

# **RADIATION PROTECTION IN AN ANIMAL RESEARCH UNIT WITH PET: OCCUPATIONAL DOSES AND ANIMAL DOSE RATES**

**J.M. Martí-Climent<sup>1</sup>, M. Ecay<sup>2</sup>, I. Bilbao<sup>2</sup>,  
E. Prieto<sup>1</sup>, M. Collantes<sup>2</sup>, I. Peñuelas<sup>1,2</sup>**

1. Servicio de Medicina Nuclear.

Clínica Universidad de Navarra. Pamplona, Spain

2. Unidad de Investigación microPET.

CIMA-Clínica Universidad de Navarra. Pamplona, Spain



**Clínica Universitaria**  
Universidad de Navarra



# Introduction

---

Preclinical research with PET radiopharmaceuticals is done at the Animal Research Unit (ARU) located at the hospital.

## Objectives

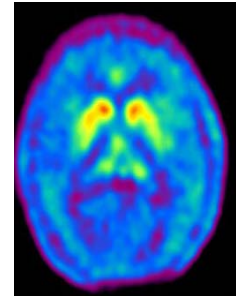
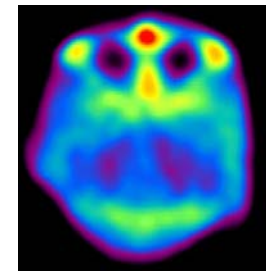
---

- To correlate the dose received by the technicians managing the PET animal unit with the workload.
- To assess the dose rates produced by the animals.

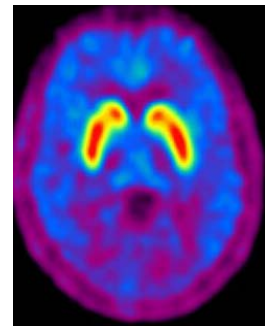
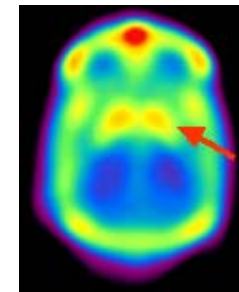
## Parkinson disease



$F^{18}$ -FDOPA



affected



control

# Material and methods

# Facility and premises

50 m to the GMP laboratory

Mosaic (Philips)

