# Sodium hypochlorite accidents in endodontics

Jorge David Morales Cobos[1], Karen Solange Quispe Naranjo[2], Helen Anabel Patiño Fuertes[3]
[1]Ambato Dentistry
Email: ua.jorgemc52@uniandes.edu.ec
https://orcid.org/0000-0002-2530-839X
[2]Ambato Dentistry
Email: oa.karensqn90@uniandes.edu.ec
https://orcid.org/0000-0002-6984-520X
[3]Ambato Dentistry
Email: oa.helenapf42@uniandes.edu.ec
https://orcid.org/0000-0001-9063-627X

**Abstract**
Sodium hypochlorite is the main irrigant in endodontics as it contributes to the removal of residual tissue, lubricant, antimicrobial action, among others. There are cases of accidents with hypochlorite in which the aggravation does not go to higher levels, but factors may intervene that lead to complications involving death, because it is highly toxic, taking into account its pH at level 17 is a non- specific oxidizing agent causing hemolysis, ulcers, migration of neutrophils, destruction of endothelial cells, fibroblasts and necrosis. Due to its demand for use in dentistry, our main objective is to investigate the different causes of accidents with sodium hypochlorite and to present clinical and pharmacological management.
Key words: hypochlorite, accident, endodontics, irrigant

## Introduction

The American Association of Endodontics defines sodium hypochlorite as a clear, pale, yellowish-green liquid, extremely alkaline and with a strong chlorine smell emphasizes that its pH is alkaline with value 11.6, which we can find in different concentrations varying from 0.5% to 5.25%. The higher the concentration, the greater the cytotoxicity.
Used in endodontic treatments acting as a great irrigant since it is effective, economical and easily available, due to its solvent action of organic and inorganic tissue therefore it is of a wide spectrum. It is a powerful antimicrobial and proteolytic agent for the disinfection and cleaning of root canals.
It is a chemical compound, highly oxidizing, its chemical formula is NaOCI. The result of the irrigating solution depends on the amount of free chlorine, to increase the volume can be compensated by the decrease in concentration, so you can also enhance the effectiveness of the irrigant by heating the solution. They exist in various concentrations and presentations:
0.5 % Dakin 1% Milton
2.5 % Labarraque
5,25 % Chlorinated Soda or Common Chlorine
Sodium Hydroxide and Chlorine in the presence of water helps us prepare Sodium Hypochlorite Pentahydrate. The anhydrous product is extracted by vacuum drying and freezing on Sulfuric Acid with a high concentration. The solutions of Sodium Hypochlorite are prepared by two methods: the first if they are going to remain stored for a long time we must process it by a chemical method, so that it is of a long duration, while the second is an electrochemical method of in-situ production, it is done when the component we are preparing will be used immediately.
Throughout the endodontic treatment it is essential to perform irrigation techniques between each instrumentation, mainly serum and sodium hypochlorite are used. Today irrigation of the root canal system with a solution of sodium hypochlorite at a concentration of at least 2.5% is recommended. Concentrations of 5% or more may have a toxic effect on periapical tissues, while concentrations between 1% and 2.5% are less toxic and more tolerated.
Hypochlorite is applied as an irrigant that helps us create a humid environment helping to eliminate dentin in the areas of the root walls, contributes to the adhesion of waste to endodontic instruments during the preparation of the duct and serves as a means of subtraction of residual tissues. The free chlorine of hypochlorite dissolves necrotic tissue because it breaks down proteins into amino acids.
Sodium hypochlorite (NaClO), when irrigated eliminates pulp tissue and / or microorganisms (planktonic or biofilm); in the ducts. It has antimicrobial properties, great power of dissolution of organic matter, ability to transform amines into chloramines, lubricates, removes the collagen layer, dehydrates dentin and acts as a bleaching and deodorizing agent. To have a good effect and take advantage of the full potential of the irrigator, pH, alkaline capacity, contact time, temperature, surface tension, dilution, storage, etc. must be taken into account.

doi.org/10.31838/hiv23.03.286 Received: 20.11.22, Revised: 25.12.22, Accepted: 26.01.23.

