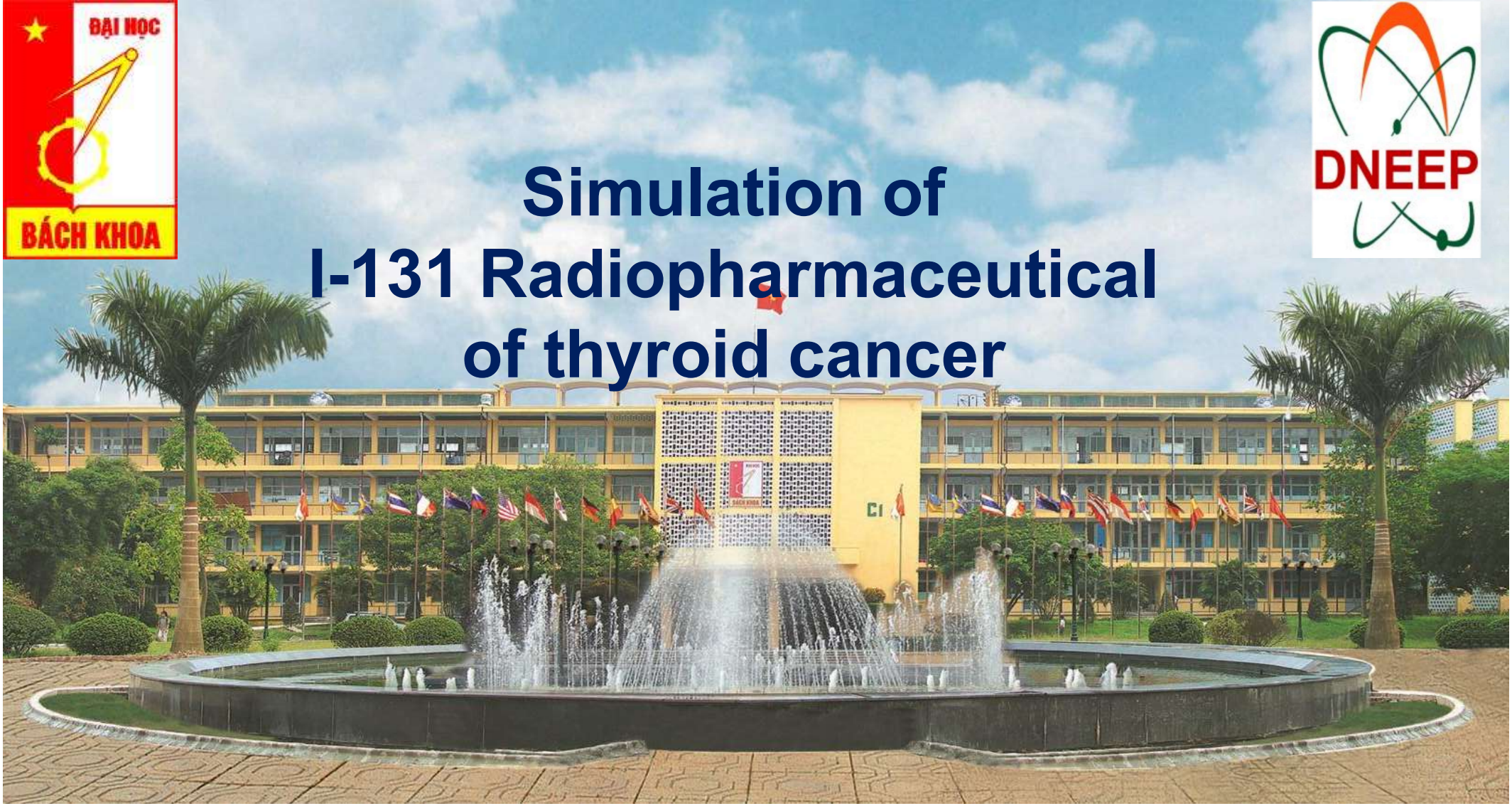


Simulation of I-131 Radiopharmaceutical of thyroid cancer

Nguyen Tat Thang

Dept. of NEEP, Hanoi University of Science and Technology

The International Conference on Medical Physics, Quy Nhon, 2019

Contents

- ✓ Introduction
- ✓ Materials and Methods
- ✓ Results
- ✓ Conclusions

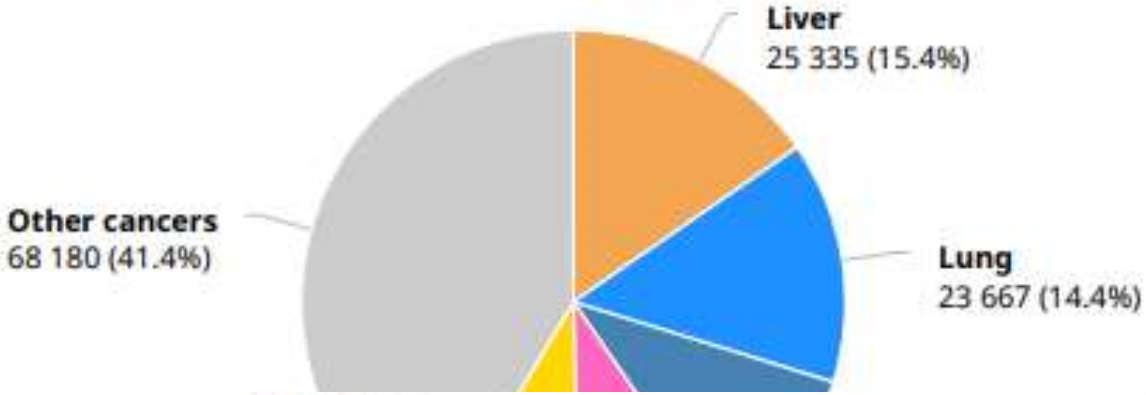
INTRODUCTION

Cancer in Vietnam

Viet Nam

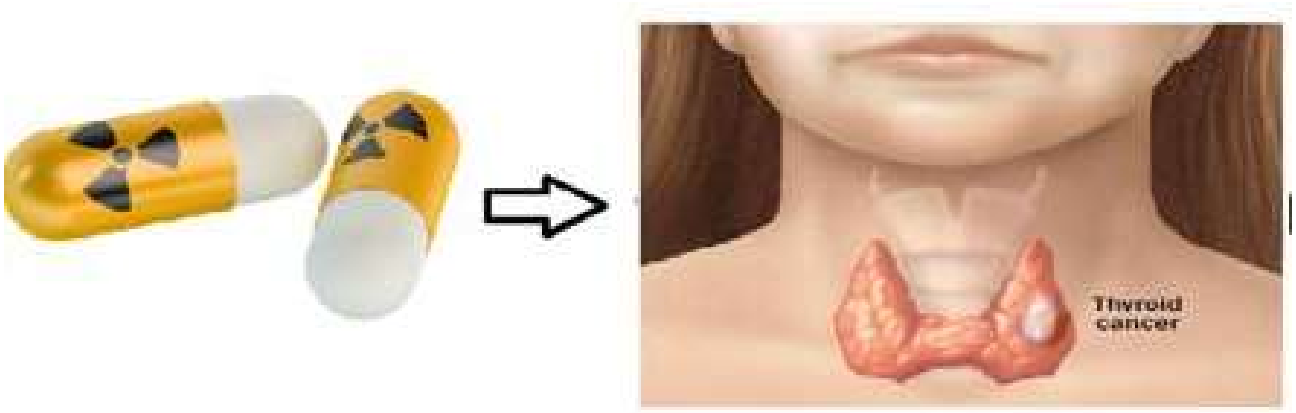
Source: Globocan 2018

Number of new cases in 2018, both sexes, all ages



	New cases				Deaths			
Cancer	Number	Rank	(%)	Cum.risk	Number	Rank	(%)	Cum.risk
Liver	25 335	1	15.4	2.59	25 404	1	22.1	2.59
