

PERSONAL EXPERIENCE WITH DOSIMETRY ATTEMPTS

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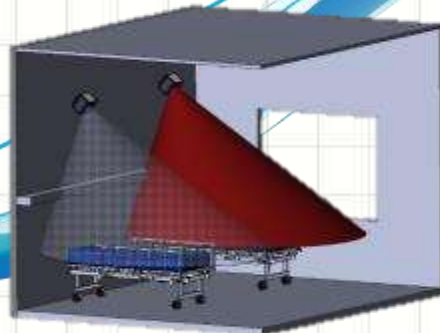
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Outline

- Sort history
- Beginnings
- tumor and WB dosimetry experiments
 - mIBG
 - DTCA
- Further development



Short history

- Clinic of Nuclear Medicine and Endocrinology 2nd Faculty of Medicine and Charles University in Prague (CNME, MUH) has a long term experience with dosimetry
- Adaptation of experience and further development brought out some clinical important results during years

Short history

- inspiration: at the dawn of Nuclear medicine in former Czechoslovakia: Václav Petržílka, Josef Šilar, Jiří Bouček
- Inspiration from work of Doc. J. Heřmanská and Ing. J. Zimák
 - Bayesian modelling of I-131 biokinetics
 - Progress in modelling of biokinetics of ^{131}I . V: Radioactive Isotopes in Clinical Medicine and Research XXII. H. Bergmann, A. Kroiss, H. Sinzinger, eds. Birkhauses Verlag, Basel - Boston, Berlin, 1997,367-370

Short history

- Bayesian estimation of effective half-life in dosimetric applications. *Computational Statistics and Data Analysis*, 24, 1997, 467-482.
- THE ORIGINAL MODEL
- <https://www.researchgate.net/publication/302041812/download>
 - inspiration for bio kinetics modeling abroad
 - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3432867/pdf/cbr.2011.1053.pdf>

History

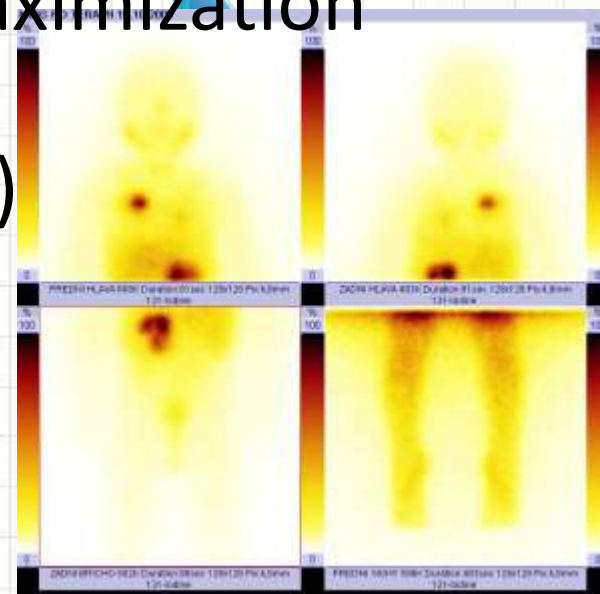
- Discontinuity of work after 2000
 - dosimetry was not the point, poor support, unfortunate events
- Restart?
 - Whole body dosimetry for child patients treated by ^{131}I -mIBG was set since 2009
 - Tumor dosimetry experiments supported 2013
 - Newer technology of whole body monitoring is now being implemented

The background features a light gray grid pattern. Overlaid on this are several flowing, wavy blue lines that create a sense of motion and depth. These lines are most prominent on the left and right sides, framing the central text. The lines vary in opacity and thickness, giving them a layered, ethereal appearance.

