

^{131}I BIOKINETIC AND CYTOGENETIC STUDIES IN ABLATION TREATMENT FOR THYROID CANCER

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INTRODUCTION

- **^{131}I HAS BEEN USED AS PART THYROID CANCER TREATMENT: PATIENTS ARE SUBMITTED TO ORAL ADMINISTRATION OF ^{131}I IN ORDER TO ELIMINATE RESIDUAL THYROID TISSUE AFTER TOTAL THYROIDECTOMY.**
- **AVERAGE ^{131}I ADMINISTERED ACTIVITY: 3.7 GBq FOR ABLATION AND 7.4 GBq FOR THERAPEUTIC PURPOSES.**

OBJECTIVE

- **STUDY IODINE BIOKINETICS AND DETECT BIOLOGICAL DAMAGE FROM INTERNALLY DEPOSITED RADIOIODINE GIVEN FOR THYROID CANCER TREATMENT.**

SELECTION OF PATIENTS

10 PATIENTS WERE SELECTED USING THE CRITERIA AIMING TO MINIMIZE ANATOMIC AND METABOLIC DIFFERENCES AND OTHER POTENTIAL DISTURBANCES:

- **FEMALE ADULTS – AVERAGE AGE 41 YEARS OLD (21 – 72 YR OLD);**
- **THYROID PAPILLARY CARCINOMA;**
- **TOTAL OR NEAR TOTAL THYROIDECTOMY;**
- **NO DETECTABLE METASTASES;**
- **NO RENAL DISFUNCTION OR OTHER SERIOUS HEALTH COMPLICATIONS;**
- **NO PREVIOUS IONIZING RADIATION OR MUTAGENIC CHEMICAL TREATMENTS;**
- **ADMINISTERED ACTIVITY RANGED FROM 2.64 to 4.05 GBq (AVERAGE 3.7 GBq)**
- **¹³¹I UPTAKE IN REMNANT THYROID TISSUE RANGED FROM 1 TO 11% OF THE ADMINISTERED ACTIVITY.**

(The present study was performed in accordance with the Brazilian Research Ethics Board)

METHODOLOGY

- **¹³¹I MEASUREMENTS:**
 - *IN VIVO* BIOASSAY: THYROID AND UPPER THIGH REGION;
 - *IN VITRO* BIOASSAY: URINE MEASUREMENTS.
- **CHROMOSSOME ABERRATIONS**

IN VIVO MEASUREMENTS

EARLY MEASUREMENT SYSTEM- 1ST WEEK



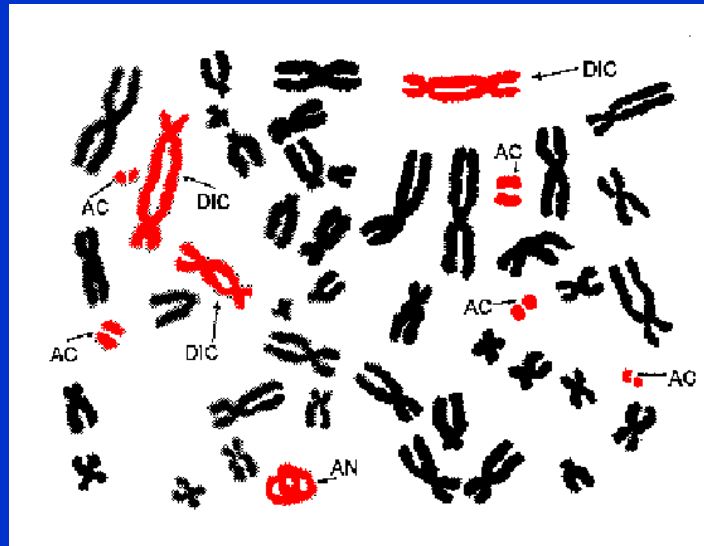
- **ORIGINALLY DESIGNED FOR *IN VIVO* DIAGNOSIS PROCEDURES;**
- **ADAPTATED FOR *IN VIVO* MEASUREMENTS AT THE FIRST HOURS/DAYS AFTER ¹³¹I ADMINISTRATION;**
- **MEASUREMENTS IN 1- 3 h INTERVALS DURING HOSPITALIZATION (FIRST 2-3 d, 6-7d POST-ABLATION) .**



