II. Medizinische Klinik

Environmental hazards – air pollution and noise as novel risk factors

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Pollution

Global Burden of Disease Study 2012, Lancet
Pollution

- Airborne particulate matter (PM)
- Ozone
- Nitrogen dioxide (NO2)
- Volatile organic compounds (benzene)
- Carbon monoxide (CO)
- Sulphur dioxide (SO2)

- Road traffic
- Power generation
- Industrial sources
- Residential heating
Six-cities and APHEA studies: HR 1.26-1.97

Not the result of harvesting (mortality displacement, or advancement of death by no more than a few days for severely ill individuals)

Mechanistic insight

Classical pathway

- CRP
- Plasma fibrinogen
- Plasma viscosity
- Adhesion molecules
Overall, the proarrhythmic potential of Oxidative stress is a critical consideration.
„Reverse preconditioning“

Peters Circulation. 2001
Mechanistic insight

Alternative pathway: direct translocation

![Graph showing GSH/GSSG ratio for different modes (0, Coarse 50, Fine 50, UFP 12.1) with error bars.]

![Diagram illustrating the alternative pathway with labels for macrophage, organic compounds, surface metals, neutrophil, oxidative stress, inflammatory mediators, particle translocation, classical pathway, and alternative pathway.]

![Micrograph showing cellular structures labeled P, M, M, M, M, and M.]

![Diagram showing relative sizes of RBC (8.0 μm), PM2.5 (2.5 μm), and Nanoparticle (0.1 μm).]
Mechanistic insight

Alternative pathway

Yatera Am J Physiol 2008
Factor XII activation is essential to sustain the procoagulant effects of particulate matter

Kilinc et al, J Thromb Haemost 2011
Courtey Prof H. Ten Cate

Diesel exhaust inhalation increases thrombus formation in man

Andrew J. Lucking, Magnus Lundback, Nicholas L. Mills, Dana Faratian, Stefan L. Barath, Jarnshid Pourazar, Flemming R. Cassee, Kenneth Donaldson, Nicholas A. Boon, Juan J. Badimon, Thomas Sandstrom, Anders Blomberg, and David E. Newby
(Aircraft) noise
Noise
How loud is too loud?

- WHO recommends $<40\text{dB(A)}$ during the night
- $<55\text{dB(A)}$ during the day

HR 1.07-1.18

Groups at risk:
- Children
- Chronically ill, elderly
- Shift workers
- Less affluent

Kälsch Eur H J 2013
Pathophysiological reactions to stress

Henry and Stephens, 1977
Subcortical arousal – annoyance is not necessary

Effect of nighttime aircraft noise exposure on endothelial function and stress hormone release in healthy adults
Aircraft noise at night induces:
- Endothelial dysfunction
- Oxidative stress
- Catecholamine release
- Increased vessel stiffness (PTT)

- Implaired sleep quality
- No habituation, rather priming
- Independent of annoyance

Schmidt FP et al. Eur Heart J. 2013
Effect of nighttime aircraft noise exposure on endothelial function and stress hormone release in healthy adults
OR 1.07-1.17 in different studies

- Hypertension
- Ischaemic heart disease
- Stroke
- Dementia
- Diabetes mellitus
Long-term exposure to fine PM and night-time traffic noise are both independently associated with subclinical atherosclerosis and may both contribute to the association of traffic proximity with atherosclerosis.

**Conclusion**

- Implications:
  - Ischemic heart disease
  - Arrhythmias
  - Heart failure
  - ICD discharge
  - Hypertensive crises
  - Ischemic stroke

- Habituation/priming, harvesting
- Annoyance
- Additive effect
- No randomized study possible
- Political implications