Tumor and WB dosimetry experiments

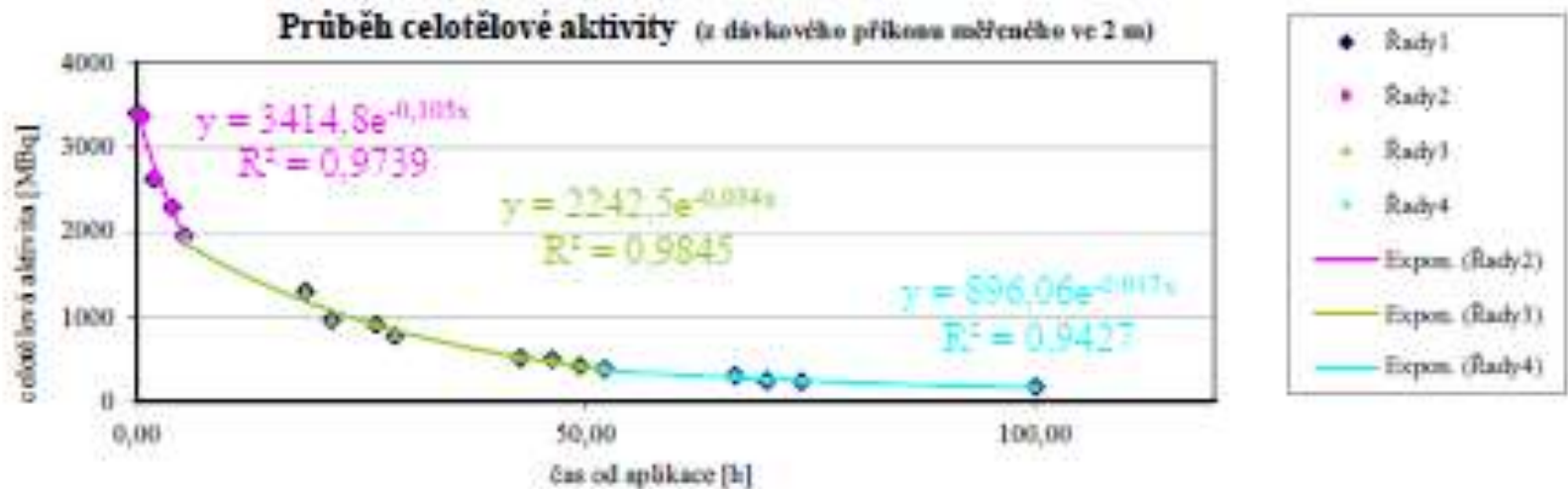
I-131 mIBG – neuroblastoma +

- ❖ 1996 – 2008 fixed activities up to 7,4 GBq (children, adults)
- ❖ 2009 – WB dosimetry (children)
 - ❖ I-131 mIBG so called ,last chance‘
 - ❖ From G. Flux publications on mIBG therapy
- ❖ Since 2012 WB dosimetry for maximization of A [MBq] administered (indicated adults - up to 14 GBq)
- ❖ children – MATIN protocols
 - WB dosimetry necessary



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- Single exponential fitting, several phases – just for the best fit



$$S_{wb \leftarrow wb} = 1,34 \cdot 10^{-4} \cdot m_p^{-0,921} \quad [\text{Gy/MBq.h}]$$

WB doses – purpose?

patient	m [kg]	age [y]	1 st		2 nd		D tot [Gy]
			A _{apl} [MBq]	D [Gy]	A _{apl} [MBq]	D [Gy]	
patient 1 (m)	13	2,7	6200	1,9	6200	1,55	3,45
patient 2 (f)	13	2,7	5550	1,57	5550	1,74	3,31
patient 3 (m)	14	3,2	5550	2,32	4450	1,82	4,14
patient 4 (f)	7,8	1,7	3400	1,72	3400	1,47	3,19
patient 5 (m)	13	1,8	5550	1,33	5550	1,02	2,35
patient 6 (f)	14	3,7	5550	3,15	1100	0,9	4,05
patient 7 (f)	11	2,3	5550	1,59	5550	1,61	3,2
patient 8 (m)	13	4,2	5550	1,37	5550	1,7	3,07
patient 9 (f)	23	9,5	7400	1,77	7764	1,46	3,23
patient 10 (f)	28	9,7	11110	1,86	11110	1,8	3,66

I-131 mIBG - neuroblastoma

- ❖ uncertainty up to 25% (for adults lower)
- ❖ WB dose \neq D wb; WB dose $>$ D wb!
- ❖ Data can be fitted better / no significant difference (except extrapolating)
- ❖ More individualized care is provided
- ❖ Some even long term regressions described

DTCA dosimetry?