Lung	23 667	2	14.4	2.57	20 710	2	18.0	2.27
Stomach	17 527	3	10.6	1.86	15 065	3	13.1	1.52
Breast	15 229	4	9.2	2.93	6 103	4	5.3	1.24
Rectum	8 815	5	5.4	0.93	4 673	6	4.1	0.44
Nasopharynx	6 212	6	3.8	0.64	4 232	7	3.7	0.47
Leukaemia	6 144	7	3.7	0.52	4 923	5	4.3	0.43
Colon	5 457	8	3.3	0.60	3 183	8	2.8	0.31
Thyroid	5 418	9	3.3	0.45	528	22	0.46	0.05
Cervix uteri	4 177	10	2.5	0.77	2 420	10	2.1	0.47

I-131 therapy for thyroid

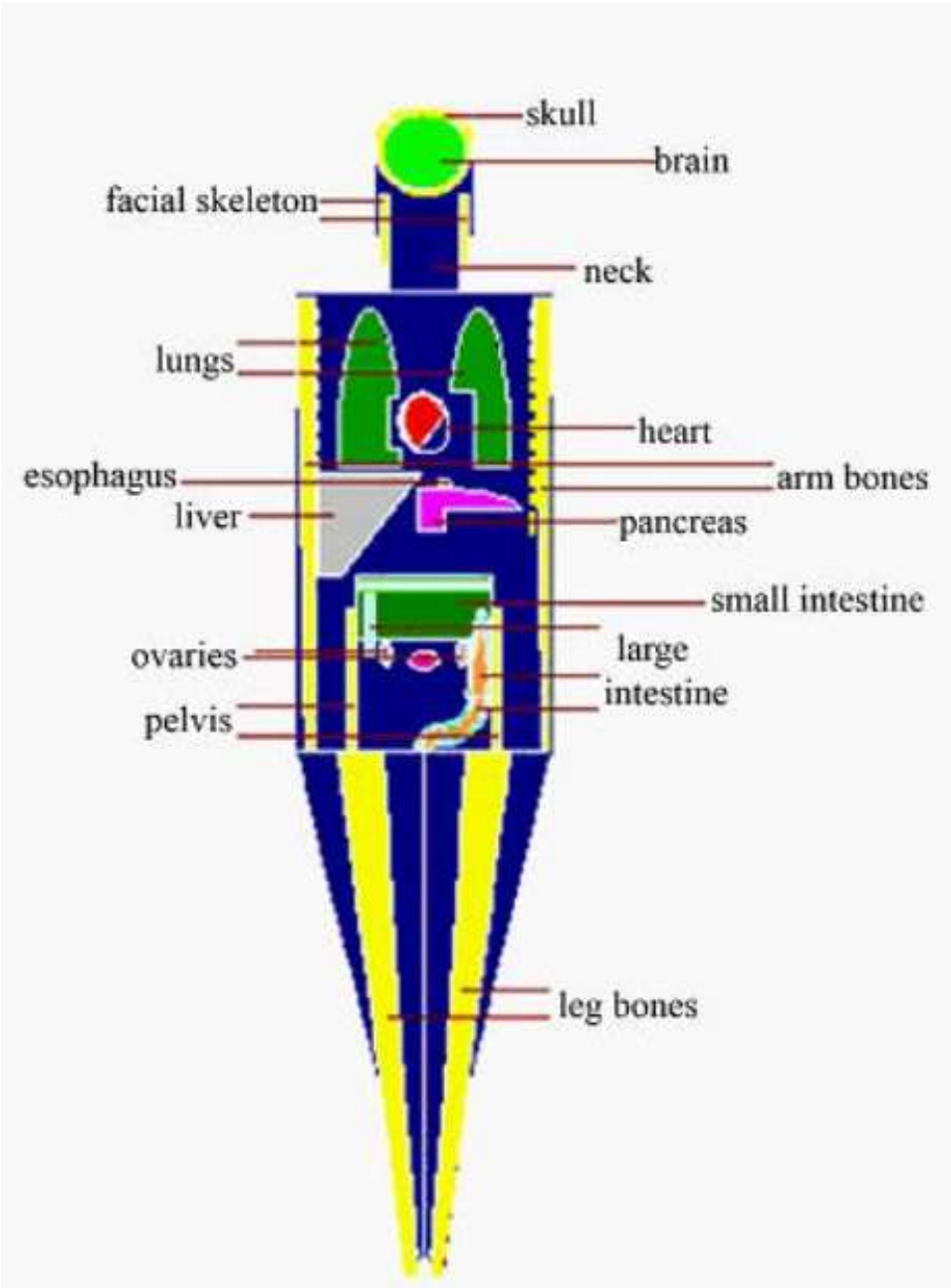


- Usually for the treatment of differentiated thyroid cancer after thyroidectomy.
- Activity of the I-131: ~ 30 ÷ 200mCi.

The affects on critical organs ??

