



HYPOCHLORITE ACCIDENTS IN DENTISTRY: A BRIEF REVIEW

Dental Science

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INTRODUCTION

Sodium hypochlorite (NaOCl) is routinely used in root canal treatment as a chemical adjunct to mechanical debridement of the root canal system.¹ It is an excellent irrigant in terms of its ability to function as a lubricant during biomechanical preparation of the root canals and to dissolve pulpal tissues and the organic components of the smear layer.² It acts as an excellent antimicrobial agent by irreversibly oxidizing microbial enzymes. Sodium hypochlorite is also very effective for flushing and displacing loose debris inside the canal space, but the apical extent of its effectiveness is a function of the depth of insertion of the irrigation needles.³

Sodium hypochlorite (NaOCl) also has cytotoxic effects and leads to tissue necrosis.⁴ These cytotoxic effects are directly proportional to the concentration of sodium hypochlorite used and occur because of its ability to oxidize and hydrolyze cell proteins.⁵ Complications which arise when NaOCl extrudes beyond the apical foramen are known as "SODIUM HYPOCHLORITE ACCIDENTS".

PROPERTIES

Properties of Sodium hypochlorite not only make it a good endodontic irrigant but also render it a potent cytotoxic agent.⁴ The pH of sodium hypochlorite is approximately around 11 to 12. A variety of NaOCl concentrations ranging from 0.5% to 5.25% have been advocated. Longer the solution remains in contact with tissue, higher the temperature of the solution, and higher the concentration, greater is the ability of NaOCl to dissolve the tissue.⁶

ADVANTAGES

The ability of NaOCl to dissolve organic soft tissue of the pulp and predentin is a result of oxidation. The powerful oxidative activity of hypochlorite not only dissolves the pulpal and dentinal tissue but also acts as a potent antimicrobial agent.⁷ NaOCl, especially when used in high concentrations, is known to be effective in dissolving organic tissue remnants and disinfecting the canal system.

DISADVANTAGES of NaOCl

Acute inflammation followed by necrosis results when NaOCl comes into contact with vital tissue. It causes severe inflammation and cellular destruction in all tissues except heavily keratinized epithelium.⁶ Cytotoxic effect of sodium hypochlorite is because of its unique reaction with organic tissues known as saponification⁸. When it comes in contact with vital tissue, it causes hemolysis, ulceration, inhibits neutrophil migration and damages endothelial and fibroblast cells.⁹ Vascular permeability is also affected by sodium hypochlorite due to either direct damage to blood vessels or by chemical mediators' release. As a result, interstitial hemorrhage is generally seen causing spontaneous swelling and bleeding¹⁰.

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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 and leads 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 penetrates the corneal stroma. The alkali moves rapidly to the anterior chamber, making repair difficult. Further degeneration of the tissues within the anterior chamber results in perforation, with endophthalmitis and subsequent loss of the eye.¹¹

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. 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.¹¹

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 Sulzberger¹². Even though allergy to sodium hypochlorite is rare, it is important for clinicians to recognize 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) Three types of NaOCl extrusion accidents have been reported in the literature:

- **CARELESS IATROGENIC INJECTION**, Hermann et al. reported a case in which an anesthetic carpule consisting of 1.8 mL of 5.25% NaOCl was inadvertently used for a mandibular block.¹³ The injection resulted in massive oedema involving the pterygomandibular space and the peritonsillar and pharyngeal areas, as well as immediate trismus.
- **INADVERTENT INJECTION OF NaOCl INTO THE MAXILLARY SINUS** has been described in three case reports with complications varying from inconsequential,¹⁴ burning sensation and accompanying nasal bleeding,¹⁵ to severe facial pain.¹⁶ A possible reason for NaOCl extrusion into the maxillary sinus was provided by Hauman et al. as thinning of alveolar bone with ageing.¹⁷
- **EXTRUSION OR INFUSION OF NaOCl BEYOND THE ROOT APEX** into the periradicular regions. By far, the majority of case reports on NaOCl accidents fall into this category. Becker et al.¹⁸ and Sabala and Powell were among the first to report incidences of forceful injection of NaOCl into the periapical tissues beyond the apical foramen.

COMPLICATIONS ARISING FROM HYPOCHLORITE EXTRUSION BEYOND THE ROOT APEX

1) Chemical burns and tissue necrosis

The effect is one of a chemical burn leading to a localized or extensive tissue necrosis. Though rare, a severe acute inflammatory reaction of the tissues develops. This leads to rapid tissue swelling within the surrounding mucosa, the skin and subcutaneous tissues. The swelling

may be oedematous, haemorrhagic or both.¹⁹ Sudden onset of pain is a hallmark of tissue damage, and may occur immediately or be delayed for several minutes or hours.⁹

2) Neurological complications

Paraesthesia and anaesthesia affecting the mental inferior dental and infraorbital branches¹⁹ of the trigeminal nerve following inadvertent extrusion of sodium hypochlorite beyond the root canals have been described. Normal sensation may take many months to completely resolve.⁴

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 irritation⁴ and in severe cases, the upper airway could be compromised.

How to recognize a NaOCl accident

- Immediate severe pain (for 2-6 minutes).
- Ballooning or immediate edema in adjacent soft tissue.
- Extension of edema to cheeks, peri-orbital region, or lips.
- Ecchymosis on skin or mucosa as a result of profuse interstitial bleeding.
- Profuse intraoral bleeding directly from root canal.
- Chlorine taste or smell because of injected NaOCl to maxillary sinus.
- Severe initial pain replaced with a constant discomfort or numbness, related to tissue destruction and distension.
- Reversible or persistent anesthesia.

Avoiding NaOCl Accidents

- The following steps can help clinicians avoid NaOCl accidents:
- Adequate access preparation.
- Good working length control.
- Irrigation needle placed 1 mm to 3 mm short of working length.
- Needle placed passively and not locked in the canal.
- Irrigant expressed into the root canal slowly.
- Constant in and out movements of the irrigating needle into the canal space.
- "Flow back" of solution as it is expressed into the canal should be observed.
- Use side delivery needles that are specifically designed for endodontic purposes.

Emergency management of accidental hypochlorite damage²⁰

Eye injuries

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

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
- Arrange review if to be managed in dental practice

CONCLUSION

Root canal treatment forms an essential part of general dental practice. Sodium hypochlorite is the most commonly used irrigant in endodontics for its ability to dissolve organic soft tissues in the root canal and being a potent antimicrobial agent. Although NaOCl accidents due to extrusion through root apices are relatively rare and seldom life-threatening, they are substantially morbid. Most reported complications occur because of incorrect determination of endodontic

working length, iatrogenic widening of the apical foramen, lateral perforation or wedging of the irrigating needle. Careful management in aforementioned scenarios can prevent any mishap. Although rare, the recognition and subsequent primary management by the dental practitioner of these complications is essential to ensure best clinical practice.

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