Determination of The Radiation Dose Received By The Patient During Positron Emission Tomography – Computed Tomography (Pet - Ct) Procedures

TURAN ŞAHMARAN[1] – **Mehmet BAYBURT**[2]

1 Hatay Mustafa Kemal University, Kırıkhan Vocational School, Hatay, Turkey.

2 Ege University, Institute of Nuclear Sciences, İzmir, Turkey.

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INTRODUCTION

- Positron Emission Tomography (PET) is a radioisotope imaging technique that has started to be used more commonly in recent years.
- Its imaging principle is using the simultaneous detection of two 511 keV annihilation photons that arise in conclusion of positron-electron annihilation.
- Positron emission tomography/computed tomography (PET/CT) has become an indispensable imaging modality for the diagnosis, staging and monitoring of therapy response of a broad range of malignancies.

INTRODUCTION

- PET/CT is a valuable tool in oncology due to the combined metabolic and morphological information provided. The PET emission scan provides physiological information using a set of detectors that are independent of CT transmission detection, and although two independent PET and CT images may be coregistered to form a single image, the two scans are most accurately coupled when both are acquired during the same exam using a combined PET and CT scanner.

INTRODUCTION

- The radiation dose to the patient from a PET-CT scan depends on the PET-CT protocol, the patient's size and physiology, amount of injected activity and the make and model of the PET-CT scanner. The combined PET-CT examination results in an increased radiation dose to patients as compared to stand alone components of PET-CT scan and also other conventional diagnostic radiology examinations.
- The effective doses from PET-CT investigations are reported to be 25 mSv1, and 13.45 - 31.91 mSv for female patients and 13.65 – 32.18 mSv for male patients from three different PET-CT protocols.

INTRODUCTION

- Amongst all the radiopharmaceuticals developed so far for PET imaging, 18F-fluorodeoxyglucose (18FDG) has widespread application and is most commonly used. Although several dose estimates in humans have been reported from internal administration of 18FDG, most of these are based on the bio-distribution studies in animals or by combining data from animals and measurements in humans.

- The aim of this study was to determine the radiation doses to which patients were exposed during PET - CT imaging and to compare these dose results with those recommended by international committees.

MATERIALS AND METHODS

- Experimental studies were carried out in the, Ege-Rad Imaging Center, Izmir, Turkey. This study was approved by the Local Ethical Committee. The informed consent was obtained from the patients.

- Thermoluminescence Dosimeters (TLD) were used for dose measurement. These TLDs are small chips with a diameter of 4.8 mm and a thickness of 0.9 mm. The LiF dosimeters used are the most preferred radiation dosimeters because they show a linear dose response of up to 1 Gray (Gy), are highly sensitive and are approximately tissue equivalent.

MATERIALS AND METHODS

- Harshaw TLD 3500 model TLD reader was used in the study. TLDs irradiated on the patient were read on TLD reader at the Institute of Nuclear Sciences of Ege University on the same day and the values obtained were recorded. Two dosimeters were used for each organ.

- The two dosimeters used for the same organ were compared and the dosimeters were obtained. Since it was difficult to work on the patient, only 4 patients could be studied.

MATERIALS AND METHODS

- For PET - CT scans, 12 mCi (444 MBq) F-18 FDG were applied to 4 pathologically similar patients for routine application. Dosimeters were left in the patients' body from injection to end of exposure. After the end of the dosing, dosimeters were taken from the patients and taken to Ege University Institute of Nuclear Sciences for dose reading.

- The PET - BT device used is the PHILIPS GEMINI GXL full ring type device.