WHOLE BODY COUNTER – AFTER 1ST WEEK

- **8” x4” NaI(Tl) DETECTOR USED FOR WHOLE BODY COUNTING;**
- **3” x 3” NaI(Tl) DETECTOR USED FOR THYROID REGION COUNTING;**
- **WEEKLY MEASUREMENTS – FROM THE SECOND WEEK POST-ABLATION UP TO THE MINIMUM LIMIT OF DETECTION (10-14 WEEKS POST-ABLATION)**

CHROMOSOME ABERRATION ANALYSIS: RADIOBIOLOGY LABORATORY (IRD/CNEN)

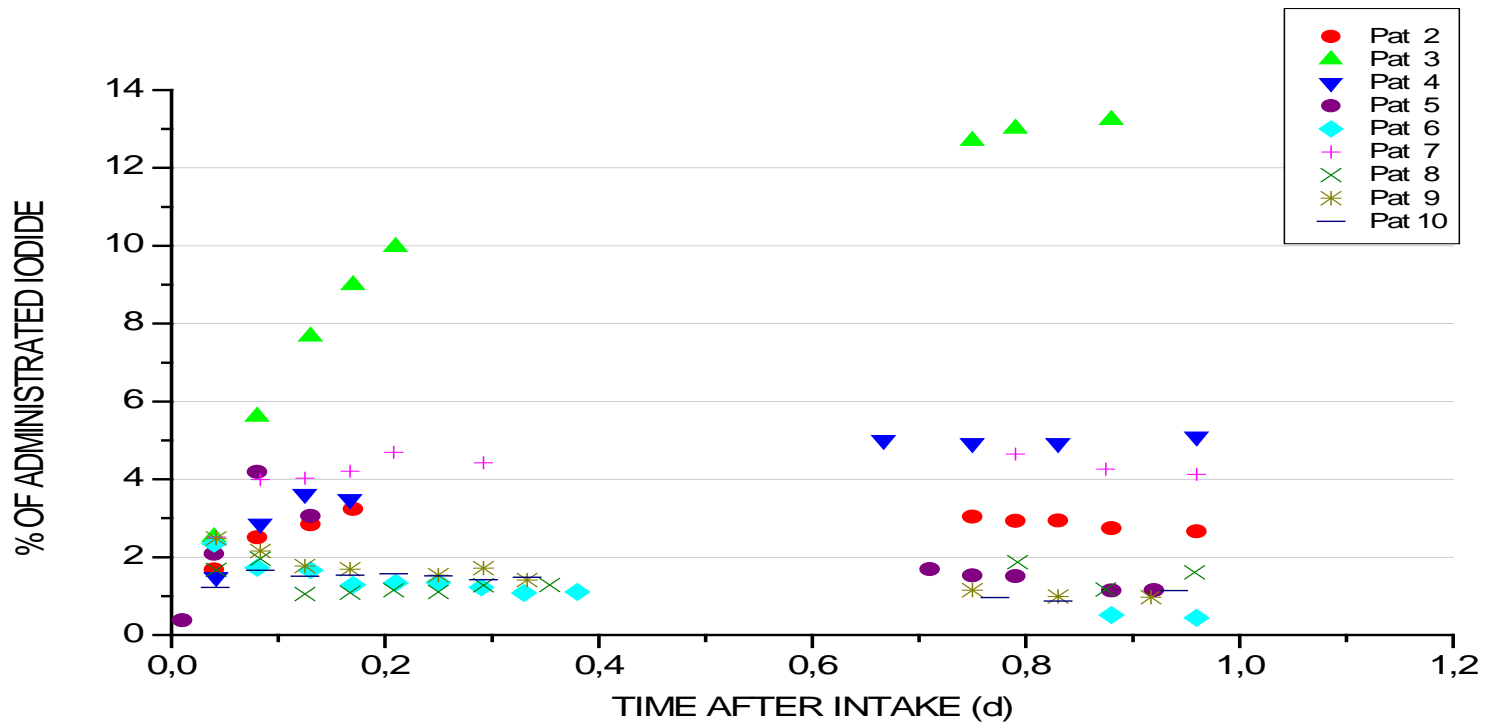


DICENTRIC CHROMOSOMES AND
CENTRIC RING IN LYMPHOCYTES
