

The Contribution of Skin Contamination Dose to the Total Extremity Dose of Nuclear Medicine Staff

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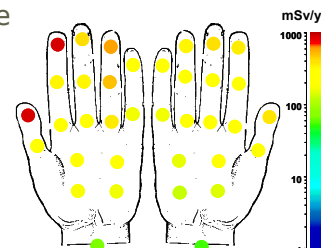


Universitair Ziekenhuis Brussel

Introduction

Manipulation syringes and vials in Nuclear Medicine

- Relatively high dose rates to hands
- Not uniformly distributed
- Annual dose limit easily exceeded at high workload



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Contaminations?

High doses can be expected

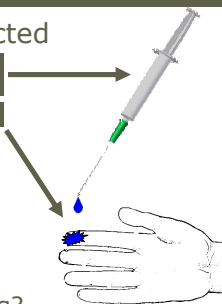
2ml-syringe with typical reference activity for common diagnostic procedure

20µl spot, 15 min exposure time

Cumulated skin dose	
^{99m} Tc	15 mSv
¹⁸ F	500 mSv !

Delacroix et al.

Dose from "sealed" manipulations: tip of iceberg?



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Origin of contaminations

Directly

- Spills
- Removing needles/catheters
- Body fluid of patients

Cross contamination

- Contaminated surfaces
- Contaminated tools / protection equipment

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Detection and quantification of contaminations

Contamination check by workers

- Time consuming, asks for self-discipline
- Short half-life radionuclides → late detection difficult
- Difficult to quantify with common contamination monitors

On-site survey needed

Protocol based on on-site detection/localisation/quantification

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Methodology/Protocol (1)

Contamination detection

- On site survey during working day
- NaI-contamination monitor



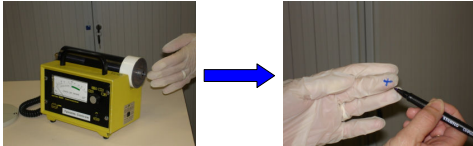
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Methodology/Protocol (2)

Contamination localisation

- Protective glove over contamination
- NaI-contamination monitor, small 1cm²-collimator
- Marking location



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Methodology/Protocol (3)

Calibrated Gamma Spectrometer

- NaI Probe mounted in large 1cm²-collimator
- Probe adjustable in height (equilibrium between dead time and sufficient count rate)
- 3 spectra acquired during 60s (repositioning finger)
- Decontaminate and recount



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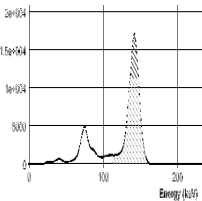
Methodology/Protocol (4)

Spectrum Analysis

- Nuclide identification
- Activity calculation averaged over 1cm²

Calculation of dose rate and cumulated dose

- (3 ref. data)
- Delacroix et al.
 - Varskin 3
 - MCNP

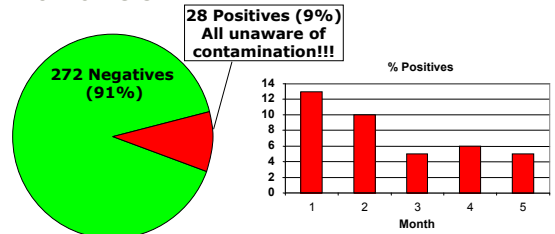


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Results: Incidence

5 months survey, 30 days, 300 inspections, 10 workers



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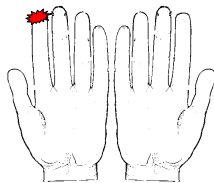
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Results: Nature of contamination

Not uniform deposits but local contaminations! (90% cases)
Mostly index tip of non dominant hand (70% cases)

Out of 28 positives:

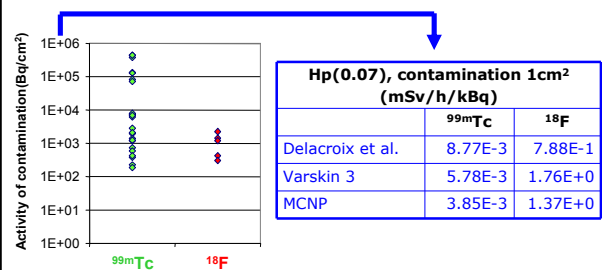
- 23 ^{99m}Tc-radiopharmaceuticals
- 5 ¹⁸F



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Results: Order of magnitude



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Factors in calculation of cumulated skin doses

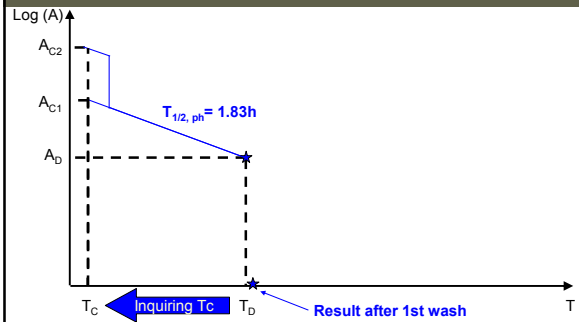
Exposure time?

- Inquiring possible time of contamination (T_c)
- Exposure starts from T_c

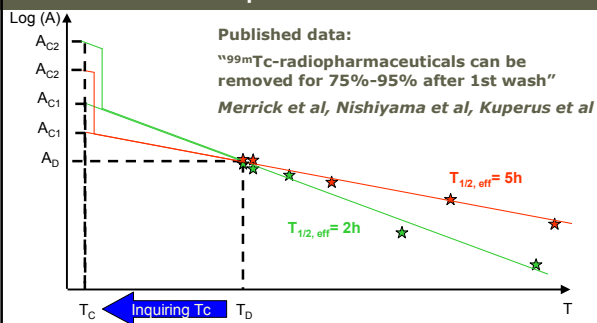
Efficiency of decontamination? $T_{1/2,eff}$?

- Determined by repeated washes and measurements of positive results
- Radiopharmaceutical-related
- ^{18}F FDG can be removed completely after 1st wash
- ^{99m}Tc -radiopharmaceuticals difficult to remove

Results: Decontamination of ^{18}F FDG



Results: Decontamination of ^{99m}Tc -radiopharmaceuticals



Results: Calculated cumulated skin doses

Conservative assumption

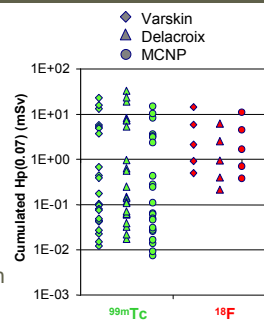
^{99m}Tc : A_{c1} , T_c , $T_{1/2,eff}$ (individual)
Exposure time: 48h

^{18}F FDG: A_{c1} , T_c , $T_{1/2,ph}$
Exposure time $T_D - T_c$

For individual worker:

Values up to 30mSv can be measured due to single contamination!

> 500mSv/y based on random survey of 30 days inspection

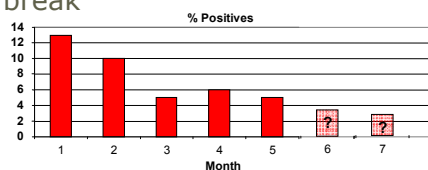


Next...

Refine dose rate calculations, clarify differences

Resume contamination survey after 2 months break

Trend?



Next...

$T_{1/2,eff}$ of radiopharmaceuticals?

- Further analysis in vivo in case of positive contamination
- Determine $T_{1/2,eff}$ using pig skin samples

Most effective decontamination protocol?

This survey=sample! → survey in other hospital?

Conclusions

Contamination survey in NM

- Positive results on a regular base
- Enables to quantify activity/dose rate

Calculation of cumulated dose

- Influenced by dose rate values, T_c and $T_{1/2eff}$
- More research needed

Possible contribution to the total extremity dose can easily exceed 500mSv/y (based on sample)

Thank you for your attention!