Differences of pH Saliva Before and After Panoramic Radiography

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Abstract

Panoramic radiography is one of radiography examination to establish diagnose that included in low dosage category. The principle of this subject involves x-ray that creates biological effects. One of target organ that has the radiosensitive characteristic to the patient which is conducted by panoramic radiography is the salivary gland. The purpose of this research is to know the differences between pH saliva before and after panoramic radiography.

The method of this research was comparative analytic by the used quantitative approach. The subjects of this research were 30 people who were indicated conducting panoramic radiography, in the range ages of 15-60 years old. The procedure of collecting saliva before and after panoramic radiography was conducting by used spitting method. Panoramic radiography tool in this research was EPX-Impla brand with 0,0049 Sv dosage.

pH saliva before and after conducted panoramic radiography showed the differences 0,09 ($p < 0,05$).

There were differences between pH saliva before and after panoramic radiography, it was decreasing pH saliva after panoramic radiography.

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Introduction

One of utilization of radiation in the medical field is to make a diagnosis of disease. The field of dentistry uses a man-made radiation in diagnosis is called dental radiography. The radiation used is x-rays. X-rays are a form of electromagnetic radiation, similar to visible light. Unlike light, however, x-rays have higher energy and can pass through most objects, including the body.[1] Radiation acts on living systems through direct and indirect effects. In direct effects, biologic molecules absorb energy from ionizing radiation and form unstable free radicals. *Indirect effects* are those in which hydrogen and hydroxyl free radicals, produced by the action of radiation on water, interact with organic molecules. The interaction of hydrogen and hydroxyl free radicals with organic molecules results in the formation of organic free radicals.[2] Usability of X-rays in the medical field is related to the presence of low dose X-ray ionizing radiation. One of the most commonly used radiography in the field of dentistry is panoramic radiography. Very low doses due to radiation exposure from panoramic radiography do not mean they have no effect on the exposed cells and tissues.[3]

Based on the data from Radiology Laboratory of Dental and Oral Hospital Padjadjaran University, the dose for once exposure to panoramic radiography was 49 x 10^{-3} Sv (0,0049 Sv). X-ray panoramic radiography used is Epx Impla brand which the latest calibrated on March 31, 2017 and used since 2008. X ray needs to be treated in order to perform its functions remain in accordance with the dose. Treatments that need include function tests, conformity test, and calibration test. The maintenance of panoramic at RSGM Unpad is not done routinely. The calibration test was finally performed in March 2017 and produced a dose of 49 x10^{-3} Sv (0,0049 Sv). Effective dose of X-ray diagnostic examination on panoramic radiography of 9 x10^{-6} until 24 x10^{-6} Sv. The number of doses used in this study exceeds the

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maximum effective dose. If the low dose released by the panoramic exceeds the effective dose it should be, then the possibility of biological effects may occur.

Radiation injury to organisms results from either the killing of large numbers of cells (deterministic effects) or sublethal damage to individual cells that results in cancer formation or heritable mutation (stochastic effects).[2] Deterministic effect that the symptoms appear by exposure above a threshold.[4] Stochastic effect is severity of clinical effects is independent of dose. Allor- none response an individual either has effect or does not. The biological effect studied in this study was the stochastic effect on pH saliva. Panoramic radiography involves the salivary glands within the radiation exposure area, so radiation exposure to the area results in a disruption of acinar cells in the salivary glands. The salivary glands have the highest doses of organs exposed to radiation because they are most radiosensitive.[5] The acinar cells damage and salivary gland shrinkage may occur during the acute phase, which then affects the composition and volume of saliva, thus affecting pH saliva as well. The previous studies by Susanti et al., showed that there was a decrease in pH saliva after exposure to X-ray radiation from panoramic radiography at 0.0042 Sv with an average decrease of 0.0638.[6]

Materials and methods

The type used of research is comparative analytic research with quantitative approach. The sample of the research is the patient who will be done panoramic radiography at Dental Radiology Installation Dental and Oral Hospital of Padjadjaran University. Sample was chosen by purposive sampling method, then can be taken research sample amounted to at least 30 people.

