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Analysis of the Heat and Moisture Exchanger Filter Method in Breast Cancer Surgery Using Electrosurgical Instrument against Formaldehyde Quantity Levels

Jumanto
Master student of Environmental and Occupational Health Universitas Jember
Jember, Indonesia

Supangat
Department of Pharmacology
Faculty of Medicine, Universitas Jember
Jember, Indonesia

Almunawir
Department of Pathological Anatomy
Faculty of Medicine, Universitas Jember
Jember, Indonesia

Abstract:

Background: Surgical smokes are the result effect of using an electrosurgical instrument. Surgical smokes may distract the surgical team's concentration directly by disturbing surgical area field view and the smell. The chemical contaminants as the result of this procedure may give indirect impact on long-term health effect especially for some organs include eye, respiration and also the possibility of malignancies. This study aims to analyze the quantity level of formaldehyde after using the modification of Heat and Moisture Exchangers (HME) filter in breast cancer surgery.

Method: This study used quasi-experimental posttest only group design with purposive sampling. The total sample in this research was 60 samples of breast cancer tissue specimens for surgical smokes analyze that was divided into 3 groups of HME filtration type, HME 1, HME 2 and HME 3. The quantity level of formaldehyde after filtration was analyzed with Kruskal Wallis test.

Results: The highest level of formaldehyde value in the HME 1 is 24.98 ppm, the lowest 7.97ppm (mean= 11.29ppm). In the HME 2 filter, the highest formaldehyde value is 13.98ppm, and the lowest 4.97ppm (mean= 7.38ppm). Meanwhile, in the HME 3 filter, the highest formaldehyde value of 11.98ppm, and the lowest 1.99ppm (mean= 4.88ppm). There is difference result in each groups of filter modification method (p value= 0.000 or 0,0001).

Conclusion: Modified filter of HME can be used as filter of surgical smokes as the result of the used electrosurgery instrument.

Keywords:- *Breast Cancer, Electrosurgical, Formaldehyde, Heat and Moisture Exchanger Filter, Surgical Smokes.*

I. INTRODUCTION

Surgical smokes are the result effect of using an electrosurgical instrument [1]. Surgical smokes may distract the surgical team's concentration directly by disturbing surgical area field view and also the smell. The chemical contaminants as the result of this procedure may give indirect impact on long-term health effect especially for some organs include eye, respiration and also the possibility of malignancies [2]. The American Occupational Safety and Health Administration (OSHA) records 500,000 incidences of respiratory health problems in each year from health workers that work in the perioperative environment that are exposed to surgical smokes every year. This number increase twice for perioperative nurses [3]. A recent study that conducted in the operating room on 45 nurses and 36 doctors showed nurses and doctors who were exposed to surgical smokes experienced headache, watery eyes, cough, burning throat, nausea, unpleasant odor absorbed in the hair, drowsiness, dizziness, sneezing and rhinitis [4]. Inhalation of surgical smokes was associated with various acute and chronic diseases that may probably related to particulate deposits in lung tissue. The particles induce an inflammatory response with alveolar congestion and interstitial pneumonia, and emphysema [5].

Surgical smokes that are produced in electrosurgical instrument sometimes exceed the recommended threshold values. The other problem is the particle size of the smokes material is too small that it makes difficult in filtration process especially for conventional suction in the operating room [6]. Heat and Moisture Exchangers (HME) is a mechanical filtration device that used to viruses and bacteria filtration [7]. Electrosurgical instrument is the most frequently used surgical procedure for dissection and hemostasis in modified radical mastectomy (MRM) for breast cancer treatment than conventional scalpels [8]. Researchers are interested to analyze the quantity level of formaldehyde after HME filtration method in breast cancer surgery that uses electrosurgical instrument.

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II. METHODS AND MATERIALS

A. METHOD

This study used quasi-experimental posttest only group design with purposive sampling. The object of this research is the smoke from breast cancer surgery that has been separated from the patient's body and intervention using an electrosurgical instrument. The total sample in this research was 60 samples of breast cancer tissue specimens for surgical smokes analyze that was divided into 3 groups of HME filtration type, HME 1, HME 2 and HME 3. The quantity level of formaldehyde after filtration was analyzed with Kruskal Wallis test.

B. MATERIALS

In this research the materials that used for filtrating the formaldehyde is Heat and Moisture Exchangers (HME). HME is a mechanical filtration device. The schematic process can be seen in Figure 1.

