SIPS 2017

SURABAYA INTERNATIONAL PHYSIOLOGY SEMINAR

PROCEEDINGS OF THE SURABAYA INTERNATIONAL PHYSIOLOGY SEMINAR

Surabaya, October 12-14, 2017

Editors:

Soetjipto
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Ferry Efendi
Purwo Sri Rejeki
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SIPS 2017

Proceedings of the
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Edited by Soetjipto, Muhammad Miftahussurrur, Ferry Efendi, Purwo Sri Rejeki and Bambang Purwanto

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Australia

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FOREWORD

Dean of Faculty of Medicine, Universitas Airlangga

Assalamu'alaikum Wr. Wb.

Distinguished Guests, all the Participants, Ladies and Gentlemen

On behalf of Faculty of Medicine, Universitas Airlangga, it is my great pleasure to welcome all the speakers, moderators, and participants on **Surabaya International Physiology Seminar 2017 (SIPS 2017)**, which will be held from today, October 12th until October 14th, 2017. I would like to express my hearty welcome to all the international speakers, **Prof. Cheng Hwee Ming**, from University of Malaya, Malaysia; **Prof. Daniel John Green**, from University of Western Australia; **Dr. Fadzil Hamzah**, from Sport Center of Changi General Hospital, Singapore and **Dr. Deanne Helena Skelly**, from Griffith University, Australia.

The aim of SIPS 2017 is to provide a platform for academicians, educators, researchers, practitioners, undergraduate and postgraduate students to share and discuss the knowledge of the recent issues, opinions, researchers about the development and innovation of physiology in medical science, dentistry, veterinary, plants and agriculture, sports and sciences.

I believe this event is a great purpose in order to develop knowledge, experiences and best practices that can be applied for the good, especially in the field of healthcare as a whole.

Finally, I would like to express my sincere acknowledgements to those who take part and especially for Department of Medical Physiology, Faculty of Medicine, Universitas Airlangga for their effort in holding this event and wishing all to have success.

Wassalamu'alaikum Wr. Wb.

Prof. Dr. Soetojo, MD.
Faculty of Medicine, Universitas Airlangga

Chair of Committee / Head of Physiology Department, Faculty of Medicine, Universitas Airlangga

Assalamu ‘alaikum Wr. Wb

Greetings,

On behalf of SIPS committee and Physiology Department, Universitas Airlangga, we are welcoming to Surabaya, City of Heroes.

This year, the annual meeting of Indonesian Physiology Society (IAIFI) is hosted at Surabaya, entitled **“Surabaya International Physiology Seminar Workshop (SIPS)”**. We present some update workshop and lectures in order to bring physiology research from basic to clinical application on humanities, animal welfare and good environment. All participants have opportunities to publish their research in presentation, poster and ISBN proceeding. Selected papers will be submitted to SCOPUS indexed proceeding/ journal and awarded as Best Poster and Best Oral Presentation.

We hope that all participants will get some interesting experiences for next 3 days, 12-14 October 2017. Enjoy our lectures and workshops, taste the culinary and take your time to sightseeing around Surabaya.

Wassalamu ‘alaikum wr. wb.

Dr. Bambang Purwanto
Chairman of Committee / Head of Physiology Department
Faculty of Medicine, Universitas Airlangga

Welcome Address - Surabaya International Physiology Seminar Workshop (SIPS)

Dear fellow Physiologists and Participants,

On Behalf of the Indonesian Physiological Society (IAIFI) and the Physiology Department Faculty of Medicine Universitas Airlangga, I would like to welcome you all to Surabaya International Physiology Seminar (SIPS), held on 12-14 of October 2017.

Finally after long-awaited Surabaya gets a turn again to host and organize the International Physiology Seminar. Hence the Steering– and Organizing Committee consisting of young energic physiologists are determined to make the Seminar a successful one. The theme of the seminar is:

"The Role of Physiology in Translation Research: From Basic to Application"

This annual meeting covers a wide range of topics of Physiology on Medicine, Dentistry, Veterinary, Plants and Agriculture, Sports and Sciences. We sincerely hope that SIPS 2017 enable to provide a platform for academicians, educators, researchers, practitioners and postgraduate students to present and discuss researches, development and innovations in wide range of topics as mentioned above. It will provide all participants to share knowledge, exchange new ideas and their experiences in many research topics, for then it will enhance future collaborations.