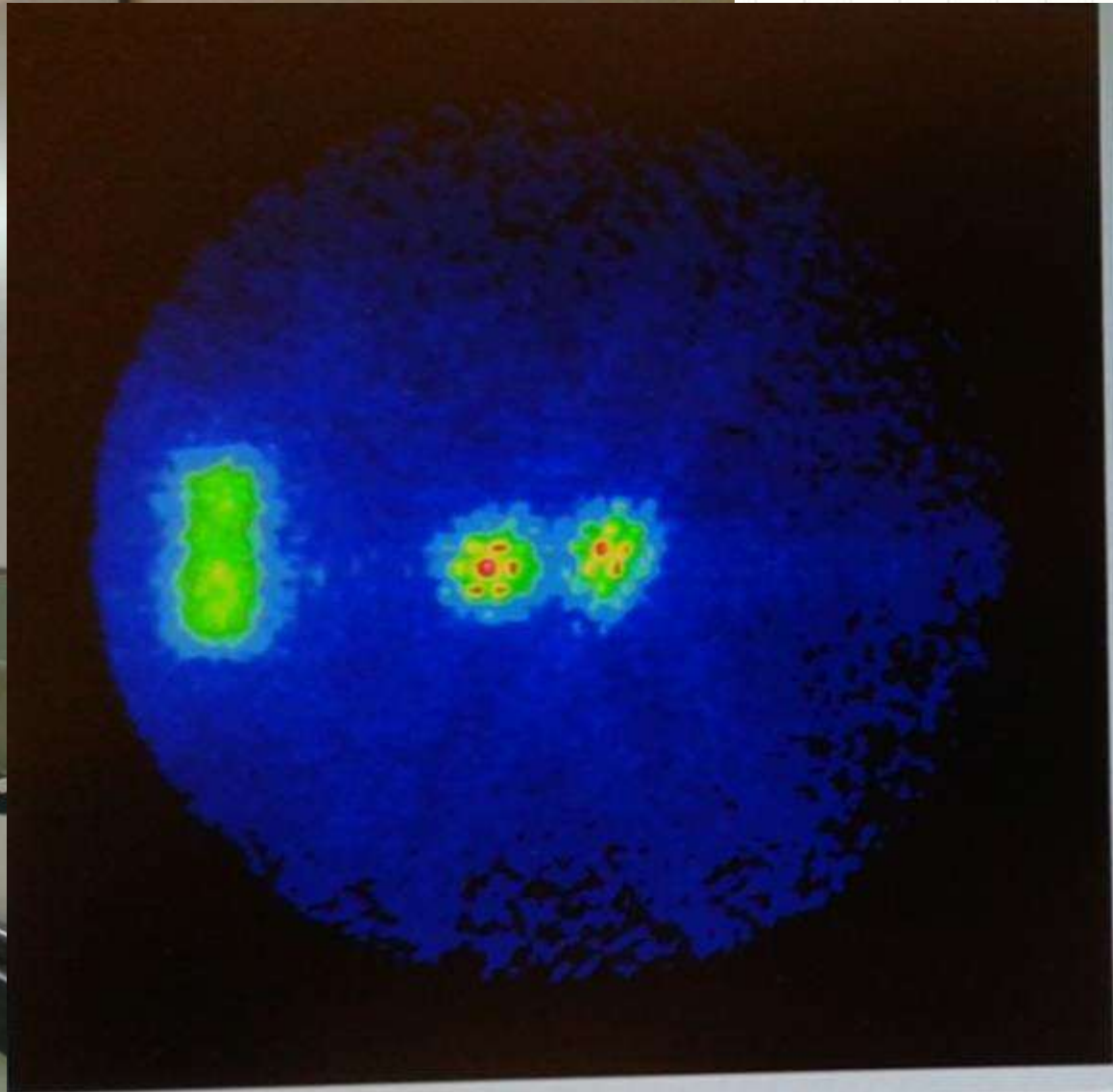
- Single head mobile mini gamma camera by DDD – SOLO Mobile (old SOPHA was not capable to acquire high activity in the FOV)
- Dedicated region
- Sitting / standing patients, remote control, I-131 standard for calibration
- Collimator comparison
MEGP x HEGP