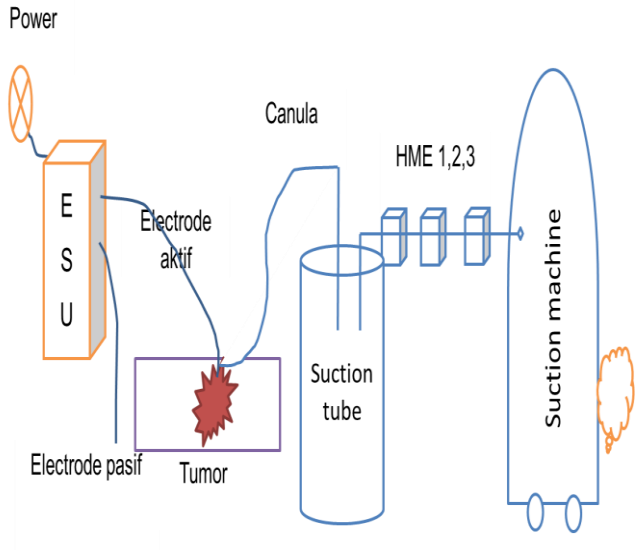

Fig. 1: Schematic process of HME filtration device

III. RESULTS

The results of this study are showed in Table 1. That was found that the HME 1 filter obtained the highest formaldehyde value of 24.98ppm and the lowest 7.97ppm, with a mean value of 11.29ppm. The HME 2 filter obtained the highest formaldehyde value of 13.98ppm, and the lowest 4.97ppm and the mean value was 7.38ppm. Meanwhile, for HME 3 filters, the highest formaldehyde value was 11.98ppm, and the lowest was 1.99ppm and the mean number was 4.88ppm. It was found that HME3 tended to experience a decrease in the average value of formaldehyde in surgical smoke. The statistical test results obtained p value = 0.000 (or 0.0001) which means that there is a difference in the average amount of formaldehyde in surgical smoke after being given the filter modification method (HME1, HME2 and HME3).

		HME1	HME2	HME3
N	Valid	20	20	20
	Missing	0	0	0
Mean		11.2900	7.3865	4.8860
Median		11.9800	7.9800	4.9800
Mode		8.00[a]	7.98	4.99
Std. Deviation		4.45958	2.30054	2.42126
Minimum		5.00	4.97	1.99
Maximum		24.98	13.98	11.98

Table 1: The quantity level of formaldehyde after using the modification of Heat and Moisture Exchangers (HME) filter

IV. DISCUSSION

The results showed that the use of HME filter modification study for filtrating the surgical smokes are proved significant. The quantity of formaldehyde after modification of the HME 1 filter, HME 2 filter and HME 3 filter, resulted in a fairly good for decreasing the formaldehyde value. Modification of the HME 1 filter has not resulted in the reduction of formaldehyde levels. Modified HME 2 filter has decreased by half from HME 1 filter. The formaldehyde value was significantly decreased in HME 3 filter. HME 1 obtained the highest formaldehyde number 24.98ppm and the lowest 7.97ppm, with a mean value of 11.29ppm. HME 2 obtained the highest formaldehyde value of 13.98ppm, and the lowest 4.97ppm and the mean number was 7.38ppm. For HME 3, the highest formaldehyde value was 11.98ppm, and the lowest was 1.99ppm and the mean number was 4.88ppm. Based on the value of central tendency (Mean, Median and mode), the standard deviation of the mean, maximum and minimum values of each HME, it was found that HME3 tends to decrease in the average value of formaldehyde.

The filter technology to prevent workers from inhaling fine radioactive particles in the nuclear industry is known as the High Efficiency Particulate Air (HEPA) filters. HEPA filters consist of fiberglass substrate which is supported by a rigid frame. To reduce airflow resistance and increase efficiency, the surface area is increased by pleating [9]. Comparing with HME filters, HME has a dead space of filtration in 60 ml [10]. To filtrate the smaller particles (<0.3μ) can be filtered by Brownian diffusion because at this size the effects of inertial impaction, interception, and Brownian motion are effective. Particles measuring 0.3μ are also most likely to be deposited in the lungs when inhaled [9].

Smoke evacuator is the only tool at this time that can be used to reduce surgical smoke. Smoke evacuator empirically clinically proven to reduce chemical exposure during the surgical process. A related study found that the average concentration of formaldehyde when not using a smoke evacuator was 39.4 ± 18.6 g/m^3 and when using a smoke evacuator it was 15.5 ± 8.4 g/m^3 [11]. But in otherwise, using a smoke evacuator alone during surgery is not enough to eliminate 100% formaldehyde, due to the effects of electrosurgical instrument. The used of HME to be a tool that

can filters surgical smoke of electrosurgical instrument, requires further research support to strengthen the existing theory. The combination of HME filter and smoke evacuator according to theoretical review and related research results can be simultaneously used to reduce the threshold value of volatile organic compounds (VOC) including formaldehyde. The limitation of this study is that the researcher did not use controls that might affect the results of the study. The research sample is only one type, breast cancer tissue that has been separated from the patient's body. This research requires large funds so that it needs to be prepared carefully if further research will be carried out with samples with various types of human organs. Suggestions for hospitals through occupational safety and health installations and infection prevention control installations can be used as tools to filter surgical smoke of electrosurgical instrument.

V. CONCLUSION

This research identified that the modification of the HME filter, including HME 1, HME 2 and HME 3, can be used as a filter for surgical smokes during surgery. Modification HME 1 filter has not resulted in the reduction of formaldehyde levels, while modification HME 2 filter has decreased by half from the HME 1 filter. And modified HME 3 filter gave significant result that made formaldehyde value tends to decrease.

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