

New Onset Asthma in a Nuclear Submariner Following Prolonged Exposure to Poor Air Quality

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Introduction: Military personnel deployed on submarines work in enclosed environments for extended periods. Nuclear submarines employ unique methods to generate oxygen and remove carbon dioxide and other air contaminants during prolonged submersion. We describe a patient with new-onset asthma after multiple extended submarine deployments. **Case Description:** A 33-year-old never smoker with no personal/family respiratory disease history noted new-onset hacking cough and postnasal drainage while deployed on a 45-day nuclear submarine mission. He reported a strong 'amine odor' throughout this and subsequent submarine deployments. His symptoms persisted with return stateside. Three weeks later, he deployed on a 90-day submarine mission. His symptoms worsened, including dyspnea, dry skin, and severe cough triggering reflux. Sitting directly under submarine air vents worsened his cough. With return, he was treated for presumed pneumonia, with minimal improvement. Two months later, he deployed for a third (90-day) submarine mission, with immediate worsening of cough and reflux. During this mission, a two-hour electrical fire disabled the automatic oxygen generator, requiring use of oxygen-generating chlorate 'candles,' creating a low oxygen environment for most of the deployment. On return, he was treated for presumed allergies. Two months later, he deployed on a fourth submarine mission (120 days), again triggering cough, dyspnea, dry skin, and new-onset wheezing. The oxygen generator again malfunctioned, requiring oxygen-generating 'candles' with a prolonged low oxygen environment and persistent strong amine odor. Subsequent pulmonary consultation led to diagnoses of new-onset asthma (based on positive methacholine challenge with normal chest imaging) and sleep apnea. His symptoms improved with treatment, but he was disqualified due to asthma from subsequent deployment. **Discussion:** The temporal onset of this submariner's respiratory symptoms during his first submarine mission, with progressive worsening on each subsequent mission, raised concern for amine exposure causing new-onset asthma. Monoethanolamine is used in submarines to scrub excess airborne carbon dioxide. Several studies link new-onset asthma with occupational exposure to amines, a class of chemicals that can have both irritant and immune-sensitizing properties. Additional potential airborne hazards aboard nuclear submarines include aldehydes, acrolein, ozone, nitrogen oxides, refrigerants and volatile organic compounds. Nuclear submariners live and work continuously in low (~19%) oxygen and high carbon dioxide environments. They may experience smoke exposure from confined space fires, low physical activity causing metabolic syndrome, circadian misalignment, and chronic stress/shift work. This case underscores the need for additional studies of submarine air quality and potential respiratory disease risks to submariners. **Funding/Disclosures:** None.

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