A multidisciplinary approach utilizing filters for surgical procedures in erythropoietic protoporphyria

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THERAPEUTIC CHALLENGE

Patients with erythropoietic protoporphyria accumulate protoporphyrin IX, which preferentially absorbs the blue spectrum of visible light (peak absorption, 405-410 nm) and releases oxygen free radicals.[1,2] Surgical procedures requiring hours of intense visible light exposure in the operating room (OR) can be challenging because of complications of free radical damage.[1,2]

SOLUTION

There are several commercially available filters that can be used to cover the overhead fluorescent lighting in the OR and perioperative rooms, the surgeons' headlights/lamps, and the surgical lighthead/lamp system (Fig 1) to minimize patient exposure to visible light. To demonstrate their effectiveness, clinical engineers can test light transmission. All tested filters limited the transmission of 340- to 470-nm wavelengths to below 5% of the original intensity without filtration while preserving the remainder of the visible spectrum for color differentiation and illumination. For all of the filters, most of the wavelengths transmitted below 470 nm from the surgical lamps in the OR were centered around a peak of 435 nm, outside the peak absorption of protoporphyrin IX (Fig 1, *D*). Care must be taken to ensure that the filtering does not impair the surgeon's visibility. The choice of filters should be evaluated by the surgeons before the operation. Skin outside of the surgical field can be protected with surgical drapes to limit unnecessary visible light exposure. Graying of the bowel should be monitored throughout the surgery as evidence of phototoxic injury that may signify impending bowel necrosis. The perioperative collaboration among dermatologists, surgeons, and clinical engineers can help prevent surgical complications.

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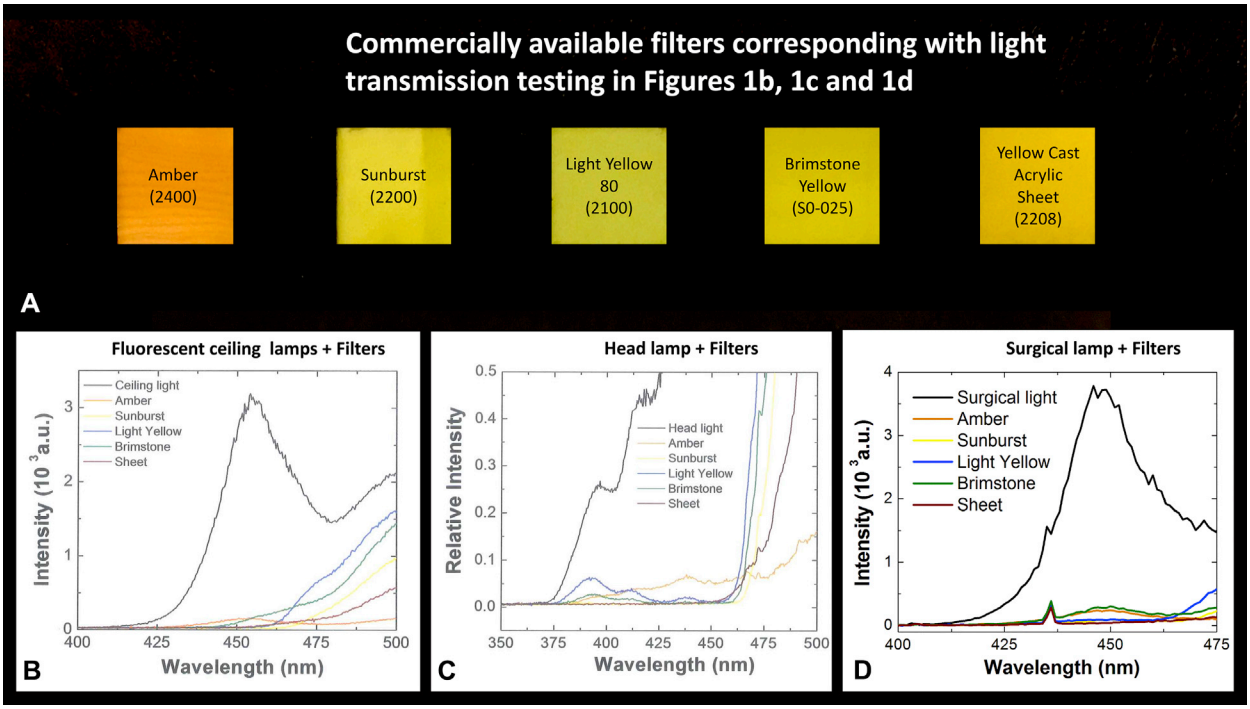

Fig 1. **A**, Light transmission testing of commercially available filters. Filters tested from left to right: Solar Graphics Amber Colored Window Film (2400), Sunburst (2200), Light Yellow 80 (2100, Solar Graphics Designs, Clearwater, FL); Brimstone Yellow (S0-025, Decorative Films, LLC, Frederick, MD); and a 1/8-inch yellow cast acrylic Lucite sheet (2208, Falken Design Corporation, Newbury Park, CA). **B**-**D**, The intensity for wavelengths emitted from the ceiling fluorescent lamps, fluorescent surgeon's headlight/lamp (F32T8/SP30/ECO and F32T8/SPX65/ECO2, GE Lighting, Cleveland, OH), and surgical lighthead/lamp (Harmony vLED surgical lighting system, Steris Corporation, Mentor, OH), respectively, and the intensity transmitted through the 5 tested filters. In **D,** there is a small transmission peak at approximately 435 nm. Other filters that limit the transmission of ultraviolet and blue light have also been described but were not included in our testing, including the TA-81 and CLS-200-X filters (Madico, Inc, Woburn, MA), Supergel #22 Deep Amber (Rosco Laboratories, Inc, Stamford, CT), and the 61011 filter (Reflectiv SA, Cretil, France).[3] a.u., arbitrary unit.

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