

Minireview

Air Pollutants – Risk assessment for human health – An alternative approach

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Introduction

Today, it is common knowledge that gaseous air pollutants and ultrafine particulate matter in the air are present worldwide [1-3], especially in big cities. Already decades ago this fact had been observed, and already at these times, scientists in Medicine had the suspicion that air pollutants were responsible for certain severe diseases [4]. With today's means and techniques exact measurements of concentrations - provided standardised conditions were defined and kept constant - could be carried out. Since a number of years, several kinds of diseases appear to be connected with air pollutants [5-23].

Ways out of this situation are under discussion, and various approaches are used for the determination of limits of upper concentrations allowed by the Governments. These approaches are a matter of ongoing discussions, and reasonable solutions both regarding the determination of critical concentrations of air pollution, and suggested solutions for their avoidance are not available.

A study of the available scientific literature on these topics shows that, in most cases, the kind of disease in the human body or in certain organs is investigated but, in many cases, the life circumstances are not well defined. There is a need for an alternative approach. It should allow exactly defined experimental conditions. After all, this should be a laboratory- medical approach that could lead to an improved knowledge of details which are needed for diagnosis of a disease and the treatment of the patient.

During the last few years, experiments with animals [19] and, even, humans - volunteers - were carried out, with unreliable results. As a rule, it was speculated that certain air pollutants could be responsible. However, often combinations of different air pollutants could not be considered. Diseases indicate dysfunctions of organs. Deeper insights could only be obtained for very specific diseases. In these cases, the obvious cause was evident, e.g. NO_x. Nevertheless, even in these cases, a

dysfunction could not be attributed to certain cells in an organ, or to structural or functional properties of the components in these cells: preservation or damage to proteins such as enzyme complexes, lipids in the cell membrane, nucleic acids, both in the cell nucleus and in mitochondria, carbohydrates with a variety of structures and functions, to just mention a few of these components. One should keep in mind that limits for allowed concentrations of air pollutants given by Governments - a Risk Assessment - should be determined with regard to the most dangerous air pollutant in the pollutant mixture in the environment.

The present communication is a research proposal for future laboratory investigations that need cooperation of several research groups. It comprises a number of experiments with the final goal to provide reliable data for a targeted medical treatment of respective diseases. Its basis is the analysis of in vitro-cultured human cells of various organs and origins and their components. The data of untreated (control) cells can be compared with the respective data obtained for exposed cells kept under strictly controlled conditions, i.e. in the presence of well defined concentrations of various known air pollutants and their combinations, and with controlled temperature and duration.

Determination of Upper Concentration Limits of Air Pollutants/Ultrafine Particulate Matter

The upper limits for concentration of air pollutants in cities, given by Governments (e.g. in Germany), are not arbitrary. As the basis, they are derived from evaluations of the frequency/number of days of absence from work due to medical findings and owing to specific kinds of illnesses. These data are compared with respective data obtained for controls (no measurable concentration of air pollutants in the environment.) The kinds of observed illnesses have been collected over a time

period of many years (s. above: 5-23); they are not disputed, especially when they caused the death of the patients.

An Alternative Approach

As mentioned above, the basis for this approach are investigations of in vitro- cultured human cells, grown along known and established procedures [25]. Their origin should be human organs that have a suspicion of being involved in diseases caused by air pollutants. The point of interest of the analyses is a possible damage done to the integrity of cellular structural and functional components. Examples are: cell membranes (proteins, lipids), enzymes and enzyme complexes, especially those that are involved in cell energetics, intracellular and extracellular transport, cell growth, cell division and doubling, cellular microtubules, metabolic pathways for the synthesis of compounds, structure and function of ribosomes, integrity of DNA and RNA (strand breaks?) both in the cell nucleus and in mitochondria, components of the nerve system including brain cells, etc.- This list could be even much longer, depending on the kind of illness. Nevertheless, such an approach has, compared with other ways of proceeding, the advantage that its focus are the human cells, the centers of any disease.

Note: Application of medically relevant substances needed for the treatment of various dysfunctions in the human body often happens via the lung [24]. For interactions of air pollutants/ultrafine particulate matter with man, the pollutants have to come in contact with the human body. One should keep in mind that air pollutants can take the same way into the human body as medically relevant substances.

This is one of the reasons why the entire lung system should receive attention. It needs special care as soon as diseases caused by air pollutants are the topic of investigations and the target of medical treatment.

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