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Evaluation of Release of Chlorine When Sodium Hypochlorite is Used With Iopamidol and Iomeprol Dye - an Invitro Study

KEYWORDS: Sodium hypochlorite, Iopamidol, Iomeprol, Chlorine-release , Contrast dyes

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ABSTRACT *Chlorine-releasing agents like Sodium Hypochlorite has established itself as an excellent intracanal irrigant due to its antimicrobial and proteolytic properties which is used in concentrations ranging from 0.5% to 5.25%. Contrast media dyes have been used to enhance the visualization of the root canal system and to better understand the root canal anatomy. In this study we have evaluated the amount of release of Chlorine when 3% Sodium hypochlorite was used with Iopamidol and Iomeprol root canal detecting dyes. 3 % Sodium Hypochlorite was subjected to a physiochemical test and comparisons were made using One way anova . Multiple comparisons were made using Bonferroni's correction. 3%Sodium Hypochlorite when used with Iopamidol , the release of chlorine was minimal but Iomeprol showed a favorable increase in chlorine . In conclusion, Iomeprol is more effective in combination with Naocl and can be used to interpret the root canal anatomy of a population that requires endodontic treatment.*

INTRODUCTION

Success in endodontic treatment has undergone a revolutionary change ever since the introduction of contrast medias that has helped to improve the visualization of the root canal system and to better understand the root canal anatomy. Contrast media are radiopaque dyes such as Iopamidol and Iomeprol have been used in angiography , venography , urography , CT have also been used in endodontic radiography for detection of ledges , perforations and better interpretation of the root canal anatomy (Naoum et al ,2003)[1].

Sodium Hypochlorite has established itself as an excellent antibacterial agent, capable of dissolving necrotic tissue, vital pulp tissue and organic components of dentin and biofilms. The main factor driving the antimicrobial and proteolytic properties of Sodium Hypochlorite solution is their content of free available chlorine [2]. The major concern in endodontics is total bacterial contamination of the root canal .For successful outcome of treatment , it is essential for the elimination of microrganisms and necrotic tissue from the root canal system [3,13].

The use of contrast media in combination with 5% Naocl , and 17% EDTA – Ruddle's solution has been successfully used clinically and mentioned in standard endodontic text (Ruddle, 2002). This contains ionic dye Hyapaque (containing sodium diatrizoate). A few other non ionic contrast media such as Iohexol (Naoum et al., 2003), Saigram (Soni et al, 2008), Ultravist (Bedford, 2004), Iopamidol (Mahale et al., 2013) have been assessed for their imaging quality in certain in vitro and in vivo studies [4,15,16].

The amount of release of chlorine at different temperatures in six different brands of Sodium Hypochlorite has been discussed in Invitro studies [5]. However , the amount of chlorine release when sodium hypochlorite is used with Iopamidol and Iomeprol root canal detecting dyes have not yet been documented .

AIM & OBJECTIVES OF THE STUDY

The aim of the study was to assess the amount of release of Chlorine when 3% Sodium hypochlorite was used with Iopamidol and Iomeprol root canal detecting dyes and to evaluate which contrast dye was effective and suitable for use in combination with NaoH intracanal irrigant solution.

MATERIALS AND METHODS

Material used:

Iopamidol (Iopamiro 370,Bracco, Patheleon Italia S.p.A ,Ferentino, Italy) and Iomeprol (Iomeron 300 , Bracco, Patheleon Italia S.p.A ,Ferentino , Italy) both non ionic water soluble radio opaque media were used. 3% Sodium Hypochlorite (Vishal Dental Care) was used as the Intracanal Irrigant solution.

Methodology :

The study was done in the department of Chemical engineering, NITK, Surathkal. A total of 10 samples of 3% concentration of Sodium hypochlorite (Vishal dental care) were used for this study. 2ml solution from sample was taken and then diluted to 100ml with distilled water in Nessler's cylinder. After the dilution was done, 10ml of solution from sample was taken.

The Samples were then divided into 3 groups (1 Control

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and 2 Test Groups)

Group I – Control Group
10ml diluted solution of Naocl (10samples)

Group II -Test Group 1
0.5ml Iopamidol dye + 10ml diluted solution of Naocl (10 samples)

Group III -Test Group 2
0.5ml Iomeprol dye + 10ml diluted solution of Naocl (10 samples)

Each sample was mixed with 5 ml of 2N sulphuric acid and a pinch of potassium iodide was added until the solution turned yellow. The solution was then titrated against sodium thiosulfate till the colour turns pale yellow. 0.5-1 ml of starch was added till the solution turned blue and titration was continued until the solution became colourless .

The procedure was done at room temperature of 27-29 degree.

Available chlorine was calculated using the formula:

Available Chlorine = Volume of titrant x Strength x Equivalent wt of Chlorine / Volume of sample

Data presentation and Analysis:
All chemical tests were performed at room temperature, mean values and standard deviations were noted. Comparisons of 3 groups were done by using one way Anova. Multiple comparisons were done by using Bonferroni's correction. Repeated measures were done with Bonferroni's correction to determine the statistical significance between each group.

Results:
The results showed that there is a significant difference between the three groups. Chlorine release was determined for all the 30 samples (10 samples for each group) and an average was estimated for each group. The average amount of chlorine release was 13457.34 ppm in the control group, 7780.89 ppm in the 1st Test group containing Iopamidol dye and 127927.8 ppm in the 2nd Test group containing Iomeprol dye.

