Maternal transfer of mercury to offspring in phocids

Habran S.[1], Pomeroy P.[2], Debier C.[3], Crocker D.[4], Houser D.[5] and Das K.[1]

[1] Laboratory for Oceanology - MARE Center, University of Liege, Liege, Belgium
[2] NERC Sea Mammal Research Unit, Gatty Marine Laboratory, University of St Andrews, St Andrews KY16 8LB, Scotland, UK
[3] Unit of Nutrition Biochemistry, Catholic University of Leuven, Louvain-la-Neuve, Belgium
[4] Department of Biology, Sonoma State University, Rohnert Park, Ca 94928, USA
[5] BIOMIMETICA, Santee, Ca 92071, USA

Introduction

Marine mammals may display high mercury (Hg) levels in their tissues, which raises the question of the importance of toxic metal transfer from mother to offspring. Indeed, Hg could be transferred from mothers to fetuses via the placenta and to suckling pups via the milk, potentially affecting them during their most sensitive periods of development. Some lactating female phocids fast during the suckling period. This fasting period involves not only an important mobilization of energy reserves, but also mobilization of potentially associated contaminants.

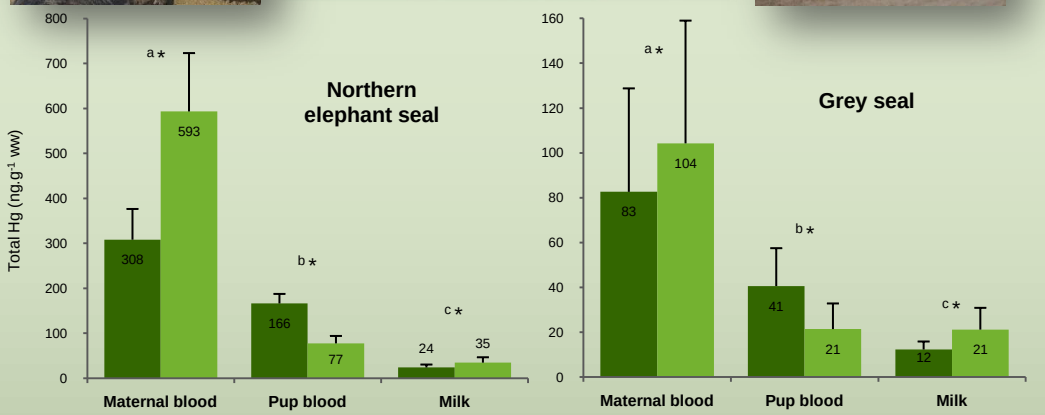
We studied and compared maternal transfer of Hg to offspring in two phocid species: the northern elephant seal (*Mirounga angustirostris*) and the grey seal (*Halichoerus grypus*).

Materials & Methods

This study was conducted at Año Nuevo State Reserve, California, during the 2005 breeding season of northern elephant seals (NES), and on the Isle of May, Scotland, during the 2008 breeding season of grey seals (GS). Hg concentrations were measured in whole blood and maternal milk of mother-pup pairs (10 for NES and 21 for GS) in early and late lactation. Total and organic Hg levels were analysed by atomic absorption spectroscopy (DMA-80, Direct Mercury Analyzer, Milestone). Organic Hg was only measured in grey seal whole blood and was first extracted and separated by an acid leaching (H_2SO_4/NaBr/$CuSO_4$) followed by extraction of the organic Hg halide with toluene.

Results & discussion

	NES	GS
Lactation	25-28 d	18-21 d
Mass	*Early ⇨ late lactation*	
Mother	453 ⇨ 330kg	164 ⇨ 123kg
Pup	43 ⇨ 114kg	18 ⇨ 39kg
Foraging area	Deep waters in Eastern and Central North Pacific Ocean	Inshore waters in North Sea



Total Hg levels (ng.g^{-1} ww) in whole blood of mother-pup pairs and maternal milk in northern elephant seal (left) and grey seal (right) in early and late lactation. Different letters and * indicate significant difference between tissues and periods (*i.e.* early and late lactation) respectively ($p<0.05$).

Total Hg levels in elephant seals were 4-5 times higher for blood and twice higher for milk than Hg levels in grey seals. Although levels were different, both species showed a similar distribution and dynamics of Hg in blood and milk throughout lactation.

Results indicated that Hg passed from the maternal tissue into the milk. The mean levels of total Hg in milk ranged from 12 to 35 ng.g^{-1} ww. From the first days after birth, pups already displayed relatively high blood Hg levels in comparison with their mother, suggesting that a high Hg transfer through placenta occurred.

Blood Hg levels in mothers and pups varied significantly throughout lactation. While maternal levels increased, pup levels were reduced by half between the beginning and the end of lactation. Remobilization of proteins and lipids during fasting and milk production in mothers might lead to a release of Hg in blood and therefore increase the levels in late lactation. On the contrary, Hg would be progressively stored in pup organs during their development. Decreasing Hg levels in pups also suggest that the Hg intake via the milk might be lower than that via the placenta.

Organic Hg levels were only analyzed in grey seal whole blood and represented 85-95% of total Hg. Any variation of organic Hg was not observed throughout lactation.

Conclusions

This study highlights

- ✓ a **transplacental** and **transmammary** transfer of Hg in both phocid populations.
  - ➢ However, further toxicology studies are needed to help understand the potential impact of this Hg transfer.
- ✓ **organic Hg** is the main Hg species in whole blood of mothers and pups (range 85-95% of total Hg)
- ✓ physiological processes such as lactation and/or fasting can **modify** Hg levels in the blood of mothers and pups.
  - ➢ Therefore, such processes and body condition should be considered carefully when interpreting Hg levels in the framework of biomonitoring.

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Corresponding author: S.Habran@ulg.ac.be