Impaired axon regeneration in rats after nitrous oxide

Krista J. Stewart
Bermans J. Iskandar
Brenton M. Meier
Elias B. Rizk
Nithya Hariharan
Joyce Koueik
Adin-Christian Andrei
Kirk J. Hogan

Video Abstract

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Abstract

Scientists at the University of Wisconsin have demonstrated that, in male rats, nitrous oxide impairs axon regeneration after multiple types of injuries. Importantly, their results could point toward a possible mechanism. Reporting in the journal Anesthesiology, the authors discuss the effects of nitrous oxide in four model systems: an in vitro evaluation of axon regeneration following a sciatic nerve injury, in vivo tests of regeneration following a sharp spinal cord or an optic nerve injury, and a test of functional recovery after a blunt spinal cord injury. In most experiments, a group of male rats received either a single 70-percent dose of nitrous oxide for two hours, a series of 80-percent doses, or no gas, and were injured or not, in the case of the controls. In some experiments, the rats also received folic acid supplementation, which helps spur axonal recovery. All experiments showed that nitrous oxide reduced the amount of axonal recovery following an injury. In cell culture, dorsal root ganglion neurons did not extend axons as far after either single or multiple nitrous oxide administrations. Similar results were found in vivo after a sharp spinal cord injury. Here, a higher percentage of neurons regenerated with folic acid. But that effect was blocked in animals receiving nitrous oxide. The finding was also replicated with a sharp optic nerve injury. These results mirrored those of the animals' functional recovery after a blunt contusion spinal cord injury. In that experiment, animals receiving folic acid supplementation recovered more quickly and more completely. But nitrous oxide nearly eliminated the benefit of folic acid administration. While the experiments were not designed to identify a mechanism, the authors suspect that nitrous oxide may be harming recovery by inactivating methionine synthesis. Future experiments are needed to determine if that's the case.