2006).

How to lessen the risk of hypochlorite complications?

As already stated, these complications are infrequent, but nevertheless, the danger of hypochlorite-induced damage can be lessened by executing these measures while performing endodontic therapy:

- The prepared solution must be stored in a lightproof, non-metallic container that is appropriately labelled.
- The patient's clothing should be protected with a plastic bib.
- The patient and clinical team should wear well-fitting protective glasses.
- Rubber dam should be used.
- Use of side venting needle to prevent the risk of accidental inoculation into the soft tissues.
- Only Luer-Lok style syringes and needles should be used, as taper seat needles may dislodge in use, with uncontrolled loss of the hypochlorite solution under pressure (Clarkson, 1998 and Manogue, 2005).
- The needle should be loosely positioned within the canal and should not reach the apical extent of the prepared canal. This may be facilitated by marking the working length on the needle with a rubber stop (Manogue, 2005).
- The irrigant should be delivered slowly with minimal pressure to reduce forcing it beyond the apex. This can be achieved by using the index finger rather than thumb to depress the plunger (Manogue, 2005). This decreases the danger of unintentional extrusion of the irrigant. Care must be taken in immature teeth with open apices to ensure that the irrigant does not go beyond the apex. Sodium hypochlorite and saline are both recommended for irrigation in immature teeth, however, if hypochlorite is used it has been suggested the final irrigation should be with saline to remove any hypochlorite from the canal (Mackie, 1998).

Sometimes, the clinician may also be required to change the treatment plan to remove the need for sodium hypochlorite, using a replacement or using it in a safer form e.g. a dilute but equally active concentration. Spangberg and Langel and found that 5% sodium hypochlorite was significantly stronger (as well as highly toxic and irritating) than required to kill the bacteria in the root canal, while 0.5% concentration dissolves necrotic tissue but has no effect on *Staphylococcus aureus* (Spangberg, 1973). They recommended the ideal solution to be one that combines maximal antimicrobial effect with minimal toxicity. Yesiloy *et al.*, also found that the antimicrobial effects of sodium hypochlorite were much less with concentrations of 2.5% and lower (Yesilsoy, 1995).

It was also suggested that chlorhexidine gluconate0.12% has the equivalent antimicrobial effect to 5.25% sodium hypochlorite. It has been proven in earlier studies that chlorhexidine treated root canals are less prone to re-infections (Heling, 1992). Chlorhexidine is the also the irrigant of choice in re-treatment cases (Manogue, 2005). Still, sodium hypochlorite remains the most popularly used and recommended endodontic irrigant as it alone combines antimicrobial and tissue dissolving capabilities essential in teeth not previously root filled.

What should you do if you suspect a hypochlorite complication?

No standard therapy for the management of complications has been documented, probably because these complications are rare and sporadic.

- The initial management entails minimizing tissue swelling by using cold compression (frozen items wrapped in a towel).
- Sometimes, because of local anesthesia, the patient may not experience pain immediately. Mild to moderate pain can be managed with analgesics such as ibuprofen and paracetamol (Hulsmann, 2000).
- Adult doses of paracetamol 1g qds and ibuprofen or ibuprofen 400mg qds can be used alternately at four hourly intervals if necessary.
- Oral antibiotics may be prescribed to minimize the risk of secondary bacterial infection; Amoxicillin 250 mg tds or Metronidazole 200 mg tds in the penicillin allergic patient.
- It should be stressed that careful patient record keeping is very important in clinical practice. The detailed record of the event should be documented including concentration and volume of the hypochlorite solution involved. The measures employed to minimize risk (e.g. rubber dam, eye protection, working length measurement) should also be documented. Clinical photographs may also be appropriate to supplement the notes.
- Conservative management for hypochlorite complications has been recommended (Halesn 2001). While this may be appropriate in patients who develop mild complications, it is not to be universally recommended.
- Urgent referral is necessary in all cases involving ingestion or inhalation of hypochlorite, as the clinical consequences cannot be predicted from the oropharyngeal symptoms. Maxillofacial advice and assessment are recommended for any suspected hypochlorite complication (Hales, 2001).

In summary, in this review we discussed the possible difficulties that can happen with sodium hypochlorite use in endodontic treatment. Although rare, the recognition and successive management by the practitioner of these problems is critical to ensure best treatment outcome.

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