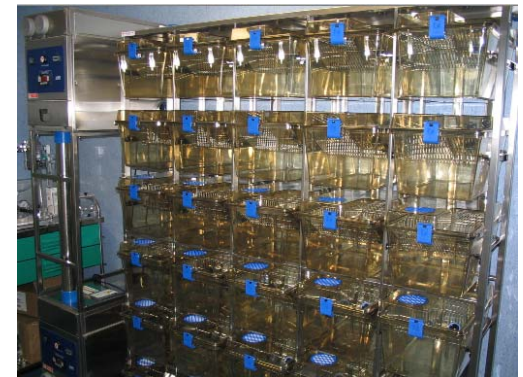


Anesthesia system

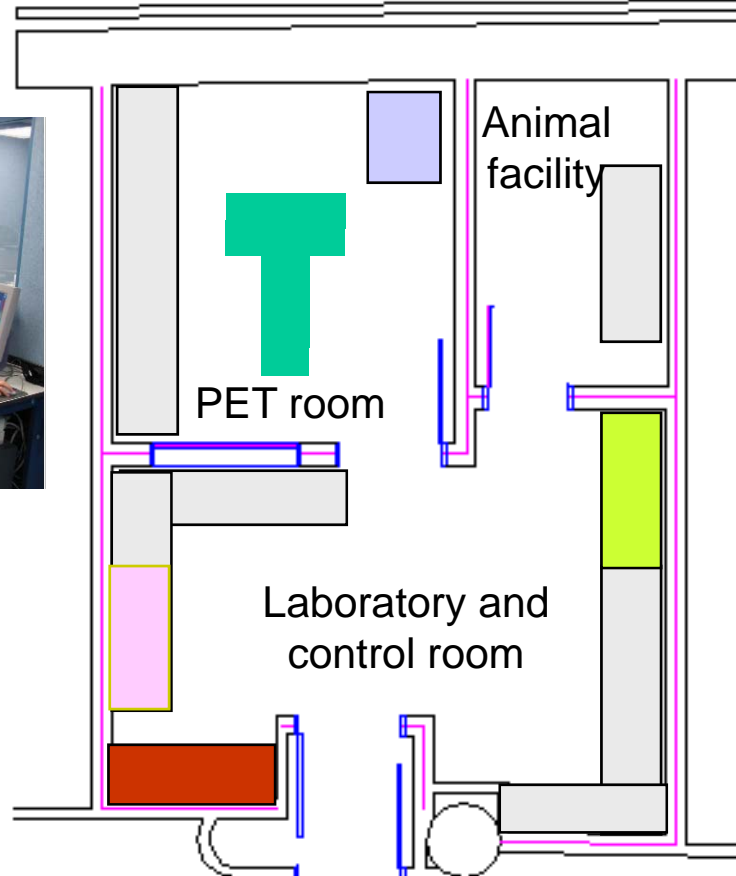
Autoradiography system  
and PET control



Rack



Cryostat



Biological security hood



## Personal

2 technicians    Tech#1    1 year exp  
                         Tech#2    3 year exp

## Period

12 months 2009

## Dosemeters

Whole body dosemeter

UD-802 AR (Panasonic)

2 chips  $\text{Li}_2\text{B}_4\text{O}_7:\text{Cu}$

2 chips  $\text{CaSO}_4:\text{Tm}$

} Hp(0.07)  
} Hp(10)

Extremity ring dosemeters

UD-807AT7N (Panasonic)

chip  $\text{Li}_2\text{B}_4\text{O}_7:\text{Cu}$

worn on the base of the middle finger on  
each hand

Official dose





## Measures

GM miniTrace S10  
(Genitron Instruments)  
 $H^*(10)$   
in contact  
at 20 cm from the animal  
At the end of the PET study



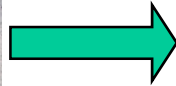
## Period

Prospectively 2010  
109 studies



# Workflow Activity manipulation and dose rate measurements

GMP  
Laboratory



Dispensing  
laboratory

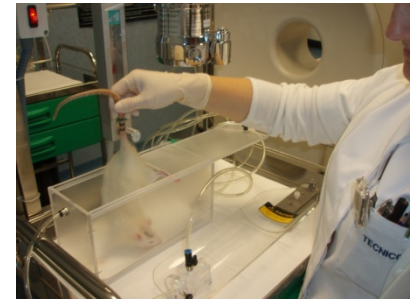
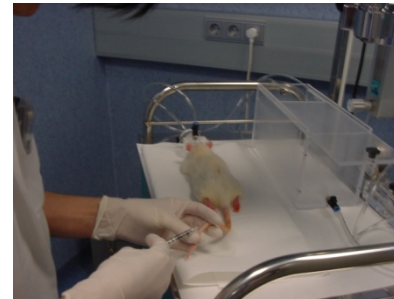


