

Occupational exposure of dermatology nurses to polycyclic aromatic hydrocarbons following application of coal tar ointments

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Introduction

- Coal tar ointments (CTO) are used in the treatment of psoriasis and eczema in the dermatology clinic of our hospital.
- CTO contains polycyclic aromatic hydrocarbons (PAH)
- PAH appear to play a part in the therapeutic effect, although the mechanism is not understood.
- It is uncertain if the high (but short-term) exposures in patients causes an increased risk of cancer.
- Since exposure to PAH is a confirmed cancer risk, a study of the occupational exposure of the nurses applying the CTO is warranted.

Introduction

- The tar is added to zinc oxide paste or white petrolatum.
- The coal tar is applied on the affected skin in thick layers.
- The treated skin is then covered with a tubular bandage.
- If needed sometimes the entire body surface is treated (such patients are admitted to the hospital)

	PAH content (µg/g CTO)	
	Pyrene (PYR)	Benz[a]pyrene (BaP)
Dark	965	455
Light	3.0	0.13

Introduction

The current practice:

- Treatment of each patient takes 10 – 30 minutes
- Gloves were used but not when treating children

Fitting tubular bandage in young patients is often done without proper protection of the skin

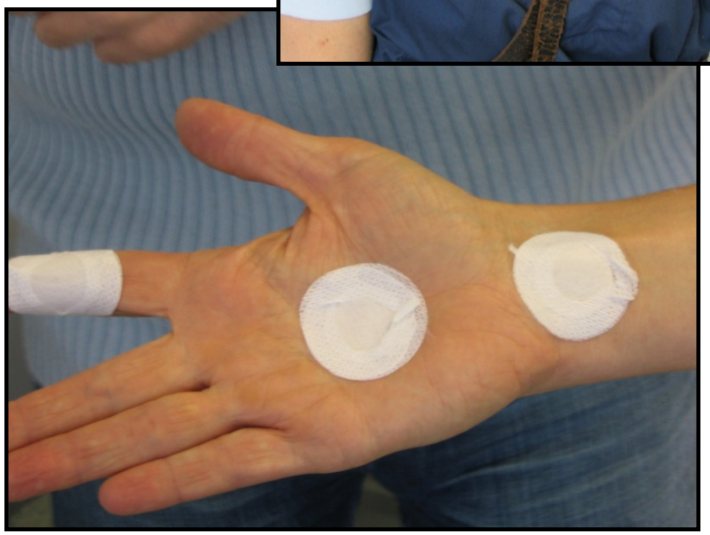
Aim

- Does the application of CTO lead to an increased uptake of PAH in nurses?
- What is the most important porte d'entrée?
- Does the use of gloves lead to a reduction in uptake?

Dermatology nurses exposed to PAH

Methods

- PYR and BaP were used as markers
- Gas phase PAH were determined using XAD-2
- Particulate PAH were determined on Teflon filters
- Contamination of the skin was determined using pads containing polypropylene membrane filters



Methods

- Uptake of PAH was assessed by determination of 1-hydroxypyrene (1-OHP) in spot urine samples
- One pre-shift sample was collected to determine baseline excretion
- Urine samples were collected until 24 h after the start of the use of CTO
- The nurses registered the volume of each collected void.
- Using this procedure the total amount of 1-OHP excreted during 24 h could be calculated.

Dermatology nurses exposed to PAH

Results

Group results (median and range) from 12 nurses in 2004.
PAH were not detected in the air (PYR < 1.2 ng/m^3; BaP < 0.02 ng/m^3)