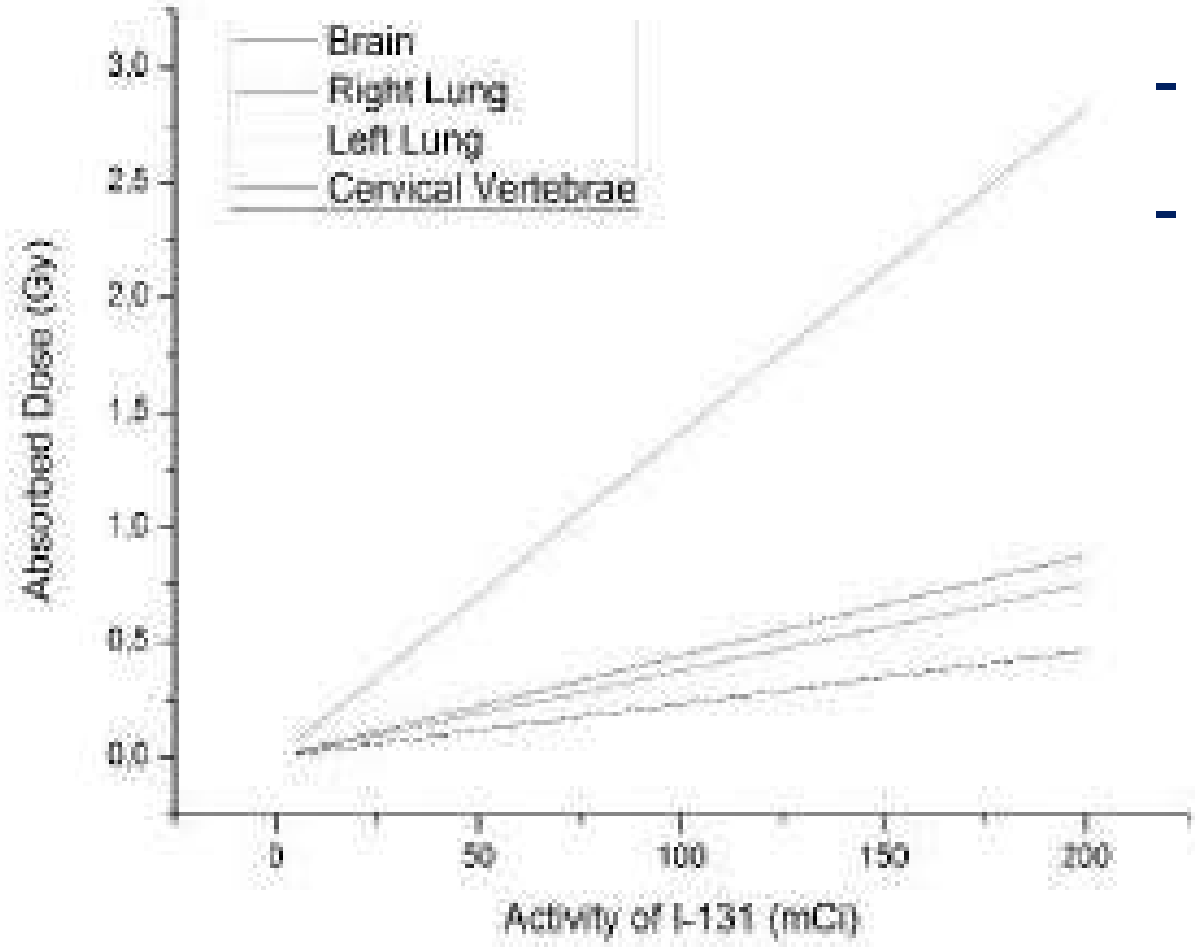
Recent assessments

- Simulation using MIRD phantom.
- Measurement using physical phantom and thermo-luminescent dosimeter.
- Activity: 100, 150, and 175 mCi.
- Absorbed dose: for thyroid, sternum, and cervical vertebrae.



Daryoush et al., World J. Nucl. Med., Vol. 14(1), 2015, 16-18.

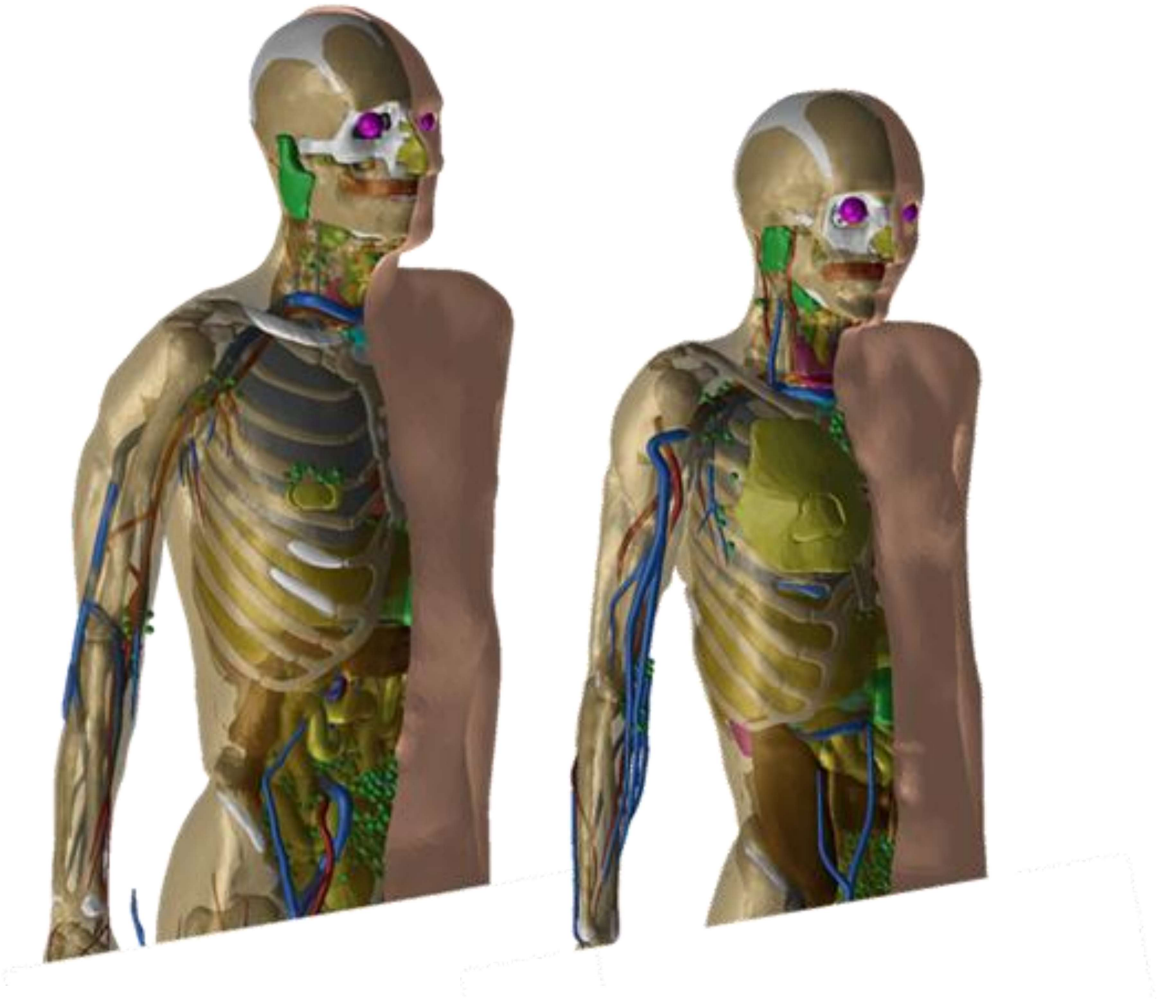
Recent assessments



- Simulation using MIRD phantom
- Activity: up to 200 mCi
- Absorbed dose: for thyroid, brain, lungs, and cervical vertebrae

Oktajianto et. al., International Journal of Engineering Technologies and Management Research, Vol. 3(9), 2016,16-24.