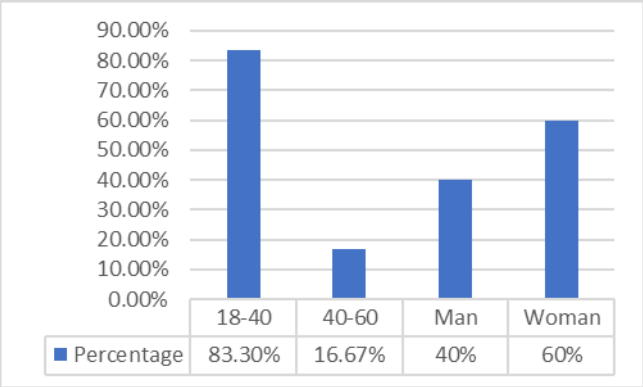
The criteria of research subjects consist of inclusion and exclusion criteria. The tool needed in this research is X-ray panoramic Epx Impla type Picasso Trio, digital of pH meter, conical tube, funnel, handscone, mask, tissue, and stopwatch. The required ingredients are saliva, buffer solution pH 4 and 7 and aquades for calibration.

The procedure of this study before the panoramic x-rays, for 5 minutes the patient will collect saliva every 60 seconds for 5 minutes in accordance with spitting method. After saliva was collected in 5 minutes, salivary pH was measured by first calibrating pH meters with aquades water, buffer solution pH 4 and 7. After calibration, the digital pH meter was immersed in saliva until the electrode sensor was immersed into saliva and showed the value certain pH. Measurements were made twice, and the results were averaged.

The data which collected then was be processed and analyzed. The next step is comparative data test using Saphiro-Wilk. The data is called to be normally distributed if p> 0,05 is obtained. If the data obtained is normally distributed then t-test paired, but if the data is not normally distributed then done wilcoxon matched pairs sign rank test.[7]

Results

The following characteristics of the research samples are presented in graphical form.



Graphic 1. Sample of Research by Age and Gender.

Graphic 1 shows that the most sample were in the group of 18-40 years old with 83,3 % and woman at 60 %. The results of the differences pH in before and after panoramic radiography are shown in the table below.

Sample	Σ	Time	pH Saliva (Before)	pH Saliva (After)	Difference
18-40	25	19,5”	6,93	6,88	0,05
40-60	5	20”	6,77	6,52	0,25

Table 1. The Results Measurements of pH Saliva Before and After Panoramic Radiography by Age.

The highest pH saliva values before and after panoramic based on Table 1 is in the 18-40 age group, while the lowest values are in the 40-60 age group.

Sample	∑	pH TimeSaliva (Before)	pH Saliva (After)	Difference
Man	12	21”6,98	6,94	0,04
Woman	18	19”6,85	6,74	0,11

Table 2. The Results Measurements of pH Saliva Before and After Panoramic Radiography by Gender.

According to Table 2, the highest pH saliva difference by gender is found in females, which is 0.11. In men the difference between pH saliva values was 0.04. Overall, the results of differences pH saliva before and after panoramic are shown in Table 3.

pH Saliva	-	SD	P Value
Pra panoramic radiography	6,91	0,429	
Pasca panoramic Radiography	6,82	0,384	
Difference of pH Saliva	0,09	0,178	0.013

= mean
SD = standar deviation
p Value = significant

Table 3. The Results Differences pH Saliva Pre and Post Panoramic Radiography

The results of this study show a decrease in salivary pH value after panoramic radiography. Data from the research results are then analyzed by using normality test to determine whether in each group normal distribution. Normality test conducted by using Saphiro Wilk (Table 4) shows the significance value of 0.000 is smaller than 0.05, it can be concluded that the data is not normally distributed.

Saphiro Wilk		
Statistic	Df	Sig.
0,830	300,000	

p< 0,05 data is not normally distributed

Table 4. Test of Normality.

Furthermore, the Wilcoxon test was performed to determine the presence of salivary before and after panoramic radiographic pH differences. The results of the normality test and Wilcoxon test are presented in Table 5.

