

Sodium Hypochlorite: Complications and Management

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ABSTRACT: Sodium hypochlorite (NaOCl), a reducing agent, is a clear, straw coloured solution containing about 5% available chlorine. It is the most widely used irrigating solution. NaOCl on ionization produces hypochlorous acid and hypochlorite ion. These are responsible for the antimicrobial ability of the same. No unanimity of opinion exists as to which concentration of NaOCl can be used in root canal therapy. On the basis of published data, 0.5- 5.2% solution is an effective concentration for the use as an irrigant in the root canal. If the canal is filled with the solution during the entire cleaning and shaping procedures, the irrigant will act as a lubricant, solvent to the pulpal tissues and a potent antimicrobial of a no. of solution studied, none was more effective than 5.2% solution of NaOCl. However 2.5% concentration of the same is commonly employed as it decreases the potential for toxicity while maintaining some tissues dissolving and antimicrobial activity. The following article deals with the various accidents caused by misuse of sodium hypochlorite and their management.

KEYWORDS: Accident, irrigation, sodium hypochlorite(NaOCl), prevention.

INTRODUCTION

Irrigation with sodium hypochlorite (NaOCl) is an important adjunct used to accomplish this goal. One negative property of NaOCl is that it can cause soft-tissue inflammation if it is expressed outside the confines of the root canal.¹ Clinically, this event manifests as pain and localized or widespread swelling. Various suggestion that have been made to prevent the occurrence of such an accident include marking the working length on the irrigation needle, keeping the needle loose in the canal, not using excessive force on the irrigation syringe, using a perforated needle tip, and keeping the needle in constant motion while irrigating. Although these suggestions are important and helpful, we wondered if following these techniques would prevent an NaOCl accident under all clinical conditions.

COMPLICATIONS OF ACCIDENTAL SPILLAGE

1) DAMAGE TO CLOTHING

Accidental spillage of sodium hypochlorite is probably the most common accident to occur during root canal irrigation. Even spillage of minute quantities of this agent on clothing will lead to rapid, irreparable bleaching. The patient should wear a protective plastic bib, and the practitioner should exercise care when transferring syringes filled with hypochlorite to the oral cavity.

2) EYE DAMAGE

Seemingly mild burns with an alkali such as sodium hypochlorite can result in significant injury as the alkali reacts with the lipid in the corneal epithelial cells, forming a

soap bubble that may be blurring of vision and patchy colouration of the cornea. Immediate ocular irrigation with a large amount of water or sterile saline is required followed by an urgent referral to an ophthalmologist. The referral should ideally be made immediately by telephone to the nearest eye department. The use of adequate eye protection during endodontic treatment should eliminate the risk of occurrence of this accident, but sterile saline should always be available to irrigate eyes injured with hypochlorite. It has been advised that eyes exposed to undiluted bleach should be irrigated for 15 minutes with a litre of normal saline.

3) DAMAGE TO SKIN

Skin injury with an alkaline substance requires immediate irrigation with water as alkalis combine with proteins or fats in tissue to form soluble protein complexes or soaps. These complexes permit the passage of hydroxyl ions deep into the tissue, thereby limiting their contact with the water dilutant on the skin surface. Water is the agent of choice for irrigating skin and it should be delivered at low pressure as high pressure may spread the hypochlorite into the patient's or rescuer's eyes.²

4) DAMAGE TO ORAL MUCOSA

Surface injury is caused by the reaction of alkali with protein and fats as described for eye injuries above. Swallowing of sodium hypochlorite requires the patient to be monitored following immediate treatment. It is worth noting that skin damage can result from secondary contamination.

5) ALLERGY TO SODIUM HYPOCHLORITE

The allergic potential of sodium hypochlorite was first reported in 1940 by Sulzberger and subsequently by Cohen and Burns.³ Caliskan *et al.* presented a case where a 32-year-old female developed rapid onset pain, swelling, difficulty in Breathing and subsequently hypotension following application of 0.5 ml of 1% sodium hypochlorite.⁴ The patient required urgent hospitalisation in the intensive care unit and management with intravenous steroids and antihistamines. A subsequent allergy skin scratch test performed two weeks⁵ after the patient was discharged confirmed a highly positive result to sodium hypochlorite. Even though allergy to sodium hypochlorite is rare, it is important for clinicians to recognise the symptoms of allergy and possible anaphylaxis. These may include urticaria, oedema, shortness of breath, wheezing (bronchospasm) and hypotension. Urgent referral to a hospital following first aid management is recommended.⁶

COMPLICATIONS ARISING FROM HYPOCHLORITE EXTRUSION BEYOND THE ROOTAPEX

1) CHEMICAL BURNS AND TISSUE NECROSIS

When sodium hypochlorite is extruded beyond the root canal into the periradicular tissues, the effect is one of a chemical burn leading to a localized or extensive tissue necrosis. Given the widespread use of hypochlorite, this complication is fortunately very rare indeed. A severe acute inflammatory reaction of the tissues develops. This leads to rapid tissue swelling both intra orally within the surrounding mucosa and extra orally within the skin and subcutaneous tissues. The swelling may be oedematous, haemorrhagic or both, and may extend beyond the region that might be expected with an acute infection of the affected tooth.