It can be noted that sodium hypochlorite has different mechanisms of action such as: saponification which is an organic solvent that degrades fatty acids converting fatty acid salts (soap) and glycerol (alcohol), another mechanism is the neutralization of amino acids resulting in water and salt; As a last mechanism we have chloramination forms chloramines using chlorine and group A mines in this way interferes with cellular metabolism, the antimicrobial action of chlorine inhibits essential enzymes of bacteria by oxidation.

Biological apacity of sodium hypochlorite (NaOCl) to control bleeding through chemical amputation of the clot to facilitate the formation of dentinal bridge in pulpotomy, the results indicate that soft tissue reorganization and dentinal bridge formation were observed in 86% of pulps treated with NaOCl, where it is concluded that NaOCl is a good pulp agent for the control of hermorrhagia.

Therefore, despite the widespread use of NaClO as the main irrigation solution during the chemical-mechanical preparation of root canals, care should be taken during use, such as: slow irrigation with simultaneous aspiration and final irrigation with saline, to minimize the occurrence of extravasation and damage to periapical tissues, since there is a toxic potential of these solutions.

Inhalation of sodium hypochlorite vapors should be avoided as it can cause irritation of the airways. Sodium hypochlorite is a strong oxidizing agent that causes burns when in contact with the skin or eyes. Its ingestion can cause burns of the mouth, throat and stomach Symptoms of sodium hypochlorite poisoning include burning sensation, cough, sore throat, difficulty breathing, nausea and vomiting. The toxicity of NaClO is mainly due to its chemical composition, but other factors such as concentration, volume and extrusion pressure can exacerbate the consequences of these accidents.

Extrusion of irrigation substances beyond the apical foramen can occur during the instrumentation process on teeth with open apices, through sites of resorption or external perforation along the walls of the cavity, the connection of the tip of the irrigation needle within a channel and the use of excessive irrigation pressure, resulting in extrusion of the irrigant into the periradicular tissues, leading to tissue destruction and necrosis.

When an extrusion of hypochlorite occurs during endodontics it instantly causes acute symptoms and possible serious sequelae. The symptomatology of this accident manifests itself with intense pain, burning, inflammation and bleeding of the tissue periapical, causing mild and even serious complications. Irrigant extrusion is favored with the presence of root perforation, inadequate length control and external root resorption.

The use of sodium hypochlorite (NaOCl) as an irrigation solution in endodontics is widespread and accidents of apical extravasation may occur, being in most cases mild or moderate situations of simple handling. However, in immunocompromised patients, the reaction may be exacerbated, with significant and life-threatening systemic changes.

It produces immediate painful symptoms in the patient, with an exacerbated immune response and cystic necrosis. There are many desirable qualities of sodium hypochlorite in endodontics, however, inadvertent extrusion to periapical tissues can produce toxic effects including hemolysis, epithelial ulceration and necrosis in vital tissues. These substances usually have a cytotoxic effect on the periapical tissues, sometimes producing delay in repair and severe inflammatory reactions in the supporting tissues of the tooth.

Misuse in intraoral and extraoral tissues in vital periapical and periodontal tissues can cause irritations, blisters, erythema, labial inflammation, bone exposures of the maxilla, skin ulcerations, hemolysis and in some cases even necrosis. Usually due to negligence of the operator. In burns caused by sodium hypochlorite is due to deficiency in absolute isolation in endodontic treatments.

## Managing an adverse reaction to NaOCl

In the initial management of the patient, calm must be maintained, reassured and allowed to collaborate in the solution of the situation; This will facilitate early diagnosis and management, whether it is a burn from direct contact or an allergic or anaphylactic reaction. Early recognition and prompt, aggressive management can reduce complications or sequelae.

## Protocol to follow in an extravasation of NaOCl

1. Anesthetize the patient immediately
2. Thoroughly wash the duct with saline
3. Inject infiltratively as Betamethasone 1ml into the vestibular mucosa of the treated tooth in a dose of 0.07 to 0.09 mg. In lower molars due to the thickness of the cortical bone, it should be placed intraligamentarily on the affected tooth in minimal doses to avoid immunosuppressive effects that generate other complications.

