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Investigation of an Optimal Time and Distance for Temperature Measurement of Short Wave Diathermy Endang Dian S Department of Electromedical Engineering, Health Polytechnic of Surabaya, Indonesia Lamidi Department of Electromedical Engineering, Health Polytechnic of Surabaya, Indonesia Abstract Location of the temperature measurement and finding the optimum time were essential in the usage of short wave diathermy (SWD) unit. Therefore, the purposeof this study is to investigate the optimallocation and time for SWD exposure. To perform this study, an artificial human body tissue (phantom) which is mimetic to a human arm was developed. The phantom was built with a dimension of 25 cm x 15 cm x 4 cm (lenght, width and high). To find the optimum time and location of exposure, four temperature sensors were placed at the difference location atthe phantom .The phantom was placed in the varies distance from 30cm to 50cm from SWD unit. This was to obtain the optimum location for exposure of SWD. The results showed that the highest temperature were obtained at the distance of 30cm with temperature of 39.14oC. At the distance of 50cm, the temperature was distributed at the optimal time of 15 minute and temperature of 32.16oC. At the distance of 40cm, it was obtained that the temperature was distributed at 36.7oC. The average temperature from four different sensors at the location of 30 cm, 40 cm and 50 cm were 39.1oC, 37. 1oC and 32. 65oC respectively. This work showed that the phantom temperature in the SWD exposure were effected by the location of the object from the SWD unit. Keywords: temperature sensors, phantom tissue 1. INTRODUCTION SWD (Short Wave Diathermy) is a therapy of warming the body's tissues by changing electromagnetic energy into thermal energy. Waves on Short Wave Diathermy is short wave 27.12 MHz. frequency therapeutic Process using the mode or continuous shines continuously over time gives a chance. For many years Short Wave Diathermy is used in therapeutic heat because the heat effects can last longer. Short Wave Diathermy research goal is to figure out the pattern of warming by measuring the temperature of the tissues of the body, at a depth of different sensors. To be able to do this research is not possible then carry out measurements on body tissues. The use of the phantom which had the same conductivity and permittivity can be used to simulate the network system of the body (Reparsky, 2002). Development of material phantom provides simulation of the electromagnetic properties of the estimate on the human body through the specified frequency and temperature range are used. Phantom material selection is important to understand the interaction between medical device implants and Short Wave Diathermy electromagnetic fields. Previous research by Lamidi, entitled measurements of temperature changes on the Phantom body tissues due to Short Wave Diathermy, 2014 using the phantom which refers to Kobayasi, 1999 and Reparsky, 2002. On the temperature taking phantom used temperature sensor LM35 type with a resolution of 10mv/° c. The sensor is mounted on a 4 point vertically with the distance between the sensors of 2 cm. Calibration of temperature sensors of four sensor with temperature range between 20 ° C to 50 ° c. Short Wave Diathermy has specifications power output 200W power consumption wavelength 600VA and 27.12 MHz. The results showed four sensors at different depths of the central value of 37, 87oC. The results of the analysis showed that if the distance of the sensor is moved 2 cm with a depth of middle temperature value remains unchanged, this indicates the sensor's data is valid. Sensor T1 on depth of 1 cm and has a temperature of 37 ± 0, correlation coefficient 0.93 63oC, Sensor T2 at a depth of 1.5 cm has a temperature of 37 ± 0, 73oC of the correlation coefficient 0.93. Sensors T3 at a depth of 2 cm has a temperature of 37 ± 0, coefficient of correlation with 90oC 0.925 and T4 sensor at a depth of 2.5 cm has a variable temperature 37 ± 1, 07OC with a correlation coefficient of 0.91 shines against time. 2. RESEARCH METHOD This research is research Pre Experimental research that is done in fact, this is because there are still variables that come into effect on the variable. Research on concept framework consists of three main stages. The first stage is the process of retrieving data temperature sensor which consists of four sensors incorporated into the phantom body tissue. The distance between the temperature sensors of 2 cm. Phantom body tissue it will being with Short Wave Diathermy at a distance with different exposure time duration 1 hour and taken its data every 5 minutes. Data capture four temperature sensors using instrumentation microcontroller with each sensor data using 8-bit ADC. Prior to the measurements then performed the calibration