THE ALUMINUM CONCENTRATION IN HUMAN POSTMORTEM LUNG TISSUE FROM SMOKERS AND NONSMOKERS AS DETERMINED BY NEUTRON ACTIVATION ANALYSIS[1, 2]

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The aluminum concentration of 40 human postmortem lung tissue samples was determined utilizing standard thermal neutron activation analysis techniques. The aluminum content of human lung tissue was shown to be unrelated to the smoking habits of the individuals studied.

Aluminum has been shown by Stitch (1957), Tipton *et al.* (1963) and Tipton and Shafer (1964) to occur in varying concentrations in human lung tissue. However, due to its ubiquitous nature and the previously contradictory chemical and spectrophotometric methods of analysis, specific information dealing with normal aluminum levels in the human lung has been limited (Mitchell, 1950, Mitchell *et al.*, 1962, and McLaughlin *et al.* 1962).

The smoking habits of the individual are but one of a myriad of variables which may affect the aluminum concentration in human lung tissue. Jenkins (1971) identified aluminum in tobacco (707 ppm), smoke (7.4 ppm), dropped ash (3,240 ppm) and cigarette paper (131 ppm). Since aluminum has been found in all of the major cigarette components, one would imagine that smoking could be one source of aluminum exposure. The purpose of the present study is to determine whether or not the smoking habits of the individual significantly affect the amount of aluminum in human postmortem lung tissue. Neutron activation analysis was chosen as the method of analysis because of its precision and accuracy.

MATERIALS AND METHODS

Postmortem lung samples were obtained from hospitals in the Akron, Ohio area. The samples were surgically removed from non-diseased portions of human lung tissue after autopsy and were never handled directly by human hands. All samples were preserved in a 10% formalin solution and were carefully protected from sources of contamination.

Information pertaining to the smoking habits of the individuals was obtained from hospital records. The information was used to group the samples into three categories: (I) Nonsmokers, (II) Smokers (more than or equal to one pack per day), (III) Heavy smokers (more than or equal to two packs per day).

Each tissue sample was placed in a clean crucible and dry ashed in an oven at 275° C for 24 hours. The ashes were powdered with a mortar and pestle, weighed on a Sartorius balance, and placed in a new polyethylene mini-vial.

Neutron activation analysis of the human lung samples was performed at The Oak Ridge Research Reactor, Oak Ridge National Laboratories, (ORNL neutron flux 3.3 x 10^{13} neutrons/cm^2/sec) using the technique described by Mantis and Norris (1973). All samples were irradiated for ten seconds by way of the pneumatic transfer system and then counted for 60 sec at a distance of three centimeters from the coaxial lithium-drifted germanium detector. The lag time was 50 sec. All data were corrected for background and dead time. The final calculations were in terms of counts per minute, full width, half-maximum at T_0. Quantitative analysis of all samples was performed using the comparator technique of Mantis and Norris (1973).

RESULTS AND DISCUSSION

Smokers (Group II) were first compared with the nonsmokers (Group I). The mean for Group II was 977 micrograms Al/g of dried lung tissue, and the mean for Group I was 1005 micrograms Al/g of dried lung tissue, (fig. 1). The difference between these two means was found not to be significant based on

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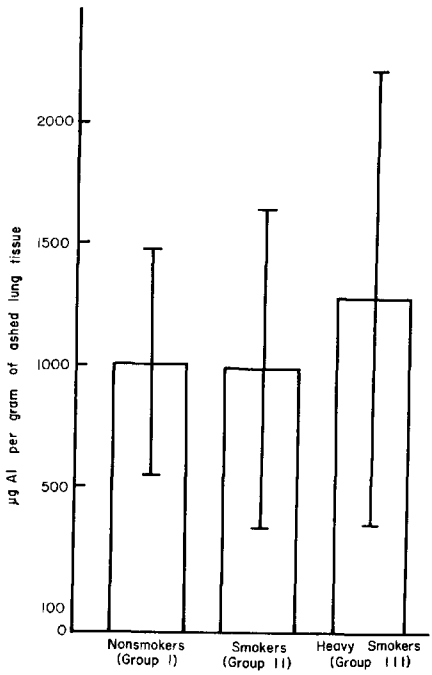

FIGURE 1. The aluminum concentration of human postmortem lung tissue. Group III consists of the 10 heaviest smokers from Group I. Bars represent the mean±standard deviation.

a T-distribution test (d.f.=38, t=.0242, p>.05).

In order to further evaluate the data, the heavy smokers (Group III) were separated from the rest of the smokers (Group II). Group III was then compare with Group I. The mean for Group III was 1275 micrograms Al/g of dried lung tissue, and the difference between the two means (Group I and Group III) was found to be insignificant based on a T-distribution test (d.f.=28, t=.5555, p>.05). Previous studies by Mantis and Norris (1973) have suggested that geographical location may be an important factor in aluminum concentrations in human lungs. This factor may have contributed to the seemingly high standard deviations reported in the present study since it was not known how long or in what other geographical location of the country the persons had lived before death.

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