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HAVOC OF CLEAR SOLUTIONS IN DENTAL CLINICS

Dental Science

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KEYWORDS

Everyday many clear solutions are used in dental clinics for different purposes like local anaesthesia, hydrogen peroxide, sodium hypochlorite, dental acrylic monomer, formalin etc. Negligence while using these solutions can cause serious injuries to the patient. Dental negligence can be of various forms, from accidental injections of toxic substances instead of local anesthetics to accidental contact with these substances.

General tendency in India is not to throw the empty vials of local anaesthetic rather they are used to store many clear solutions like formalin, monomers etc. Also the dentists are in a habit of using syringes loaded by the assistants.

Different types of accidents can be caused by clear solutions [1-11]

1. Accidental spillage of sodium hypochlorite
2. Extrusion of NaOCl in maxillary antrum
3. Infusion beyond root apex
4. Iatrogenic injection
5. Allergy

Complications caused by clear solutions

Accidental spillage[8]

1. Damage to clothing- spillage of minute quantity of solution will cause irreparable bleaching.
2. Eye damage- blurring of vision, patchy colouration of cornea, loss of epithelial cells in outer corneal layer and if the alkali moves to the anterior chamber it may cause degeneration of tissues of anterior chamber resulting in perforation.
3. Damage to skin - alkali burns
4. Damage to oral mucosa- alkali burns and ulcers

Allergy[8]

Allergic potential of hypochlorite was first reported in 1940[12,13]. Although allergy to hypochlorite is rare but the clinician must be familiar to the signs and symptoms for early detection and management. The signs and symptoms are urticaria, oedema, shortness of breath, wheezing and hypotension. Allergy to formalin – formaldehyde is well known mucous membrane irritant and a primary skin sensitizing agent associated with both contact dermatitis and immediate anaphylaxis.[14]

Formaldehyde is an ingredient of dental materials- root canal filling materials, formacresol, sealers and cements, polymers etc. Kie-SwiereczyDska M et al.[15] examined incidence of allergy to aldehydes in 280 health care workers suffering from skin lesions. They reported an incidence of 13.9% allergy to formaldehyde and 12.4% to glutaraldehyde. Kijima et al[16] in 2007 reported 2 cases of generalized Utricaria after dental treatment.

Hauman CHJ and love RM[17] in their review paper described the content and biocompatibility of root canal filling materials. A large group of sealers/cement, according to the authors contain substantial amounts of paraformaldehyde and are able to liberate formaldehyde into water in amounts sufficient to cause local allergic reactions.

Denture base resins have many undesirable effects that have been widely documented in the literature. The most common and frequently reported problem with the patients is having allergic reactions to denture base acrylic resin. The symptoms of allergy are mouth soreness and burning sensation. Areas presenting with burning sensation include the palate, tongue, oral mucosa, and the oropharynx.[18,19] Allergic tests carried on the skin of patients has also confirmed that the denture base acrylic resin is responsible for allergic reactions.[20,21,22]

Extrusion of sodium hypochlorite in maxillary sinus may be due to alveolar bone thinning with ageing, particularly in areas surrounding the tooth apices.[23]

Complications arising from extrusion of hypochlorite beyond root apex were categorized in 3 catogaries by Spencer et al[24]

- Chemical burns and tissue necrosis, which include tissue swelling(oedamatous, haemorrhagic or both). The hallmark of tissue damage,pain, may be experienced immediately or can be delayed for several minutes or hours.
- Neurological complications in the form of paresthesia or anaesthesia in the distribution of mental, inferior dental and infrorbital nerves have been reported. Facial nerve including the buccal branch may be involved. Nerve injury may take many months to completely resolve or can be irreversible.
- Upper airway obstruction may be caused by direct ingestion of hypochlorite due to leakage of solution during irrigation or inhalation by the patient leading to throat irritation and in severe cases compromise airway.
- One study reported upper airway obstruction due to ludwig's angina caused by the extrusion of hypochlorite beyond root apex of lower second molar

Complications due to extrusion in maxillary antrum[25]

- Burning sensation
- Severe nasal bleed or bleeding through root canal

Complications due to inadvertant injection[2,3,4,7,10,11,25,26]

Local signs and symptoms include severe burning pain immediately after injection followed by palpable tender swelling and erythmea . This may be followed by ulceration. There may be associated nerve damage.

Causes of iatrogenic injections of clear solutions[4,7]

1. In most clinics in India L.A from multiuse vials is used with disposable syringes. Cartridges are not in common use
2. Hiring of undertrained and/or illiterate dental assistants. This is because of nonavailability of trained assistants specially in remote places.
3. Reusing local Anaesthetic bottles for storage of dental chemicals.
4. During endodontic treatment, use of L.A and hypochlorite is almost simultaneous and there is a possibility that clinicians mistakes one for another.