With great interest and enthusiasm I look towards the success of this Seminar, and wish all of you every success and a pleasant stay in Surabaya.

May Allah Swt. bestow upon us His Blessings.

On Behalf of the Steering and Organizing Committee Senior Physiologist,
Prof. R. Soedarso Djojonegoro

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Keywords: Aluminium Foil, Electromagnetic Radiation, Malondialdehyde, Mobile Phones, Oculi.

Abstract: Mobile phones produce electromagnetic radiation (EMR) whilst transmitting data. The EMR can generate the oxidative stressors that might affect the oculi of the mobile phone users. Aluminium foil (AF) has been proposed as a shield against EMR because it has the potential to cause absorption loss and reflection loss. This study investigates whether the AF can reduce the mobile phone's EMR as an oxidative stressor to the subjected rat oculi by measuring the malondialdehyde (MDA) levels and comparing these to the controls. Thirty-two adult male rats were divided equally into 4 groups (n=8). Groups K1 and K2 were the control groups with and without AF by respectively, as were study groups in groups P1 and P2. The rats in the study groups were exposed to EMR from a mobile phone with specificity absorption rate 0.84-1.86 W/kg in standby mode and connected to Wi-fi for 4 hours daily for 30 days. The MDA levels of the right oculus were measured using spectrophotometry. Data was analysed by Kruskal-Wallis test (SPSS v.23). The MDA levels in groups III and IV was higher than in groups I and II; it was significantly highest in group III compared to the others with significance level of $p < 0.05$. Groups I and II had no significant modulation in the MDA levels. This study demonstrated that AF could be a shield against EMR, and that was shown by the lower levels of the MDA in the shielded subjects.

1 INTRODUCTION

Electromagnetic radiation (EMR) has been known to have adverse effects on biological tissue through the formation of free radicals. Cell phones use electromagnetic waves for data transmission purposes (Hamada, Singh and Agarwal, 2011). Today, telecommunication service providers use higher frequencies bandwidth (up to gigahertz) for fast internet data transmission in telecommunication (Kumar, 2013). The higher frequency band usage in electromagnetic waves tends to generate more energy radiation. The energy of electromagnetic waves absorbed by biological tissue can lead to formation of reactive oxygen species (ROS) that can damage lipids, proteins, and DNA (Hamada, Singh and Agarwal, 2011). ROS that bind to lipids in the form of polyunsaturated fatty acids (PUFAs) will result in residual products, one of which is malondialdehyde (MDA). MDA is often used as an indirect oxidative stress reaction marker because it is the one of end-products of oxidative stress and it has non-toxic properties (Ayala and Muñoz, 2014).

The amount of energy of electromagnetic wave radiation received by biological tissue is called the specific absorption rate (SAR) (Hasan Sallomi, 2012). The eyes (*oculi*) comprise a primary vision sensory organ that has a high electrical conductivity (Gandhi, Lazzi and Furse, 1996). The energy of electromagnetic wave radiation that is received by biological tissue is directly proportional to the electrical conductivity (Sallomi, 2012). In addition, human oculi were irreversible to tissue damage, so they become sensory organs whose high risk of hazard from the radiation of electromagnetic waves (Cejka and Cejkova, 2015).

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The Effect of an Aluminium Foil Shield on Reducing The Strength of Electromagnetic Radiation of Mobile Phones Reaching the Oculi of Adult Male Rats.
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Several previous studies have proved that exposure to electromagnetic wave radiation can lead to thinning of the cornea and corneal epithelium thickness in mice and cataracts on the oculi of dogs and rabbits (Elder, 2003), as well as increased oxidative stress in macular degeneration of the retina (SanGiovanni and Chew, 2005).

Aluminium foil (AF) is a mild, thin and low-cost conductor material that can be considered to be a shield against electromagnetic wave radiation (Pratap *et al.*, 2014). The effectiveness of the shield is determined by the amount of reflection loss, absorption loss, and internal reflection loss proportional to the high electrical conductivity and low magnet permeability (Cheung, 2009). AF has an electrical conductivity of 0.63 S/m and a magnet permeability of 1 H/m (Cheung, 2009). The effectiveness of AF against electromagnetic wave radiation is still not known.