MATERIALS AND METHODS

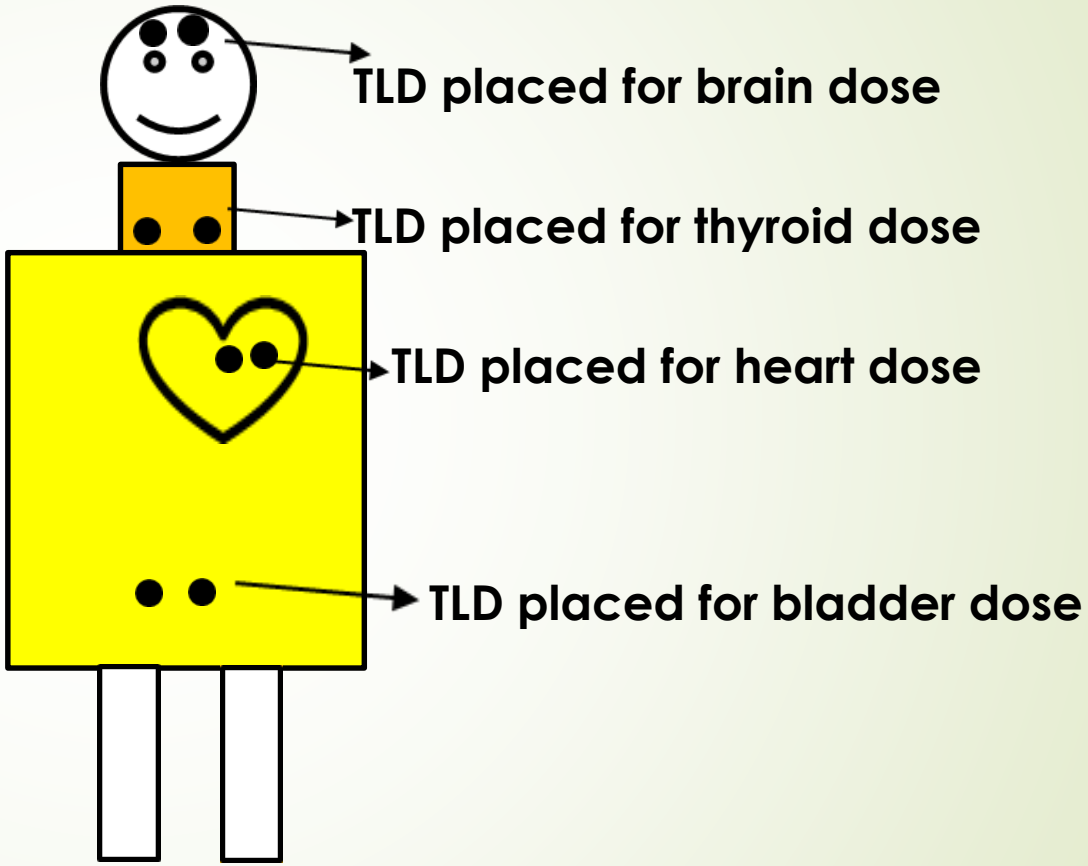

Fig. 1. TLD positions placed on the patient

RESULTS

Patient No	Brain Dose (mGy)	Thyroid Dose (mGy)	Heart Dose (mGy)	Bladder Dose (mGy)
1	16.97	9.06	16.54	21.84
2	20.36	8.70	16.79	23.19
3	7.57	7.62	18.51	36.65
4	4.18	9.16	28.23	24.03
Mean	12.27	8.63	20.01	26.42

Table 1. Results of brain, thyroid, heart and bladder doses with TLD dosimeters

RESULTS

Doz (mGy/MBq)				
	ICRP	MIRD	Nureg/CR-6345	This Study
Brain Dose	0.026	0.046	0.019	0.027
Thyroid Dose	0.0097	0.021	0.010	0.019
Heart Dose	0.065	0.068	0.060	0.045
Bladder Dose	0.17	0.073	0.19	0.060

Table 2. Comparison of brain, thyroid, heart and bladder doses with international results