Sudden onset of pain is a hallmark of tissue damage, and may occur immediately or be delayed for several minutes or hours. Involvement of the maxillary sinus will lead to acute sinusitis.¹⁹ Associated bleeding into the interstitial tissues results in bruising and ecchymosis of the surrounding mucosa and possibly the facial skin (Fig 3) and may include the formation of a haematoma. A necrotic ulceration of the mucosa adjacent to the tooth may occur as a direct result of the chemical burn.⁷ This reaction of the tissues may occur within minutes or may be delayed and appear some hours or days later. If these symptoms develop, urgent telephone referral should be made to the nearest maxillofacial unit. Patients will be assessed by the on call 20,22 maxillofacial team. Treatment is determined by the extent and rapidity of the soft tissue swelling but may necessitate urgent hospitalization and administration of intravenous steroids and antibiotics.⁷ Although the evidence for the use of antibiotics in these patients is anecdotal, secondary bacterial infection is a distinct 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 required depending on the extent and character of the tissue swelling and necrosis.

2) NEUROLOGICAL COMPLICATIONS

Paraesthesia and anaesthesia affecting the mental,⁸ inferior dental and infraorbital branches⁹ of the trigeminal nerve following inadvertent extrusion of sodium hypochlorite beyond the root rsn *et al.* in 2005. In both cases, the buccal branch of the facial nerve was 18 affected. Both patients exhibited a loss of the naso-labial groove and a down turning of the angle of the mouth. Both patients were reviewed and their motor function was regained after several months. Sensory and motor nerve deficit are not commonly associated with acute dental abscesses. As there is no other current evidence in the literature it is¹⁰ possible that these neurological complications were a direct result of chemical damage by sodium hypochlorite, but further research (including nerve conduction studies) is required.

3) UPPER AIRWAY OBSTRUCTION

The use of sodium hypochlorite for root canal irrigation without adequate isolation of the tooth can lead to leakage of the solution into the oral cavity and ingestion or inhalation by the patient. This could result in throat irritation¹¹ and in severe cases, the upper airway could be compromised. Ziegler¹⁰ presented a case of a 15-month-old girl who presented in the accident and emergency unit with acute laryngotracheal bronchitis, stridor and profuse drooling from the mouth as a result of ingestion of a high concentration of household sodium hypochlorite. A similar clinical presentation might occur with the ingestion of any caustic substance. Opinion varies as to the best concentration of hypochlorite, with some practitioners using undiluted household bleach. Fibre optic nasal tracheal intubation followed by surgical decompression has been required to manage airway compromising swelling arising within three hours of accidental exposure to sodium hypochlorite during root canal treatment (Fig. 4)

PREVENTION

Preventive measures that should be taken to minimise potential complications with sodium hypochlorite

- Plastic bib to protect patient's clothing.
- Provision of protective eye-wear for both patient and operator.
- The use of a sealed rubber dam for isolation of the tooth under treatment.
- The use of side exit Luer-Lok needles for root canal irrigation.
- Irrigation needle a minimum of 2 mm short of the working length
- Avoidance of wedging the needle into the root canal.
- Avoidance of excessive pressure during Irrigation.

Emergency management of accidental hypochlorite damage Eye injuries

- Irrigate gently with normal saline. If normal saline is insufficient or unavailable, tap water should be

used

- Refer for ophthalmology opinion

Skin injuries

- wash thoroughly and gently with normal saline or tap water

Oral mucosa injuries

- Copious rinsing with water
- Analgesia if required
- If visible tissue damage antibiotics to reduce risk of secondary infection
- If any possibility of ingestion or inhalation refer to emergency department

Inoculation injuries

- Ice/cooling packs to swelling first 24 hours
- Heat packs subsequently
- Analgesia
- Antibiotics to reduce the risk of secondary infection
- Request advice or management from Maxillofacial Unit

MANAGEMENT

Proper treatment, the experience can be traumatic and frightening for the patient. General practitioners should therefore take extra precautions to avoid such situations. The best treatment is always prevention. To prevent the adverse effects of NaOCl, consider the following steps:

1. THOROUGHLY EXAMINE THE TOOTH TO BE TREATED.

A complete clinical and radiographic assessment of the tooth may reveal that the root canal system is complex enough to warrant referral to an endodontist for proper management.

2. ALWAYS USE ISOLATION: A RUBBER DAM IS THE MOST EFFECTIVE

Barrier to protect the intraoral tissue from the damaging effects of NaOCl.

3. USE AN APEX LOCATOR TO CONFIRM THE WORKING LENGTH.

After radiography, this is the most accurate and reliable method of determining the actual working length.

4. WHEN IN DOUBT, OBTAIN A RADIOGRAPH

If you are encountering difficulty in locating the canals during canal preparation, stop and obtain another film. Be confident about the area you are working in.

5. USE PROPER NEEDLE TYPE AND SIZE.

A smaller-bore, side-venting irrigating needle of a size appropriate for the prepared canal is recommended.

6. USE A PLASTIC STOPPER ON IRRIGATING NEEDLES.

The binding point. A stopper can guarantee the position of the needle tip inside the canal system, where tactile sensation is limited.

7. USE AN APPROPRIATE METHOD TO DELIVER THE IRRIGATION SOLUTION.

Use low, constant pressure, withdrawing the needle slightly from

CONCLUSION

Sodium hypochlorite accidents were relatively rare in endodontic practice. Such an event does not decrease the long-term endodontic prognosis for the involved tooth. Sodium hypochlorite accidents may be caused by additional factors other than faulty irrigation technique. Thus the use of sodium hypochlorite as an irrigant is beneficial apart from the rarest of the cases the probability of which again is very less.

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