2 METHODS

The type of this study is laboratory experimental research which has been approved by Bioetik Unit and Humanities Faculty of Medicine Universitas Airlangga (No. 167/ EC/ KEPK/ FKUA/ 2017). This research was conducted in July-August 2017 at Animal Laboratory of Medical Faculty of Universitas Airlangga. This study used 32 white rats (Rattus norvegicus) Wistar strains, whose weight was 200-300 grams and aged 2-3 months. A total of 32 rats were divided into 4 groups with each group consisting of 8 rats (n=8). Group I (negative control) was a group of male Wistar rats that were not given exposure to EMR nor shielding AF. Group II (positive control) was a group that was not given exposure to EMR but was given shielding AF. Group III was a group given EMR exposure but not given shielding AF. Group IV was a group given exposure to EMR and given shielding AF. Prior to conducting the study, the 4 groups were acclimatized for 7 days in both the care cage and the exposure cage. Food and drink were given to male Wistar rats *ad libitum* in equal amounts for each group.

The source of electromagnetic wave radiation was cell phone GSM 2100 (frequency 2100 MHz) (Taiwan) with SAR 0.84-1.86 W/Kg in standby mode and connected to Wi-fi (wireless fidelity). The influence of AF on the electric field and magnetic field of the mobile phone was measured before conducting research using GM 3120-EN-00 Electromagnetic Radiator Tester (Benetech, China). The thickness of the AF coating fold was determined to reduce EMR by half of the initial doses. The duration of daily radiation was 4 hours continuously for 30 days. During the radiation of electromagnetic waves, the rats were placed in a plastic container measuring 20 x 16 x 9 cm, which was covered by a wood-framed fencing wire. A mobile phone was taped to the inner floor of this plastic box container and covered with a plastic bag, which was coated with plastic mica. In group IV, AF was placed under the plastic mica and above the phone to prevent damage to the AF.

After 30 days, the rats were prepared to be harvested. The rats were anesthetized using ketamine. After anesthetization, the right oculi of the rats were removed by surgery and then transferred into the Eppendorf tube. The examination of MDA levels began with the calibration of standard solutions. Fresh eye tissue was homogenized using mortar and stamper with added PBS buffer. Then homogenate was sentrifuged on 3000 rpm for 15 minutes. A supernatant (4 mL) of homogenate was added by 1 mL TCA 15% and 1 mL of 0.37% TBA in 0.25 N HCl. Then, the preparation was heated at 80° C for 15 min. After that, the preparation was cooled for 1 hour. Then the preparations are confused (concentrated) at 3000 rpm for 15 minutes. After that, the supernatant was measured using spectrophotometry at 532 nm wavelength.

The reading of results used UV-VIS U-2810 Spectrophotometer Model: 122-000 No: 1819-011a (Hitachi, Japan). Measurement of MDA level was done twice. The absorbance data was converted to MDA concentration and tested statistically by comparative method using SPSS software version 23.

3 RESULTS

The results of measurements of MDA average levels in groups I, II, III and IV on spectrophotometers with wavelength 532 nm 2 repetitions are shown in table 1 and figure 1.

Table 1: Descriptive data of mean MDA level examination results.

Groups	Absorbance (OD)	MDA concentration level (ng/mL)
K1	0,062 ± 0,015	0,111 ± 0,051
K2	0,082 ± 0,024	0,177 ± 0,078
P1	0,148 ± 0,029*	0,395 ± 0,094*
P2	0,085 ± 0,022	0,188 ± 0,073

* highest results

(data: mean ± standard deviation)

The result of the normality test using the Shapiro-Wilk test shows that group II has abnormal data distribution (*p* value < 0,05). The results of the Kruskal-Wallis test and post hoc Mann-Whitney test showed that there were significant differences between group III and other groups (table 2 and table 3).

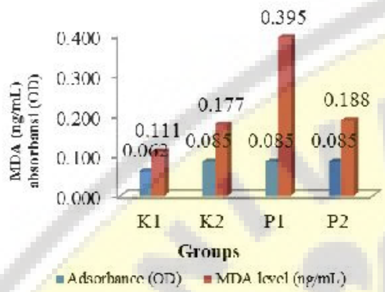

Figure 1: Bar chart of absorbance and MDA levels.

Table 2: Kruskal-Wallis test results of MDA level in rats' oculi.

Variable	*p* value	Explanation
Mean of MDA level	0,000***	Significant

p value is significant *p < .001

Table 3: Mann-Whitney test results of MDA levels in rats' oculi between groups.