ARU

Injection

Positioning

Removal

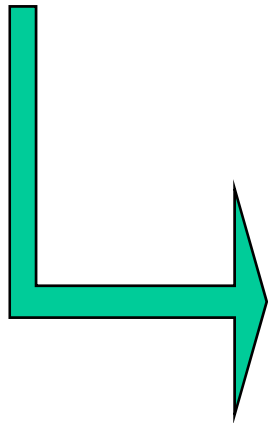


Dose rate measure  
and decay correction

Injection

Massage

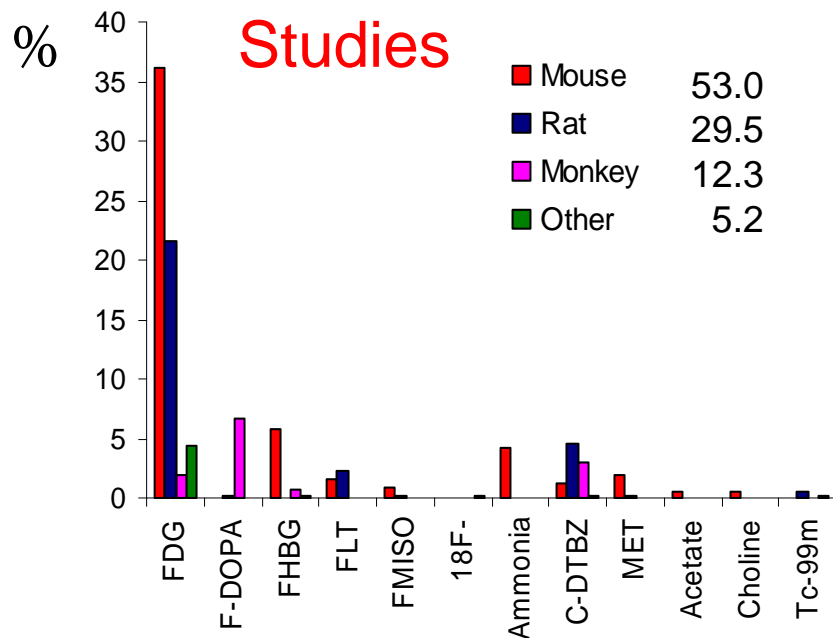
Removal



# Workload 2009

	Studies	Activity	
	863	23.7 GBq	
	%	%	Activity/study (MBq/study)
Mouse	53.0	33.2	17
Rat	29.5	19.3	18
Monkey	12.3	32.7	73
Other	5.2	14.8	78

mean 27  
median 18

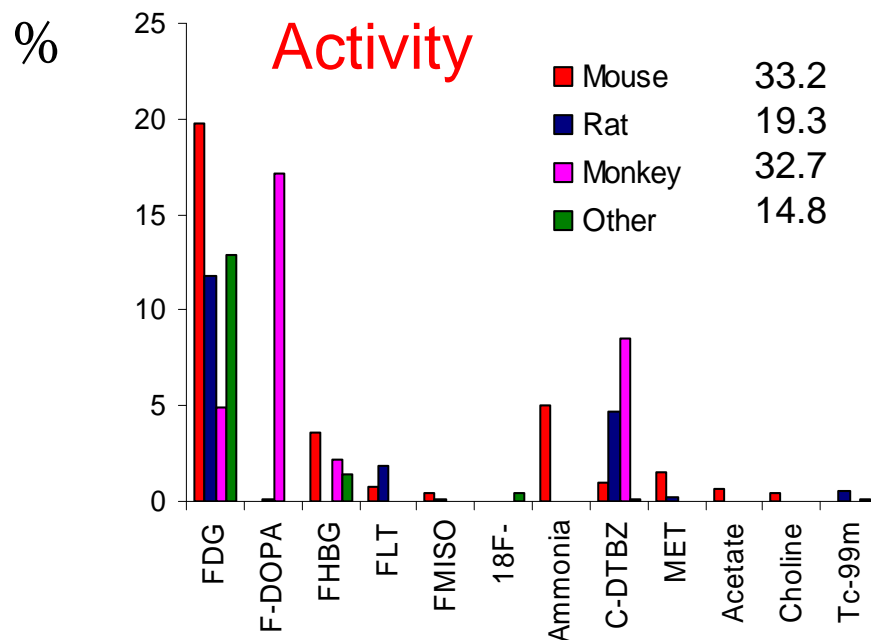
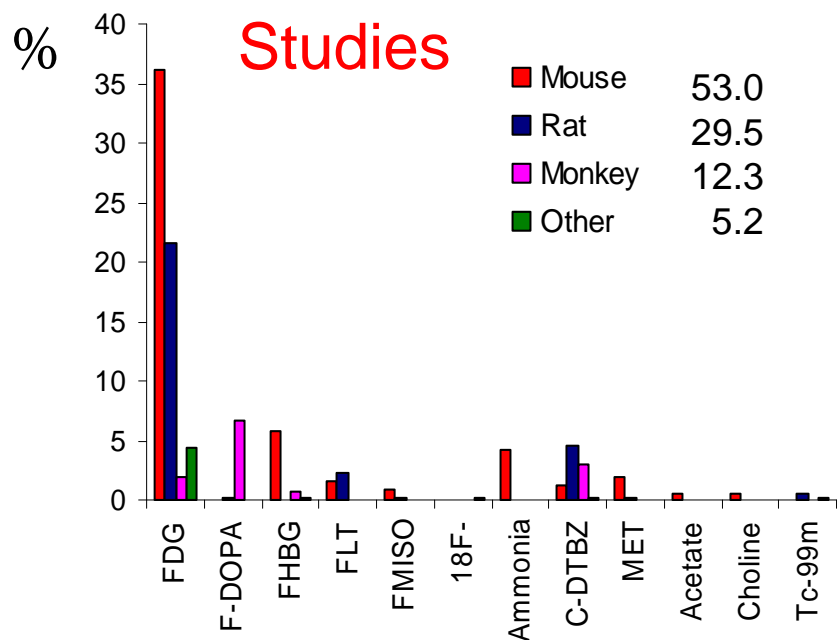