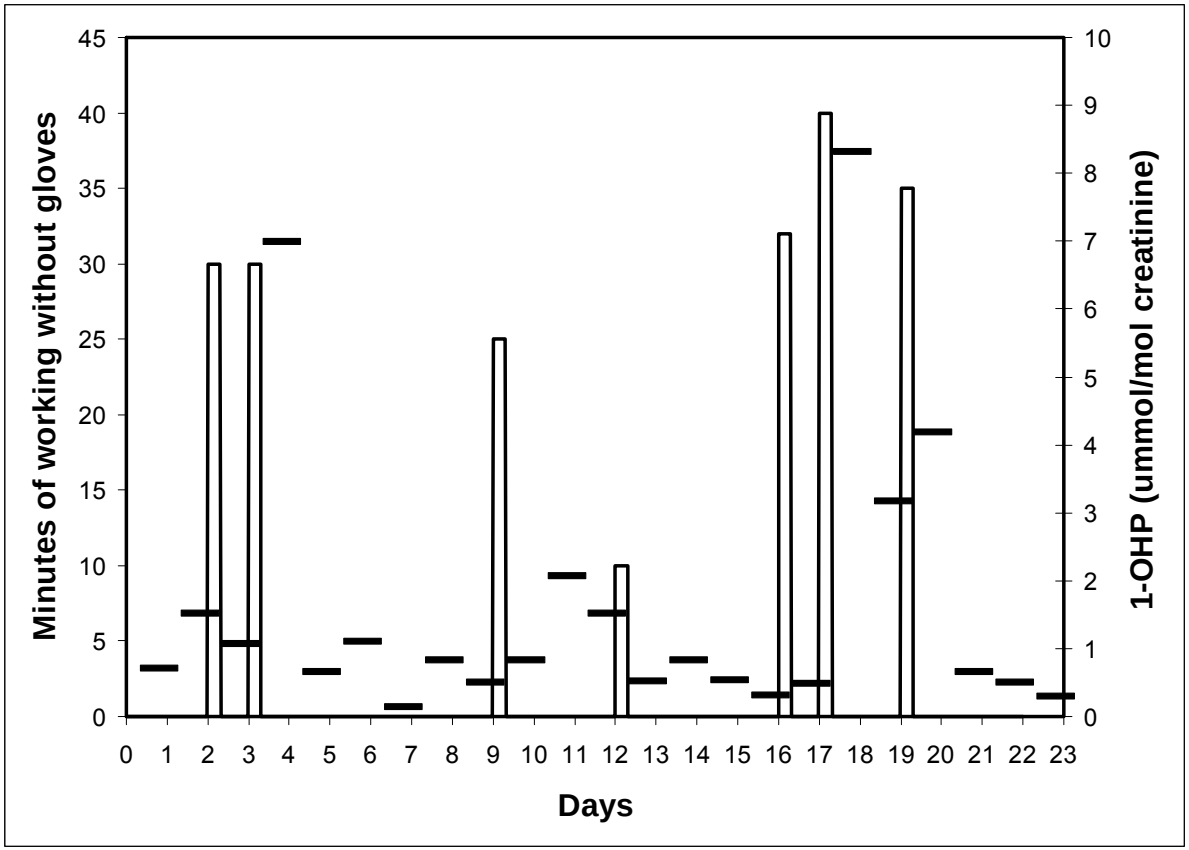
Skin contamination				Excretion of 1-OHP		
Finger (ng/cm^2)	Palm (ng/cm^2)	Wrist (ng/cm^2)	Total (ng)	Highest (µmol/mol crea)	Change from baseline (µmol/mol crea)	Total (nmol)
52 (9.4-189)	5.0 (0.2-202)	16 (0.2-300)	174 (1.1-338)	0.12 (0.04-0.35)	0.04 (-0.09-0.18)	2.5 (1.3-8.3)

Amount of CTO applied
Duration of CTO treatment
Amount of PAH on skin
} no correlation with 1-OHP excretion

Dermatology nurses exposed to PAH

Results

Three weeks follow up in one nurse working a total of 422 h with CTO (including 202 h without gloves, as shown below)

