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Ideal Disinfectant Characteristics According Data in Published Literature

Saimir Heta, Ilma Robo, Rialda Xhizdari, Kers Kapaj

***Abstract*—**The stability of an ideal disinfectant should be constant regardless of the change in the atmospheric conditions of the environment where it is kept. If the conditions such as temperature or humidity change, it is understood that it will also be necessary to approach possible changes in the holding materials such as plastic or glass bottles with the aim of protecting the disinfectant, for example, from the excessive lighting of the environment, which can also be translated as an increase in the temperature of disinfectant as a fluid. In this study, an attempt was made to find the most recent published data about the best possible combination of disinfectants indicated for use after dental procedures. This purpose of the study was realized by comparing the basic literature that is studied in the field of dentistry by students with the most published data in the literature of recent years about this topic. Each disinfectant is represented by a number called the disinfectant count, in which different factors can influence the increase or reduction of variables whose production remains a specific statistic for a specific disinfectant. The changes in the atmospheric conditions where the disinfectant is deposited and stored in the environment are known to affect the stability of the disinfectant as a fluid; this fact is known and even cited in the leaflets accompanying the manufactured boxes of disinfectants. It is these cares, in the form of advice, which are based not only on the preservation of the disinfectant but also on the application in order to have the desired clinical result. Aldehydes have the highest constant among the types of disinfectants, followed by acids. The lowest value of the constant belongs to the class of glycols, the predecessors of which were the halogens, in which class there are some representatives with disinfection applications. The class of phenols and acids have almost the same intervals of constants. If the goal were to find the ideal disinfectant among the large variety of disinfectants produced, a good starting point would be to find something unchanging or a fixed, unchanging element on the basis of which the comparison can be made properties of different disinfectants. Precisely based on the results of this study, the role of the specific constant according to the specific disinfectant is highlighted. Finding an ideal disinfectant, like finding a medication or the ideal antibiotic, is an ongoing but unattainable goal.

***Keywords*—**Different disinfectants, phenols, aldehydes, specific constant, dental procedures.

I. Introduction

THE ideal disinfectant for surfaces, instruments, air, skin, both in dentistry and in the fields of medicine, does not exist. This is for the sole reason that all the characteristics of the ideal disinfectant cannot be contained in one; these are the characteristics that if one of them is emphasized, it will conflict with the other. A disinfectant must be stable, not be affected by changes in the environmental conditions where it stands, which means that it should not be affected by an increase in temperature or an increase in the humidity of the environment. Both of these elements contradict the other element of the idea of an ideal disinfectant, as they disrupt the solubility ratios of the base substance of the disinfectant versus the diluent [1]-[5].

Under ideal conditions, the disinfectant should be effective at application concentrations as low as possible. The disinfectant should not damage the tissues or the tools, the surfaces. But, as a mechanism of action, the most frequent disinfectants act by precipitating proteins or dissolving lipids as a constituent part mainly of the cytoplasmic membrane of the bacteria they act on. During the selection of these proteins, their action cannot be affected by foreign proteins, fibers or exudates. This is another element in determining the ideal disinfectant [1], [4], [6]-[12].

The ideal disinfectant should be odorless, another element seen in the perspective of classes, subclasses of organic and inorganic components, an integral part of disinfectants classified as: alcohols, aldehydes, acids, halogens, oxidizers, metals, soaps, cations, paints, compounds with combined actions; understandably difficult to achieve [13]-[16]

Beyond the fact of being effective, a disinfectant or antiseptic is cheap in production cost, based on the possibility that the individual efficiency constant of this disinfectant allows for use. Increasing the concentration of the disinfectant solution increases the cost of production by reducing the expected time of giving the effect, an element much required in practice during dental treatments.

If after a patient the disinfectant of the surfaces of the dental chair was 4%, then the disinfection would be carried out in 7 minutes, while if the concentration was 2%, then the time to wait for disinfection would be about twice the time above, so about 15 minutes. From this logic, it can be understood how a disinfectant affects the duration of the treatment, the post-procedural disinfection protocol and all translate into the significant cost/efficiency ratio of the application of this or that type of disinfectant after dental treatments. [1], [5], [8], [13]-[17].

II. Materials and Methods

Understanding how the disinfectant or antiseptic works is important since their effects against different types of bacteria, viruses, spores, fungi, etc. must be controlled. If they destroy the bacterium (bactericidal) or stop the bacterium's

Saimir Heta is with University of Medicine, Faculty of Medicine, Tiranë, Albania.

