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Rapid communication

Energy-dependent UV light-induced disruption of (−)sulpiride antagonism of dopamine

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Abstract

The dopamine D2 receptor antagonist sulpiride decreases the spontaneous locomotor activity of Planaria in an enantiomeric-selective and dose-dependent manner. We now report that (−)sulpiride (0.1 μM)-induced decrease of planarian locomotor activity is significantly ($P < 0.05$) attenuated by low-energy (366 nm) ultraviolet (UV) light and to a greater extent by high-energy (254 nm) UV light. The phenomenon offers a novel approach for studying dopamine D2 receptor transduction processes in a simple in vivo model.

Keywords: D2 receptor; UV light; Planaria

Ultraviolet (UV) light-induced photorelaxation of isolated thoracic aorta previously contracted to steady-state isometric tension by an α-adrenoceptor agonist is a well-known phenomenon (Furchgott et al., 1955). However, we are unaware of any reports on the use of UV light in a model of dopamine receptor activity or on an in vivo model of drug action. Carolei et al. (1975), Venturini et al. (1989), and Palladini et al. (1996) have shown that Planaria, a type of flatworm, respond with characteristic behaviors to dopamine D1 and D2 receptor agonists and antagonists. In prior work, we observed that the dopamine D2 receptor antagonist sulpiride decreases the spontaneous locomotor activity of planarians in an enantiomeric-selective ((−)sulpiride ⩾ (+)sulpiride) and dose-dependent manner (manuscript in preparation). In the present study, we tested if irradiation by UV light of different wavelengths (energy levels) would disrupt the (−)sulpiride–D2 bond and attenuate the effect of (−)sulpiride on planarian locomotor activity.

Brown planarians (*Dugesia gonocephala*, s.l.) were purchased from Carolina Biological Supply (Burlington, NC) and acclimated for at least 24 h before use. Locomotor activity was measured by counting the number of gridlines (0.5 cm apart) that were crossed by planarians placed individually into a clear plastic petri dish (14 cm diameter containing room-temperature water) per minute over a 5-min observation period. Six groups were tested: (1) untreated planarians; (2) planarians soaked in (−)sulpiride (0.1 μM, 0.5 ml; purchased from Research Biochemicals, Natick, MA) for 1 h; (3) planarians exposed to long-wave (366 nm) UV light (UV-L) (5-in perpendicular above); (4) planarians exposed to short-wave (254 nm) UV light (UV-S) (5-in perpendicular above); (5) combination of (2) and (3); and (6) combination of (2) and (4).

The results of all groups are summarized in graphical form in Fig. 1. The data are plotted as the means (±S.E.M.) of 10 planarians/group. Untreated planarians displayed a characteristic constant locomotor activity over the 5-min observation period of about 19 gridlines/min (cumulative mean = 95.5 ± 4.1). Neither UV-L nor UV-S alone had any effect on the locomotor activity of untreated planarians. (−)Sulpiride (0.1 μM) significantly ($P < 0.05$) reduced the slope of planarian locomotor activity, consistent with previous findings. The (−)sulpiride-induced decrease of planarian locomotor activity was significantly ($P < 0.05$) attenuated by UV-L and was attenuated to an even greater extent by UV-S.

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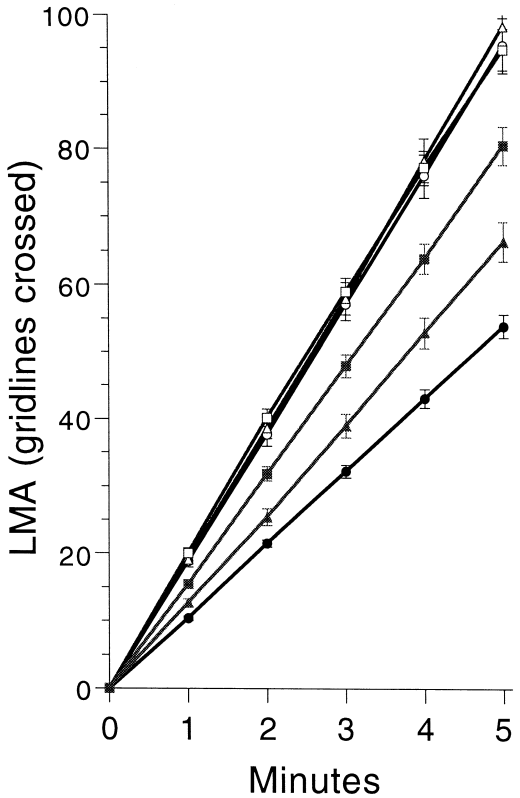

Fig. 1. Locomotor activity of planarians ($N = 10$ each line), expressed as the means ± S.E.M. of the cumulative number of gridlines crossed per minute. (○) untreated planarians; (●) planarians treated with (−)sulpiride (0.1 μM); (△) planarians exposed to UV-L (366 nm) only; (□) planarians exposed to UV-S (254 nm) only; (▲) (−)sulpiride-treated + UV-L; and (■) (−)sulpiride-treated + UV-S.

In summary, the locomotor activity of planarians that was suppressed by (−)sulpiride reverted back toward control (untreated) levels when the planarians were exposed to UV light during testing. It seems unlikely that the observed changes can be explained as toxic effects, since the UV light reverted the locomotor activity toward normal levels and the effect was greater for high-energy UV light (254 nm $= 7.83 \times 10^{-19}$ $J = 4.89$ eV) than for low energy UV light (366 nm $= 5.43 \times 10^{-19}$ $J = 3.39$ eV). The results are more consonant with the view that the UV light either (1) stimulated the release of some as yet unidentified substance in a wavelength-dependent manner, or (2) disrupted the dopamine D2 receptor binding or transduction process. The latter view is consistent with a considerable body of evidence from study of UV-induced photorelaxation of rabbit isolated thoracic aorta suggesting that UV light disrupts the drug-receptor bond (Tallarida et al., 1975, 1979; Jacob and Tallarida, 1977; Raffa et al., 1985). We conclude that this model offers a valuable new tool for the study of dopamine D2 (and possibly other) receptor function in a simple in vivo model.

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