	After-Before
Z	-2.480[a]
Asymp. Sig. (2-tailed)	0.013

Table 5. Wilcoxon Test Results

Based on statistical analysis, Wilcoxon test shows that the significance value of data is 0,013, the p value is smaller than α, so it is known that there is difference of saliva before and after panoramic radiography from x ray having dosage 0,0049 Sv.

Discussion

The results of the 30 samples showed the average value of pH saliva before conducted the panoramic radiography with a dose of 49 x Sv (0,0049 Sv) is 6,91 and after conducted the panoramic radiography is 6,82. The difference result from this research is 0.09. Previous research on salivary pH differences due to panoramic radiographic exposure also decreased the pH value. Susanti et al. showed that pH saliva after panoramic radiography was lower than pH saliva before radiation. Salivary pH value before the panoramic radiography in the previous study was 7.8075 and after the panoramic radiography of 7.7438. The study had a difference of 0.0638. The difference in pH saliva value in this study could be influenced by radiation exposure from panoramic radiography.[6] Very low doses due to exposure to panoramic radiography radiation do not mean they have no effect on the exposed cells and tissues. The effective dose released by the panoramic radiography is greater than the maximum effective dose.

Panoramic radiography in this study use X-rays belonging to electromagnetic rays. The effects of radiation rays if exposed to the body can cause biological effects. Biological effects can occur directly and indirectly. The initial interaction between ionizing radiation and matter occurs at the level of the electron within the first 10^{-13} second after exposure. About two thirds of

radiation-induced biologic damage results from indirect effects and 1/3 of them are from direct effects. Direct effects occur in biological molecules that absorb energy from ionizing radiation and form unstable free radicals. Generation of free radicals occurs less than 10^{-10} seconds after interaction with photon. Because water is the predominant molecule in biologic systems (about 70% by weight), it frequently participates in the interactions between x-ray photons and biologic molecules. A complex series of chemical changes occurs in water after exposure to ionizing radiation. Collectively these reactions result in the radiolysis of water $H_2O \quad H_2O + e^-$.[2]

The OH^- free radical is more important in causing such damage. Organic free radicals are unstable and transform into stable. These altered molecules have different chemical and biologic properties from the original molecules. In addition, ionizing radiation also causes the formation of harmful hydrogen peroxide compounds to the body, which can damage cells in the body by causing broken single / double strand brake, cross-linkage changes and basic changes.[2,6] The biological effects is occurring in this study included to the cellular level stemming from panoramic plane radiation to salivary glands.[8,9] According to Susanti, et al. salivary pH decrease is one of the negative effects that panoramic radiographic patients may experience. This is due to the area of radiation involving several salivary glands both major and minor.

The cells that make up the salivary glands consist of serosa and mucosa. The largest salivary glands affected by radiation are the parotid glands (consisting of the asini serus cells) and the submandibular glands (consisting of serus and mucus asini cells). This is happened because of the serus asini cells are more radiosensitive than the mucus asini cells. The content of water molecules is more prevalent in serus and highly reactive cells.[6,9,10] (1-3)Therefore the salivary glands include the radiosensitive glands. Decrease pH saliva in this study occurred due to biological effects of low-dose radiation exposure that occurs in the salivary glands, especially asini cells.

Asini cells are cells that function as primary secretions secrete saliva. This acinar secretion then flows through the ducts so rapidly that the ductal reconditioning of the secretion is considerably reduced.[11] One of the compositions of saliva is bicarbonate ion. The secretory process for bicarbonate is concentrated within acinar cells and released following receipt of a secretory stimulus. The carbonic acid-bicarbonate system is the most important buffer in stimulated saliva, while in unstimulated saliva it serves as the phosphate buffer system.[12,13] This radiation-induced stimulus causes salivary flow rate to decrease the total concentration of protein, sodium, calcium, chloride, and bicarbonate so that it can affect pH saliva. Biological processes that occur as a result of radiation exposure in the body cause a series of changes in the cellular level, so there has been no cellular damage only changes that interfere with cell function.[10]