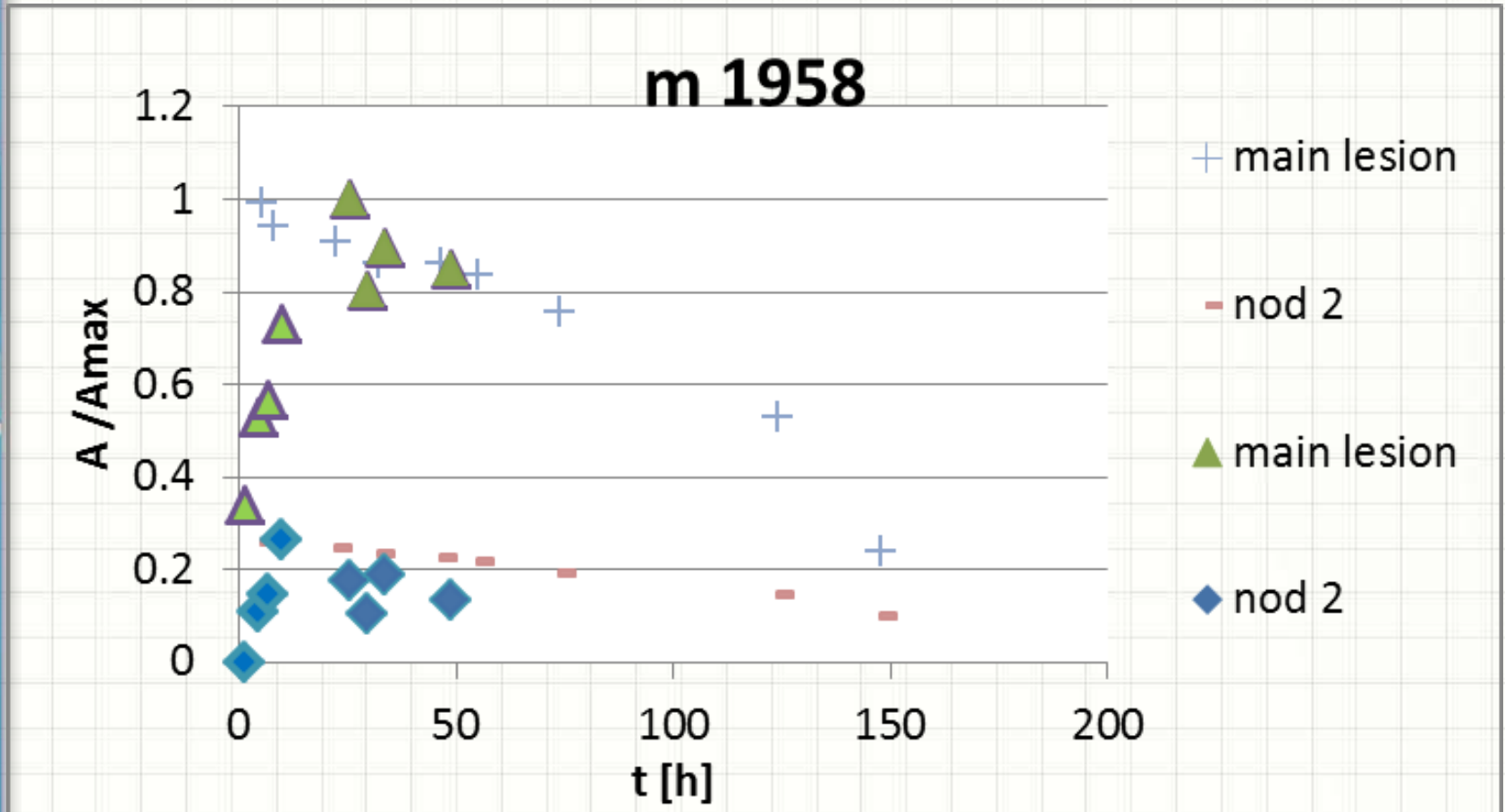
Time schedule of patient treatment

- ❖ Tuesday – diagnostic (100 MBq)
 - ❖ Excretion measurement 1, 24, 48 h; Camera examination (3 min.; 4-7x during 50 h)
- ❖ Thursday – therapy (patient particularly specific treatment from 3.0 up to 5.5 GBq*)
 - ❖ WB measurement (Hx rate up to 12x during 6 days), Camera examination (3 min.; 5-9x during 6 days) – standard used
- ❖ Data processing

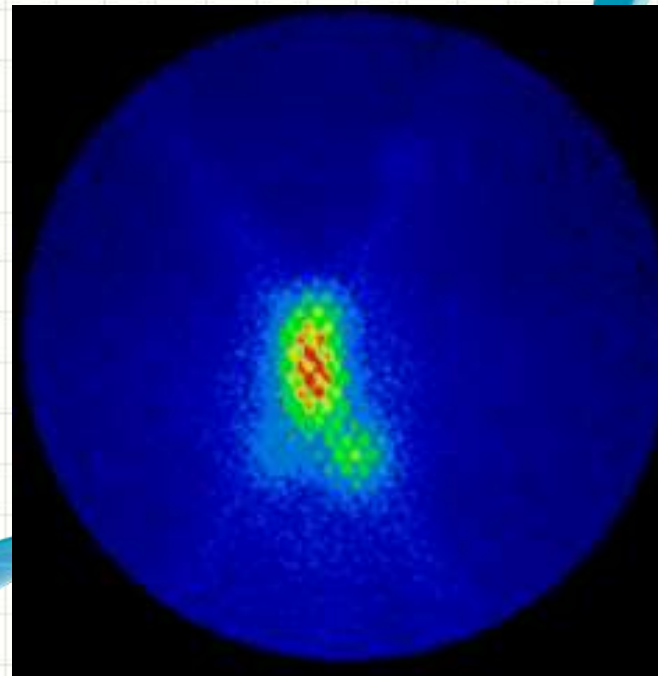
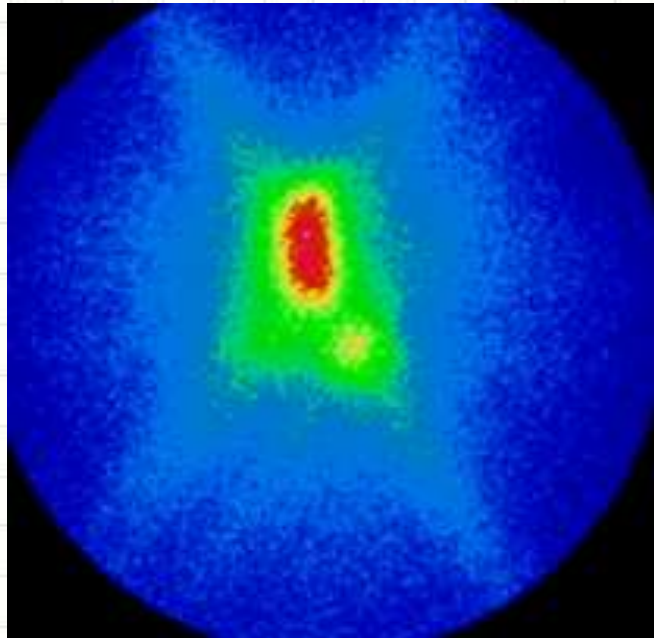
Acquisition



