Pre-surgical exposure to blue light reduces organ damage in mice

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A 24-hour exposure to bright blue light before surgery reduces inflammation and organ damage at the cellular level in a mouse model, according to new research from the University of Pittsburgh School of Medicine.

The finding, reported in today's issue of the *Proceedings of the National Academy of Sciences*, suggests a potential pre-treatment light therapy that could improve outcomes in patients undergoing procedures characterized by a period of blood restriction, such as liver resection or organ transplantation. The research was funded by the National Institutes of Health (NIH).

"We were incredibly surprised by our results," said senior author Matthew R. Rosengart, M.D., M.P.H., associate professor in the Pitt School of Medicine's departments of Surgery and Critical Care Medicine. "There's long been evidence suggesting that light and circadian rhythms profoundly influence our biology, and specifically the physiological response to stress. So while we were expecting to find some correlation with light spectrum and the immune response, we were not expecting results quite so striking,"

Light is complex and consists of intensity, duration of exposure and wavelength. This study is one of the first that accounts for this complexity and derives results that could guide future clinical trials in humans.

Dr. Rosengart and his team compared what happened when mice were exposed to red light, ambient white fluorescent light similar to that in hospitals and high-intensity blue light 24 hours before kidney or liver surgery involving periods of blood restriction and restoration.

The high-intensity blue light outperformed the red and white light, attenuating cellular and organ injury through at least two cellular mechanisms. The blue light brought about a reduction in the influx of neutrophils, a type of white blood cell involved in inflammation, which can lead to organ damage and other problems. Additionally, blue light inhibited dying cells from releasing a protein called HMGB1 that triggers organ-damaging inflammation.

The team then tested whether the blue light was acting through the optic pathway or some other mechanism, like the skin. Blind mice had the same healing response regardless of whether they were exposed to blue or red light, indicating that the protective impact of blue light does, indeed, act through the optic pathway.

The team then looked at whether one color of light might disrupt the circadian rhythm, which is linked to immunity, more than another. Blood from mice exposed to red, white and blue light had similar concentrations of melatonin and corticosteroid hormones. Furthermore, the mice under each of the lights also had similar activity levels. These data indicate that the effects of blue light were not mediated by a disruption of sleep, activity or circadian rhythms.

Finally, Dr. Rosengart stresses that mice are nocturnal animals with visual, circadian and immune biology that is distinct from humans. Thus, the results of his study should not be broadly extended to patients or hospital settings until robust clinical trials have been performed to show whether or not pretreatment with intensive blue light is safe.

More information: Blue light reduces organ injury from ischemia and reperfusion, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1515296113

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