The decline of bicarbonate ions is related to the source of the hydrogen ion concentration in the extraoral fluid secretion. The lower bicarbonate ion component, the higher hydrogen concentration is mean the lower the salivary pH. Based on the results of the study grouped into a certain age category, there is the difference between the lowest and highest pH saliva value. The lowest pH saliva values occur at 40-60 years of age, this is because age is one of the things that can affect salivary secretion. Histologic analyses have demonstrated with advancing age the parenchyma of the salivary glands is gradually replaced by adipose and fibrovascular tissue, and the volume of the acini is reduced.[12]

Females produced lower pH saliva values than men in this study. The influence of gender is a factor that can affect salivary secretion, particularly with hormonal changes in women involving the flow of salivary secretions. The gland size is of primary importance for the volume response of the gland. A gender difference in the unstimulated whole saliva flow rate (UWSFR) may be due to a difference in the sizes of the salivary glands. Parotid and submandibular gland sizes and flow rates in females were significantly smaller than those in males.[4,14]

This research uses the same panoramic X-ray device in the Radiology Installation for each sample, as well as the digital pH meter in measuring the pH value, the same treatment to the subject, because the subject is indicated for panoramic radiography, and the data taken in the form of primary data, allows researchers to see the patient's condition directly.

However, this study ignores one of the anxious factors, because this study does not

measure the level of anxiety in patients who do panoramic radiography, for it is expected to do next research. The hypothesis that has been proposed based on the theory of the previous framework is evidenced by the results of this study.

Conclusions

Based on the result of research, it can be concluded that there is difference of pH saliva between before and after panoramic radiography that is decreasing.

Declaration of Interest

The authors report no conflict of interest.

References

1. Bioenginering NIoBIa. X-Ray. National Institutes of Health. 2017; 1.
2. White SC, Pharoah MJ. Oral Radiology Principles and Interpretation. 6 ed. Los Angeles: Mosby Inc; 2009; 18-19, 24, 32-35, 175.
3. Wall BF, Kendall GM, EDWARD AA, BOUFFLER S, MUIRHEAD CR, MEARA JR. What are the risks from medical X-rays and other low dose radiation? British Journal of Radiology. 2006;79(940):285–294.
4. Kamiya K, Sasatani M. Effects of radiation exposure on human body. Japanese Journal of Clinical Medicine. 2012;3(70):367-374.
5. Farman AG. Panoramic Radiology. 1 ed. USA: Springer; 2007; 28.
6. Susanti NT, Prasetyarini S, Shita ADP. Pengaruh pajanan radiasi sinar-X dari radiografi panoramik terhadap pH saliva. e-Jurnal Pustaka Kesehatan. 2017;4(2):353.
7. Sugiyono. Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D). . Bandung: Alfabeta. 2016; 124, 207, 213.
8. Gori T, Munzel T. Biological effects of low radiation: of harm and hormesis. . European Heart Journal. 2012;33:292-295.
9. Eroschenko VP. Atlas Histologi di Fiore. Jakarta: EGC; 2010; 264-279.
10. Alatas, Z. Efek Kesehatan Pajanan Radiasi Dosis Rendah Prosiding Seminar Aspek Keselamatan Radiasi dan Lingkungan pada Industri Non-Nuklir: Hearing before the Puslitbang Keselamatan Radiasi dan Biomedika Nuklir – BATAN. 2003; 27-39.
11. Guyton A, John E. Textbook of Medical Physiology. Philadelphia: ELSEVIER SAUNDERS. 2006; 793-794.
12. Almeida P, Ana M, Pharm, Maria A, Antonio A, Lucina R. Saliva Composition and Functions: A Comprehensive Review. The Journal of Contemporary Dental Practice. 2008;9(3):2-8.
13. Edgar M, Dawes C, O'Mullane D. Saliva and Oral Health. United Kingdom: Stephen Hancocks Limited. 2012; 30-31.
14. Ekstrom Jr, Messana I, Khosravani N, Castagnola M. Saliva and the Control of Its Secretion. USA: Springer. 2012; 30-31.