Causes of Extrusion of NaOCl in maxillary antrum[11,23]

1. Alveolar bone become thinner with ageing, particularly in areas surrounding the tooth apices
2. Irrigation pressure might cause extrusion of NaOCl into maxillary sinus if the Schneiderian membrane was misiing

Causes of Infusion beyond root apex[27,]

May occur because of operators fault like forceful injection.

1. Additional factors like Working length, active Irrigation, open apex, fractured root, perforation, presence of lateral canals and fenestrations may also be responsible.

Chances of extrusion in periradicular tissues are more in buccal and infraorbital region as the apex of teeth lying in these areas may sometimes fenestrate the overlying alveolar bone naturally.

The accidents are more common in maxilla than mandible because of thin and less denser bone. It is more common in upper premolars, also this type of accidents are more common in teeth with periradicular lesion because of bone resorption that results in fenestration of the overlying bone

Guidelines for prevention of accidents[2,4,7,8]

- All the staff working in dental clinic should have a thorough introduction and education of dental drugs and chemicals used in the clinics
- Local anesthetic bottles should never be used with existing labels
- All consumables must be stored in a bottle different from the bottle of L.A and if at all used then must be labelled clearly
- All chemicals that are not used for injection must be physically removed from clinical areas
- Untrained and Illiterate assistants should not be allowed to handle injectable drugs
- Use of different types of syringes and needles for irrigation and injection can help identify the contents
- Clinician should ensure the content of the syringe if it was loaded by the assistant or the dentist himself should load the syringe
- Use of cartridges should be encouraged
- There should be one predefined area where labelled bottles are kept.
- Plastic bib should be used to protect patients clothings
- Protective eye-wear should be used by the operator and patient
- Use of sealed rubber dam for isolation of tooth under treatment
- Use of side exit luer-lok needles for root canal irrigation
- Irrigation needle should be atleast 2mm short of the working length
- Avoid wedging of needle into the root canal
- Avoid excessive pressure during irrigation

Management of complications[7,8]

Remain calm and inform the patient about the cause and nature of complication.

Precise details of the event should be documented including concentration and volume of the solution involved. The notes can be supplemented with Clinical photograps. In case of eye injuries irrigate gently with normal saline. If normal saline is not available the irrigation can be done with normal tap water and refer the patient for ophthalmology opinion. In case of skin injuries wash thoroughly with saline or normal tap water.

Oral mucosal injuries ,copious rinsing with water. Analgesics can be prescrribed if Needed. In case there is visible tissue damage prophylactic antibiotics should be prescribed to reduce the risk of secondary infection.

If there is any possibility of ingestion or inhalation immediate referal to emergency department

In case of inoculation injury[2,3,7,11]

- Try to dilute the injected chemical by injection of normal saline at the same site of injection
- In case of sloughing/necrosis debridement and surgical intervention is required. The area is then cleaned with copious irrigation with normal saline.
- In case of bleeding let the bleeding continue as it helps to flush the irritant out of the tissue.
- Icebag compresses for 24 hours (15 min. Interval) to minimize swelling
- Warm compresses after 24 hours (15 min interval)
- Rinsing with warm saline for 1 week to improve circulation to the affected area.
- For pain control initially local anesthetic nerve block can be given. Acetaminophen based narcotic analgesics for 3-7 days (NSAIDS should be avoided to decrease the amount of bleeding in soft tissues)
- Antibiotic prophylaxis for 7-10 days to prevent secondary infection or spreading of existing infection.
- Steroid therapy to control inflammation. Steroids can be given locally at the site of injection and intravenously.
- Blood samples of the patient are collected and sent for liver and kidney function tests.
- For home care povidone iodine gargles are suggested.
- Patient is recalled for constant observation and dressing change. Dressings of iodoform gauze or gauze soaked in povidone iodine are recommended

In case of formalin accidents where formaldehye enters the blood stream, artificial ventillation may be needed to maintain oxygen saturation, as it causes hemolysis. Dialysis can also be started to remove formalin from the blood[28,29]. Infusion of N-acetylcysteine with hemodialysis has been used to prevent the conversion of formaldehyde to formic acid thereby reducing the metabolic acidosis.[30]

Submucosal injection of dexamethasone has been demonstrated to decrease the postoperative discomfort after third molar surgery. The injection of low dose dexamethasone in the surgical site achieves a concentration at the injury site without the loss due to the distribution to other compartments or the onset of elimination.[31]

Cases reported

Pushp Chander Swami et al[2] in 2016 reported a case of accidental intraoral injection of formalin in a 52 year old healthy man during extraction. The patient complained immediately of severe burning pain. After it was noticed that a wrong vial was injected , injection of 5ml of normal saline was given at the same site, followed by intravenous injection of avil 45 mg (Pheniramine maleate) & dexamethasone 8 mg was injected intramuscularly. These 2 were continued for next 3 days. On the 2nd day Chymoral forte (trypsin/chymotrypsin) 50mg orally was prescribed. After 3rd day only symptomatic treatment was advised.

