Effect of Cold Plasma on *Helicobacter pylori* Inactivation and Its Role in Gastric Cancer Prevention

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ABSTRACT

Atmospheric cold plasma (ACP) has emerged as a promising technology in microbiology, particularly for treating infections and medical disinfection. It shows significant activity against *Helicobacter pylori*, a key pathogenic bacterium linked to chronic gastritis, peptic ulcers, and an increased risk of gastric cancer. The growing resistance of *H. pylori* to conventional antibiotics highlights the need for alternative therapeutic strategies, and ACP generates a variety of reactive species, including free radicals and charged ions, which can effectively inactivate *H. pylori* by disrupting cell membrane, inducing oxidative damage, and destabilizing biofilms. Existing laboratory studies confirm its ability to reduce bacterial load on surfaces and in biological samples, even against resistant strains, although variability in findings—due to different plasma sources, operating conditions, and experimental models—illustrates a lack of standardization in research. Current evidence supports ACP as a non-antibiotic method for inactivating *H. pylori*. Studies have indicated that its reactive species can disrupt cell membranes, alter metabolic processes, and weaken biofilms. However, the differences in outcomes emphasize the need for more standardized methodologies. This review article aims to summarize current evidence and examine the mechanisms, potential applications, and challenges of using cold plasma in the management of *H. pylori*-related infections. Despite its strong antimicrobial potential, limited data on safety, tissue interactions, and long-term effects necessitate further research to optimize parameters, improve comparability, and conduct clinically oriented evaluations. Ultimately, ACP exhibits significant anti-*H. pylori* potential through mechanisms such as membrane disruption, oxidative damage, and biofilm destabilization, positioning it as a promising adjunct or alternative to conventional therapies in light of rising antimicrobial resistance. Nonetheless, clinical validation of optimal dosing, safety, and long-term biological effects remains essential.

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