A CONCEPTUAL STUDY OF PRANAVAHA SROTODUSHTI DUE TO AIR POLLUTION W.S.R. TO RAJ & DHOOM

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ABSTRACT

Raj (Dust particle), Dhoom is a minute particles present in the environment. Often these particles are too small to be seen but, because they are airborne, they can be breathed in through the nose and mouth. There is a higher risk of developing Pranavaha Srotodushti (Vitiation of air flowing channels) in individuals who are exposed to Raj because of their occupation in these areas. All the Nidana described in reference of Shvasa Roga can be considering Nidana of Pranavaha Srotodushti. Majority of urban India is affected with dust particles. It is frequently seen in all ages that are exposed to dust particles. In recent years miscellaneous group of diseases are emerges as a major life threatening problem which were not so prominent in past, Pranavaha Srotodushti (Respiratory Diseases) one of them.

Keywords: Raj, Dhoom, Nidana, Pranavaha Srotodushti.

INTRODUCTION

Air pollution is the introduction of chemicals, particulate matter or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere. The main air pollutants are represented by gases forms, particles in suspension, different ionizing radiation and noise. The gases forms are: oxidized and reduced forms of carbon (CO₂, CO), of nitrogen (NO₂, NO), SO₂, O₃ etc. The particulate forms are PM10 & PM2.5 particulate matter, heavy metals with toxic effect (Pb, Cd, As), polycyclic aromatic hydrocarbons etc. The air pollutants factors can be chemicals, mechanics, physical and acoustic. Most of the sources of air pollution are related to man's activities as a result of the modern lifestyle. Principal pollution sources include chemical plants, industry automobiles, coal-fired power plants, oil refineries, petrochemical plants, nuclear waste disposal activity, incinerators, plastics factories, and other heavy industry. Agricultural air pollution comes from spraying of pesticides and herbicides. Harmful effects of pollution have both acute and chronic effects on human health. Health effects range anywhere from minor irritation of eyes and the upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and death. Air pollution can affect the quality of the air we breathe, the water and even the rain that we are experiencing. The Greenhouse Ef-
flect also referred to as global warming. Ozone depletion is another result of pollution.\textsuperscript{1}

**Air Quality Index (AQI)**\textsuperscript{2}

The Air Quality Index (AQI) is a standardized indicator of the air quality in a given location. It measures mainly ground-level ozone & particulates (except the pollen count), but may also include \( \text{SO}_2 \) & \( \text{NO}_2 \). Various agencies around the world measure such indices, though definitions may change between places.

**Table No. 1**

<table>
<thead>
<tr>
<th>S.No</th>
<th>AQI Category (Range)</th>
<th>( \text{SO}_2 ) (24-hr avg.) (µg/m(^3))</th>
<th>( \text{NO}_2 ) (24-hr avg.) (µg/m(^3))</th>
<th>( \text{PM}_{2.5} ) (24-hr avg.) (µg/m(^3))</th>
<th>( \text{CO} ) (8-hr avg.) (mg/m(^3))</th>
<th>( \text{O}_3 ) (8-hr avg.) (µg/m(^3))</th>
<th>( \text{PM}_{10} ) (24-hr avg.) (µg/m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Good (0-50)</td>
<td>0-40</td>
<td>0-40</td>
<td>0-30</td>
<td>0-1.0</td>
<td>0-50</td>
<td>0-50</td>
</tr>
<tr>
<td>2.</td>
<td>Satisfactory (51-100)</td>
<td>41-80</td>
<td>41-80</td>
<td>31-60</td>
<td>1.1-2.0</td>
<td>51-100</td>
<td>51-100</td>
</tr>
<tr>
<td>4.</td>
<td>Poor (201-300)</td>
<td>381-800</td>
<td>181-280</td>
<td>91-120</td>
<td>10-17</td>
<td>169-208</td>
<td>251-350</td>
</tr>
<tr>
<td>5.</td>
<td>Very poor (301-400)</td>
<td>801-1600</td>
<td>281-400</td>
<td>121-250</td>
<td>17-34</td>
<td>209-748</td>
<td>351-430</td>
</tr>
<tr>
<td>6.</td>
<td>Severe (401-500)</td>
<td>&gt;1600</td>
<td>&gt;400</td>
<td>&gt;250</td>
<td>&gt;34</td>
<td>&gt;748</td>
<td>&gt;430</td>
</tr>
</tbody>
</table>

