Using Air Pollutant and Other Data to Address Important Hypotheses about the Role of PM Components in Determining Health Outcomes

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Introduction: What are the Key Health Effects Questions?

Research Topic 5: Assessment of Hazardous Particulate Matter Components

Cardiovascular Responses to Air Pollution (Particles)

Epidemiologic Observations:

- **Increased cardiac mortality**
- **Increased hospitalizations for CVD**
- **Increased hospitalizations for CHF**
- **Increased arrhythmia (Defibrillator intervention)**
- **Changes in heart rate and heart rate variability**

Major Health Concerns

Does PM Exposure Lead to:

- Accelerated progression of atherosclerosis?
- Alterations in vasculature structure?
- Accelerated progression/causation of COPD?
- Remodeling of the airway (Asthma)?
- Evidence for systemic/immunologic effect?

Pollutant Effects on the Lungs & Heart

Early (hrs)	• Epithelial Injury
	• IL-8, IL-6, RANTES, MIP-2, etc.
	• Bronchoconstriction
	• Airway Inflammation
	  • PMN
	  • Eosinophils
	  • Lymphocytes
		• Endothelial Dysfunction
		• Adhesion molecules
		• ↑ Circulating IL-6
		• Platelet activation
		• Prothrombosis
		• ↓ DLCO
		• Vascular tone
			• ↑ HR
			• HRV
			• Autonomic NS
			• Ischemia
			• Arrhythmias

Late (days)	• ↑ Airway permeability • ↑ A-a pO_2	• ↑ Plasma viscosity • ↑ Fibrinogen, CRP, • ↑ Coagulation	• ↓ HRV • Arrhythmias
Later (Wks-mos)	• Repair & remodeling • Progression of airways disease	• Atherosclerosis	• Progression of coronary artery disease

Cardiovascular Responses to Air Pollution (Particles)

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Assessment of Components: How might it Clarify CV Observations

Might explain variable response: (Pope & Dockery 2006)

Reported 9 studies of HR responses:

a) In 5 studies, ⇑ pulse rate

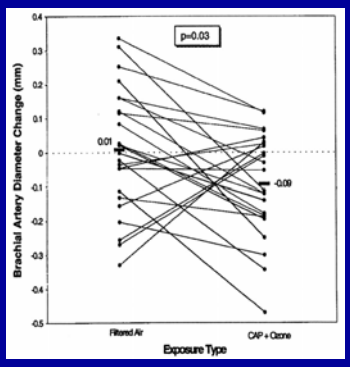
b) In 2 studies, ⇓ pulse rate

c) In 2 studies, no change

Similar variation with components of HRV

Particles and Ozone Cause Acute Arterial Vasoconstriction

Brook, et al. Circulation 2002



The Major Component Hypotheses

- PM mass
- PM particle size, surface area
- Ultrafine PM
- Reactive transition metals
- Organic compounds (e.g. on diesel PM)
- Acids
- Biogenic particles
- Sulfates and nitrates
- Peroxides
- Soot (e.g.elemental carbon)
- Co-pollutants - SO2, CO, etc.

Goal of this Session

To Better Understand How We can Use Air Pollutant Data to Address Important Hypotheses about the Role of PM Components in Determining Health Outcomes

Probably Greater Opportunity to Use this Type of Analysis When we Physiological Measurements with Variability in Response

Using Air Pollutant and Other Data to Address Important Hypotheses about the Role of PM Components in Determining Health Outcomes:

Lessons from ARIES: Paige Tolbert (Emory)

Challenges to Testing Hypotheses in PM Component Studies: Lucas Neas (EPA)

Panel Discussion

Approaches to Using PM Components to Identify Sources: Phil Hopke

Using Air Pollutant and Other Data to Address Important Hypotheses about the Role of PM Components in Determining Health Outcomes:

Panelists: Lucas Neas, Paige Tolbert, Bryan Hubbell, Joel Schwartz

a) What are the challenges to using existing data in different types of epidemiologic studies -
   - -Limitations of existing datasets to characterize spatial and temporal variation;
   - - Imputation of missing data over time & space;
   - - Correlation among components, handling of data below detection limits;
   - - Other sources of measurement error

Panel Discussion (Cont'd):

b) What current issues are most significant in affecting comparability of results

c) Other challenges: for example, ultrafine and coarse particles

d) What are the issues for which we can agree on solution?