OF IRRADIATED WHOLE BODY

- FIRST BLOOD SAMPLE WERE COLLECTED IMMEDIATELY BEFORE ¹³¹I ADMINISTRATION (CONTROL SAMPLE);
- SECOND BLOOD SAMPLE WERE COLLECTED WHEN *IN VIVO* BIOASSAY MEASUREMENTS REACHED MINIMUM DETECTION LEVELS.

IN VIVO ^{131}I MEASUREMENTS THYROID REGION - FIRST 24 h (RADIOACTIVE DECAY CORRECTED)

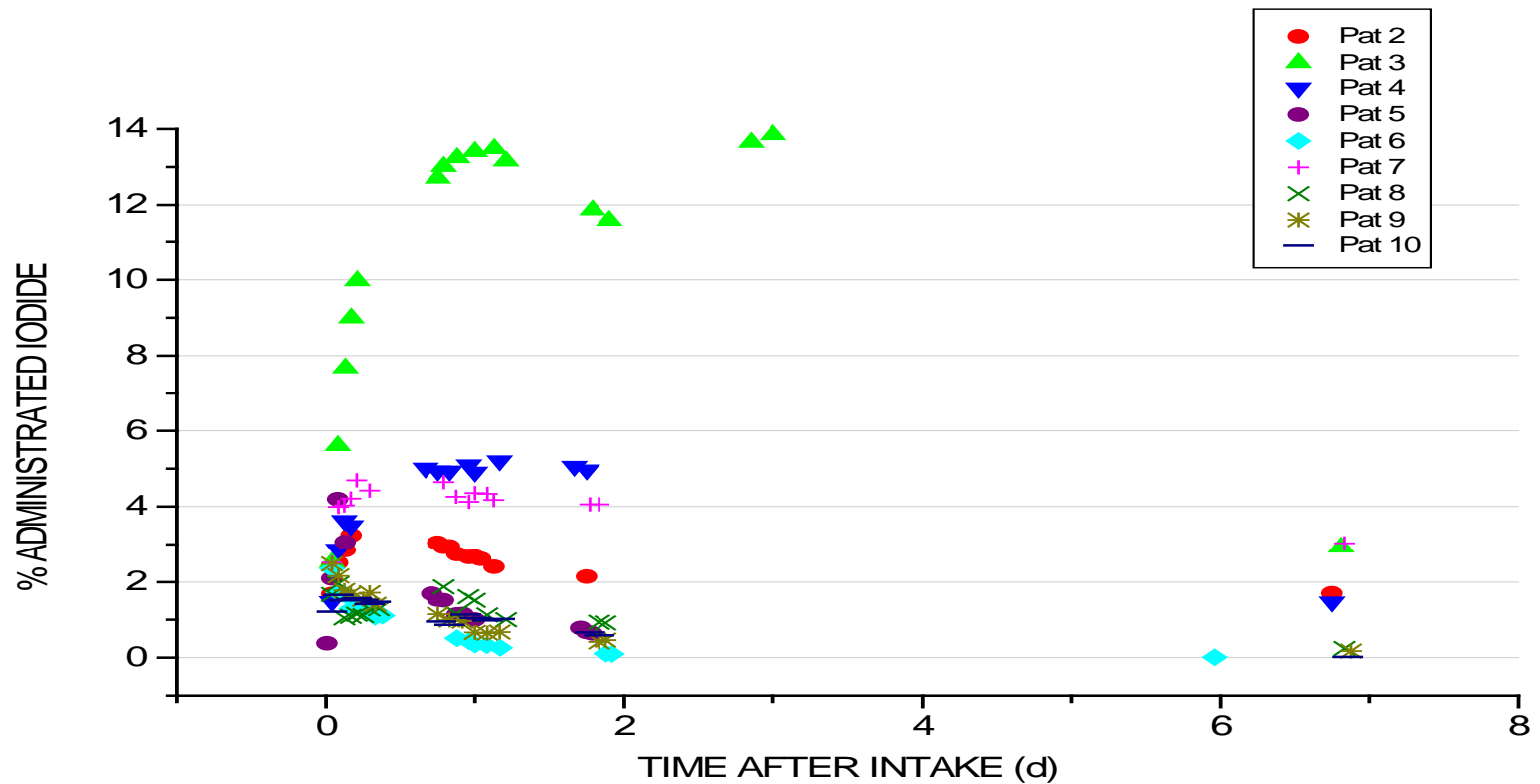
- RETENTION AND ELIMINATION OF ^{131}I : COMPLEX PATTERN
- FIRST DAY - ASCENDENT AND DESCENDENT CURVES