- Relative: A/A_{max} comparison for diagnostic & therapy



MEGP x HEGP



Dosimetry results and problems

- ❖ Large variations in absorbed doses <X0 Gy, X00 Gy>
 - ❖ Mainly due to uncertain volume (US determined)
- ❖ poor correlation of uptakes (diag x ther)
- ❖ Further investigation?
 - ❖ Discrepancy diagnostic x therapeutic uptake
 - ❖ High activity in UFOV
 - ❖ Possible for new gamma cameras
- ❖ At least biokinetics information . . . models can wait

Low risk DTCA = low A therapy?

- 1.1 GBq + rhTSH ? 1.8 GBq + rhTSH
- Stage: T1aN0M0, T1bN0M0
- D [Gy] ? – WBD, biokinetics . . . valid idea?
- New gamma camera available

- 2 M; 13 F, PTC x 2 M; 17 F

- Follow up . .



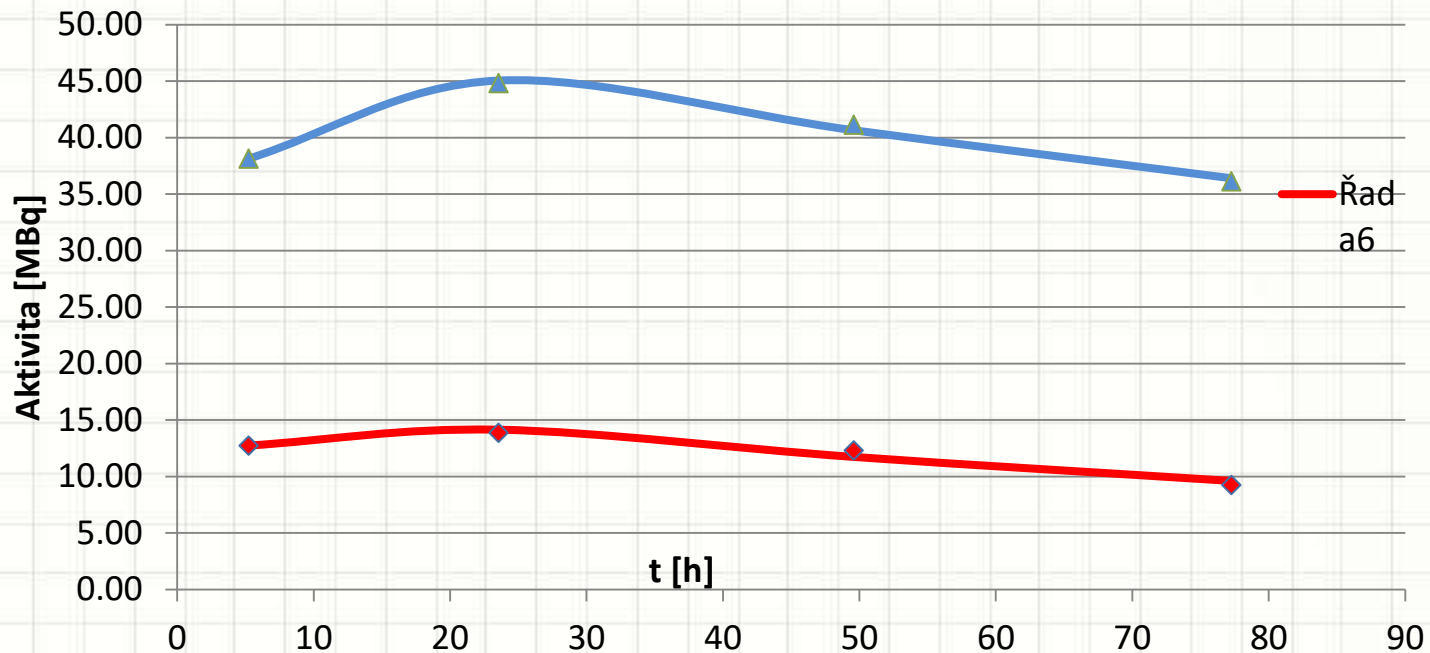
1.1 GBq

1.85 GBq

- **18%** no accumulation **24%**
- **27%** > 300 Gy **19%**
- **33%** <150 Gy , 300 Gy > **19%**
- **27%** Low dose **19%**
- Low dose + low TGL **19%**

Any risk?

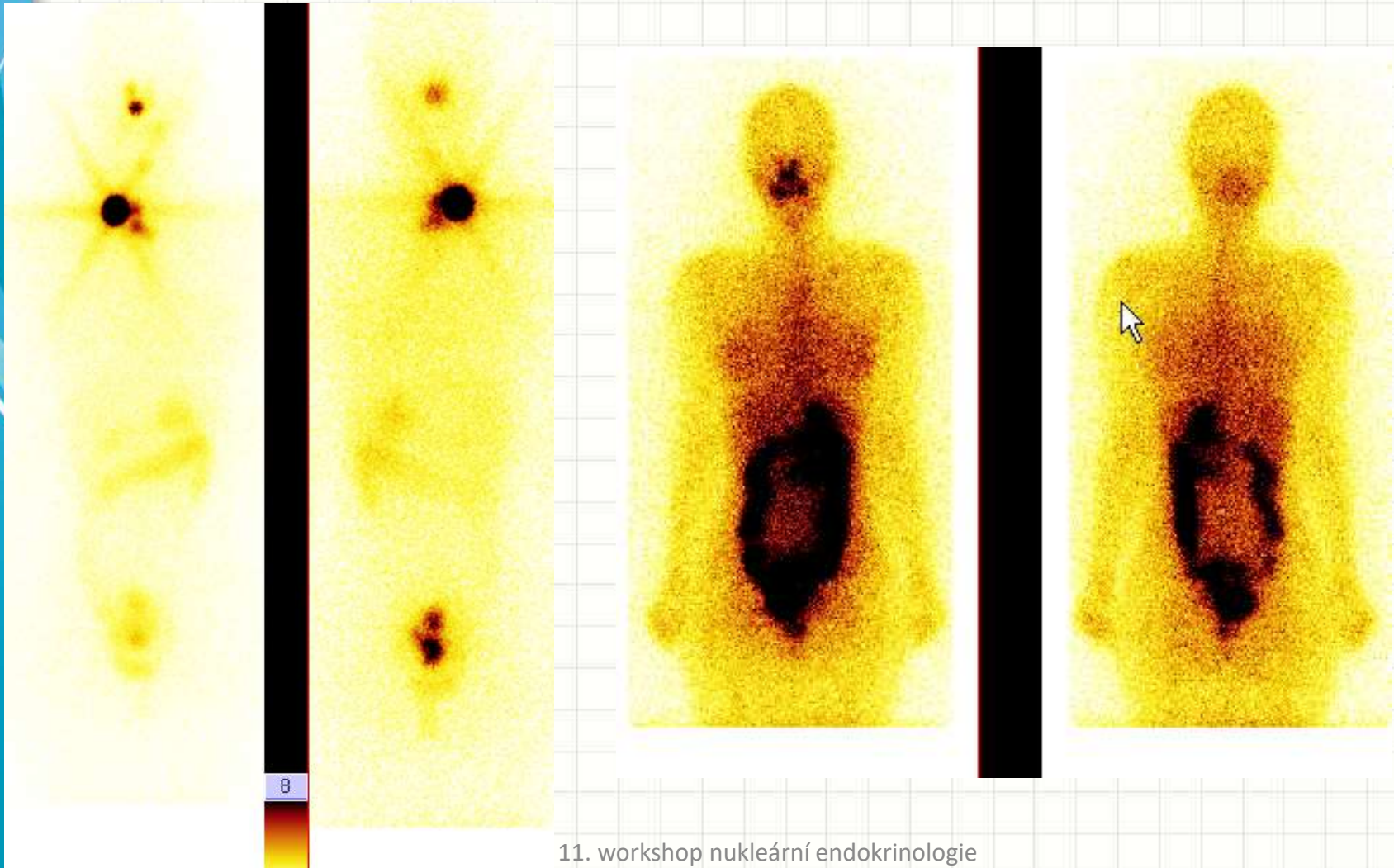
- F75, 95kg, thyroid remnants : TG LL 0,08ml, RL 0,11 ml
- High accumulation!