RF	Studies (%)
FDG	64.0
F-DOPA	6.8
FHBG	6.6
FLT	3.8
FMISO	1.0
18F-	0.2
Ammonia	4.3
C-DTBZ	9.0
Mehionine	2.2
Acetate	0.6
Choline	0.6
Tc-99m	0.8



# Workload 2009

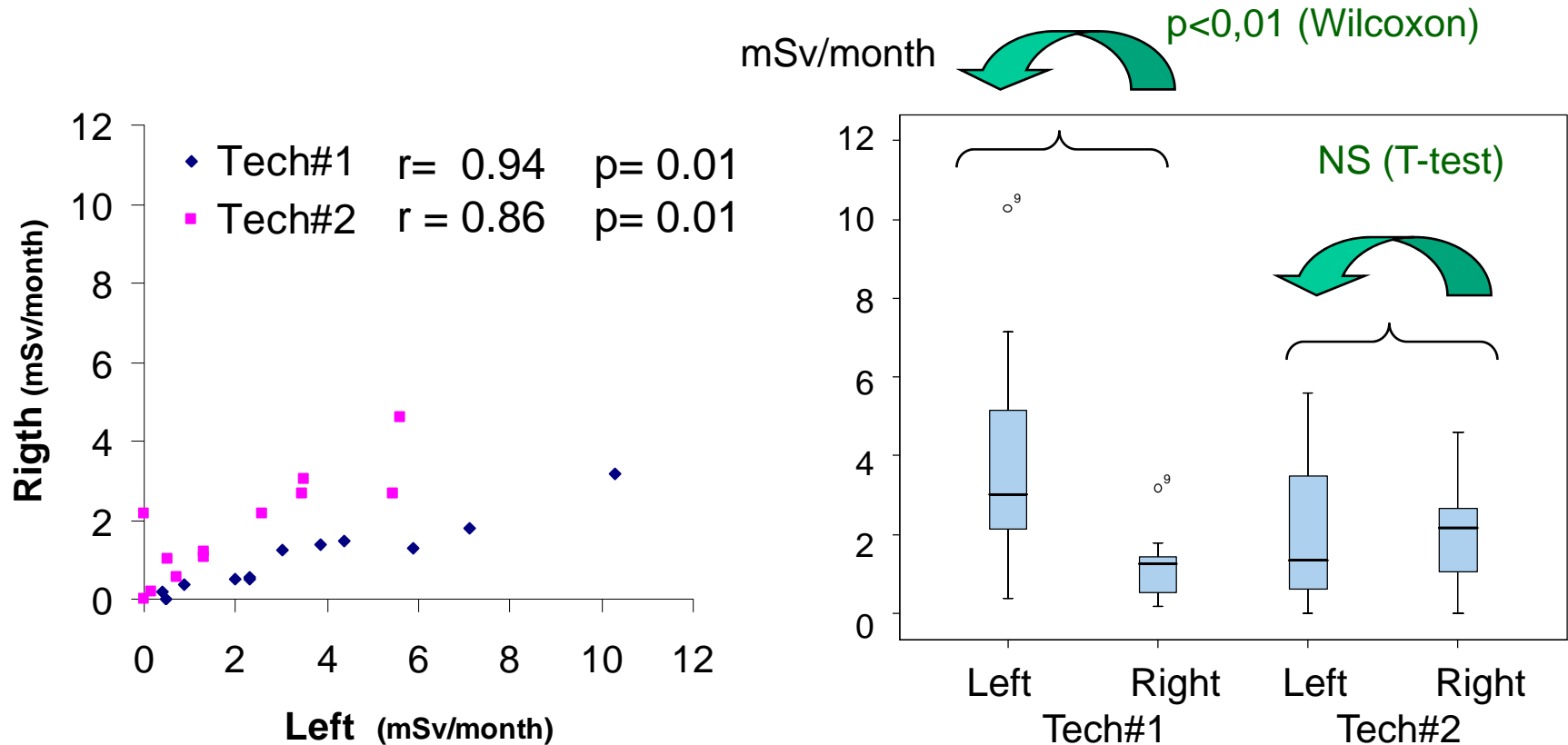
# Radiopharmaceuticals



RF
FDG
F-DOPA
FHBG
FLT
FMISO
18F-
Ammonia
C-DTBZ
Mehionine