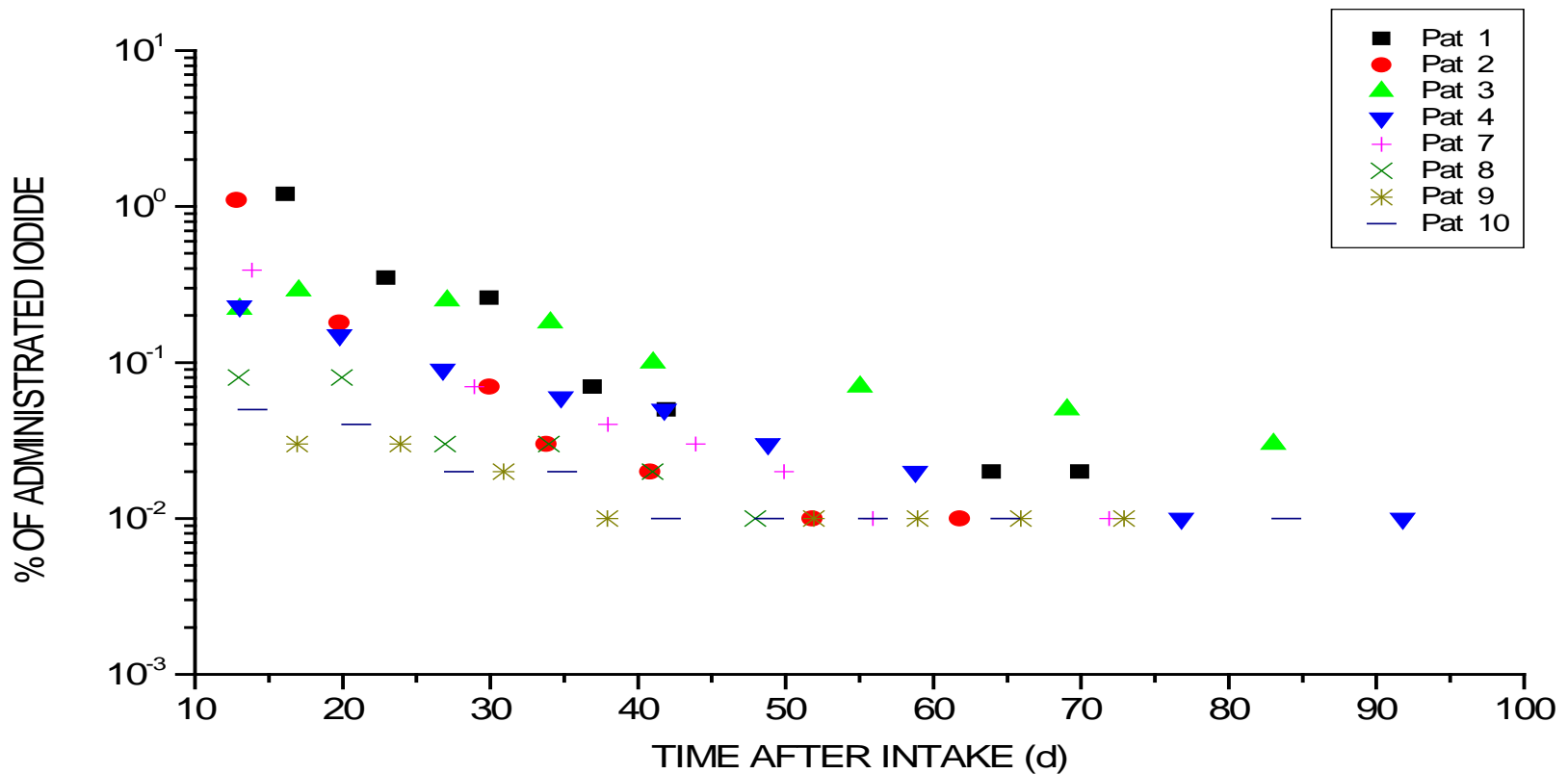
PATIENTS 3 AND 4 PRESENTED SEVERE AND MODERATE DEGREES OF THYROIDITIS, RESPECTIVELY.