Mesh-type ICRP reference phantoms



MRCPs
(Mesh-type Reference Computational Phantoms)

C. H. Kim, et al., ICRP 2017 Proceeding (2018)

Objective of the study

Calculation of **the dose values caused by I-131 source in critical organs** to evaluate the risk of thyroid treatment by using the mesh-type ICRP reference phantoms.

MATERIALS AND METHODS

The mesh-type ICRP reference phantoms

Male

Female

Numerical Data

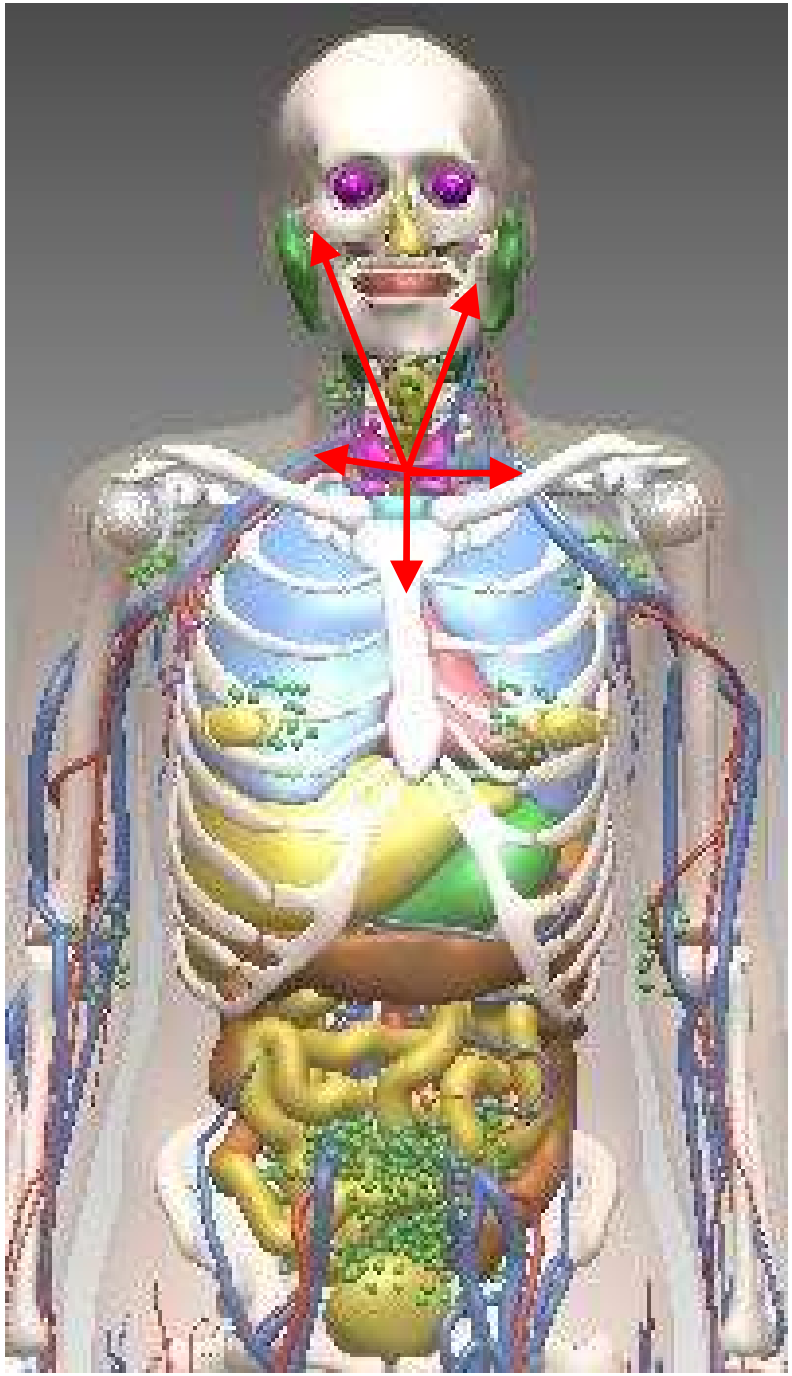
Properties	Male MRCP	Female MRCP
Height / Weight	176 cm / 73 kg	163 cm / 60 kg
Number of organs	48	48
Deviation from ICRP 89 *	< 0.1%	< 0.1%
Number of tetrahedrons	8,232,811	8,596,890
Avg. volume of tetrahedron	8.64 mm^3	6.89 mm^3
File size (ASCII)	436 MB	457 MB

* Organ mass deviation from the ICRP-89 reference values.