process for each sensor. This is done so that the data is valid. The second phase is the analysis and validation of the data, the data for each temperature sensor in the analysis to get the link between the distance of the temperature sensor 2 cm with the results of the temperature. The fourth data fruit temperature sensors placed on the phantom body tissues as compared to data sets of long time exposure to Short Wave Diathermy. The second dataset will then compare advance to recognize the nature of the propagation of temperature on each sensor with a duration time duration shines his diathermy The next step is to analyze the pattern of rising heat effect of Short Wave Diathermy on panthom body tissues with different Exposure and how long it will be used to raise the temperature of the phantom body tissue. On the taking of temperature by using the phantom used temperature sensor LM35 type with a resolution of 10mv/° C. The sensor is mounted on a 4 point vertically with the distance between the sensors of 2 cm. Calibration of temperature sensors of four sensor with temperature range between 20 ° C to 60 ° C. Short Wave Diathermy used as external power specification has a very 200W 600VA power consumption frequency and 27.12 MHz. Instruments used in data capture four temperature sensors is microcontroller AT89s51 with the addition of 8- bit resolution ADC as shown in Figure 3.1. The instrument data acquisition device is that software and hardware for data acquisition of temperature is displayed. Data microcontroller instrument of measurement results is displayed on the LCD screen. To be recorded and processed by the correlation between the temperature at four sensors and the duration the length of a very Short Wave Diathermy. 3. RESULT AND DISCUSSION Body Temperature A variety of body temperature according to the (TamsuriAnas 2007): • Hypothermia, when body temperature less than 36 ° C • Normally, when body temperature ranges between 36 – 37.5 ° C • Febris/pireksia, when body temperature between 37.5 – 40 ° C • Hyperthermia, when body temperature over 40 ° C Based on the distribution of temperature in the body, known temperature core (core temperature), that is the temperature which is present on the network, such as cranial, thoracic, abdominal, cavity and pelvic cavity. This temperature is usually maintained relatively constant (approx. 37 ° C). In addition, there is the surface temperature (surface temperature), that is the temperature of the skin, subcutaneous tissue, and fat. These temperatures usually can fluctuate by 20 ° C to 40 °C. Short Wave Diathermy Shortwave diathermy refers to the heating network in part by using an electric field and a magnetic field which turns at high frequencies. Shortwave radiation is the deciding factor in the exercise therapy. SWD produces an electric field and a magnetic field of back and forth with 27.12 MHz. frequency due to radio waves with frequencies in the range of 10 MHz to 100 MHz is called a short wave. Figure 1 the Short Wave Dhiathermy Short Wave Diathermy equipment consists of a series of sine wave generator that produces alternating current with a frequency of 27.12 MHz sine wave Generator supplying energy to the resonant circuit with transformer action. (Guo,2011) Sine wave generator consists of a power supply, an oscillator with a good frequency stability and power amplifier. The power supply converts AC voltage of electric nets nets (frequency 50 Hz) to the DC power required for the equipment. The DC voltage is used to provide power at generator sine wave, a resonance circuit oscillating at 27.12 MHz (Bicknell,1995) Short Wave DhiatermyPhysiology Effect Physiological effects on the implementation of Short-Wave therapy Diathermy SWD cause temperature increase. A number of physiological response is found while the process very Short Wave Diathermy are: 1. At the level of the body's cells, increase in temperature increases the rate of biochemical reactions. Cell metabolism increases cause increased demand for oxygen and nutrients. 2. Blood supply is increased. Increased output from the waste products of the cells triggers dilation of the capillaries and arteries. Temperature rise itself led to some widening, especially in shallow tissue where the greatest warming to occur. In addition, stimulation of the ends of the sensory nerve (superficial tissue) can cause dilation reflex. 3. Temperature rise can cause muscle relaxation. If there is abnormal muscle activity caused by pain, treatment with Short Wave Diathermy can be beneficial. 