RESULTS

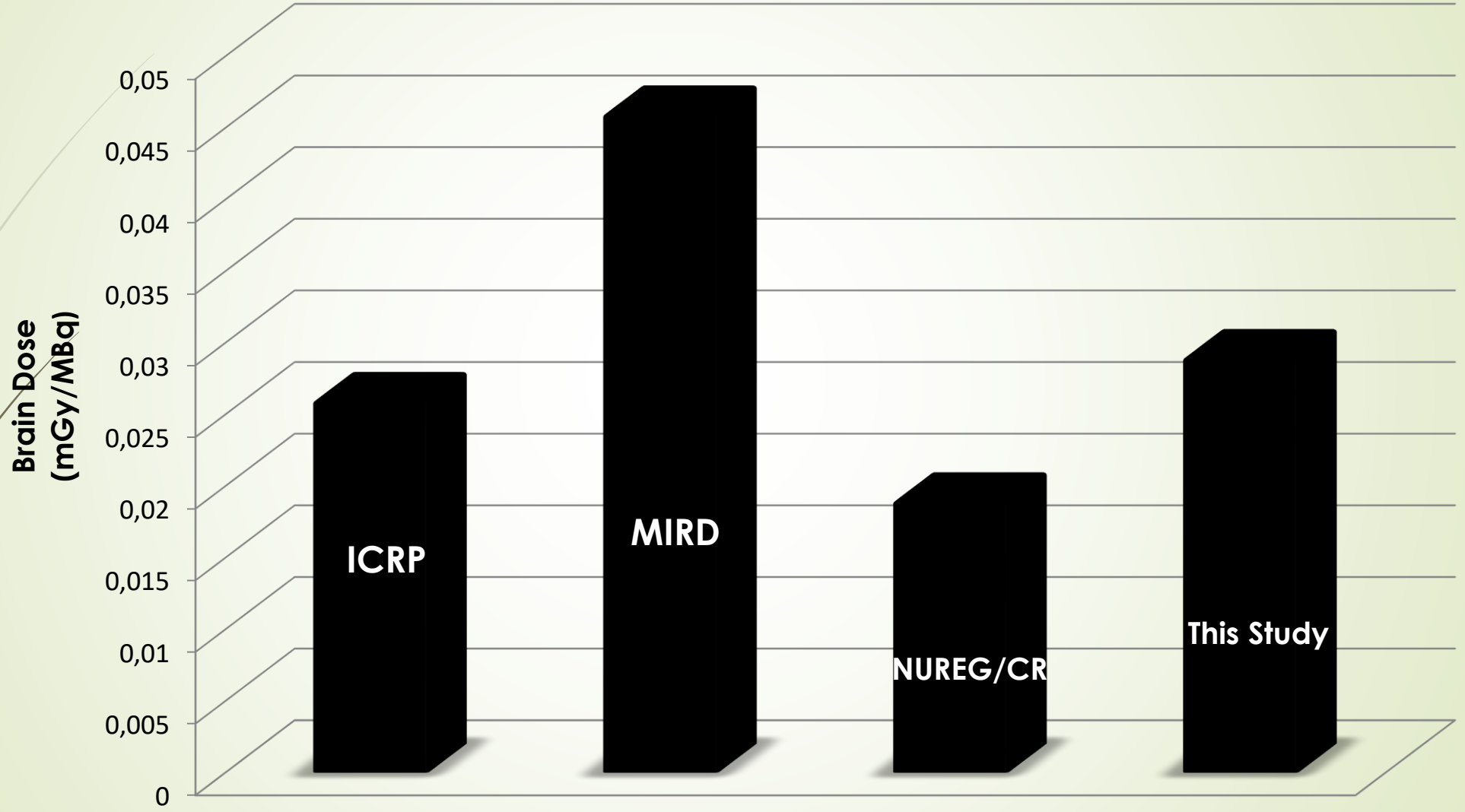

Fig.2. Comparison of TLD results for brain dose

RESULTS

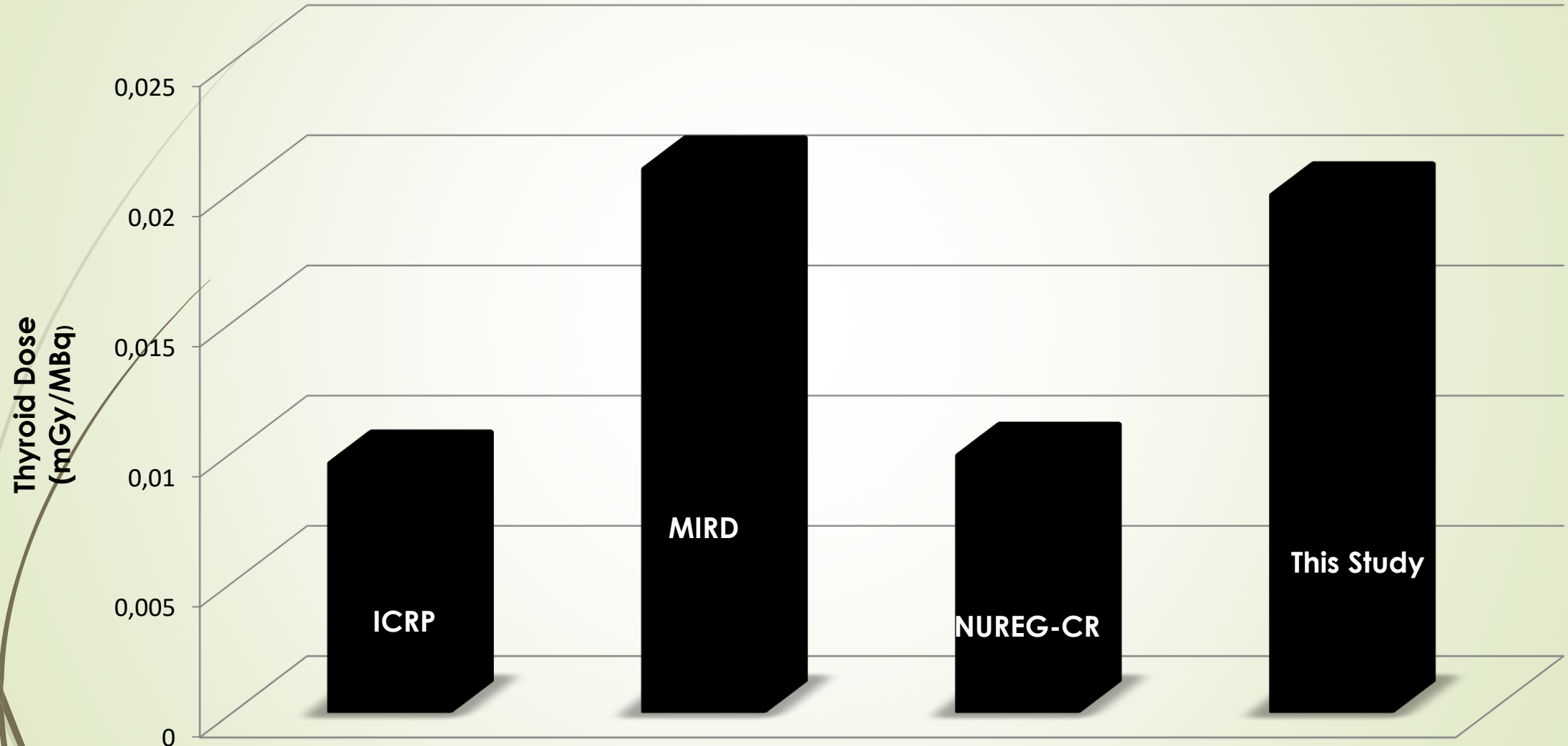

Fig.3. Comparison of TLD results for thyroid dose

RESULTS

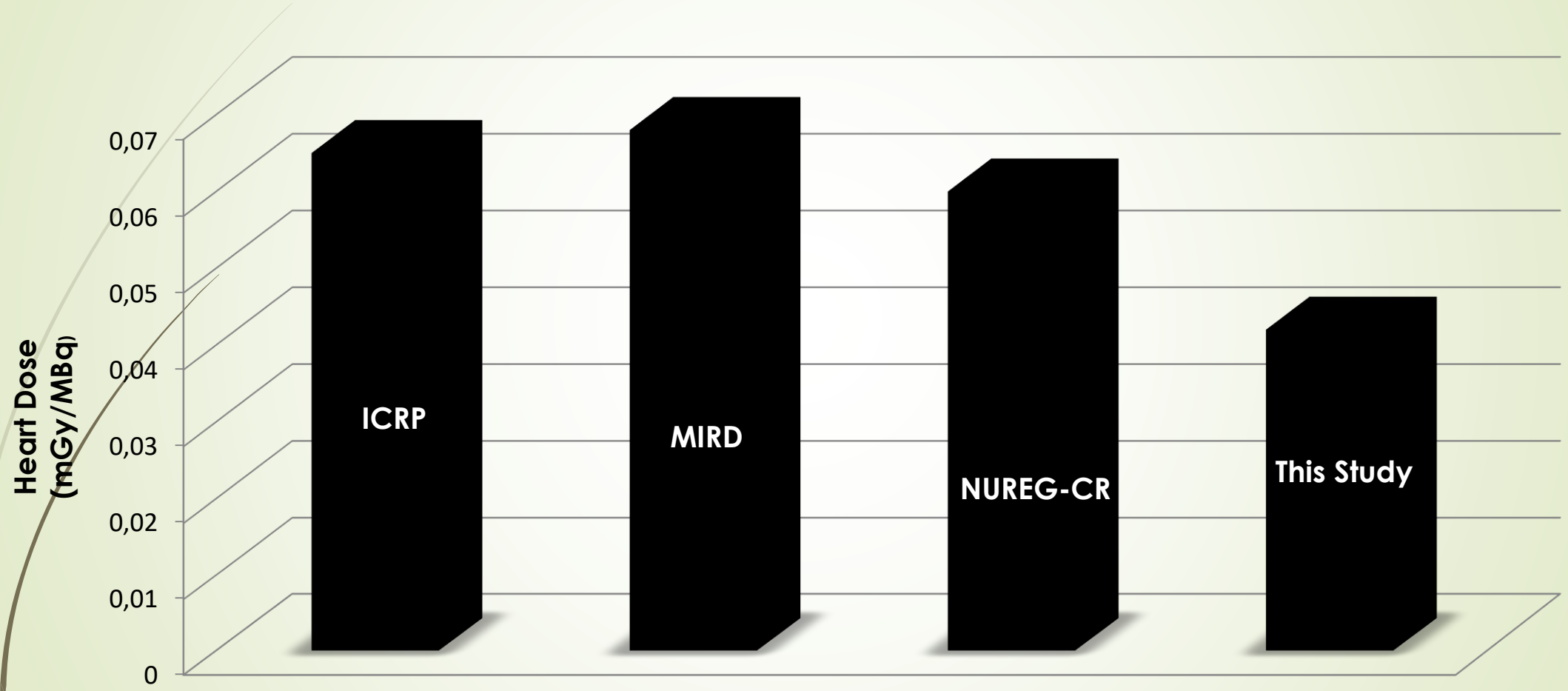

Fig.4. Comparison of TLD results for heart dose