Groups (I)	Groups (J)	*p* value of MDA concentrations mean	Explanation
K1	K2	0.058	Not significant
	P1	0.001**	Significant
	P2	0.046*	Significant
K2	K1	0.058	Not significant
	P1	0.003**	Significant
	P2	0.529	Not significant
P1	K1	0.001**	Significant
	K2	0.003**	Significant
	P2	0.001**	Significant
P2	K1	0.046*	Significant
	K2	0.529	Not significant
	P1	0.001**	Significant

p value is significant **p* value < .05; ***p* value < .01.

4 DISCUSSION

The results of this study indicate that the highest MDA levels are present in the group receiving electromagnetic wave radiation without AF, which is significantly different from that of the other groups. MDA is one of the markers of oxidative stress through the lipid peroxidation process, especially in unsaturated fatty acids (polyunsaturated acids) found in cell membranes (Ayala and Muñoz, 2014). The oculi comprise one of the high-risk organs that interact directly with the EMR produced by the phone especially during the calling mode (Hamada, Singh, and Agarwal, 2011). The oculi have higher electrical conductivity and permittivity than other head organs, increasing the risk of damage caused by EMR exposure (Gandhi, Lazzi, and Furse, 1996). In the oculi, lipid peroxidation has an important role in degenerative oculi disease (age-related macular degeneration, cataracts, glaucoma, diabetic retinopathy) (Njie-Mbye *et al.*, 2013).

Electromagnetic wave radiation triggers an increase in the activity of the mitochondria so that it will form an amount of free radicals or ROS that are more excessive than the antioxidant enzymes formed in the oculi (De Iuliis *et al.*, 2009). This unbalanced increasing of ROS will lead to oxidative stress conditions that result in lipid peroxidation, protein denaturation, and DNA damage (Ayala and Muñoz, 2014). The exposure to cell phone radiation with a frequency of 900 Megahertz (MHz) and SAR of 1.2 W/kg at 4 x10 minutes per day in standby conditions and resting phases for 30 days could lead to oxidative stress on corneal and lens oculi tissue by increasing oxidative stress markers significantly, such as MDA, superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), and catalase (CAT) (Balci, Devrim and Durak, 2007).

Continuous exposure to EMR over long periods of time will lead to changes in the structure and function of the oculi tissue, which can lead to decreased thickness of the anterior corneal epithelial layer and corneal stroma; increased oxidative stress biomarkers in the cornea, lens and retina; and changes in the clarity of the lens (Balci, Devrim and Durak, 2007; Akar *et al.*, 2013; Nita and Grzybowski, 2016).

In addition, the results of this study prove that AF can reduce oxidative stress due to EMR radiation. There is a significant difference between group III with group IV in MDA levels. The shielding effectiveness is determined by its potential to cause absorption loss (αA), and reflection loss (αR) for electric field and magnetic field. The conductivity factor and the electrical permeability and magnetization of an insulating material are directly proportional to the results of reflection losses (αR), absorption losses (αA), and internal reflection losses (αIR) (Cheung, 2009). AF has good relatively magnetic permeability and electrical conductivity as conductor material, that is, 1 H/m and 0.63 S/m (Cheung, 2009) respectively. The effectiveness of the shield depends on the depth of the skin. At 1 sheet of AF depth, electromagnetic wave radiation will lose about 63% of the energy (Pratap *et al*., 2014). To increase the effectiveness of the insulation against the magnetic field, AF must be arranged into several layers of depth (Pratap *et al*., 2014). AF does not effectively weaken magnetic fields (Pratap *et al*., 2014). This study proves that 1 layer of AF can reduce the electric field more than 1/100 times from the initial value while to reduce the magnetic field by ½ times from the initial value, it requires 10 layers of AF. It also proves that AF is more effective to insulate an electric field than a magnetic field. Further research is needed to study AF as an insulating material and why it cannot be a magnetic field baffle at microwave frequencies.

5 CONCLUSIONS

EMR from cell phones can cause oxidative stress. This process increases lipid peroxidation processes (especially in PUFAs) that can be measured by elevated MDA levels. This study has proven that the groups of rats exposed to EMR without an AF shield had the highest levels of MDA due to lipid peroxidation process compared with other groups. The groups of rats exposed to EMR that used AF as shields had lower MDA levels. In this study, AF has been shown to reduce electromagnetic wave radiation through the potential of reflection loss, absorption loss, and internal reflection loss.

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