**Table No. 2**

<table>
<thead>
<tr>
<th>IND-AQI</th>
<th>Associated Health Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (0-50)</td>
<td>Minimal Impact</td>
</tr>
<tr>
<td>Satisfactory (51-100)</td>
<td>May cause minor breathing discomfort to sensitive people</td>
</tr>
<tr>
<td>Moderate (101-200)</td>
<td>May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults</td>
</tr>
<tr>
<td>Poor (201-300)</td>
<td>May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease</td>
</tr>
<tr>
<td>Very Poor (301-400)</td>
<td>May cause respiratory illness to the people on prolonged exposure. Effect may more pronounced in people with lung and heart diseases</td>
</tr>
<tr>
<td>Severe (401-500)</td>
<td>May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced even during light physical activity</td>
</tr>
</tbody>
</table>

**Detailed description of two major air pollutant –**

1) *Raj* (Suspended Particulate Matter)
2) *Dhoom* (Smoke)

1) *Raj* (Suspended Particulate Matter)\textsuperscript{3}

For the first time, U. S. Environmental Protection Agency (EPA) has promulgated primary and secondary national ambient air quality standards (NAAQS) for six criteria pollutants: \( \text{SO}_2 \), \( \text{NO}_x \), \( \text{CO} \), \( \text{O}_3 \), \( \text{PM}_{10}/\text{PM}_{2.5} \), and Pb. Primary pollutant are health-related and secondary pollutants are welfare-related. In India, Central Pollution Control Board (CPCB) has accepted the same definition with little bit
change, in National Air Quality Monitoring Program. Suspended particulate matter (SPM) in air generally is considered to be all airborne solid and low vapor pressure liquid particles. Suspended particulate matter in ambient air is a complex, multi-phase system consisting of a spectrum of aerodynamic particle sizes ranging from below 0.01 μm to 100 μm and larger. Respirable particles are attributed to growth of particles from the gas phase and subsequent agglomeration; most coarse particle (sizes 2.5-10 μm) is made of mechanically abraded or ground particles. Particles that have grown from the gas phase, either because of condensation, transformation, or combustion, occur initially as very fine nuclei (0.05 μm). These particles tend to grow rapidly to accumulation mode particles around 0.5 μm which are relatively stable in the air. Coarse particles, on the other hand, are mainly produced by mechanical forces, such as crushing and abrasion. These coarse particles therefore normally consist of finely divided minerals, soil, or dust that result from entrainment by the motion of air or from other mechanical action within their area. Since the mass of these particles is normally >3 μm, their retention time in the air parcel is shorter than that of the fine particle fraction. These smaller particles penetrate deeply into the lung, where the potential for health effects is the greatest. In addition, the smaller particles typically are man-made. TSP typically has a bimodal distribution, with naturally occurring particles centered at about 10 μm & man-made particles centered at about 0.4 μm.

**Table No. 3**

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Size range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPM (Suspended Particulate Matter)</td>
<td>All air born solid &amp; Low vapor pressure liquid particle ranging from below 0.01 μm to 100 μm &amp; larger</td>
</tr>
<tr>
<td>PM (Particulate Matter)</td>
<td>No preference to size selection</td>
</tr>
<tr>
<td>TPM (Total Particulate Matter)</td>
<td>&lt; 100 μm</td>
</tr>
<tr>
<td>PM10 (thoracic fraction)</td>
<td>≤10 μm</td>
</tr>
<tr>
<td>PM2.5 Respirable Suspended Particulate Material (RSPM)</td>
<td>≤2.5 μm</td>
</tr>
<tr>
<td>PM1</td>
<td>≤1 μm</td>
</tr>
<tr>
<td>Ultra-fine (UFP or UP)</td>
<td>≤0.1 μm</td>
</tr>
<tr>
<td>PM10-PM2.5 (coarse fraction)</td>
<td>2.5 μm - 10 μm</td>
</tr>
</tbody>
</table>