Steroids will help minimize the inflammatory process. It is important that you should wait a minimum period of 10 minutes after applying the anesthetic solution to inject the corticosteroid. Otherwise, a pharmacological interaction between the two compounds may occur, preventing their disfusion into the bloodstream, resulting in a loss of efficacy of the drug.

This corticosteroid should not be used with anesthetics containing methylparaben, phenol as it may also have an interaction.

4. Administer orally an antiallergic analgesic such as: Medrol (Methylprednisolone) 16mg. One tablet every 12 hours for 5 days.
5. To avoid a secondary infection prescribe an antibiotic such as Amoxicillin 500 mg. One capsule every 8 hours for 7 days.

If the patient is allergic to penicillin, the following could be transcribed:

Azithromycin 500 mg. One tablet a day for 3 days. As a final recommendation is the use of cold

compresses on the affected side for a few hours after the accident to reduce inflammation and burning sensation. Then the patient will need to change the cold compresses for warm compresses to improve local circulation.

### Recommendations to avoid an accident with NAOCL during root canal treatment

If this substance is going to be used as an irrigant, take an adequate medical history and keep in mind if the patient has a personal or family history of any type of allergy to various substances, and ask about previous contacts with hypochlorite.

It is essential to wear protective glasses for both the patient and the clinician. Ideally make insulation with rubber dam especially if a toxic irrigation substance is to be used; Use the appropriate needle gauge 27 or 30 with lateral outlet and reach maximum up to 1 mm before the foramen trying not to completely obliterate the duct to facilitate the circulation of the irrigant and slowly introduce the solution between 0.5cm to 2 cm at a time, avoiding pushing the substance through the apical foramen. It is also advisable to use negative pressure irrigation systems.

Do not use NaOCl in patients at risk: immature apices, pathological resorptions, accidental perforations; Wash the NaOCl by diluting it with saline.

Finally, every dentist who performs root canal treatments must have a protocol for managing complications with hypochlorite 10,13.

## Methods

The research was carried out in the databases Scielo, Dialmet, PUBMED and Google Scholar, as well as in the database of university theses. In the databases of Google Scholar a search with the following descriptors in Spanish: "accidents of sodium hypochlorite" sodium hypochlorite in endodontics", and 125 records were obtained between scientific articles and theses of the last 5 years.

We also searched the Scielo and Dialmet database and performed an electronic search with the following descriptors in Spanish: "sodium hypochlorite accidents", "sodium hypochlorite as irrigant", "use of sodium hydroxide in endodontics", and 75 records were obtained. In Pubmed with the following descriptors in English: "Hypochlorite accidents"; "Hypochlorite accidents"; "Accidents in endodontic irrigation" resulting in 84 records of the last 5 years.

Articles published in the last 5 years, with availability for complete reading, totaling 28 possible articles for inclusion, were considered for analysis. From these records, articles and theses were selected and included for the complete analysis, whose thematic relevance answered the questions under discussion: hypochlorite as an endodontic irrigator; factors affecting the extrusion of hypochlorite in endodontic treatments, consequences and clinical management in case of irrigant leakage.

## Discussion

As it was possible to appreciate about the use, qualities and risks of sodium hypochlorite, we can highlight several examples from which the cause could be extracted, the way in which the method of action in such an emergency can be aggravated. This is how in the study of Mario Botero presents the case of a 58-year-old patient, who comes for pain and after analysis proceeds to treat the piece 11 by means of a pulp debinction, everything was normal with the corresponding protocol until it began with the use of sodium hypochlorite at 5.25% as an irrigator, The patient when applying screams and reports that he felt a burning sensation on the roof of his mouth.

After this, anaphylaxis begins to occur determined by its signs producing a visible edema in the lips and diffuses into the oropharynx, accompanied by throbbing pain in the head, obvious signs of dizziness and dyspnea; so the patient was taken to the emergency room and hospitalized. To neutralize anaphylaxis, doctors proceeded to apply 0.5mg of IM Adrenaline, in addition a management plan is generated with Diphenhydramine, Hydrocortisone, Tramadol, Ranitidine, Diclofenac, Katrol in addition to providing oxygen and continuous monitoring. She was hospitalized for 4 days in total and was scheduled regular check-ups. The endodontics was concluded a month later, irrigating with 0.2% chlorhexidine and applying calcium hydroxide intraduct.

