

Increased Brain White Matter Axial Diffusivity Associated with Fatigue, Pain and Hyperalgesia in Gulf War Illness

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RESEARCH HIGHLIGHTS:

- Approximately 175,000 veterans who deployed to the Persian Gulf War from 1990-1991 reported a cluster of medical symptoms, identified as Gulf War Illness (GWI). This list of symptoms includes widespread pain, fatigue, headache, cognitive and gastrointestinal dysfunctions.
- By studying physical changes in the brains of affected veterans, researchers found patterns indicating neuropathological mechanisms for the presentation of GWI symptoms, as well as the specific area of the brain adversely affected. Researchers found alterations in the white matter tract (akin to telephone wires) that connect gray matter regions known to process the feelings of pain and fatigue.
- Future studies are needed to verify whether the techniques used in this study are able to differentiate between individuals with and without GWI symptoms. Researchers recommend additional longitudinal studies to further examine presentations of GWI, including analysis of white and gray matter changes in certain regions of the brain.

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ABSTRACT:

“Background: Gulf War exposures in 1990 and 1991 have caused 25% to 30% of deployed personnel to develop a syndrome of chronic fatigue, pain, hyperalgesia, cognitive and affective dysfunction.

Methods: Gulf War veterans (n=31) and sedentary veteran and civilian controls (n=20) completed fMRI scans for diffusion tensor imaging. A combination of dolorimetry, subjective reports of pain and fatigue were correlated to white matter diffusivity properties to identify tracts associated with symptom constructs.

Results: Gulf War Illness subjects had significantly correlated fatigue, pain, hyperalgesia, and increased axial diffusivity in the right inferior fronto-occipital fasciculus. ROC generated thresholds and subsequent binary regression analysis predicted CMI classification based upon axial diffusivity in the right inferior fronto-occipital fasciculus. These correlates were absent for controls in dichotomous regression analysis.

Conclusion: The right inferior fronto-occipital fasciculus may be a potential biomarker for Gulf War Illness. This tract links cortical regions involved in fatigue, pain, emotional and reward processing, and the right ventral attention network in cognition. The axonal neuropathological mechanism(s) explaining increased axial diffusivity may account for the most prominent symptoms of Gulf War Illness.”

Implications

FOR PRACTICE

Approximately 25 percent of Gulf War veterans have reported a cluster of symptoms that have come to be known as Gulf War Illness (GWI). Although no discernible source or event common to all those who suffer have been determined, results of this study offer some insight as to the causes. Doctors assessed symptoms of what is now known as Chronic Fatigue and Chronic Multisymptom Illness using clinical assessments, blood tests, and dolorimetry, a test of sensitivity to pressure-induced pain. Positive results for GWI symptoms are related to anomalies in the nerve bundles that connect areas of the brain that perceive and process pain and fatigue. Since there is no current treatment for this neurological issue, diagnosis with fMRI offers no immediate benefit to veterans; however, doctors are able to treat the symptoms of GWI. While there will be no immediate change to care plans, this study represents new physical evidence of this neurological illness. Veterans and their families should watch for additional research on GWI, and clinical researchers should continue to fund and participate in trials aimed at studying and regenerating brain tissue, which could have significant benefits for veterans struggling with GWI.

FOR POLICY

It is important for policy makers to work with the Department of Defense and Veterans Health Administration to continue to fund GWI research. Future research may be able to confirm the findings of this study, provide new insight on neurological pathways and brain tissue, and eventually identify treatment options. Beyond research and trials, an evidence-based approach to establish a formal diagnosis procedure, resulting from cooperation between researchers, policy makers and Department of Veterans Affairs (VA) administrators, could be extremely beneficial. Finally, policy makers may wish to work with VA hospitals and other places veterans receive care to ensure that care providers are updated on neurological evidence of GWI, and best practices for treatment of symptoms of fatigue and pain management.

FOR FUTURE RESEARCH

In order to verify the results of this study, future researchers should repeat procedures using larger samples. Future studies should also include multiple homogeneous comparison groups, rather than a single group of both civilians and non-GWI veterans. As this study only investigated changes in the white matter region of the brain, researchers should further examine gray matter areas and their relation to any dysfunctional white matter present. Longitudinal studies will provide better answers about what changes veterans can expect as the years progress, so in addition to cross-sectional analyses, researchers should pursue long-term studies of veterans with GWI.

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