Pathophysiology of Neurotrauma

Understanding Differences in Blast versus Non-Blast Injuries are Important to Guide Treatment

Blast-induced mild traumatic brain injury (mTBI) is a unique injury that is prevalent within the military population. Information pertaining to the effects of blast injuries has been obtained from computer simulations, animal models, and even post-mortem brain tissue, often in severe and moderate traumatic brain injury subjects (*Shively et al. 2016*). However, non-invasive in vivo indicators that are sensitive to the effects of blast-induced mTBI are at present unavailable. Such a limitation makes treatment of mTBI symptoms complicated and recovery difficult to assess. Researchers at the National Intrepid Center of Excellence (Bethesda, Maryland) and Walter Reed National Military Medical Center (Bethesda, Maryland) conducted a study to explore functional and structural connectivity in the brain. The researchers used a combined multimodal imaging approach to identify changes in pathways of the brain relating to blast-induced chronic mTBI.

A total of 241 Service members diagnosed with chronic mTBI and blast as the primary mechanism of injury were compared to 140 Service members with only non-blast injuries. Resting state Functional Magnetic Resonance Imaging, diffusion tensor imaging, and structural magnetic resonance imaging images were acquired using a 3T scanner. As shown in Figure 1, the data were processed to yield maps of mean diffusivity, the default mode network, and the sensory-motor network. Canonical correlation analysis and independent components analysis were then used to compute connectivities among regions.

The results showed distinct functional and structural differences between blast and non-blast subjects within white matter regions such as the genu of the corpus callosum, posterior thalamic radiation and brain stem, and within gray matter regions such as the precuneus, superior temporal gyrus, frontal gyrus, posterior cingulate and primary sensory cortex were present (*Nathan et al. 2017*; Figure 2).

The blast mechanism of injury induces widespread effects on the brain as reflected by dispersed functional connectivity differences in the brain. Moreover, these changes are significantly different from those caused by non-blast sources of mTBI. Understanding the extent of damaged regions may help to inform appropriate treatment and assessment of long-term symptoms and recovery in Service members.

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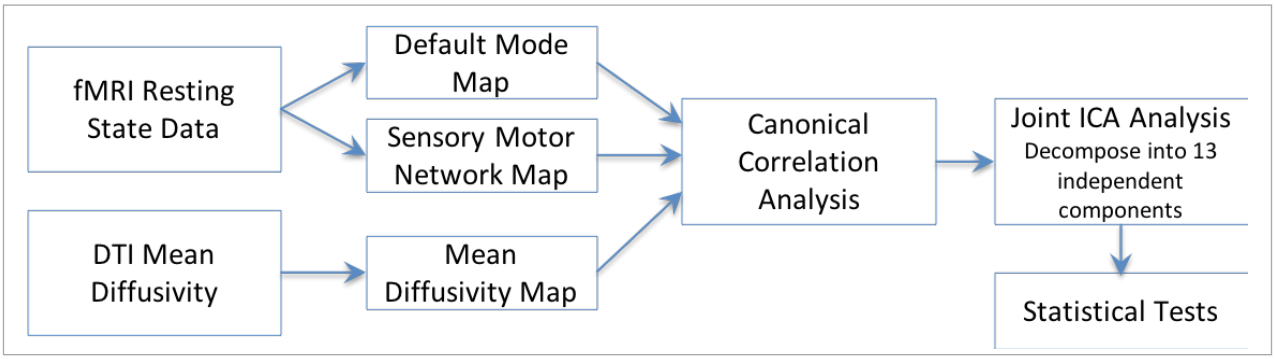

FIGURE 1: Diagram of processing methods. (Figure used with permission from the authors)

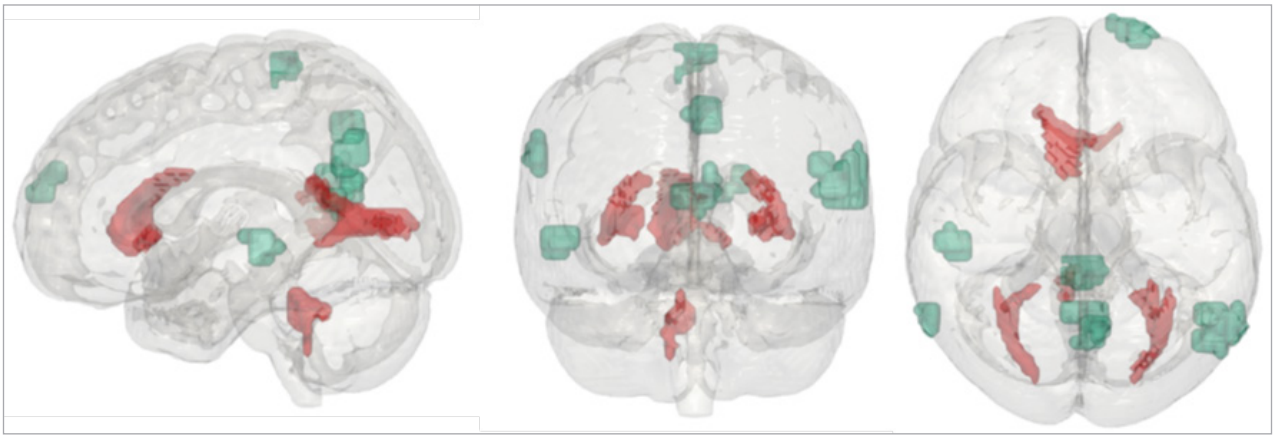

FIGURE 2: Differences in functional connectivity in gray matter regions (green) and white matter integrity (red) between blast-TBI and non-blast-TBI suggest that the blast has unique and widespread effects on both white matter pathways and gray matter networks. (Figure used with permission from the authors)

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