RESULTS

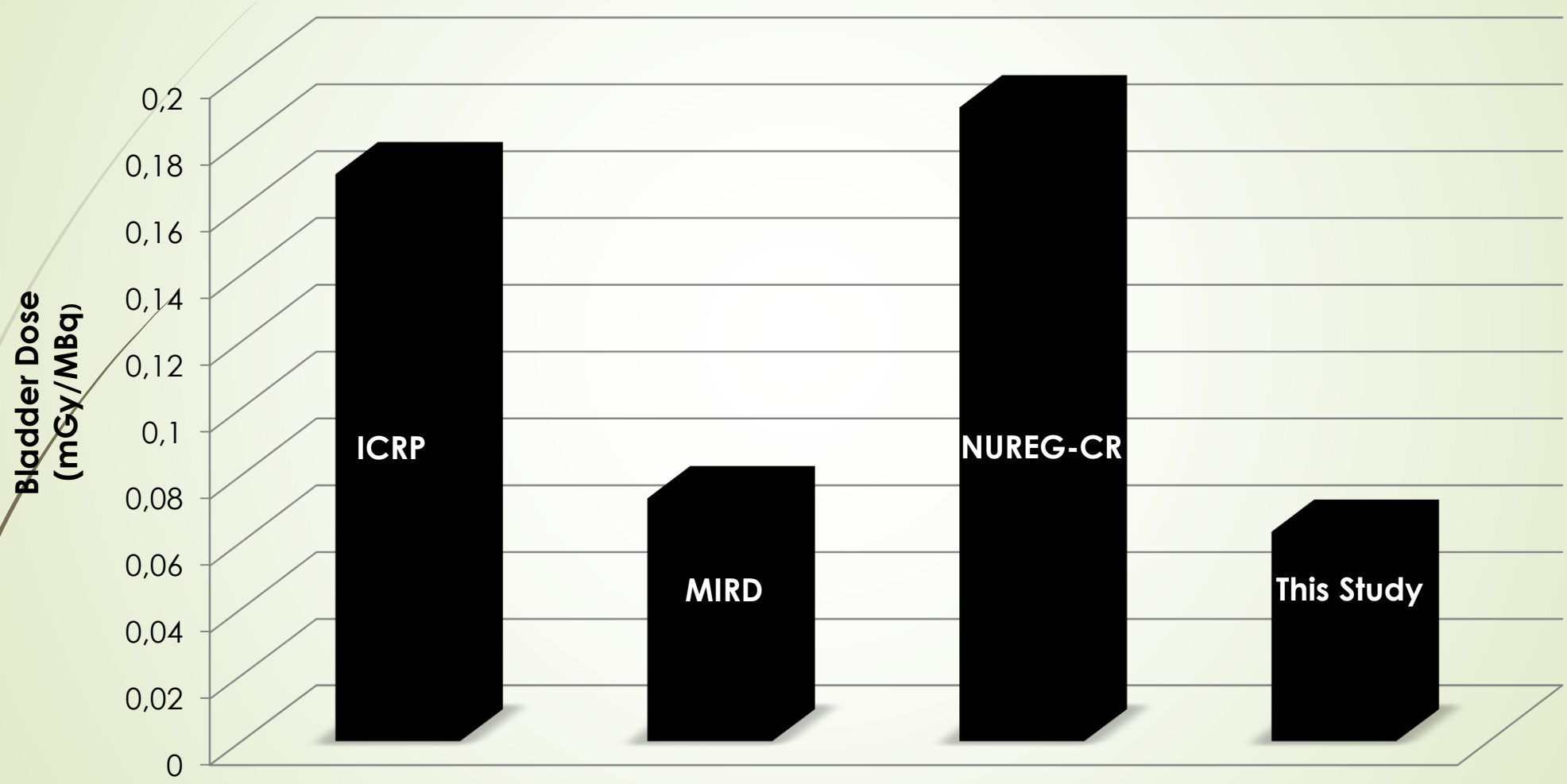

Fig.5. Comparison of TLD results for bladder dose

CONCLUSIONS

- As a result of this study, it was observed that the lowest dose values were found in thyroid and the highest dose value was found in the bladder. Most radiopharmaceuticals used in nuclear medicine are excreted in the urinary tract. Therefore, it is expected that the dose value in the bladder is higher than the other organ regions.
- Variation of dose results between patients may depend on patients' height, weight, age, metabolic status of the body, and disease status. It was shown in the study that the mean dose values obtained from the patients during the extraction were within the dose limits recommended by international organizations.

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Thank you for your attention.