EVALUATING THE INFLUENCE OF THE INHALED SEASALT AEROSOL IN VENTILATORY FUNCTIONS OF SEAFARERS.

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Abstract:
Background: Seafarers those who are working in the upper deck of the ship are continuously exposed to sea salt aerosol. Aerosol inhalation has shown to have deleterious effects on the respiratory system. Performing spirometry can detect and quantify respiratory system abnormalities by the various parameters of PFT.

Aim: To evaluate the effect of chronic exposure and inhalation of sea salt aerosol on pulmonary function of seafarers.

Materials and methods: The present study was carried out in 40 non-smoking healthy seafarers of age between 30 - 50 years who were working in the top deck of the ship. Pulmonary function test (PFT) parameters like, FEV1, FVC, FEV1/FVC, PEF and FEF 25-75 were measured by using ultrasonic wave flow sensing spirometer and compared with the same PFT parameters of individuals residing away from the shoreline with other attributes similar to the test group.

Results: No significant difference was observed in all the PFT parameters studied (FEV1, FVC, FEV1/FVC, PEF and FEF 25-75) between seafarers and control group.

Conclusion: The study shows that exposure and inhalation of seasalt aerosol has no deleterious effect on the respiratory system.

Keyword: Seafarers, Spirometry, PFT

Introduction:
An aerosol is a colloid of fine solid particles or liquid droplets, in air or another gas. Aerosols occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation and sea spray. Humans also contribute for the generation of the particulate aerosols like burning of fossil fuels in vehicles and various industrial process. The consequence of aerosol exposure is a topic of great interest and a considerable debate and disagreement. Increased number of mortality and other health problems associated with inhalation of particulate aerosols was first demonstrated in the early 1970s.
Aerosols have also shown to have an important role in the treatment of various forms of respiratory disease, with bronchodilators for the therapy of asthma being particularly important. The size of the particle is a main determinant of where in the respiratory tract the particle will come to rest when inhaled. Because of their small size, particles less than 10\(\mu\)m can penetrate the deepest part of the lungs such as the bronchioles or alveoli\(^3\). Size of sea salt aerosols size ranges widely from \(\sim\)0.05 to 10 \(\mu\)m in diameter, so it has easier access to the deepest part of the lungs. Seafarers who are working in the upper deck of the ship for more than 8 hours per day are exposed to increased level of sea salt aerosol. Sea salt aerosols are usually formed by the physical activity of the ocean surface. The purpose of the present investigation was to measure the effect of inhalation of sea salt aerosol on pulmonary functions in seafarers working in the upper deck of the ship for more than 8 hours/day.

**Aims and objectives:**
To compare the parameters of Pulmonary function test like FEV1, FVC, FEV1/FVC, PEF and FEF\(_{25-75}\) in healthy non-smoking seafarers working in the upper deck of the ship and in healthy non-smokers away from the sea.

**Materials and methods:**
The study was conducted in two groups. Group I: Forty non-smoking healthy individuals between the age group 30-50 years who were residing away from sea shore. Group II: Forty non-smoking, healthy seafarers of age between 30-50 years who were working in the top deck of the ship more than 8 hours per day for more than 10 years. Pulmonary function test parameters like FEV1, FVC, FEV1/FVC, PEF, FEF\(_{25-75}\) were assessed by using computerized ultrasonic wave flow sensing spirometer "EASY ONE", Switzerland.

**Inclusion criteria:**
The test group included male seafarers (working in the top deck of the ship > 10 years) aged between 30 to 50 years, who are non smokers with good cardiopulmonary reserve and without any ENT pathology. The control group included individuals away from the sea shore with other attributes similar to the test group.

**Exclusion criteria:**
Males age < 30 yrs, > 50 yrs, smokers, individuals suffering from respiratory, cardiovascular and ENT disorders were excluded.

**Procedure:**
After obtaining institutional ethical committee clearance and written informed consent from , suitable individuals for the study were selected according to the inclusion & exclusion criteria . Complete history was recorded and anthropometric measurements were taken from all individuals before the test. They were explained about the aim, objective, nature, non-invasiveness of the test and verbal consent was obtained from them before the test. General and systemic examinations were done. PFT was done with ultrasonic wave flow sensing spirometer. Spirometry procedure was clearly explained and demonstrated to the subjects and done in the sitting posture. The nostrils were closed with a nose clip throughout the manoeuvre. Attempts with good effort and those fulfilling the acceptability and reproducibility criteria of ATS were saved. The procedure was repeated thrice with 15
minutes interval between them. Best of the individual parameters from 3 readings were taken for data analysis.

**Results:**

Data were analyzed by using students 't' test by SPSS statistical software 17.0. No significant difference in the mean values was observed in age, height, weight, BMI and all the parameters of the pulmonary functions studied (FVC, FEV1, FEV1/FVC, PEF and FEF 25-75) in seafarers working on the upper deck of the ship compared with the control individuals.

**Comparison of mean values of PFT parameters between seafarers and control group**

<table>
<thead>
<tr>
<th>parameters</th>
<th>Seafarers</th>
<th>Control</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>3.3 ± 0.84</td>
<td>3.7 ± 0.6</td>
<td>0.06</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>2.93 ± 0.43</td>
<td>3.4 ± 0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>0.94 ± 0.05</td>
<td>0.92 ± 0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>PEF (L/s)</td>
<td>6.59 ± 2.54</td>
<td>7.6 ± 2.14</td>
<td>0.33</td>
</tr>
<tr>
<td>FEF 25-75 (L/s)</td>
<td>3.62 ± 0.08</td>
<td>4.18 ± 1.24</td>
<td>0.14</td>
</tr>
</tbody>
</table>

p value = 0.05. Not significant

**Discussion:**

Inhalation of different types of aerosols has been reported to produce adverse effects on lungs (4,5,6). In the present study no significant change in the pulmonary function was observed between the control and seafarers (inhaling sea salt aerosol) in all the parameters studied. Sea salt aerosol, which originally comes from sea spray, is one of the most widely distributed natural aerosols. Sea salt aerosols are mainly constituted of sodium chloride (NaCl), but other chemical ions which are common in sea water, such as K⁺, Mg²⁺, Ca²⁺, SO₄²⁻ and so on, can also be found. Recent study revealed that sea salt aerosols contain a substantial amount of organic matter (7,8). Sodium chloride aerosol has been shown to have bactericidal and bacteriostatic effect on respiratory passage (9,10). Halotherapy or speleotherapy is a drug-free method of treating various respiratory diseases. In this controlled air medium which simulates a natural salt cave microclimate is used. The main curative factor in it is also dry sodium chloride aerosol with particles of 2 to 5 m in size (11). Since sodium chloride has a considerable negative charge of particles and the inner surfaces of airways have slight positive charge therefore salt aerosol particles penetrate into the lumen of respiratory tract and embed intensively. In addition negative electrostatic charge of salt aerosol increases lumen’s stability. Negative ions have also been shown to have revive and speed-up cilia beat. Thus nowadays Aerosols play an important mode of the treatment of various forms of respiratory disease (12).
Conclusion:
No significant difference was observed in the pulmonary function test of seafarers when compared with the control group. It might be due to the fact that inhalation of sea salt aerosol provides enhanced ciliary motility and better humidification of the inhaled air and thus sea salt aerosol has no deleterious effect on the lungs of seafarers working in the upper deck of the ship over long period. The study has the limitation of small sample size. Future studies with larger sample size can be conducted to establish the above results.

References:
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