Passage of Inhaled Particles Into the Blood Circulation in Humans

To the Editor:

It is clear from Figure 2 in the article by Nemmar et al1 that their aerosol contained a high level of a species somewhere between Technegas and Pertechnegas. Technegas generation demands a 100% inert atmosphere to work properly. Even minute traces of oxygen will begin to create a mixed oxide species. Machines that are not fully serviced at regular intervals can trap sufficient oxygen in the carbon deposited on the chamber walls, for example, to generate Pertechnegas. The immediate clinical sign is thyroid uptake in the images. This alone is often the first reason to call in a service engineer. There should be no visible thyroid on a study done using a properly functioning machine. Even the original discovery of Pertechnegas arose out of a wrongly filled argon cylinder. A curious alumina micro-aerosol within gas cylinders made of aluminum was implicated in a whole series of inadvertent Pertechnegas studies generated from “ultra high purity argon.”

We did not explore the transitional phase between pure carbon-coated compounds and the Technetium Oxide species named Pertechnegas, but we were aware of a “third species” that we hypothesized to be either an insoluble or poorly soluble oxide of Technetium or an incomplete closure of the carbon “cage.” I suspect the machine used by the authors of this article1 is sitting right at the transitional phase and is producing a high level of this “third species.”

As part of the process of convincing regulatory agencies of the behavior of Technegas in the body, in 1986 I had five volunteers breathe in a small (~30 MBq) dose, and a posterior view was taken on a gamma camera. Twenty-four hours later, the imaging procedure was repeated, and after correcting for decay, <3% of the material had moved from the lung fields. This also very neatly demonstrated that Technegas had penetrated beyond the 16th division of the bronchial tree, the lower limit of the mucociliary escalator.

Much of the background science and procedural help may be found at our University Web site at http://jcsmr.anu.edu.au/Technegas.

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Response

We thank Dr Burch for his interest in our article1 and his comments with respect to the characteristics of the aerosol of the Technegas apparatus.

The possible presence of a “species somewhere between Technegas and Pertechnegas” in the aerosol is a surprising suggestion. In his letter, Dr Burch does not refer to any published experimental evidence supporting the existence of this so-called “mixed oxide” species. To our knowledge, such species has never been documented in the scientific literature and, moreover, it is not clear what the biological characteristics of this speculative agent might be.

Apart from the lack of evidence about the presence of such species in the generated aerosol, its hypothetical presence does not compromise the results and conclusions of our study. Thin layer chromatography (TLC) showed a clear difference between the chromatographic behavior of the radioactivity in the blood of the volunteers after inhalation of the aerosol (most radioactivity staying at the application point of the TLC plate) and in blood spiked with pertechnetate or obtained after the intratracheal instillation of pertechnetate in hamsters (all radioactivity moving with the solvent front). We used ultrapure argon (>99.9997%) for generating Technegas without contaminating oxygen as prescribed by the instructions of the manufacturer of the apparatus.2 The TLC analysis of the collected Technegas aerosol indicated that no pertechnetate was present and thus we can be confident that we have used an aerosol not containing pertechnetate. However, some in vivo reoxidation of technetium to pertechnetate is possible and likely, because we observed a gradual rise in activity migrating with the solvent front on TLC in the blood samples. Nevertheless, shortly after inhalation of the aerosol, the fraction of activity in the blood migrating with the mobile phase (pertechnetate) was low, whereas at that time-point there was clearly already accumulation of activity in the liver, which was not followed by washout. Such behavior can be expected for small particles, which are cleared from the blood by the Kupffer cells, but not for pertechnetate.3

Dr Burch mentions a very low washout of activity from the lungs after inhalation of Technegas in his clinical studies, a result which differs from ours. This can probably be explained by varying characteristics of the Technegas particles (size and composition) from Technegas generators with a different history and age. Apparently, a fraction of the particles formed in our apparatus possessed the appropriate properties to allow demonstration of migration from the lungs into the blood and persistent accumulation in the liver. However, most of the inhaled particles stayed in the lungs, as it was the case in the experience of Dr Burch.

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