

A “philosophical molecule”: hydrogen may overcome senescence and intractable diseases

Shin-ichi Hirano^{1,*}, Yusuke Ichikawa¹, Ryosuke Kurokawa¹, Yoshiyasu Takefuji², Fumitake Satoh¹

¹ MiZ Company Limited, Kamakura, Japan

² Faculty of Environment and Information Studies, Keio University, Fujisawa, Japan

*Correspondence to: Shin-ichi Hirano, DVM, PhD, s_hirano@e-miz.co.jp.

orcid: 0000-0002-8610-8922 (Shin-ichi Hirano)

Abstract

It has been revealed that the cause of senescence and diseases is associated with the reactive oxygen species “hydroxyl radicals” ($\cdot\text{OH}$). Senescence and diseases may be overcome as long as we can scavenge $\cdot\text{OH}$ mostly produced in mitochondria. It is one and only one “molecular hydrogen” (H_2) that can both penetrate into the mitochondria and scavenge the $\cdot\text{OH}$. The H_2 in the body can function in disease prevention and recovery. H_2 gas is explosive so that a safe hydrogen inhaler has to be developed for home use. We would like to advocate the great use of H_2 .

Key words: Google; Amazon; Facebook; Apple; hydroxyl radicals; mitochondria; molecular hydrogen; oxidation; reactive oxygen species; reduction; rejuvenation; senescence

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INTRODUCTION

Although modern medicine has evolved so far with stalling rapidly in the 21st century, large walls hinder the development of medicine. There are many diseases which cannot be cured or healed by treatment based on “element reductionism.” The element reductionism is associated with one treatment. Many diseases are caused not by single factor abnormalities but by multiple factors with various mechanisms. These multiple factors may not have been elucidated in modern medicine. However, we have recently developed how we can break through these challenges. A key solution lies in using molecular hydrogen (H_2).

From a scientific standpoint, all activities of the molecules can be called the exchange of electrons: “oxidation” and “reduction.” From the viewpoint of the longevity of the youth, oxidation means “senescence” while reduction does “rejuvenation.” Life activity begins after the birth, and immediately the oxidation proceeds. It means that “electrons are deprived” to be oxidized. H_2 , supplying electrons, can be said that the reducing agent “rejuvenated material.” Senescence and diseases can be interpreted as oxidative phenomenon, rejuvenation and recovery as reductive one. The substance with oxidizing maximizes the phenomenon. In this paper, we propose the possibility that H_2 will overcome the senescence and intractable diseases from the viewpoint of mitochondrial oxidation and reduction.

REACTIVE OXYGEN SPECIES AND MITOCHONDRIA

What is the most potent oxidizing one? It is hydroxyl radicals ($\cdot\text{OH}$). About 90% of reactive oxygen species (ROS) are generated in the mitochondria in the cells.¹ The $\cdot\text{OH}$ have been generated in large quantities almost all within the mitochondria. Mitochondria are the organs that create the energy ATP that is necessary for our life activities.

Mitochondrial functions can be compared to the boiler of a steam locomotive. In the past, the term “boiler” as a word for locomotive originated from the fact that the boiler occupied most of the body of the locomotive. In the same way, mitochondria are energy generating organs for life activities that must be necessary for life. Locomotives run with fuel, but in that case a large amount of soot, imperfect combustion substance is generated. When energy conversion is performed, the combustion efficiency is not perfect without exception. In the mitochondria, when converting the incorporated material into energy, about a few percent of the imperfect combustion substance are produced. The imperfect combustion materials are ROS. There are a variety of ROS that can be used usefully. If they are not necessary for life, metabolic system to scavenge by the use of enzymes has been constructed. However, in the mitochondria of the generated ROS, there is only $\cdot\text{OH}$ that cannot be reduced by any means. The $\cdot\text{OH}$ is generated in the mitochondria, and can cause oxidation, senescence and diseases. Because $\cdot\text{OH}$ has the strongest oxidizing power, and reacts with nucleic acids (DNA), lipids and proteins that make up our bodies and destroy them. This vandalism is an oxidative reaction. We do not know how to handle with $\cdot\text{OH}$. Antioxidants except H_2 are not very effective especially because of the impossibility into the cell and mitochondria. We should scavenge the $\cdot\text{OH}$ that produces in the mitochondria. Is there any substance that can scavenge it? It is H_2 that can solve the vandalism of $\cdot\text{OH}$.

DEVELOPMENT OF THE EQUIPMENT TO DELIVER H_2 TO OUR BODY

We have reported that drinking of H_2 water produced in our electrolytic cell released a pioneering study to inhibit oxidative disorders in the liver of rats in 2005.² This is the first hydrogen medicine paper in Japan. Two years later, a series of papers



on H_2 began to emerge from other research institutes.³ We have reported the equipment to deliver H_2 to the living body.^{4,5}

H_2 is capable to pass through all materials, because H_2 is the smallest molecule. Only H_2 can pass through the cell membrane and also pass the mitochondrial membrane, while the other antioxidants cannot do that to scavenge the $\bullet OH$. H_2 has been reported to react with two kinds of strong ROS,^{3,6} *i.e.*, $\bullet OH$ and peroxynitrite (ONOO-).⁷ However, it is reported that H_2 reacts with ONOO- somewhat.³ The reactivity of H_2 with $\bullet OH$ is high and quick. As observed from the production of H_2 in the body (gut),^{8,9} it is completely harmless for the body. H_2 does not interfere with the metabolic system. Rather, H_2 can scavenge the waste, $\bullet OH$ in soot that has occurred in the metabolic reaction, harmless and non-toxic. In conclusion, it is only H_2 that can penetrate into the mitochondria and can also scavenge $\bullet OH$ (Figure 1). Thereby, the H_2 in the body can function in disease prevention and recovery.¹⁰⁻²⁶ There is a possibility of longevity of youth.