Durga shanker gupta[3] et al in 2011 reported a case of formalin induced iatrogenic cellulitis, a case due to dental negligence. In this case report approximately 1 ml of formalin 10% was administered to a 23 year old healthy male who reported to the department for the extraction of a decayed tooth in the 2nd quadrant. Immediately after the injection the patient reported severe burning pain at the site of injection and was restless. On clinical examination intraoral as well extraoral swelling was noticed. Steroids were given for pain and swelling and antibiotics for prevention of secondary infection.

Gururaj Arakeri et al[4] in 2012 reported a case of inadvertent injection of formalin mistaken for local anaesthetic agent in a 35 year old healthy male. The patient was administered formalin in the posterior superior alveolar nerve region.immediately after injection patient complained of Severe burning sensation over cheek region and also around eye. The patient also complained of heaviness in the chest, not associated with dyspnea. The patient was afebrile with all vital signs within normal limits.

Hanan Balto et al[5] in 2001 described a case of accidental injection of sodium hypochlorite through root canal into periradicular tissue and immediate extensive facial sequelae. After local anaesthesia and rubber dam isolation root canal instrumentation was performed on a 17 year old female patient. After the final instrumentation a 25 guage needle attached to 10 c.c disposable syringe was inadvertently wedged in the canal and approximately 1.5 cc of NaOCl was expressed into the root canal and periradicular tissues accidentally the canal was dried , 2% iodine potassium iodine was placed and the access cavity was closed with cavit. 15 minutes after the discharge the patient came back complaining of severe pain and swelling of upper lip. The mucous membrane of the upper lip showed ecchymosis. The cavit was removed and profuse haemorrhage was discharged from the root canal. After irrigation with normal saline the canal was left open for drainage of exudate. antibiotics and analgesics were prescribed and she was instructed to use ice packs.

Veeresh S Tegginmani et al [6] reported a case of hypochlorite accident in a 31 year old healthy woman. After intermittent irrigation with unbuffered 3 % NaOCl and normal saline $Ca(OH)_2$ dressing patient was discharged. 4 hours after the discharge patient reported in distress

and severe pain. Clinically there was tense , shiny, and warm swelling extending from left lower eyelid to corner of mouth and from ala of nose to angle of mandible. As NaOCl accident was suspected canal was opened and copious irrigation with saline was done . cold compresses were placed to control swelling and pain . antibiotics and analgesics were prescribed. Swelling completely disappeared in 3 months Pushkar Parkash Wakins et al [7] in 2011 reported accidental injection of sodium hypochlorite instead of local anaesthetic in 33 year old female patient scheduled for endodontic procedure. She was inadvertently infiltrated with 1.2 ml of 3 % sodium hypochlorite in the labial vestibule adjacent to canine. Immediately the patient complained of severe pain and burning sensation. Clinically a wound was seen in the vestibule and extraoral ecchymosis was observed corresponding to the infilterated area. For pain control nerve block was administerd and steroids were injected around wound. Copious irrigation was done and necrotic tissue was removed. Gauze soaked in povidone iodine was placed and antibiotics and analgesics were prescribed. Dressings were changed for 7 days. Healing was complete by 4 weeks.

K P Saujanya et al[10] in 2014 reported cases of dental negligence. Formalin instead of local anaesthetic was injected for inferior alveolar nerve block to a 8 year old male patient. Patient complaied of pain and clinically sloughing was noticed at the pterygomandibular raphae area.irrigation was done and antibiotics analgesics and steroids were prescribed. The patient was kept on observation and dressing change. The patient was asymptomatic after 15 days.

A 31 year old male patient reported with the complaint of severe burning sensation and ulcers on the lower lip since 2 days. The patient had undergone root canal treatment 3 days before and accidentally sodium hypochlorite contacted his lower lip mucosa resulting in chemical burn in that area. Copious irrigation of the area was done with normal saline and analgesics and antibiotics were prescribed. Complete healing of the area was seen after 10 days.

Tajamul Hakim et al[11] in 2017 reported a case of palatal mucosa necrosis due to accidental injection of sodium hypochlorite instead of L.A. after the injection the patient reported severe pain which continued for 2 days. Intraoral examination revealed grayish white necrotic tissue involving half of the palate. The surrounding area was purple and swollen. Surgical debridement was done followed by iodoform dressing. The patient recovered after 3 months.

CONCLUSION

Apart from education of the staff, accurate use of medical consumables and checking of all equipment is recommended. As we know the eyes can see only what is there in mind, every dentist should have knowledge of the precautions and management about handling of the toxic substances used in clinics and should try to prevent these preventable accidents.

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