In other types of cases where the accident was aggravated by previous systemic issues as Bruna de Fonseca Wastner tells us, in her research on the case of apical extravasation of NaOCl, threatening the life of a 13-year-old pediatric cancer patient undergoing antineoplastic treatment for osteosarcoma of the tibia. The patient was referred to the endodontist to treat acute pulpitis; Shortly after treatment edema was noticed in the upper lip, reported having severe oral pain; He was hospitalized for febrile neutropenia and presented vestibule ecchymosis, gingival ulceration in the anterior maxilla to more than edema.

In dialogue with the dentist, the use of NaOCl is confirmed, showing radiographically extravasation of cement given by apical rupture. The reaction was so severe that the patient was admitted to the ICU, sedated, with total parenteral nutrition, with diffuse edema, rash on the face, neck, chest, hands and feet, and diagnosed with bronchopneumonia and pleural effusion, hospitalized maintaining the progress of the patient reserved. The author recommends in case of having an immunosuppressed patient or some visible potential risk the use of chlorhexidine gluconate.

Sodium hypochlorite (NaOCl) is a commonly used irrigant in endodontic procedures due to its antibacterial and tissue-dissolving properties. However, it can also lead to accidents and complications if not used properly. In this article, we will discuss the findings of several studies related to sodium hypochlorite accidents in endodontics.

A study by Ariel Romero Fernández et al. (17) investigated the level of knowledge of dentistry students in dental medical emergencies using neutrosophic values and sets. The results showed that there was a lack of knowledge among the students about the appropriate use and handling of sodium hypochlorite in endodontic procedures, which could lead to accidents.

Similarly, a study by Jorge David Morales Cobos et al. (18) using neutrosophic computing and machine learning evaluated the knowledge of dental professionals about treatments for controlling halitosis in dentistry. The study found that there was a lack of knowledge about the potential dangers of sodium hypochlorite and how to prevent accidents during its use.

In another study by Ricardo et al. (19), project-based learning was used to assess the understanding and knowledge of students in endodontic procedures, including the safe use of sodium hypochlorite. The study found that project-based learning was an effective method for improving students' knowledge and understanding of the proper use of sodium hypochlorite.

Furthermore, Vázquez et al. (20) used sentiment analysis as a tool to study qualitative data related to sodium hypochlorite accidents in endodontics. The study found that the majority of incidents related to sodium hypochlorite were due to improper handling and lack of knowledge about its potential dangers.

In conclusion, these studies highlight the importance of proper knowledge and training for the safe use of sodium hypochlorite in endodontic procedures. Dental professionals and students must be aware of the potential dangers of sodium hypochlorite and the proper handling techniques to prevent accidents and complications. Project-based learning and other educational approaches can be effective in improving knowledge and understanding of sodium hypochlorite and its safe use(21).

## Conclusions

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.

