



## Neurophysiological Deficits and Biochemical Changes

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### Description

Direct or indirect exposure to an explosion can induce traumatic brain injury (TBI) of various severity levels. Primary TBI from blast exposure is commonly characterized by internal injuries, such as vascular damage, neuronal injury, and contusion, without external injuries. Current animal models of blast-induced TBI (bTBI) have helped to understand the deleterious effects of moderate to severe blast forces. However, the neurological effects of mild blast forces remain poorly characterized. Here, we investigated the effects caused by mild blast forces combining neuropathological, histological, biochemical and neurophysiological analysis. For this purpose, we employed a rodent blast TBI model with blast forces below the level that causes macroscopic neuropathological changes. We found that mild blast forces induced neuroinflammation in cerebral cortex, striatum and hippocampus. Moreover, mild blast triggered microvascular damage and axonal injury. Furthermore, mild blast caused deficits in hippocampal short-term plasticity and synaptic excitability, but no impairments in long-term potentiation. Finally, mild blast exposure induced proteolytic cleavage of spectrin and the cyclin-dependent kinase 5 activator, p35 in hippocampus. Together, these findings show that mild blast forces can cause aberrant neurological changes that critically impact neuronal functions. These results are consistent with the idea that mild blast forces may induce subclinical pathophysiological changes that may contribute to neurological and psychiatric disorders [1].

### Neuroprotective Effect of Nebivolol

Metabolic abnormalities including hyperglycemia, hyperlipidemia, and oxidative-nitrosative stress are involved in the progression of diabetic neuropathy. In the present study, we targeted oxidative-nitrosative stress using nebivolol, a  $\beta_1$ -receptor antagonist with vasodilator and antioxidant property, to evaluate its neuroprotective effect in streptozotocin-induced diabetic neuropathy in rats. Diabetic neuropathy develops within 4–6 weeks after administration of streptozotocin (55 mg/kg, i.p.). Therefore, after confirmation of diabetes, subtherapeutic doses of nebivolol (1 and 2 mg/kg, p.o./day) were given to diabetic rats for 8 weeks. Nebivolol treatment significantly improved thermal hyperalgesia, grip strength, and motor coordination. Nebivolol also reduced levels of malondialdehyde, tumor necrosis factor- $\alpha$ , and nitrite in diabetes. Moreover, nebivolol increased the levels of superoxide dismutase and catalase in sciatic nerve homogenate of diabetic rats. Further, nebivolol exerted positive effects on lipid profile, sciatic nerve's morphological changes and nerve conduction velocity in diabetic rats. Results of the present study suggest the neuroprotective effect of nebivolol through its antioxidant, nitric oxide-potentiating, and antihyperlipidemic activity [2].

The amounts of the three proteins decreased significantly in the distal segment of sciatic nerve, whereas they remained unchanged in the brain and proximal sciatic nerve. The quantitative decline in these marker proteins in the distal sciatic nerve could be related to neurophysiological deficits in the peripheral nerves. This study indicates that the biochemical changes observed are consistent with the clinical and pathological findings of n-hexane neuropathy. These nerve-specific marker proteins can be used to assess solvent-related peripheral neurotoxicity [3].

Compression may induce morphological and neurophysiological changes in nerve roots. However, it has also been demonstrated experimentally that nucleus pulposus, without any compression, may induce similar changes when applied epidurally. The present study was undertaken to examine the morphological and functional effects of autologous nucleus pulposus and the combination of nucleus pulposus and compression in a pig model. Nucleus pulposus from a lumbar disc in the same animal was applied epidurally around the first sacral nerve root in the pig, with or without a specially designed constrictor. After 1 week, nerve root conduction velocity was determined in the exposed and in the contralateral control nerve root by local electrical stimulation and EMG recordings in the back muscles. Nerve root specimens were processed for blinded light-microscopic evaluation. There was a significant reduction in nerve conduction velocity for all exposed nerve roots as well as contralateral control nerve roots when nucleus pulposus had been applied. There were no statistically significant differences between the nerve conduction velocities recorded following the combined application of nucleus pulposus and compression and those recorded after application of nucleus pulposus alone. The reductions were similar to the reduction induced by the constrictor per se, as seen in a previous study. In all series there was also a decrease in conduction velocity in the control nerve roots, in contrast to previous studies. Light microscopy demonstrated axonal changes only in nerve roots exposed to the constrictor. In conclusion, both epidural nucleus pulposus and compression may induce a significant reduction in nerve conduction velocity. The combination, however, of these two agents does not increase the magnitude of such dysfunction. The potency of nucleus pulposus to induce changes in nerve roots after epidural application was further indicated by the fact that reduction in nerve conduction velocity also occurred in the contralateral control nerve roots in this series. The histological data suggest that axonal injury cannot alone explain the reduction in nerve conduction velocity, and that the morphological basis for the functional changes must be sought at the subcellular level [4].

### Polymorphisms in Circadian Genes

Polymorphisms in circadian genes such as CLOCK convey risk for bipolar disorder. While studies have begun to elucidate the molecular mechanism whereby disruption of Clock alters cellular function within mesolimbic brain regions, little remains known about how these changes alter gross neural circuit function and generate mania-like behaviors in Clock- $\Delta 19$  mice. Here we show that the phasic entrainment of Nucleus Accumbens (NAC) low-gamma (30-55 Hz) oscillations to delta (1-4 Hz) oscillations is negatively correlated with the extent to which Wild-Type (WT) mice explore a novel environment. Clock- $\Delta 19$  mice, which display hyperactivity in the novel environment, exhibit profound deficits in low-gamma and NAC single-neuron phase coupling. We also demonstrate that NAC neurons

in Clock- $\Delta$ 19 mice display complex changes in dendritic morphology and reduced GluR1 expression compared to those observed in WT littermates. Chronic lithium treatment ameliorated several of these neurophysiological deficits and suppressed exploratory drive in the mutants [5].

## References

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