Abstract

Acute air pollutant inhalation is linked to adverse cardiac events and death, and hospitalizations for heart failure. Diesel exhaust (DE) is a major air pollutant suspected to exacerbate preexisting cardiac conditions, in part, through autonomic and electrophysiologic disturbance of normal cardiac function. To explore this putative mechanism, we examined cardiophysiologic responses to DE inhalation in a model of aged heart failure-prone rats without signs or symptoms of overt heart failure. We hypothesized that acute DE exposure would alter heart rhythm, cardiac electrophysiology, and ventricular performance and dimensions consistent with autonomic imbalance, while increasing biochemical markers of toxicity. Spontaneously Hypertensive Heart Failure rats (SHHF, 16 months) were exposed once to whole DE (4 h, target $PM_{2.5}$ concentration: 500 $\mu g/m^3$) or filtered air. DE increased multiple heart rate variability (HRV) parameters during exposure. In the 4 h after exposure, DE increased cardiac output, left ventricular volume (end diastolic and systolic), stroke volume, HRV, and atrioventricular (AV) block arrhythmias while increasing electrocardiographic measures of ventricular repolarization (i.e., ST- and T-amplitudes, ST area, Tpeak-Tend duration). DE did not affect heart rate relative to Air. Changes in HRV positively correlated with post-exposure changes in bradyarrhythmia frequency, repolarization, and echocardiographic parameters. At 24 hours post-exposure, DE-exposed rats had increased serum C-reactive protein and pulmonary eosinophils. This study demonstrates that cardiac effects of DE inhalation are likely to occur through changes in autonomic balance associated with modulation of cardiac electrophysiology and mechanical function, and may offer insights into the adverse health effects of traffic related air pollutants.

Diesel Exhaust Inhalation Increases Cardiac Output, Bradyarrhythmias, and Parasympathetic Tone in Aged Heart Failure-Prone Rats

1. Alex P. Carll[*]
[*]Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, NC, 27599, carll.alex@epa.gov
2. Robert M. Lust[†]
[†]Department of Physiology, Brody School of Medicine, East Carolina University, Greenville, NC, 27834, lustr@ecu.edu
3. Mehdi S. Hazari[‡]
[‡]Environmental Public Health Division, NHEERL, US Environmental Protection Agency, Research Triangle Park, NC, 27711, hazari.mehdi@epa.gov
4. Christina M. Perez[§]
[§]Curriculum in Toxicology, University of North Carolina, Chapel Hill, NC, 27514, clamb@email.unc.edu
5. Q. Todd Krantz[‡]
[‡]Environmental Public Health Division, NHEERL, US Environmental Protection Agency, Research Triangle Park, NC, 27711, krantz.todd@epa.gov
6. Charly J. King[‡]
[‡]Environmental Public Health Division, NHEERL, US Environmental Protection Agency, Research Triangle Park, NC, 27711, king.charly@epa.gov
7. Darrell W. Winsett[‡]
[‡]Environmental Public Health Division, NHEERL, US Environmental Protection Agency, Research Triangle Park, NC, 27711, winsett.darrell@epa.gov
8. Wayne E. Cascio[‡]
[‡]Environmental Public Health Division, NHEERL, US Environmental Protection Agency, Research Triangle Park, NC, 27711, cascio.wayne@epa.gov
9. Daniel L. Costa[¶]
[¶]Office of Research and Development, US Environmental Protection Agency, Research Triangle Park, NC, 27711, costa.dan@epa.gov
10. Aimen K. Farraj[‡]
[‡]Environmental Public Health Division, NHEERL, US Environmental Protection Agency, Research Triangle Park, NC, 27711, farraj.aimen@epa.gov

Running Title: DE alters cardiac & autonomic function

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Corresponding author: Aimen K. Farraj, Ph.D, DABT; U.S. Environmental Protection Agency, Environmental Public Health Division, Mail Code: B143-01, Research Triangle Park, NC 27711; e-mail: farraj.aimen@epa.gov; Tel: (919) 541-5027; Fax: (919) 541-0034

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