Dose calculations with Geant4

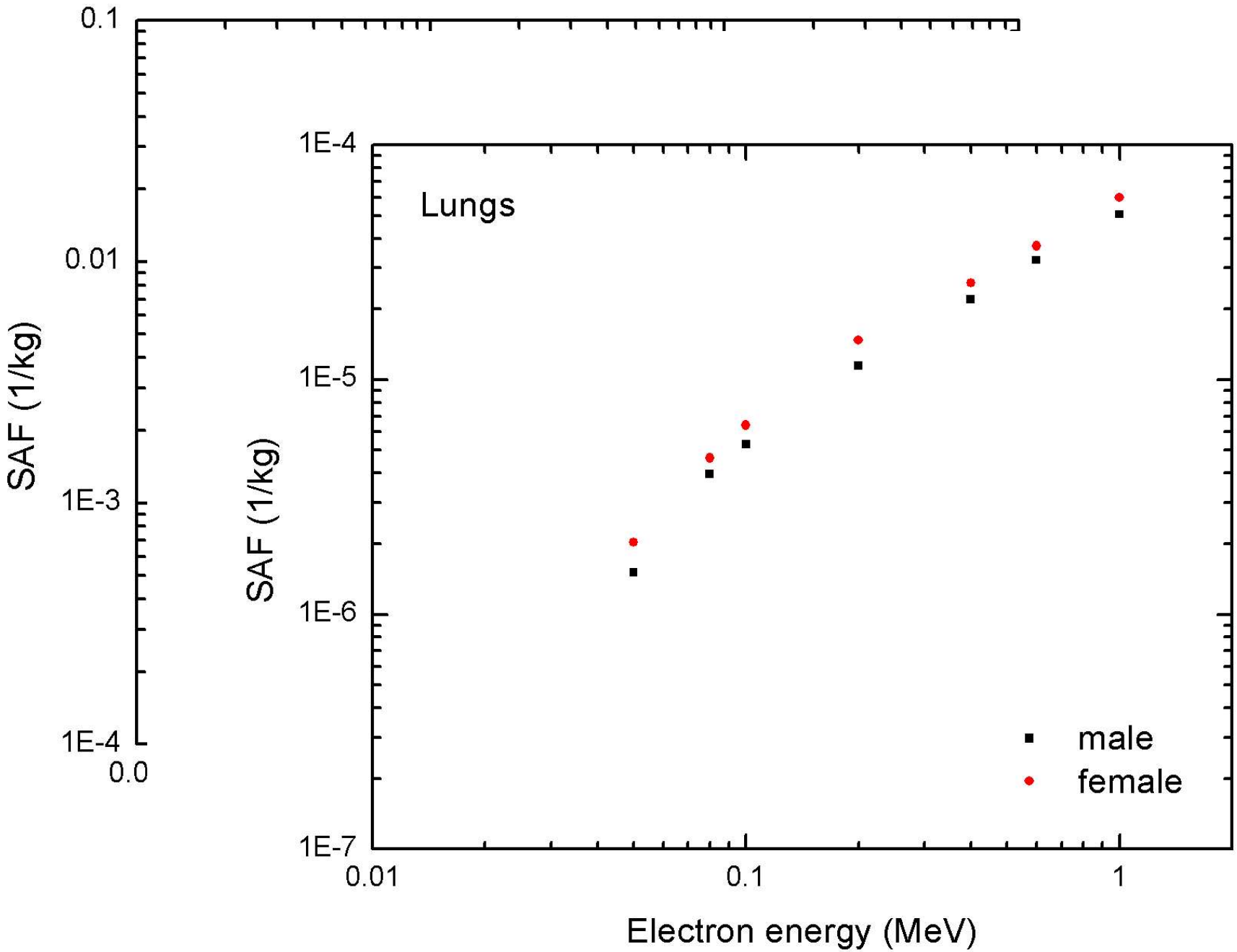
- **Calculated values**
  - ✓ Organ/tissue specific absorbed fraction
  - ✓ Organ/tissue absorbed dose

- **MC simulation conditions**
  - ✓ Geant4 version: 10.4
  - ✓ Physics library: *G4EmLivermorePhysics*
  - ✓ Secondary range cut: 1 μm
  - ✓ Relative errors: less than 5%
  - ✓ Source organ: thyroid
  - ✓ Target organs: thyroid, brain, lungs, RBM, salivary glans, oesophagus