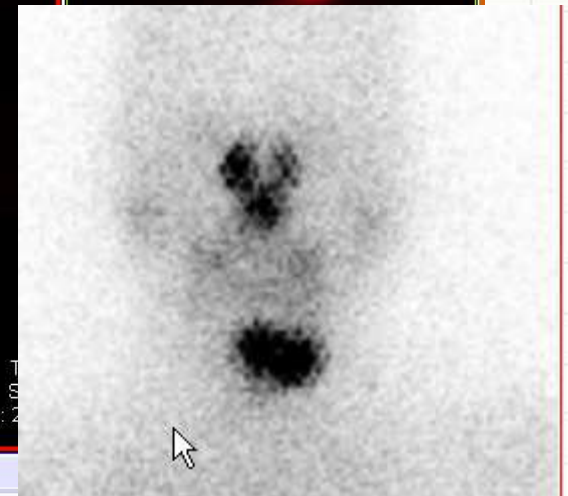
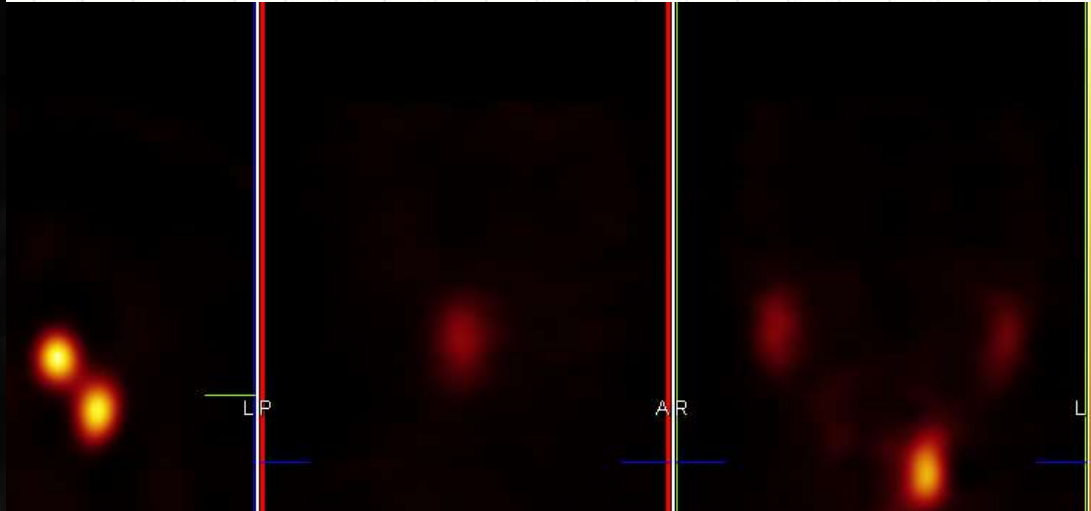
WB dose

- 1.8
- 1.1
- 44 ± 11 mGy/GBq vs 31 ± 8 mGy/GBq
- still it is rHTSH stimulation

F2005 (repeated 3x)



Volumetric?



T: 2,4
S: 2,4
P: 125,8
53

P

F

P: 2

Any closings

- 1.1 group – remission for over 3 1.8 group 1 patient repeated (remission over 2 y)
 - both groups 3 patients increasing tgl
- uncertainty in dose . . . 300 Gy - is this the ONE?
- 1.1 GBq against EANM recommendation
- patient selection may severely influence the results

New possibilities?

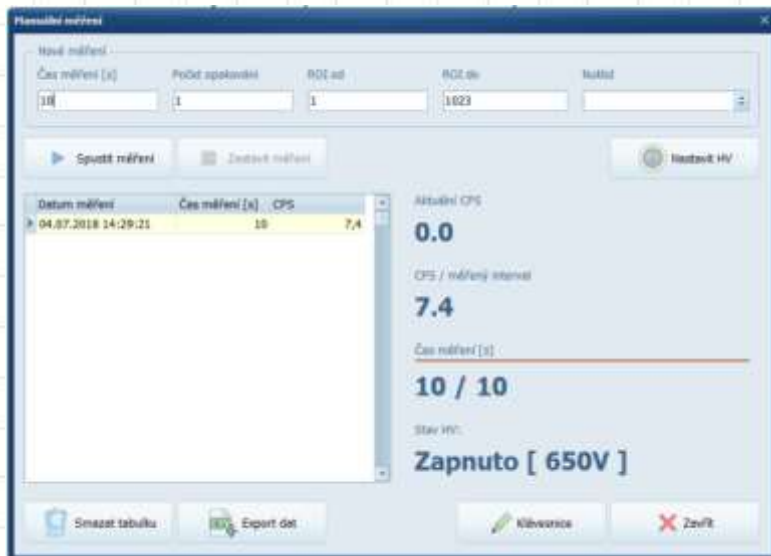
- Before: hand made measurement 1m and 2 m (PA/ AP+PA) using low dose rate probe SVLD
- Highly demanding, time consuming, sleeping patients?