Based on One way ANOVA (Table 1), there was a significant difference between the first, second and the third groups. Based on Bonferroni's Correction (Table 2) , there was a significant difference between the control group and the second group containing Iopamidol dye , the second group and the third group containing Iomeprol dye but there was no significant difference between the Control and the third group .

TABLE 1
ONE WAY ANOVA : COMPARING THE THREE GROUPS

Groups	Count	Sum	Average	Variance
GROUP 1(Sodium Hypochlorite - control group)	10	134573.4	13457.34	395295.1
GROUP 2 (Sodium Hypochlorite + Iopamidol)	10	77808.9	7780.89	331400.4
GROUP 3 (Sodium Hypochlorite + Iomeprol)	10	127927.8	12792.78	456633.9

Source of Variation	SS	df	MS	F	P-value
Between Groups	1.93E+08	2	96304610	244.1533	<0.001
Within Groups	10649964	27	394443.1		
Total	2.03E+08	29			

GRAPH I

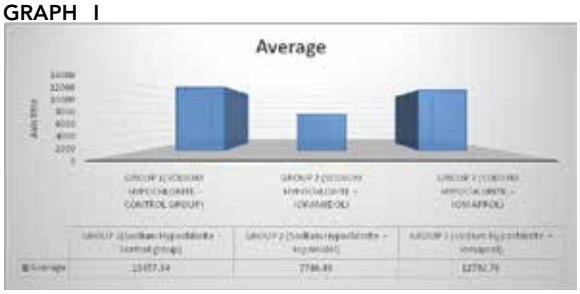

TABLE 2
SUBGROUP ANALYSIS: BONFERRONI'S CORRECTION

		Mean	Variance	Observations	Pooled Variance	df	t Stat	P(T<=t) two-tail
pair 1	GROUP 1(Sodium Hypochlorite - control group)	13457.34	395295.1	10	363347.7	18	21.0572	<0.001
	GROUP 2 (Sodium Hypochlorite + Iopamidol)	7780.89	331400.4	10				
pair 2	GROUP 1(Sodium Hypochlorite - control group)	13457.34	395295.1	10	425964.5	18	2.27684	0.035239
	GROUP 3 (Sodium Hypochlorite + Iomeprol)	12792.78	456633.9	10				
pair 3	GROUP 2 (Sodium Hypochlorite + Iopamidol)	7780.89	331400.4	10	394017.2	18	-17.8537	<0.001
	GROUP 3 (Sodium Hypochlorite + Iomeprol)	12792.78	456633.9	10				
	only if p value is less than 0.0166 it is significant							

DISCUSSION
The World health organization recommends 25,000ppm available chlorine in 5.25% of Naocl [5,11,14]. This study compared the amount of release of Chlorine when 3% Sodium hypochlorite was used with Iopamidol and Iomaprol root canal detecting dyes. Since the cytotoxicity of irrigants is

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directly proportional to the concentration and exposure time of the irrigant , 3% Sodium hypochlorite was considered potentially less cytotoxic and used in this study [17].

Iopamidol is a 2nd generation dye and Iomeprol is a 3rd generation dye , both are non-ionic contrast media which are low in osmolality, less chemotoxic, better tolerated and less viscous compared to ionic contrast media [6,12]. These non ionic low osmolar contrast media are more hydrophilic than ionic osmolar contrast media. Due to their water affinity, the increased hydrophilicity makes the body perceive them to be more accommodating with the oral environment . Iopamidol and Iomeprol have been used in angiography, venography , urography , CT intravenously and intrathecally for its enhanced visualization properties but it hasn't been used with an organic solvent [1].

In this study, when 3% Sodium Hypochlorite was used with Iopamidol dye, the release of chlorine was minimal but Iomeprol dye showed a favorable increase in chlorine (graph 1). The main factor that is driving the efficacy of Sodium hypochlorite is the content of free available chlorine. Chlorine(a strong oxidant) presents an antimicrobial action inhibiting bacterial enzymes leading to an irreversible oxidation of sulphydryl groups of essential bacterial enzymes [5,9,10].

Based on the results, in Group II, Iopamidol being a 2nd generation dye interfered with the chlorine release. In Group III, Iomeprol being a 3rd generation dye comparatively did not interfere with the chlorine release when used with Naocl solution. This could be because Iomeprol has high water solubility and low chemotoxicity compared to Iopamidol. It also has lower osmolality and viscosity than other nonionic agents and is the first contrast medium to be formulated without edetic acid (EDTA) [7].

Based on a study conducted by Hideki Tabaru et al, the absorption rates of electrolytes such as Cl ,Na and K were increased according to the elevation of osmolalities and concentrations in the test solutions [8] . Since the Iopamidol dye has higher osmolality of 600 to 1000 mOsm/kg than Iomeprol dye with 280–290 mOsm/kg of osmolality (the same osmolality as Huaman plasma) , the test solutions with Iopamidol dye had more absorptions rates of chlorine whereas the test solutions with Iomeprol dye did not comparatively interfere with the chlorine release when used with Naocl solution [6].

Therefore, the combined use of Sodium hypochlorite solution and Iomeprol dye helps to achieve the antimicrobial and proteolytic properties of the intracanal irrigant solution and the enhanced visualization properties of the contrast dye to obtain an improved and excellent disinfection and imaging quality of the root canal anatomy.

CONCLUSION

The results of this study showed that Iomeprol contrast dye is more effective in combination with Naocl irrigant solution and can be used to interpret the root canal anatomy of a population that requires endodontic treatment.

The ability to deliver the Irrigant in combination with contrast dyes can play an imperative role in revolutionizing imaging and irrigation systems. Development of such an approach can boost the success of endodontic treatment to levels never seen before.

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