Acetate
Choline
Tc-99m

Studies (%)	Activity (%)
64.0	49.3
6.8	17.2
6.6	7.3
3.8	2.6
1.0	0.5
0.2	0.4
4.3	5.0
9.0	14.2
2.2	1.7
0.6	0.6
0.6	0.4
0.8	0.7

## Finger dose Hp(0.07) (mSv/month)



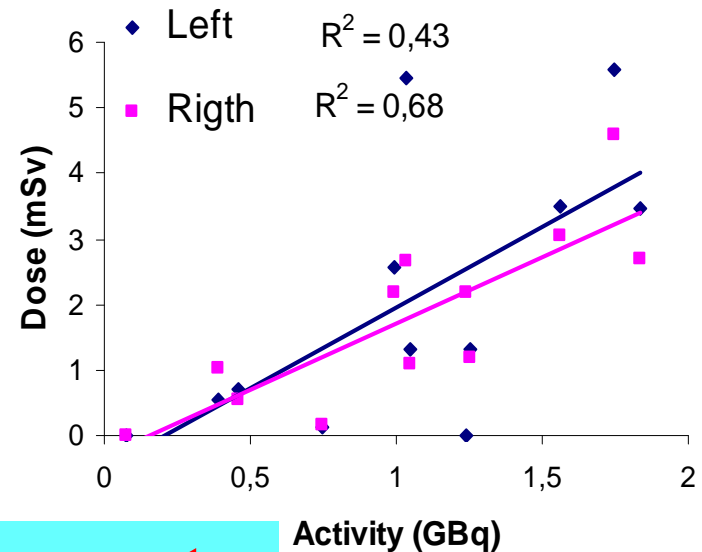
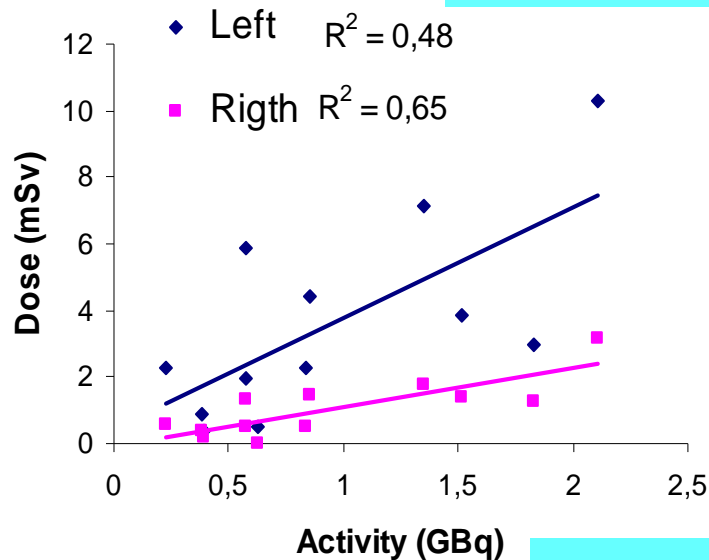
# Results