Ilma Robo is with University of Medicine, Faculty of Dental Medicine, Tiranë, Albania (corresponding author, e-mail: ilmarobo@yahoo.com).

Rialda Xhizdari and Kers Kapaj are with Albanian University, Faculty of Dentistry, Tiranë, Albania.

multiplication cycle (bacterostatic), it does not mean that they are effective against the spores that the latter produce.

A disinfectant cannot be applied as an antiseptic, since the inflammation-initiating effect that the disinfectant has can be expressed on the surface of the skin or mucosa where it is applied as an antiseptic. Another important difference is the ability of the antiseptic to adhere to the layers of the epithelium and penetrate deep into them, overcoming the difficulties encountered by the presence of powerful desmosomes as intraepithelial intercellular connections. This increasing penetrative ability is indicated by the % of the antiseptic and the action time, consequently influenced by the specific constant of an antiseptic, expressed as the product of the multiplication of the % by the action time, also expressed by the cost of the individual production of the antiseptic [1], [3], [6], [8], [12], [13], [16].

The study aims to extract the constant of each disinfectant/ antiseptic used during dental disinfection protocols, accompanied by the side effects of the surface of the skin or mucosa where it is applied in the role of antiseptic. In the end, attempts were made to draw conclusions about the best possible combination for disinfectants after a dental procedure, based on the data extracted from the basic literature required during the development of the pharmacology module, as a module in the formation of a dentist, against data published in the literature.

III. Results

Based on the data collected from literature sources, Table I shows the characteristics of the disinfectants/antiseptics used after dental treatments, along with the field of action of each of them and how they act against viral bacteria, fungi, etc. Table I shows the classes of disinfectants according to application rates. At this table is shown the areas where they are effective and specifically by which mechanism of action.

TABLE I
DATA ON THE CHARACTERISTICS OF DISINFECTANTS USED AFTER DENTAL PROCEDURES

Type	%	Mechanism of action	Representative of
Alcohols	70%	Water dryer	Ethanol
	60-70%	Precipitating proteins	Isopropanol
Glycols	1g/100 cm^3	Non-toxic	Triethylene glycol
Aldehydes	1-10%	Binds to free amine groups of proteins	Formaldehyde
			Glutaldehyde
Phenol	1-2%	Dissolves lipids	Cresol
	5%	Increases cytoplasmic permeability	Hexachlorophene
	4%		Chlorhexidine
Acids	5%	Related to pyridoxine	Boric acid
		Inhibits bacterial growth	Salicylic acid
		Prevents water binding	
		Reduces sweating	
Halogens	1:20.000	Clears iodine from fixed solution	Betadine
	5%	Precipitates organic content	Povidone-Iodine
	4%		Hypochlorous acid
	10%		Sodium hypochlorite
	30-35%		
	0.5-0.6%		
Oxidants	0.3-1-3%	Oxygen with catalytic action	H_2O_2
		It oxidizes the organic content	Potassium permanganate
Metals	0.02%	It inhibits enzymes with sulfonic groups	Mercury
	1%	Precipitate proteins	Silver

For each disinfectant, some characteristics are given according to the specifications of the columns of the table.

TABLE II
FIELD OF ACTION OF DISINFECTANTS/ANTISEPTICS

	Instruments	Surface	Air	Oral measures	Skin	Organism	Water
Alcohol	+	+			+		
Glycols		+	+				
Aldehydes	+	+		+	-	+	
Phenol	+	+			+	+	
Acids					-	-	
Iodine					+	+	
Chlorine		+			+		+
Oxidants	-					+	
Metals					+	+	

Table II shows the data collected from the literature on the field of application of disinfectants/antiseptics. Table III summarizes the side effects of disinfectants used in post-dental treatment procedures.

IV. Discussions

The sensitivity of the disinfectant to changes in the atmospheric conditions of the environment where it is kept is a known fact [1], [12], [13]. The care against this element is always accompanied by the advice on the application of the specific disinfectant, in order to have the desired clinical result.