IN VIVO ^{131}I MEASUREMENTS THYROID REGION FIRST WEEK (RADIOACTIVE DECAY CORRECTED)

- MEASUREMENTS DURING HOSPITALIZATION

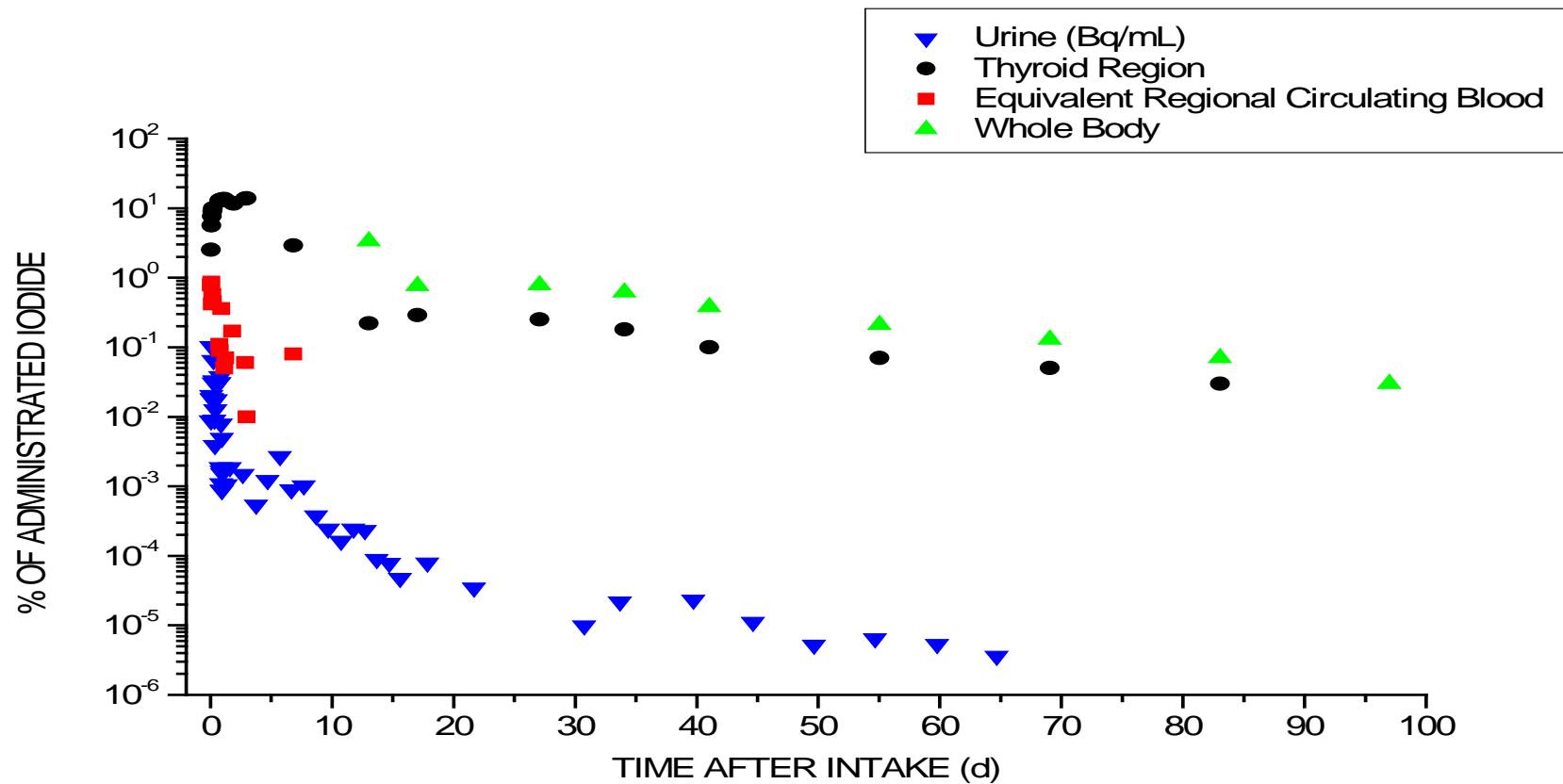


IN VIVO ^{131}I MEASUREMENTS THYROID REGION AFTER 10 d (RADIOACTIVE DECAY CORRECTED)



BIOASSAY ANALYSIS

(DECAY CORRECTED)



PATIENT N^o. 3 (SEVERE THYROIDITIS)

IN VITRO BIOASSAY ANALYSIS

MEAN PERCENTUAL VALUES OF IODINE ELIMINATED BY URINE:

TIME AFTER INTAKE (HOURS)	% ADMINISTERED ACTIVITY IN URINE
24	67
48	90
72	94