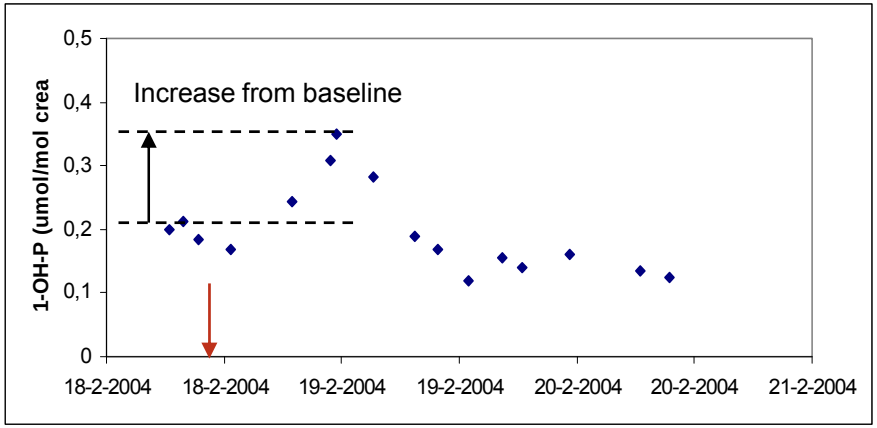


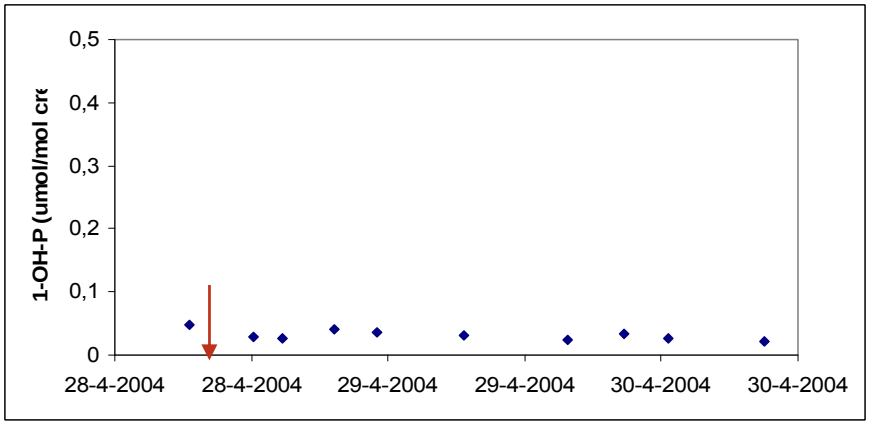
Dermatology nurses exposed to PAH

Results

Examples of follow-up of nurses who treated just one patiënt. The moment of treatment is Indicated by ↓

In nurses who reported visible contamination Of hands the excretion of 1-OHP was (on average) <u>two-fold</u> increased





Dermatology nurses exposed to PAH

Results

Nurses were asked to treat one patient with and one patient without gloves. Below the pairs of 35 observations are shown.

	Total amount excreted (µmol)	Highest post-exposure level (µmol/mol creat)	Baseline (µmol/mol creat)	Change from baseline (µmol/mol creat)
Without gloves	1.34 (0.19 – 5.6)	0.31 (0.06 – 0.98)	0.05 (0.01 – 0.28)	0.23 (0.00 – 0.74)
With gloves	0.69 *** (0.17 – 3.3)	0.12 (0.04 – 0.70)	0.04 (0.01 – 0.13)	0.06 (0.00 – 0.57)
Change	-0.58 (-1.0 – 5.1)	-0.18 (-0.81 – 0.04)	0.00 (-0.09 – 0.14)	-0.16 (-0.74 – 0.02)

*** $p < 0.001$

Dermatology nurses exposed to PAH

Results

2004: loose-fit PE gloves

2007: tight-fit vinyl gloves + Tyvek© sleeve

Results

Comparison of skin contamination on total of three pads (ng)

Subgroup	Sub-stance	2004		2007	
		Median	Range	Median	Range
Paired observations (N = 6)	PYR	349	145.6-1113	0.9**	nd – 35.6
	BaP	184	60.5-394	4.6*	0.2-31.7
Unpaired observations (N = 10 - 12)	PYR	173	1.1-1113	3.7*	nd-93.5
	BaP	107	5.5-394	3.2*	0.5-171

nd = not detected; * $p < 0.005$; ** $p < 0.001$

Results

Comparison of excretion of 1-OHP (total and increase from baseline)

Subgroup	1-OHP	2004		2007	
		Median	Range	Median	Range
Paired observations (N = 6)	Total (nmol)	1.6	0.84-5.0	0.69*	0.45-3.4
	Increase (µmol/mol creat)	0.05	-0.01-0.18	0.03	0.01-0.17
Unpaired observations (N = 10 –12)	Total (nmol)	1.5	0.74-5.0	0.64*	0.15-2.8
	Increase (µmol/mol creat)	0.04	-0.09-0.18	0.02	-0.01-0.05

* $p < 0.05$

Discussion

- We were uncertain if the results obtained in 2004 could be interpreted as ‘elevated occupational exposure’. However, the decrease shown in 2007 clearly indicated that there was room for improvement.

- The determination of PAH contamination on pads gives an indication if gloves protect the skin but it does not provide an accurate estimate of skin contamination

Conclusions

- The skin contamination on pads was reduced dramatically (two orders of magnitude)
- This resulted in a > 50 % reduction of uptake of PAH as indicated by excretion of 1-OHP

“Before treatment”

“After treatment”

Recommendations

- The department should order longer gloves to protect the wrist
- Repeat the study in 2-4 years

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