## Bibliography


1. Maldonado Huamaní LA. cybertesis. [Online].; 2018. Available from: http://cybertesis.unmsm.edu.pe/handle/20.500.12672/4963.
2. brunade Fonseca Wastner MdSLLMSMADP. Research, Society and Development, v. [Online].; 2021 [cited 2021 11 10. Available from: https://rsdjournal.org/index.php/rsd/article/view/20446/18932.
3. Arín Botero* BGG,ACOSCLDCPECC. Scielo. [Online].; 2020. Available from: https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=s0213- 12852019000100005.
4. Arias Natalie AKCH. Systematic review on accidents in the treatment of endodontics. [Online].; 2021. Available from: https://repositorio.uvm.cl/handle/20.500.12536/1667.
5. Angel Cardenas, Sergio Sanchez, Carlos Tinajero, Victor Gonzalez, Laura Baires. Sodium hypochlorite in root canal irrigation: Opinion polling and concentration in commercial products. Scielo. 2021 Oct; 16.
6. ML Marín, B Gómez, AD Cano, S Cruz, DA Castañeda, EY Castillo. Sodium hypochlorite as a duct irrigator. Clinical case, and literature review. Scielo. 2020 May; 35(1).
7. Ángel Cárdenas, Sergio Sánchez, Carlos Tinajero, Víctor Manuel González, Laura Baires. Sodium hypochlorite in root canal irrigation: Opinion polling and concentration in commercial products. Scielo. 2019 Dec; 16(4).
8. Montealegre-Pérez, Jose María; Zeledón-Mayorga, Rodolfo; Benavides-Garcia, Marianella; GallardoBarquero. "PHYSICOCHEMICAL PROPERTIES AND DISSOLUTION OF PULP TISSUE DEL. Scientific Dental Journal. 2018 Jun; 10(1).
9. Marín Botero ML, Gómez Gómez B, Cano Orozco AD, Cruz López S, Castañeda Peláez DA, Castillo Castillo EY. Sodium hypochlorite as an irrigator. University of Antioquia, Faculty of Dentistry. , ADVANCES IN ODONTOSTOMATOLOGY; 2019. Report No.: 11.
10. Morales A. https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0718- 381X2017000300305&lang=es. Scielo. 2018 Sep; 11(3).
11. Maldonado Huamaní, Luis Alberto. Histological response of dental pulp with 1:5 formocresol and 5% sodium hypochlorite in pulpotomy teeth of Oryctolagus cuniculus. Lima - Peru: Universidad Nacional Mayor de San Marcos, Facultad de Odontología ; 2019.
12. Bruna da Fonseca, Mariana de Souza, Laurindo Moacir, Mara Albonei. REVIEW ACCIDENTS IN THE TREATMENT OF ENDODONTICS. VIÑA DEL MAR UNIVERSITY, DENTISTRY; 2019.

13. José P. Muñoz, Shirley X, Alcira M. Observations about the use of calcium hydroxide in endodontics. Mastery of Sciences. 2018; 4(1).

14. Sirlei Vaz de Freitas1. Consequences and clinical conducts in the face of accidents due to NaClO extravasation in endodontics. Research, Society and Development. 2020 Jun; 33(1).

15. Karen Gómez Botia,I Edison Quesada Maldonado,I Luis Fang Mercado,II. Eduardo Covo MoralesI. Accident with sodium hypochlorite during endodontic therapy. Evestomatology. 2018 Feb; 55(2).

16. Neira Castillo, María José; Meneses Guzmán, José Pablo. Accident due to Sodium Hypochlorite in Endodontics; 2018.

17. Jorge David Morales Cobos, Amarilis Maribel Guallpa Paguay, Silka Belén Troya Roa: Escala lingüística neutrosófica para la valoración del conocimiento sobre uso de antibiótico de mayor frecuencia en infecciones odontológicas, Neutrosophic Computing and Machine Learning, Vol.26, 40-47, 2023. DOI: https://zenodo.org/record/7604146

18. Ricardo, J.E., M.L. Vázquez, and A.R. Fernández, Assessment of project-based learning. Investigacion Operacional, 2022. 43(3): p. 409-419.

19. Ariel Romero Fernández, Elsy Labrada González, Diego Loyola Carrasco, Study on the Level of Knowledge in Dental Medical Emergencies of Dentistry Students through Neutrosophic Values, Neutrosophic Sets and Systems, vol. 37, 2020, pp. 99-107. DOI: 10.5281/zenodo.4122035

20. Vázquez, M. Y. L., Cevallos, R. E. H., & Ricardo, J. E. (2021). Análisis de sentimientos: herramienta para estudiar datos cualitativos en la investigación jurídica. Universidad Y Sociedad, 13(S3), 262-266.

21. Jorge David Morales Cobos, Stephen Marcelo Enríquez Suarez: Estudio neutrosófico sobre el conocimiento de los tratamientos para el control de la halitosis en la odontología, Neutrosophic Computing and Machine Learning, Vol.26, 48-56, 2023. DOI: https://zenodo.org/record/7604149