(Dose vs Activity) / month

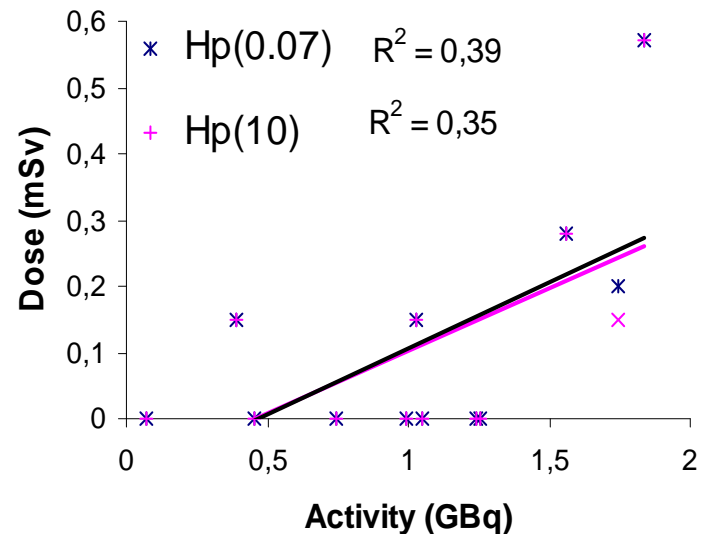
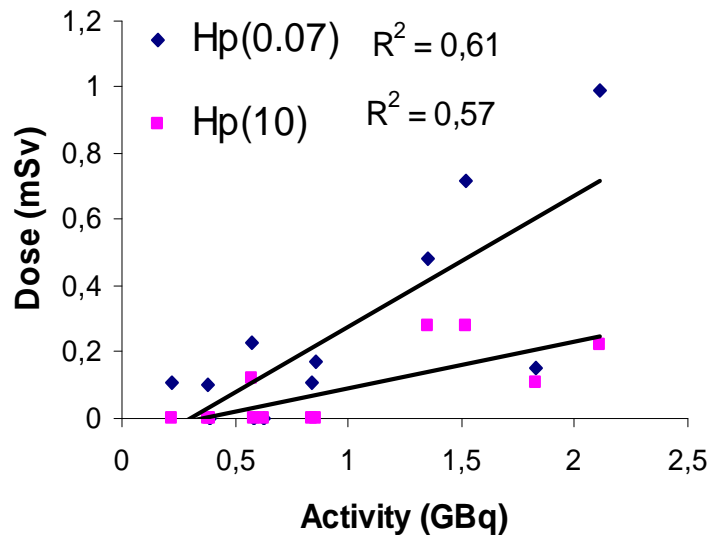
Tech #1

Extremity ring dosemeter

Tech #2



Whole body dosemeter



$p < 0.05$

1 year

Tech#1

Tech#2

---

**Activity  
Studies**

(GBq)

11.3

12.4

441

422

---

**Whole body dosemeter**

Hp(0.07) (mSv)

3.06

1.35

Hp(10) (mSv)

1.01

1.30

---

**Ring dosemeter**

Left

Hp(0.07) (mSv)

42.88

24.58

Right

Hp(0.07) (mSv)

12.50

21.34

---



Mean dose rate  $H^*(10)$  ( $\mu\text{Sv/h}$ )