The constants of disinfectants according to the classification based on the data collected and presented in Table I are for alcohols 70-120, glycols 0.2, aldehydes 30-200, phenols 15-60, acids 100, povidone iodine halogens 5-75, hypochlorous acid halogens 150, sodium hypoclotrite halogens 30-35, oxidizers 18-60, metals 0.2-10. The part of halogens should be singled out, where specific results were obtained according to the representatives of this class, since it is these representatives that find scope for clinical application in dentistry. Hypochlorous acid or sodium hypochlorite as irrigating solutions for root canals of endodontically treated teeth. Povidion-iodine substance is recently applied in combinations and specific dosage recommendations for the treatment of fungal infections in the oral cavity [17]. So, the highest value belongs to aldehydes if the constants are compared, and the lowest value belongs to glycols and metals. If we compare the applied concentrations of disinfectants, they belong to 60-70% as the highest values for alcohols (isopropanol) and 30-35% for halogens in the form of hypochlorous acid. For both of these common disinfectants, the characteristics of their application as disinfectants of solid surfaces, have expressed the data in Table II [2], [6], [8], [10], [11], [13].

TABLE III
SIDE EFFECTS OF DISINFECTANTS

Type	Side effects	Their solution
Alcohol	Tissue damage	Used in combination with other solutions
Glycols	Non-toxic	Combined with alcohols diluted in different % in water
Aldehydes	Irritant, tissue irritant	Caution the combination with sodium hypochlorite - Lysoform It is combined with amino active soap 16% aldehyde +10% ethyl alcohol It is combined with sodium bisulphite Glutaraldehyde
Phenol	5% tissue irritant Enters the central nervous system Reduces temperature	Cresol is mixed with soaps – Lysol with different % Hexachlorophene – Ritosept hand wash Chlorhexidine - Prinosept
Acids	Toxic	Salicylic acid + alcohol content
Jodine	Non-toxic	Light and moisture promote the release of O.
Chlorine	Damage metals, plastic parts, clothes	Beware of combining with formalin as it gives explosive effects.
H_2O_2	Damages tissues Disinfection time is short Not stable Damages metals	Care must be taken to allow the gas to escape if it is used for disinfection of the "pits".
Metals	Tissue irritant, irritant	It is applied to areas where they are not in contact with soft tissues

The high constancy is not at the advantage of these solutions as it consequently does not affect the time reduction of the action time or the time needed for the adequate disinfection of the areas where they are applied.

If the data must be analyzed about the field of application of disinfectants, it can be said that alcohols are 3 out of 7 effective areas, glycols 2 out of 7 effective areas, aldehydes 4 out of 7 effective areas, phenol 4 out of 7 effective areas, acids 0 out of 7 effective areas, iodine 2 in 7 effective zones, chlorine 3 in 7 effective zones, oxidizers have 1 in 7 effective zones and metals 2 in 7 effective zones. From data of Table II it can be said that the ideal in the "bunch" of disinfectants fluctuates between aldehydes and phenols.

Aldehydes are presented with constants 30-200 and phenols with constants 15-60. If we compare these two disinfectants, phenols are more ideal than aldehydes as they are applied in lower concentrations and with shorter durations, while aldehydes are with higher concentrations and longer duration of action.

Based on the data in Table III, glycols are the most ideal disinfectants as they are presented with the characteristics of being non-toxic to the organism, but compared to the data in Table II, these disinfectants have a reduced field of action. Areas of action that can be added if, based on the data in Table III, are combined and produced together with alcohols, without presenting synergistic effects with each other.

From the data of table III, we can again say that iodine and chlorine can be added after glycols to the ideal of disinfectants, since they are inorganic elements that are part of the organism, but the field of their application, based on Table II, is reduced. In dentistry, these are good disinfectants of the oral mucosa or the solid structures of the canals of vital teeth.

V. CONCLUSIONS

The search for the "ideal", in the conditions where its defining criteria are also established, not only for disinfectants but also for any medication or pharmaceutical product, is an ongoing search, without any definitive results. In this mine of data in the published literature if there is something fixed, calculable, such as the specific constant for disinfectants, the search for the ideal is more concrete. In the disinfection protocols for dental procedures, different disinfectants are applied since the field of action is different, including water, air, aspiration devices, tools, dental measures, disinfectants used in full accordance with the production indications.

ETHICS DECLARATIONS

Ethics Approval and Consent to Participate

As the authors of the article, we state that there is no violation of the code of ethics during the realization of this article. Consent in the participation of patients in the study was performed with the signature of the patients themselves, procedures based on national protocols.

Consent for Publication

Not Applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets analyzed during the current study are available from the corresponding author.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTIONS

IR collected the scientific data and wrote the manuscript. SH revised and edited the manuscript. Literature research was conducted by SH. KK and VO collected the scientific data. All authors read and approved the final manuscript.

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