Condensed version and key points from the study:

Two weeks of hydrogen inhalation can significantly reverse adaptive and innate immune system senescence patients with advanced non-small cell lung cancer: a self-controlled study

Study Overview
A self-controlled study published in Medical Gas Research (2020) with two objectives: to characterise immunosenescence (immune system ageing) in advanced non-small cell lung cancer (NSCLC), and to investigate whether hydrogen gas inhalation could achieve immune reconstitution. 20 NSCLC patients were enrolled from July to September 2019.

What Is "Immunosenescence"?
Immune cell senescence refers to the phenotypic characteristics of individual lymphocytes where immune function does not necessarily decrease during ageing alone. Immune cell exhaustion refers to the decrease in immune function due to excessive free radicals in the mitochondria, causing the cell to lose its function and enter programmed cell death regardless of age. Senescence and exhaustion do not indicate an inevitable and progressive decline of all immune functions, but rather constitute a highly dynamic process of remodelling and adaptation.
In plain terms: cancer patients' immune cells become either "aged out" or "burned out" — and this study asked whether hydrogen could reverse both.

How the Treatment Was Delivered
All patients inhaled a mixture of hydrogen (66.7%) and oxygen (33.3%) at a gas flow rate of 3 L/min for 4 hours each day for two weeks. Crucially, none of the patients received any standard cancer treatment during the hydrogen inhalation period — making it possible to attribute any immune changes directly to hydrogen.

What Was Wrong With the Immune System Before Treatment Two categories of immune dysfunction were identified prior to hydrogen therapy:

Cells that were abnormally high (overworked/burned out): Patients presented with abnormally high levels of exhausted cytotoxic T cells, senescent cytotoxic T cells, and killer Vδ1 cells. Hydrogenbiology
Cells that were abnormally low (depleted/non-functional): Abnormally low indicators included functional helper and cytotoxic T cells, Th1, all natural killer T cells, natural killer cells, and Vδ2 cells. HHO Bulgaria
In the detection of the innate immune response, there was a decreased proportion of NKT, activated NK and killer NK cells, and an insufficient content of Vδ2 subsets among γδ T cells — suggesting that both the adaptive and innate immune systems jointly contribute to the progression of NSCLC.

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Key Results After Two Weeks of Hydrogen

- After 2 weeks of hydrogen therapy, the number of exhausted and senescent cytotoxic T cells decreased to within the normal range, and there was an increase in killer Vδ1 cells.
- After 2 weeks of hydrogen therapy, all six previously abnormally low cell subsets — functional helper and cytotoxic T cells, Th1, total natural killer T cells, natural killer cells, and Vδ2 cells — increased to within the normal range.
- In short: across both the immune cells that were too high and those that were too low, hydrogen restored near-normal levels across the board in just two weeks.

Why This Is Significant

- By comparing immune functions before and after hydrogen inhalation, the study found that 2 weeks of hydrogen inhalation was enough to reverse multiple senescent or exhausted immune cell markers — a remarkably rapid response.
- This study is unique in that it focused purely on the immune system itself, with no concurrent cancer treatment, providing a cleaner signal for hydrogen's immunological effects.

Conclusions

Current data suggest that immunosenescence in advanced NSCLC affects nearly all lymphocyte subsets, and that 2 weeks of hydrogen treatment can significantly improve most of these metrics.

Limitations to Keep in Mind

- This was a self-controlled study — meaning patients were compared to themselves before and after, with no separate control group. This design cannot rule out natural fluctuations in immune markers over time.
- The immunosenescence characteristics obtained in advanced NSCLC can only be used as a reference for other cancer types, as there may be huge differences among different cancer types requiring further study.
- Only 20 patients were enrolled, which is a very small sample.
- The study assessed immune cell changes only — it did not measure clinical outcomes such as tumour response, progression-free survival, or overall survival.
- The study was conducted at a single cancer hospital in China (Fuda Cancer Hospital, Jinan University).

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