4. Sensory nerve Response when heat is useful for the relief of pain in General. Mild warming appears to inhibit the transmission of sensory impulses through nerve fibers. In addition, when the pain resulting from inflammation of tissues, an increase in temperature can lead to secondary pain relief effects. On the conditions of distance 50 cm on the distribution of temperature during 15 minutes taken at the data every two minutes average values obtained 32.61 oC. At Normal temperature average temperature distribution on a 15 minute obtained the value of 36.7 °C. Thus the difference in temperature between the distance of 50 cm and a normal of 4.26 oC. There are 30 cm distance on conditions of temperature rise being average temperature distribution at 39.14 oC. This value has the difference between 6.53 oC, as in table 1 Table 1 table of Distribution in three States Distance 50 cm Distance 40 cm Distance 30 cm 32,3 36,4 38,5 32,5 36,6 38,7 32,58 36,7 39 32,6 36,9 39,3 32,62 37 39,4 32,8 37,2 39,5 32,9 37,3 39,6 Average= 32,61 Average =36,87 Average = 39,14 The placement of the four sensor affect the value of the distribution of temperature, As shown in table 2. Depth of laying the sensor also affects the temperature generated at each sensor. Average with four temperature sensors are placed at different depths of the obtained values of 32.65 oC on condition the distance 50 cm. At a distance of 40 cm average worth amounting to 37.1 °C the temperature difference in the placement of the four sensors are of 4.45 oC. Whereas, in laying a conditioned sensor 30 cm obtained average temperature of 39.1 °C. This value is closely 6.45 oC between 40 cm and 50 cm distance. Table 2 distribution of Tables on the four sensors on the three phantom arm State Distance 50 cm Distance 40 cm Distance 30 cm T1 = 1 cm 33,2 37,18 39,6 T2 = 1,5cm 32,7 37,15 39,2 T3 = 2 cm 32,5 36,8 39 T4 = 2,5 cm 32,2 36,5 38,6 Average 32,65 37,1 39,1 Phantom Creation Boy Tissue Phantom body tissues to be used as a simulation of the tissues of the body that will be exposed to diathermy must have characteristics correspond to the body's tissues. The nature of the phantom must have a conductivity and permittivity that correspond to the body's tissues. Dimensions of a phantom created by the author is a phantom arm hand chain dimensions tailored to the actual size. Figure 2 Phantom Dimensions compared to the actual arm In addition to the corresponding dimension of the phantom, as well as the shape of the cross-section transverse body tissue in the phantom as far as possible in accordance with the actual body tissues. Transverse cross-section shape of the insert appropriate figure 2. After the phantom arm hand ready, then it's done making pits on the phantom with the distance between the sensors with a depth of 2 cm each sensor that is 1 cm, 1.5 cm, 2 cm and 2.5 cm. Characteristic of Sensor Test Sensor characteristics testing conducted to know the characteristics of each sensor. The use of four sensors should have the same characteristics, because if there is a difference then the measurements are carried out is not true. The sensor used is the LM35 temperature sensor with characteristics that any increase in output voltage will produce 1oC 10mVolt. Figure 3 shows the calibration process at four sensors to be used. Figure 3 calibration process 4 temperature sensors To match the actual characteristics, then the temperature measurement is performed as many as 7 times for each sensor. Voltage temperature sensor are compared with voltage calibrator. The computed value is theaverage value and standard deviations can be seen in attachment. Four temperature sensors that there is then measured at temperature between 20oC to 50oC. 4. CONCLUSION Phantom Arm that is conditioned on Short Wave Diathermy distance 50 cm, 40 cm and 30 cm spread shows a different temperature difference after being with shortwave dhiathermy. With the highest temperature at 30 cm Distance conditions. On the distance 50 cm the distribution of temperature during a 15-minute average value obtained 32, 61oC. At a distance of 40 cm is obtained a value of 36.7 ° C. On the conditions of a 30 cm there is a temperature rise being average temperature distribution at 39.14 oC. The depth placement of the sensor affect the temperature generated at each sensor. The average of four temperature sensors are placed at different depths obtained a value of 32, 65oC of 50 cm. Temperature normal distance 40 cm average worth amounting to 37.1 ° C. In the placement of the sensor conditioned distance 30 cm obtained average temperature 39, 1oC. 5. SUGGESTION 1. Made the Phantom arm with a differenconcentration of materials to be able to simulate the actual body temperature 2. Shortwave diathermy power setting needs to be added in order for the conditioning of the body temperature monitored can be further maximized REFERENCES Al-Mandel M M., Watson T. (2008),Pulsed and continuous short wave therapies. In: Watson T, Ed. Electrotherapy: Evidence Based Practice. 12th edn. Edinburgh: Churchill Livingstone; 137. Bricknell R., Watson T.(1995),The thermal effects of pulsed shortwave diathermy. Br J TherRehabil 2:430-4. 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