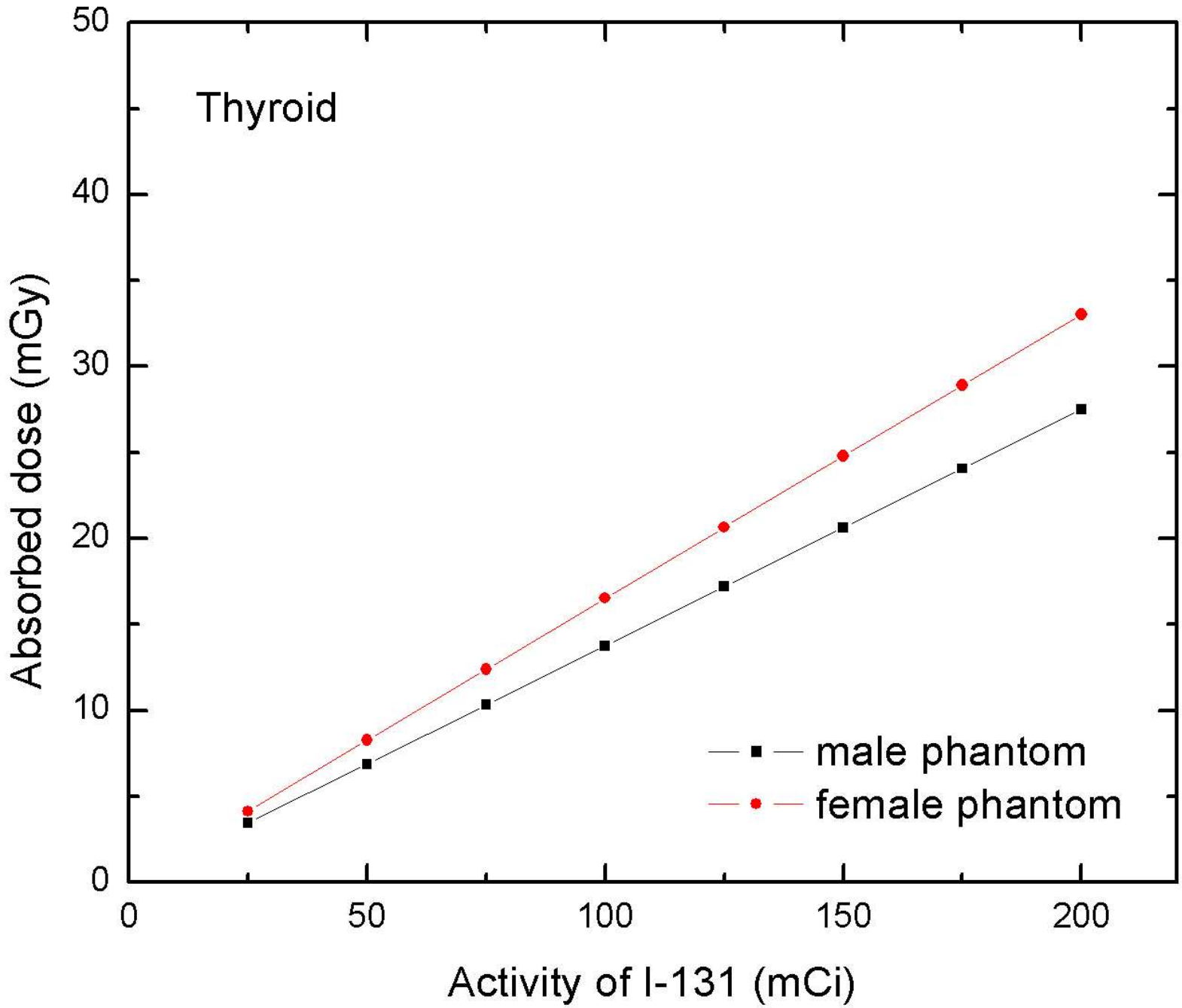


RESULTS

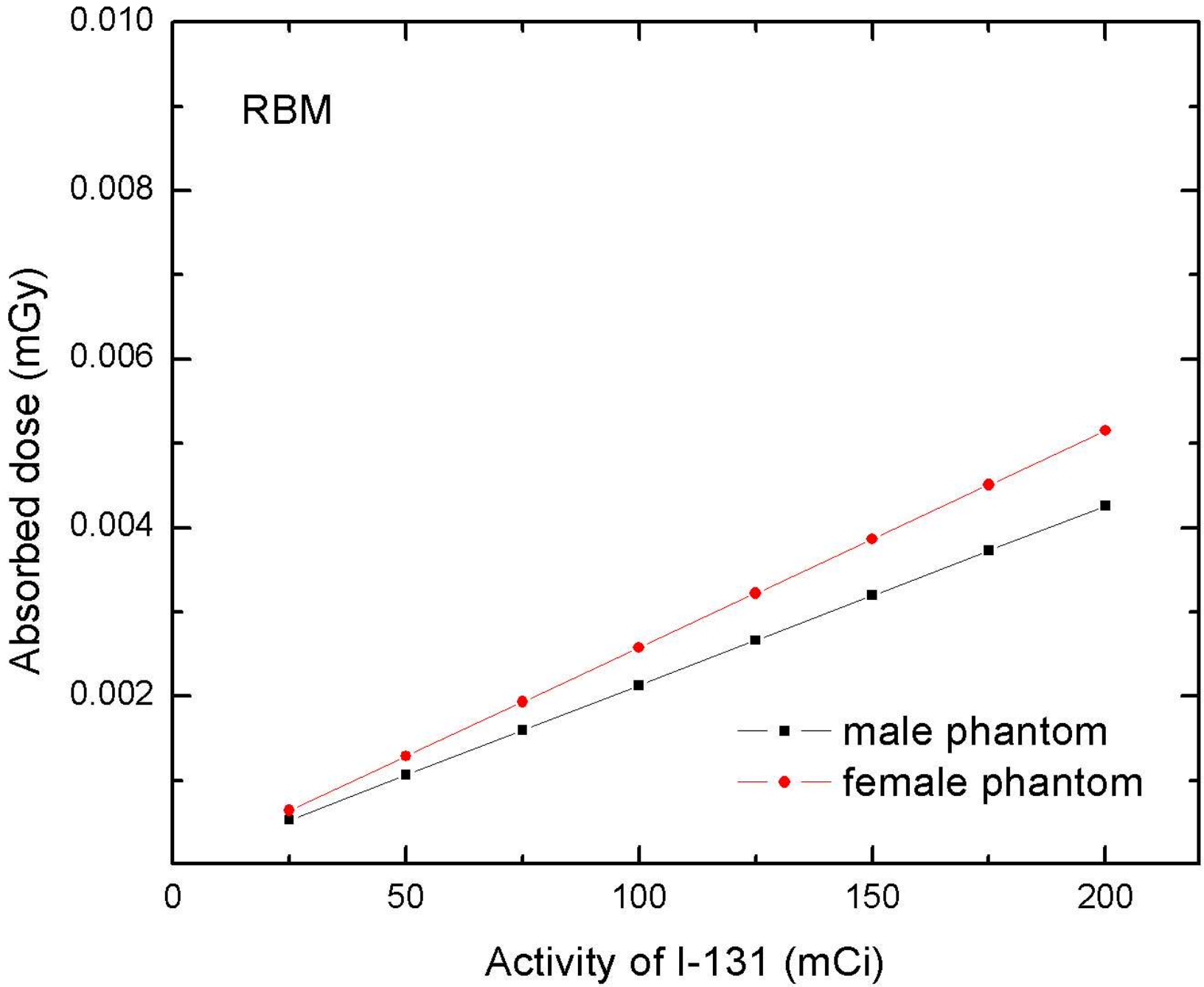
The SAF values



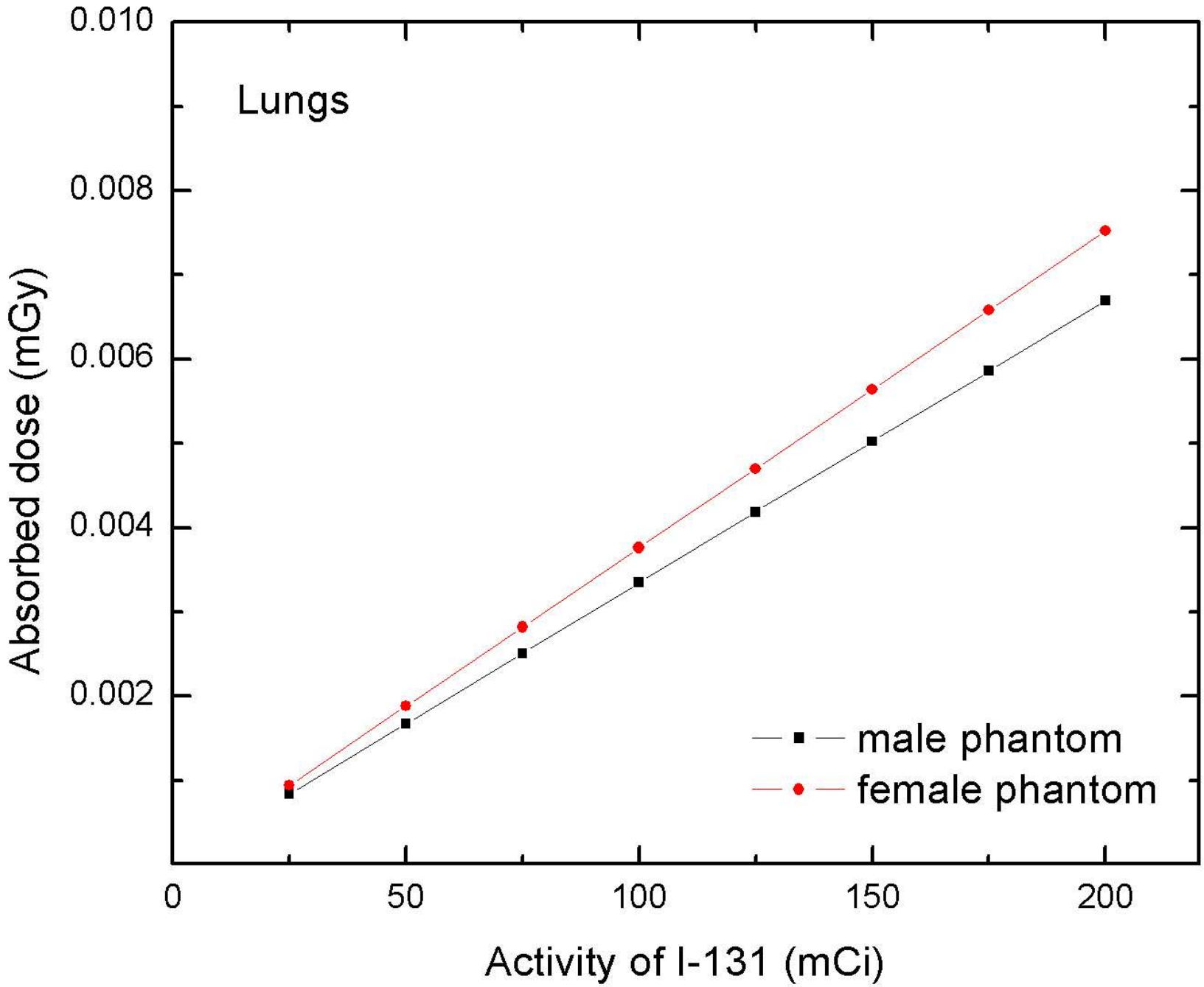
Absorbed doses for thyroid



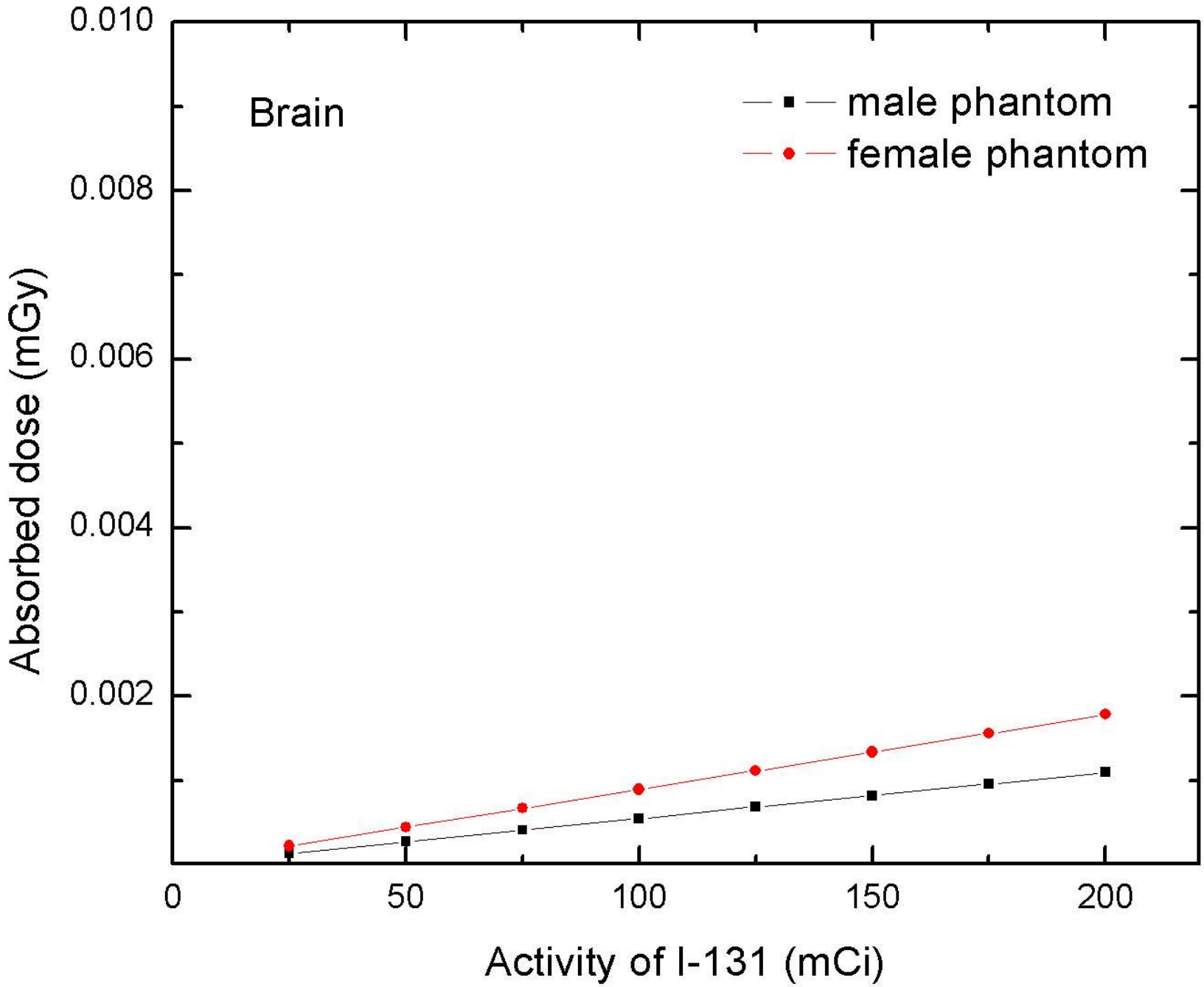
Absorbed doses for critical organs



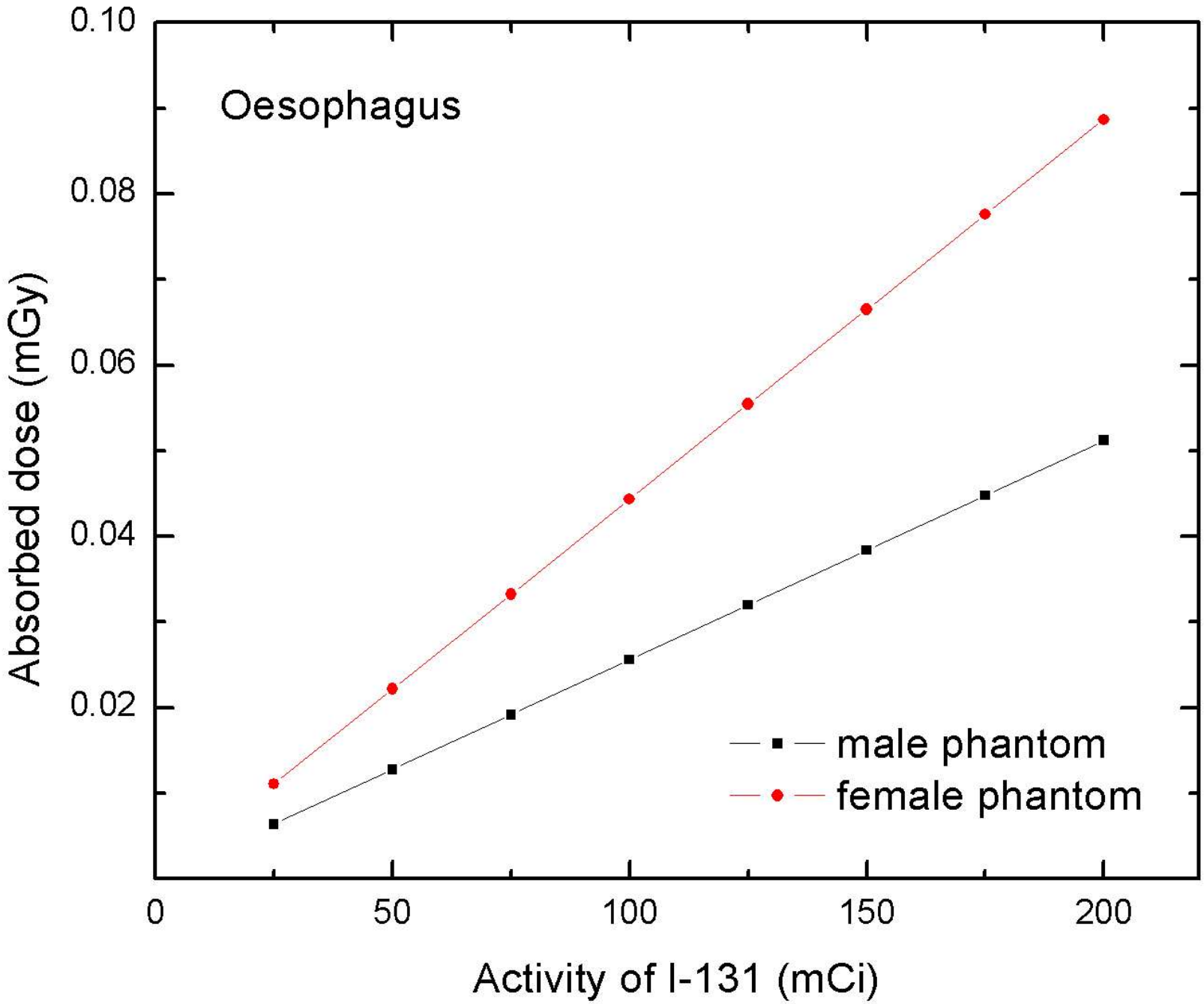
Absorbed doses for critical organs



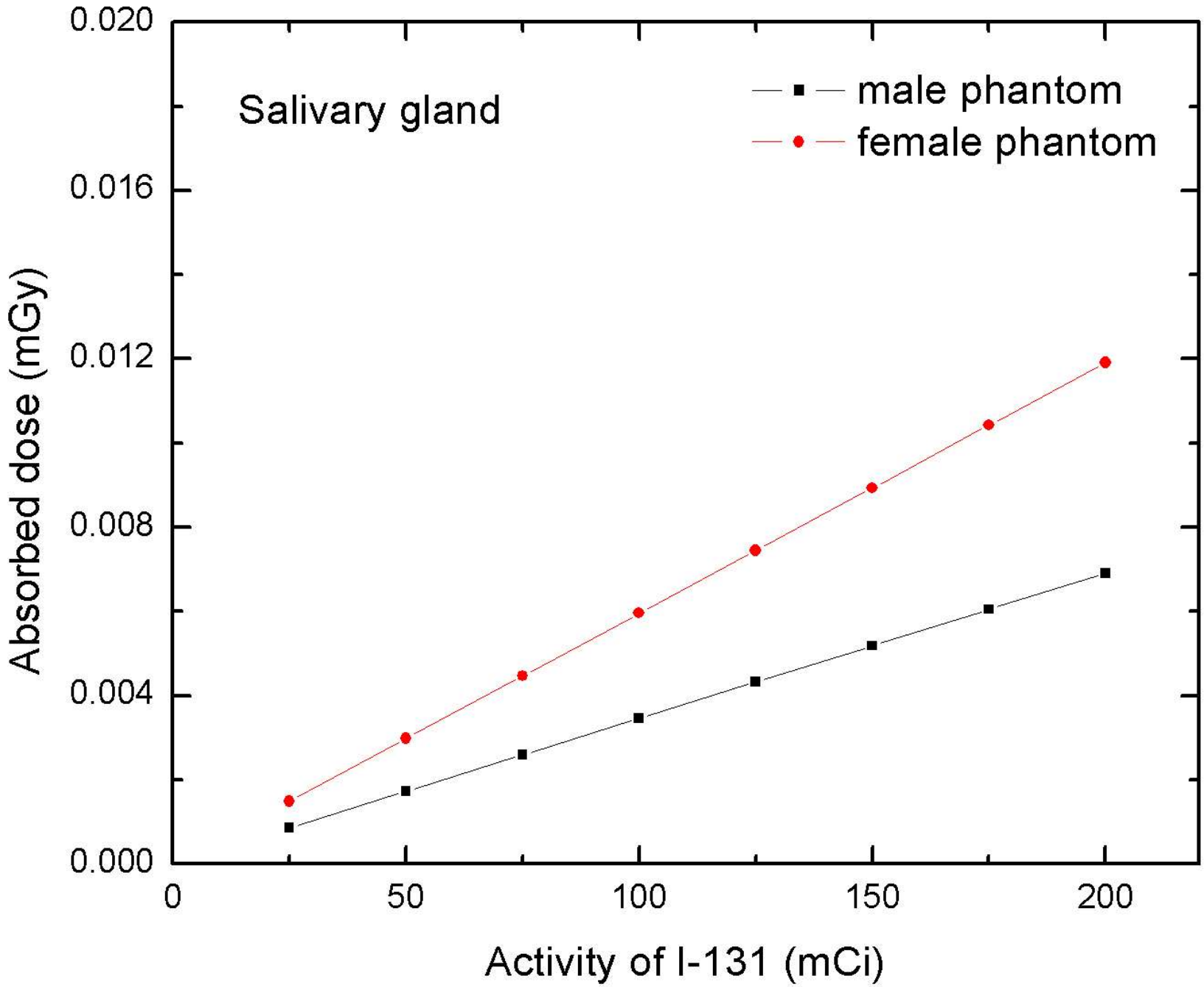
Absorbed doses for critical organs



Absorbed doses for critical organs



Absorbed doses for critical organs



CONCLUSIONS

- The absorbed doses were calculated for critical organs using the mesh-type adult ICRP phantoms:
  - **+ The absorbed doses in thyroid were calculated for the activity of I-131 from 25 – 200mCi.**
  - **+ The doses for critical organs are not higher than 0.1mGy, less than the deterministic levels for those organs.**
- In this study, the transported mechanism of I-131 in body was not considered, and the anatomical data of real patients may not be similar to reference data.

→ the absorbed doses in critical organs **may be changed** in realistic situation.

→ It's necessary to study more in future.

Thank you very much for your kind attention!!