GAFA AND PUBLIC ORGANIZATION IN THE US

There are many diseases which we cannot treat well. The massive fund-raising of Google, Amazon, Facebook and Apple (GAFA) is continuing to discover the cure for those diseases. Apple CEO Tim Cook said that in the future, if anybody asks what Apple's greatest contribution to humankind is "health" will be his answer.²⁷

The wasteful medical treatment is rampant in the modern therapy. The medical expense increase of the nation is spurred. As a solution, there is a "Choosing Wisely" in the United States. This is a public organization in Philadelphia of United States, the United States Internal Medicine Specialist Certification Organization Foundation (ABIM Foundation) becomes the epicenter, bundling the medical Society of the United States, to announce a wasteful medical treatment. For example, United States Clinical Oncology Society, United States gastroenterological Society, United States Psychiatric Society, United States Cardiology Association, United States

Obstetrics and Gynecology Society, United States Pediatrics Association, *etc.*, the world's first medical Association has presented themselves with "the medical act that seems unnecessary."

How should we overcome various problems including medical problems and social problems? As mentioned in this paper, we would like to propose a safe H_2 medical use with no adverse effects. H_2 may be able to solve various problems by combining with modern treatment or alone use in the future. This proposal does not deny the modern medicine indiscriminately. Especially in acute diseases, the modern medical treatments are very effective certainly. However, there are diseases due to chronic diseases and complex factors that cannot be covered by modern medicine. Up to now there are more than 600 papers regarding the use of H_2 , including about 50 clinical trials papers. The use of H_2 is indispensable in the future, and we would like to advocate the promotion of hydrogen medicine.

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Author contributions

SH, YT and FS designed and wrote the manuscript. YI and RK supported this study by giving advice and revised the manuscript. All authors read and approved the final manuscript.

Conflicts of interest

The authors have no conflicts of interests to declare.

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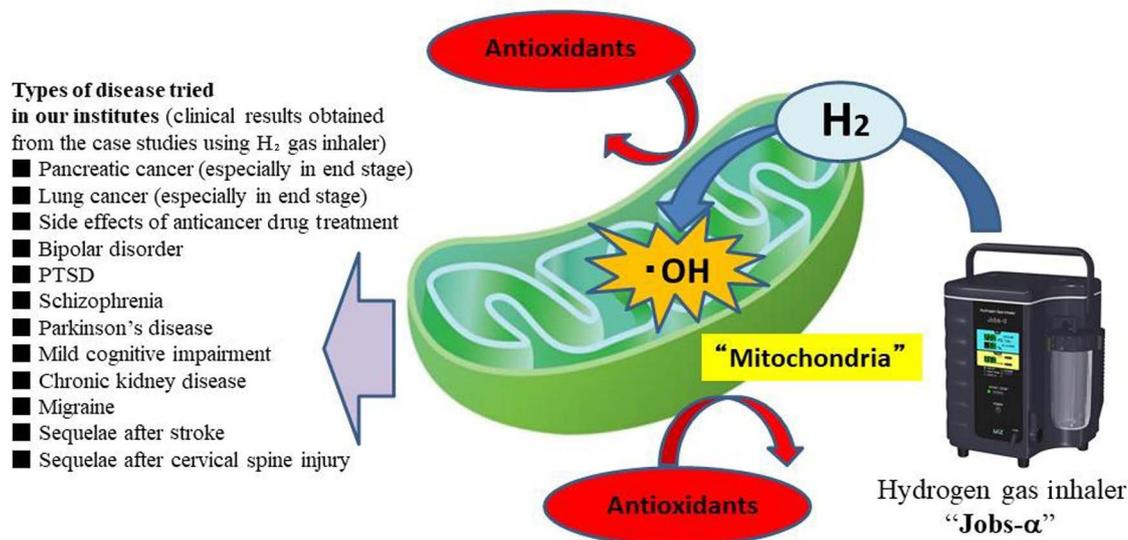


Figure 1: "Molecular hydrogen" (H_2) is the only molecule that can both enter the mitochondria and scavenge the hydroxyl radicals.

Note: Inhalation gas was prepared by mixing of H_2 gas and air, where the H_2 gas was produced by the electrolysis of water, and the concentration was controlled under the detonation limit of the mixture of H_2 gas and air (below 10% H_2 concentration in the apparatus "Jobs-α"). $\bullet OH$: Hydroxyl radicals; PTSD: posttraumatic stress disorder.



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