**Hazards of Raj**

A dust within range of 0.5 to 3 micron is a health hazard producing, after a variable period of exposure, a lung disease known as pneumoconiosis, which may gradually cripple a man by reducing his working capacity due to lung fibrosis and other complications. The hazardous effects of dust of lung depend upon a number of factors such as (a) chemical composition (b) fineness (c) concentration of dust in the air (d) period of exposure and (e) health status of the person exposed. Therefore, the threshold limit values for different dust are different. In addition to the toxic effect of the dust on the lung tissues, super imposition of infection like tuberculosis may
also influence the pattern of pneumoconiosis. The important dust diseases are –

**i) Inorganic Dust Diseases**

- a) Coal dust: Anthracosis
- b) Silica: Silicosis
- c) Asbestos: Asbestosis, cancer lung
- d) Iron: Siderosis

**ii) Organic (vegetable) Dust Diseases**

- a) Cane fiber: Bagassosis
- b) Cotton dust: Byssinosis
- c) Tobacco: Tobacossis
- d) Hay or grain dust: Farmers’ lung

**2) Dhoom (Smoke)**

Smoke is the collection of airborne solid and liquid particulates and gases emitted when a material undergoes combustion or pyrolysis, together with the quantity of air that is entrained or otherwise mixed into the mass. It is commonly an unwanted by-product of fires (including stoves, candles, oil lamps, and fireplaces), but may also be used for pest control (cf. fumigation), communication (smoke signals), defense (smoke-screen) or smoking (tobacco, marijuana, crack, etc.). Smoke is used in rituals, when incense, sage, or resins are burned to produce a smell for spiritual purposes. Smoke is sometimes used as a flavoring agent and preservative for various foodstuffs. Smoke is also sometimes a component of internal combustion engine exhaust gas, particularly diesel exhaust. Smoke inhalation is the primary cause of death in victims of indoor fires. The smoke kills by a combination of thermal damage, poisoning and pulmonary irritation caused by carbon monoxide, hydrogen cyanide other combustion product. Smoke particles are an aerosol (or mist) of solid particles and liquid droplets that are close to the ideal range of sizes for Mie scattering of visible light.

**Etiological factors affecting Pranavaha-Srotas**

*Raj* (dust), *Dhoom* (smoke), *Shi-taSthana* (cold environment), *Shita Ambu Sevana* (drinking cold water), and *Ati-Vyayama* (exercise) etc. *Raj* is one of the prime factors which cause the vitiation of *Srotasa*. *Raj* is considered as *Dhuli*. *Dhuli* indicate minute particles which are visible or may not visible to our naked eyes. Which enters through mouth and nose develops diseases such as *Kasa, Hikka, Shvasa, Pratishyaya*. Dust particle has various classifications according to size, shape and different origin. The dust particle hamper’s the breathing pattern when it is excessively inhaled. Dust and smoke particles add friction to the air flow during breathing. Particles larger than 30-50µm in size tend to not to be inhaled through the nose whereas particulates on the order of 5-10µm impact on the nasopharynx and enter the conducting airway.

Dust particle is most commonly inhaled by individual. Exposure to more dust particles for longer duration increases the risk for health problem in respiratory tract system. The diseases due to dust particles is commonly seen in developing countries because of improper guidance, no preventive measures, lack of amenities, improper road and many more. The coating of dust, pollen grains etc. which comes under *Raj* causes *Shvasa, Kasa* etc. which are due to *PranavahaSrotodushti*.

**PranavahaSrotasMula**

*Mula* refers to developmental or generative place *PranavahaSrotas* have *Hridaya* (Heart), *Mahasrotas* and *Rasa-vahinidhamani* added by *Susruta* as originative places technically any organ takes in and sends out *is Hridaya* – either Heart or Lung.

**PranavahaSrotodushtiLakshana**
In Ayurvedic Text Symptoms of PranavahaSrotodushti is described in very short. PranavahaSrotodushti are a group of symptoms which show the clinical presentation of Respiratory problems.