96	95
120	96

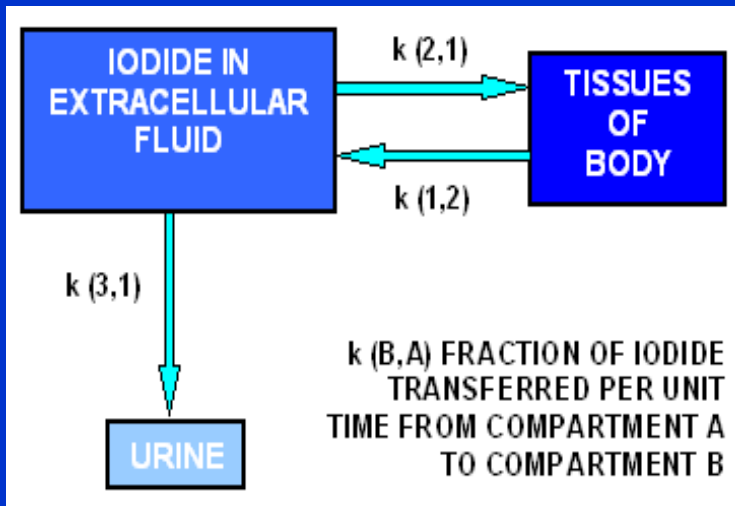
- **WHOLE BODY RETENTION OF IODINE CALCULATED FROM URINARY EXCRETION CURVES:**

1ST TERM: AVERAGE BIOLOGICAL HALF-LIFE – 0.81 d

2ND TERM: AVERAGE BIOLOGICAL HALF-LIFE - 10 d

BIOKINETIC MODEL

COMPARTMENTAL MODEL PROPOSED



CONSIDERATIONS:

- 100% OF IODIDE ABSORPTION IN THE GASTROINTESTINAL (GI) TRACT
- IODINE ORGANIFICATION NOT CONSIDERED
- TISSUES OF THE BODY COMPARTMENT: REMNANT THYROID TISSUE, SALIVARY GLANDS, STOMACH WALLS