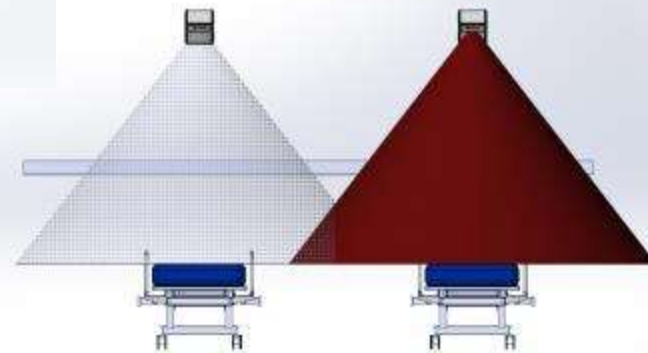
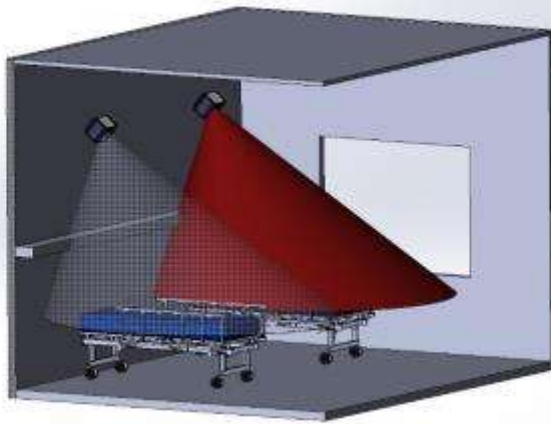
- Companies: No interest in dosimetry solutions x no requirements

New monitoring system

- Measurements in bed (only x0 y delay)
- Can be started by parent, any educated personnel even by the patient
- Spectroscopic!



Geometry



So what to be sad about?

- Disappeared experience push the current level of knowledge back again and again and again
- Old raw data loss causes extreme problems to follow up better modeling

Acknowledgements

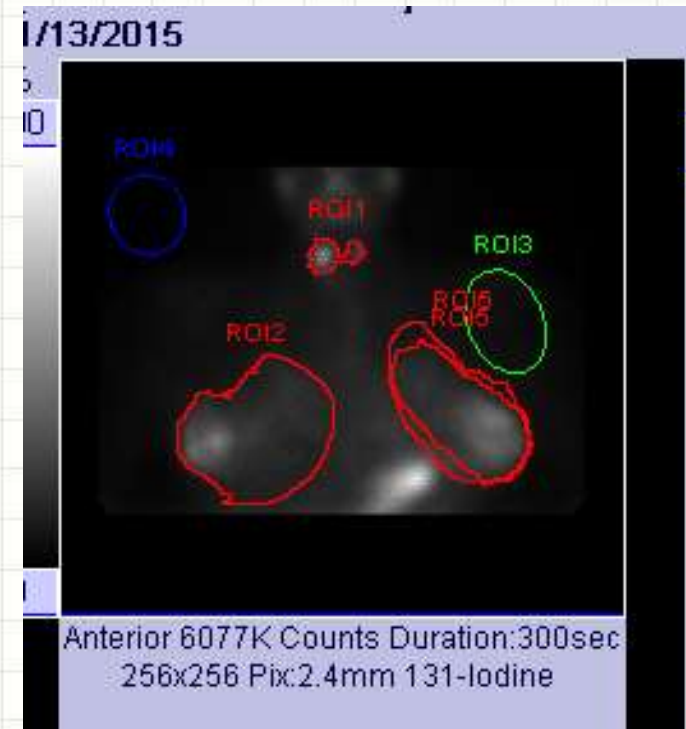
Patient – volunteers

DDD Diagnostic



What is the dosimetry good for?

- Breast cancer risk?
- Thyrogen f 198X
- about 1.8 GBq ^{131}I



So?

- D to breast = 1,0 +/- 0,3 Gy (excel / olinda)
- (6, 30, 50, 76 h after therapy)
- Breast cancer risk increment from 5 – 10 x