- Atisrustam (too long respiration)
- Atibaddham (restricted respiration)
- Kupitam (agitated respiration)
- Alpalpam (shallow / short respiration)
- Abhikshanam (frequent / increased / repeated respiration)
- Sashabdam (stertrous respiration)
- Sashoola (painful respiration)

Then we see that, these all Lakshana are related with ShvasaRoga. Even the treatment of PranavahaSrotodushti is also indicated to follow the same treatment of ShvasaRoga. On the basis of these reasons it may be assume that— all the causes or Nidana described in reference to ShvasaRoga can be consider as Nidanas of PranavahaSrotodushti.

Samprapti (Pathogenesis)

Raj and Dhoom are mainly Ruksha, Shuska and KharGuna yukta so after intering in the PranavahaSrotasa, they vitiated VataDosha. And this vitiated VataDoshay may produce PranavahaSrotodushti by method described below-

Raj and Dhoom (Ruksh, Shuska, KharGuna Yukta)

In Pranavaha Srotasa

Vata Prakopa

Sankoch

Absorb Moisture of Prakrita Shlesma

Obstruct the function of Prana Vayu

Dried Shlesma & obstruct the function

Obstruct the function of Prana Vayu

DISCUSSION

Ayurveda is science of life, which deals with every aspects of life. Prevention & management of diseases are vividly described in Ayurvedic text. Various etiological factor related to diseases have been mentioned. The classification of causative factor is so broad & scientific that it even includes major problem of present era also. Vayu Dushti (Air Pollution) is one such factor which is creating a continuous threat today on health. It is mentioned in Charaka Samhita Vimana Sthana in Janpadodhvansa Adhyaya. As Acharya Charaka has mentioned that – “vitiated Vayu would be unhealthy.”
It is very similar to the modern definition of Air Pollution as – “Presence of any material that imbalance the natural air and has an adverse effect on human, plants, animals and its resources are considered Air pollution.”

The components of Air Pollution described by Acharya Charaka (Ch. Vi. 3/6-1) are – Air Pollution is only a small part of Vayu Dushti as - Unusual change in the properties of seasonal air, Stagnant air, Fast moving air, Un-Cutaneous air, Excessive cold air, Excessive hot air, Excessive humid air, Excessive velocity of air from every direction, Excessive whirlwind air, Bad odor, Excessive humidity, Sand particle, Dust, Smoke are the properties of Anarogyakara Vayu.

According to modern concept, all properties of Vayu Dushti mentioned above are not incorporated under Air Pollution. Polluted air is very harmful for human, animal, plants and its resources. That is why Acharya Charaka has considered vitiating Vayu under Anarogyakar Vayu (Polluted Air).

Modern science has made so many advancements and we precisely know that Bad odor are produces by which gases, what % of humidity should consider as excessive humidity, which kinds of problems may be created by Sand particle, what’s material comes under Dust & Smoke and what kinds of diseases can be produced by them.

As we know, most of all diseases produced by Air Pollution are of Respiratory system and the Respiratory system is considered closely equivalent to PranavahaSrotasa. In PranavahaSrotasa, Prana word is used for “Prana Vayu”. It means the place where Prana Vayu abode & move should consider as PranavahaSrotasa. On the basis of this, most of Acharyas consider PranavahaSrotasa, equivalent to Respiratory system. It also seems right in reference to diseases, which are consider in PranavahaSrotasa are the same diseases which are consider in Respiratory diseases.

In the reference of “Pranayatan”, Prana word is used for ‘Life’ & ‘Ayatan’ means habitat. It means the places where life dwell specially consider as “Pranayatan”.

Most of all diseases produced by Air Pollution are of Respiratory System. And the Respiratory System is the System which consider equivalent to PranavahaSrotasa. In classical text the description of Air pollution due to natural resources, as –wind born dust and smoke from wildfire etc. but in Present era due to modern Civilization, urbanization and industrialization anthropogenic (man-made) sources era becoming most responsible for the Air pollution. Transport, Power Plants, Oil Refining, Burning Crop Waste, Fumes from Paints, Varnish Spray nuclear Weapons, Toxic gases are main anthropogenic sources responsible for Air pollution.

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