- PATIENTS WITH SEVERE AND MODERATE DEGREES OF THYROIDITIS - IODINE RETENTION WERE RELATIVELY LONGER THAN FOR OTHER PATIENTS, ALONG THE FIRST 200 h: COMPATIBILITY WITH CLINICAL SIGNS

CHROMOSOME ABERRATION ANALYSIS CONTROL

- CONTROL SAMPLES: NO DICENTRIC CHROMOSOME OR CENTRIC RING WAS OBSERVED IN TOTAL OF 4050 LYMPHOCYTES CELLS (AVERAGE 500 CELLS ANALYZED FOR EACH PATIENT).
- CYTOGENETIC DOSIMETRY INDICATES THAT ¹³¹I ACTIVITIES PREVIOUSLY ADMINISTERED FOR DIAGNOSIS PURPOSES DID NOT INDUCE THE FORMATION OF CHROMOSOME ABERRATIONS SUCH AS DICENTRIC AND CENTRIC RING.

CHROMOSOME ABERRATION ANALYSIS

DOSES ESTIMATED BY CYTOGENETIC DOSIMETRY: 0.2 TO 0.3 Gy

(BASED ON ^{60}Co EXTERNAL DOSE CALIBRATION CURVES)

Patient N°	Frequency of dicentrics	Dose (Gy)
1	0.016	0.32
2	0.010	0.22
3	0.014	0.29
4	0.012	0.26
7	0.010	0.22
8	0.014	0.29
9	0.012	0.26
10	0.014	0.29

CONCLUSIONS

- THE IODINE RETENTION IN THE THYROID REGION DOES NOT FOLLOW THE SAME PATTERN IN THE FIRST DAY, WITH ASCENDANT AND DESCENDANT CURVES, WHICH WAS SEEN IN 8 OUT OF 10 PATIENTS.
- PEAK IODINE UPTAKE IN THYROID REGION WAS OBSERVED FROM 1 TO 5 HOURS AFTER ADMINISTRATION.
- THYROIDITIS, INFLAMMATORY CLINICAL SYMPTOM, WAS SHOWN TO DELAY THE ELIMINATION OF IODINE. MAXIMUM RADIOIODINE UPTAKE IN THYROID REGION OCCURRED IN 3 DAYS FOR PATIENT WITH SEVERE THYROIDITIS AND 28 HOURS FOR PATIENT WITH MODERATE THYROIDITIS.
- 6 DAYS AFTER ABLATION DOSE, THE AMOUNT OF IODINE IN THYROID REGION FOR PATIENTS THAT PRESENTED THYROIDITIS ARE SIMILAR TO THE OTHERS.

CONCLUSIONS

- **IN THE FIRST 24 HOURS AFTER IODINE ADMINISTRATION, IT IS NOT POSSIBLE TO DISTINGUISH A SINGLE EXPONENTIAL DECAY PATTERN FOR IODINE ELIMINATION IN URINE.**
- **IODINE RETENTION:**
 - 1ST TERM: AVERAGE BIOLOGICAL HALF-LIFE – 0.8 d**
 - 2ND TERM: AVERAGE BIOLOGICAL HALF-LIFE - 10 d**

CONCLUSIONS

CYTOGENETIC ANALYSIS:

- **¹³¹I ACTIVITIES FOR THYROID CANCER TREATMENT (2.64 TO 4.05 GBq) RESULTS IN INDUCTION OF DICENTRIC CHROMOSOMES IN LYMPHOCYTES.**
- **THE MEAN ESTIMATED WHOLE BODY DOSE (SD) IS EQUIVALENT TO AN EXTERNAL UNIFORM DOSE OF 0.27 0.04 Gy.**
- **THE FREQUENCY OF UNSTABLE CHROMOSOME ABERRATIONS OBTAINED IN THE CURRENT STUDY PRESENTED GOOD CORRELATION WITH ¹³¹I ADMINISTERED ACTIVITY VALUES AND 24 HOURS RETAINED ACTIVITY IN WHOLE BODY.**

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