HISTOPATHOLOGICAL LESIONS CAUSED BY PETROGENIC HEAVY METALS (CADMIUM, BARIUM, MERCURY AND LEAD) IN MAMMALS AND BIRDS

ANDREU MASDEFIOL GARRIGA - FACULTAT DE VETERINÀRIA UAB - JUNY 2016

INTRODUCTION & OBJECTIVE

Since 1970s, the oil industry in the Peruvian Amazon has inflicted severe damage to the ecosystems in which the indigenous communities live, and there are indications that pollutants are present in concentrations hazardous to the local human population. This literature review aims to determine the natural and anthropogenic sources of four petrogenic heavy metals (cadmium, barium, mercury and lead), and the symptoms and histopathologic effects that may produce.

Table 1: Sources of Cd, Ba, Hg and Pb

		Cadmium	Barium	Mercury	Lead
Oil and oil by- products	**Formation waters**	<0.005–0.2 mg/L	1.3–650 mg/L	<0.001–0.002 mg/L	0.002–8.8 mg/L
Air	**Other mining**	-	Gold, coal	Gold	-
	Industry	Metal and steel	Glass, paint	-	Metal, electricity
	Geologic activity	Volcanoes	-	Volcanoes	-
	Others	-	-	Mineral deposits, fires	Formerly, leaded fuels
Water	**Soil erosion**	-	Yes	Yes	-
	Industry	Chemical and metallurgic	-	Chemical, metallurgic, textile, pharmaceutical	Iron and steel
	Mining	-	Gold	Gold	-
	Others	Sewage waters	-	-	-
Soil	**Mining**	-	Gas	Gold	Coal and metal
	Biocides	-	Insecticides	Pesticides	-
	Industry	-	-	-	Electric
	Waste	Sewage waters and products containing metal	-	-	Industrial emissions
	Others	Soil fertilisation, atmospheric pollution, geologic activity, petrol burning	-	-	Formerly, leaded fuels
Food		Cereals, tobacco, vegetables, animal target organs	Vegetables, seaweed, cereals, nuts and fish	Long lived, large and predator fishes	Vegetables, meat, coffee, tea, cocoa and seafood

Table 2: Symptoms caused by the intoxication of Cd, Ba, Hg and Pb

System	Cadmium	Barium	Mercury	Lead
Respiratory	Humans: Dyspnea, chest pain, conjunctivitis, rhinitis, non-cardiogenic pulmonary edema. Chronically, emphysema	Humans: Unspecific affectation	Humans: Dyspnea, cough, pneumonia, edema and emphysema, pneumothorax	-
Digestive	Humans: Gastrointestinal irritation, vomiting, diarrhoea, salivation, colic	Humans: Stomach ache, vomiting. Rats: In severe poisonings, intestinal obstructions and haemorrhages	Humans: Stomatitis, abdominal pain, nausea, vomiting, inflammatory bowel disease, gastrointestinal perforation	Humans: Colic, constipation, nausea, anorexia and vomiting
Reproductive	-	Humans: Unspecific affectation	-	Humans: Decreased fertility, miscarriages, stillbirths, infant mortality, sexual dysfunction and impaired spermatogenesis
Haematic	Humans: Iron deficiency anemia	Humans: Unspecific affectation	Humans: Leukocytosis, neutrophilia	Humans: Normocromic normocytic anemia
Musculoskeletal	Humans: Osteoporosis, osteomalacia, spontaneous fractures	Humans: Muscular weakness and paralysis	-	Humans: Joint pain, muscle weakness
Renal	Humans: Renal failure, tubular nephropathy, decreased glomerular filtration rate	Humans: Hemoglobinuria, and renal failure and degeneration	-	Humans: Enzymuria and proteinuria, interstitial nephritis, chronic renal failure, alteration of the renin-angiotensin-aldosterone system. Rats: interstitial fibrosis, decreased glomerular filtration rate
Neurologic	Rats: Peripheral neuropathy Humans: behavioural changes, olfactory function impairment	Humans: Paralysis	Humans: Ataxia, tremors, depression, nervousness, fatigue, insomnia, irritability, Parkinson, dysarthria	Nonhuman primates and rats: learning deficits. Humans: attention deficit and hyperactivity, irritability, headache, neuropsychological deficits, chronic encephalopathy, decreased peripheral nerve conduction, loss of libido, lassitude, loss of skills. In children ataxia, seizures, encephalopathy, decreased performance, cognitive deficits
Cardiovascular	-	Rats: Ventricular tachycardia, disruption of the heart rate, hypotension	-	Humans: hypertensive vascular disease, increased systolic blood pressure. Rats: Increased systolic blood pressure and the risk of ischemic arrhythmias
Cancer	Humans: prostate, lung, breast, kidney, testis, bladder, gall bladder, pancreas. List of IARC Group 1 carcinogen	-	-	Rats and Mice: pituitary, adrenal of, prostate, breast, kidney and brain gliomas. List of IARC "Probable carcinogen"
Death	Not reported	Yes	Yes	Not reported
Others	Widespread organic failure, fluid loss	Rats: Decrease in body weight	Ophthalmic signs, hipersensitivity to mercury	Genotoxic effects

CONCLUSIONS

1: Cadmium and barium are the best indicators of petrogenic pollution because of the high presence in the oil by-products and the low concentrations in the environment.

2: The intoxication by cadmium and lead causes the most serious histopathological lesions, although mercury may cause important neurological alterations.