Polveri ultrafini e nanoparticelle

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Le Nanopatologie

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Nano
pathology
The Role of Micro and Nanoparticles in Biomaterial-Induced Pathology

Project
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Nanopathology

is the branch of learning that deals with how the organism reacts to the presence of micro- and nano-particles
Unvoluntary nanoparticles are already released by incineration and power-plants, fondries and they are disseminated in the environment.
Impact of the environmental nanopollution
Mechanisms of entrance of nanoparticles into the human body

Respiratory system

Blood circulation
Mechanisms of entrance of nanoparticles into the human body

Digestive system

Lymph circulation

Size <20 μm

Polluted food
Pulmonary Mesothelioma

Asbestos fiber
Lung

*Nemmar et al.: Circulation 2002, 105:411*

*Passage of 100nm sized particles in the blood and in the liver*
Ni Group:
nodules observed on both sides (particles + bulk material) in all animals 6 months after implantation

Co Group:
Nodules observed on the left side (nanoparticles IM) in all cases 8 months after implantation
- nothing on the right side (bulk material implanted SC)
Nickel and Cobalt nanoparticles induced rabdomiosarcoma after 6-month implantation in rats, the bulk samples only fibrotic capsules or granulomas.
Nanoparticles of Gold in a liver granuloma. The patient was treated with colloidal gold particles for knee arthrosis.
Bladder Carcinoma in a mine-sweeper
Gulf-War kidney

Cluster of nano Hg-Se

20 μm

Hg, Se, S, Cl, O, Na, Ca

Hg Se
Barium-sulphate nanoparticles found inside a thrombus
BLOOD

Soldier’s wife affected by Burning Semen disease

Red cells
Bladder cancer with Cobalt & Tungsten
Colon cancer
with clusters of Silver nanoparticles
Industrial Hamburger
Hay

![Hay Image]

![X-ray Spectrum]

C, O, Mg, Al, Si, Ag

KeV
Gas emission of a diesel car
Blood clot in vivo
Cancerogenic liver tissue with nanoparticles of Titanium inside a cell nucleous
Liver cancer
Section of a lymph node in a civilian of Sarajevo affected by Hodgkin Disease (FEG-ESEM)
Particle of Antimony- Cobalt found in a soldier’s sperm
ESEM image of sperm with a foreign body

spermatozoon

Lead nanoparticle

20 μm
Malformed lamb born inside a groundfire in Sardinia, 2003
Internal organs of the malformed foetus
Malformed lamb from Sardinia
Neu-Laxova syndrome is a rare congenital abnormality characterised by intrauterine growth restriction, microcephaly, facial dysmorphism, short neck, edema, scaly skin and perinatal death. Additional features such as spina bifida, cryptorchidism and shallow orbital cavities have been reported. Chromosomal analysis in reported cases has revealed a normal karyotype and an autosomal recessive inheritance has been postulated.
“Taschentuch-Test“ am Auspuff-Endrohr

herkömmlicher Diesel

PEUGEOT HDi mit Partikelfiltersystem FAP
Polvere cittadina con Cerio Palladio Zirconio
Particelle su filtro trovate in area urbana
Polmone

Ce Nd La

10μ
Cigarette from Sarajevo
Cigarette from Baghdad
Anchovy’s liver from the Adriatic sea
Uncontaminated bread
Factors influencing the pathogenicity of micro- and nanoparticles

**PHYSICAL**
- Foreign body
- Size
- Shape
- Surface area
- Concentration
- Intake velocity
- Radioactivity

**CHEMICAL**
- Composition
- Corrodibility
- Speciation

**BIOLOGICAL**
- Organ (cell) involved
- Health condition
- Individual variability
What is the cell reaction to a discrete, non-continuous stimulus?
Balb Cells with Co nanoparticles by Sabbioni J RC-Ispra
Hematite nanoparticles inside a 3T3 cell nucleus during the mitotic phase
Project objectives
- In-vitro tests of interaction of engineered nanoparticles (NP) with cells,
- Identification of the modes of NP-cell interaction
- Application of the laboratory-developed cellular models on the field investigations

Specific challenges:
- Development of:
  - 1 in vitro nanotoxicological tests, and single cell-to-NP interaction
  - 2 new sensors to detect specific NP-induced biological reactivities
  - 3 evaluation of NP pollution in industrial settings

Expected impact:
- Better understanding of the possible risks related to nanopollution and criteria to assess the risk case by case.
- Assessment of the health risk for nanotechnological operators, citizens and end-users and identification of safety procedures
- Criteria for prevention and contribution to Standards for policy makers
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Acronym: DIPNA

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Thanks

Memento quia pulvis es et in pulverem reverteris