

Paraquat herbicide diminishes chemoreflex sensitivity, induces cardiac autonomic imbalance and impair cardiac function in rats

Pereyra, K.V.
Schwarz, K.G.
Andrade, D.C.
Toledo, C.
Rios-Gallardo, A.
Díaz-Jara, E.
Bastías, S.S.
Ortiz, F.C.
Ortolani, D.
Del Rio, R.

Abstract

Paraquat (PQT) herbicide is widely used in agricultural practices despite being highly toxic to humans. It has been proposed that PQT exposure may promote cardiorespiratory impairment. However, the physiological mechanisms involved in cardiorespiratory dysfunction following PQT exposure are poorly known. We aimed to determine the effects of PQT on ventilatory chemoreflex control, cardiac autonomic control, and cardiac function in rats. Male Sprague-Dawley rats received two injections/week of PQT (5 mg·kg⁻¹ ip) for 4 wk. Cardiac function was assessed through echocardiography and pressure-volume loops. Ventilatory function was evaluated using whole body plethysmography. Autonomic control was indirectly evaluated by heart rate variability (HRV). Cardiac electrophysiology (EKG) and exercise capacity were also measured. Four weeks of PQT administration markedly enlarged the heart as evidenced by increases in ventricular volumes and induced cardiac diastolic dysfunction. Indeed, end-diastolic pressure was significantly higher in PQT rats compared with control (2.42 ± 0.90 vs. 4.01 ± 0.92 mmHg, PQT vs. control, P < 0.05). In addition, PQT significantly reduced both the hypercapnic and hypoxic ventilatory chemoreflex response and induced irregular breathing. Also, PQT induced autonomic imbalance and reductions in the amplitude of EKG waves. Finally, PQT administration impaired exercise capacity in rats as evidenced by a ~2-fold decrease in times-to-fatigue compared with control rats. Our results showed that 4 wk of PQT treatment induces cardiorespiratory dysfunction in rats and suggests that repetitive exposure to PQT may induce harmful mid/long-term cardiovascular, respiratory, and cardiac consequences. NEW & NOREWORTHY Paraquat herbicide is still employed in agricultural practices in several countries. Here, we showed for the first time that 1 mo paraquat administration results in cardiac adverse remodeling, blunts ventilatory chemoreflex drive, and promotes irregular breathing at rest in previously healthy rats. In addition, paraquat exposure induced cardiac autonomic imbalance and cardiac electrophysiology alterations. Lastly, cardiac diastolic dysfunction was overt in rats following 1 mo of paraquat treatment.

Author keywords

autonomic balance

breathing

cardiac function

chemoreflex control

paraquat herbicide