Animal	Monkey	Rat	Mouse	Mouse
<b>RP</b>	<b>DTBZ</b>	<b>FDG</b>	<b>FDG</b>	<b>FLT</b>
Number	13	60	30	6
Weight (g)	5257	398	25	19
<b>Activity (MBq)</b>	<b>84</b>	<b>20</b>	<b>18</b>	<b>19</b>
<b>RP Incorporation</b>	<b>0:00</b>	<b>1:00</b>	<b>1:00</b>	<b>0:40</b>
<b>Scan duration</b>	<b>0:40</b>	<b>1:00</b>	<b>0:15</b>	<b>0:20</b>

Mean dose rate  $H^*(10)$  ( $\mu\text{Sv/h}$ )

Animal		Monkey	Rat	Mouse	Mouse
<b>RP</b>		<b>DTBZ</b>	<b>FDG</b>	<b>FDG</b>	<b>FLT</b>
Number		13	60	30	6
Weight (g)		5257	398	25	19
<b>Activity (MBq)</b>		<b>84</b>	<b>20</b>	<b>18</b>	<b>19</b>
<b>RP Incorporation</b>		<b>0:00</b>	<b>1:00</b>	<b>1:00</b>	<b>0:40</b>
<b>Scan duration</b>		<b>0:40</b>	<b>1:00</b>	<b>0:15</b>	<b>0:20</b>
<b>Before</b>	H*(10) at 0cm	376	262	835	1095
	H*(10) at 20cm	76	24	32	40
<b>After</b>	H*(10) at 0cm	115	181	761	965
	H*(10) at 20cm	25	16	29	34

**PET scan**

# Discussion

## MBq/study

microPET	27
PET-CUN <sup>1</sup>	433

## Hp(10)

## $\mu\text{Sv/GBq}$

## $\mu\text{Sv/study}$

microPET	97	2.69
PET-CUN <sup>1</sup>	27	11.82

## Finger Hp(0.07)

microPET	2150	58.6
PET-CUN <sup>1</sup>	89	38.5



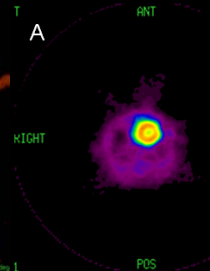
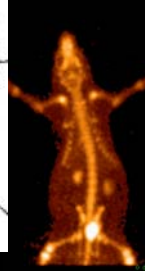
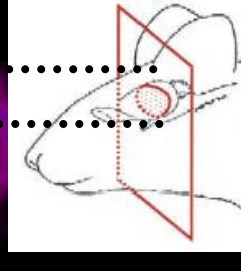
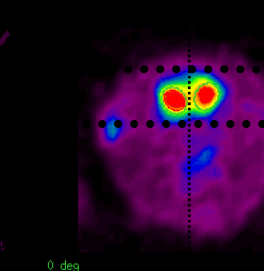
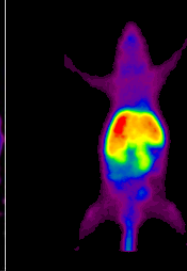
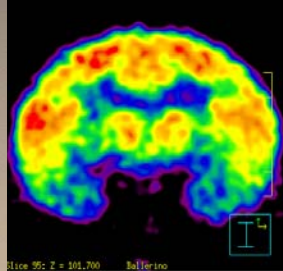
## Conclusions

---

The results have shown that extremities are the limiting organs as far as regulatory dose limits for workers are concerned.

The procedures followed by the technicians at the animal research unit for the administration of PET radiopharmaceuticals and managing the animals are satisfactory and involve an acceptable radiation exposure risk.





# **RADIATION PROTECTION IN AN ANIMAL RESEARCH UNIT WITH PET: OCCUPATIONAL DOSES AND ANIMAL DOSE RATES**

**J.M. Martí-Climent<sup>1</sup>, M. Ecay<sup>2</sup>, I. Bilbao<sup>2</sup>,  
E. Prieto<sup>1</sup>, M. Collantes<sup>2</sup>, I. Peñuelas<sup>1,2</sup>**

1. Servicio de Medicina Nuclear.

Clínica Universidad de Navarra. Pamplona, Spain

2. Unidad de Investigación microPET.

CIMA-Clínica Universidad de Navarra. Pamplona, Spain



**Clínica Universitaria**  
Universidad de Navarra

