

¹³¹I-RETENTION MEASUREMENTS AND LOCALIZATION BY A HIGH-SENSITIVITY WHOLE-BODY COUNTER

G.GREIFENEDER,¹ H. AIGINGER,¹ F. STEGER,² J. FLORES³

¹ Atominststitute of the Austrian Universities, Vienna, Austria

² Austrian Research Center Seibersdorf, Seibersdorf, Austria

³ Institute of Nuclear Medicine, University of Vienna, Austria

INTRODUCTION

A widely used method to investigate thyroid gland carcinomas but also disorders of the thyroid gland is the measurement of the ¹³¹I-retention behaviour using a high-sensitivity whole-body counter (HWBC). Normally just the retention of oral administered Radioiodine is controlled. However, it is possible to visualize the distribution of ¹³¹I (using a modified profilescantechnique) beside the retention in the human body and this provides much better information on human metabolism as will be demonstrated in the following.

MATERIALS AND METHODS

Experimental equipment

The profile scanning system used consists of four 8"x4" NaI(Tl)-crystals with multi-slit focused lead collimators inside a massive shielding chamber (total weight of the order of 74 t). Two of these linear scanning detectors are placed above and two below the bed and can be arranged independently in three dimensions. The scanning motion and the data aquisition was controlled separatly for each detector by a central computer.

Clinical studies

To demonstrate the power of the high sensitive profilescantechnique we investigated 28 patients with total thyroid gland ectomy before and after ¹³¹I-therapy. To ensure the absence of new metastasis and to localize remains of thyroid gland oral dosis with 20 µCi of radioactive Iodine has been provided. One hour and 72 hours after administration linear profile scan measurements relative to a comparative standard have been done by the HWBC. Thereby each patient was placed at a fixed position on the bed. The profile of count rates was measured by the profile scanning system (scanning time 600 s, scanning length 190 cm) using a special detector configuration shown in Fig.1.

To study the rate of accumulation of ¹³¹I in the human body after its oral administration the retention value has been calculated from the measured count rates and a correction of background radiation and patient activity has been done.

$$R = \frac{P_{72h} - LW_R}{P_{1h} - LW_P} \cdot 100 \cdot \frac{S_{1h}}{S_{72h}} \quad [\%]$$

P _{1h}	count rates 1 h after administration (patient)
S _{1h}	count rates 1 h after administration (standard)
P _{72h}	count rates 72 h after administration (patient)
S _{72h}	count rates 72 h after administration (standard)
LW _p	patient activity
LW _R	background radiation

The profiles thus obtained for each scanning detector represents the longitudinal localization of the ^{131}I -distribution. To achieve the three-dimensional portrayal of the ^{131}I -distribution by the linear profile scan measurements a computational model¹ has been used. The model based on the special detector configuration allows to determine the distribution of radioactivity in the human body from the measured counts (beside the ^{131}I -retention behaviour). So count rates can be directly attributed to organs of the human body.

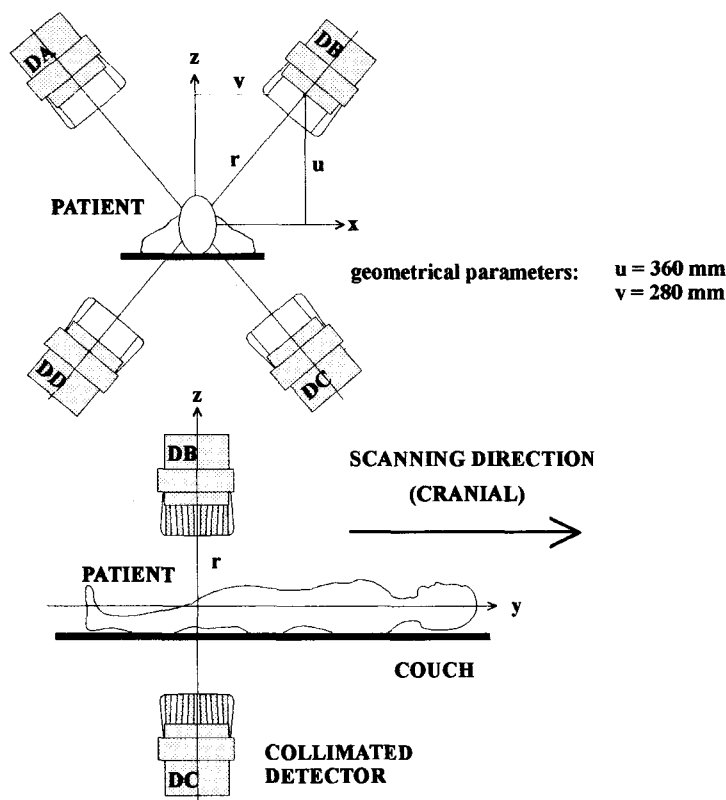
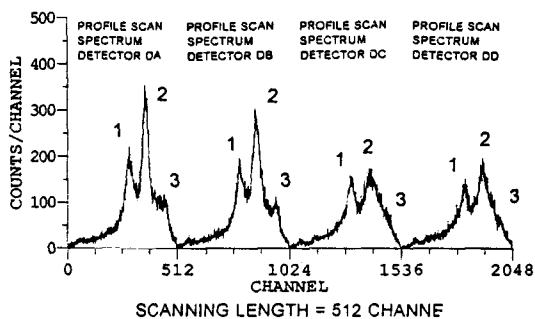


Fig.1. Detector configuration.

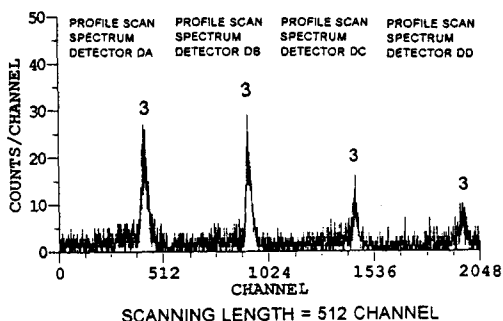
RESULTS

After oral administration of ^{131}I , the inorganic iodide is absorbed from the gastrointestinal tract within one hour and is completely transformed to plasma and extraiodide pool. Major portion of the total iodine content is taken up by metastases, most of which is in the form of iodinated aminoacids and the rest of the portion is excreted by the kidney. Normally a retention value of more than 3 % 72 hours after administration is interpreted as a possible of metastasis. Regarding the spatial ^{131}I -distribution in addition a decision between localization and dislocalization is possible. Thereby it turned out that one of 10 patients with total thyroid gland ectomy before ^{131}I -therapy showed a retention value of 2.32 % although a localization could be detected shown in Fig.2. On the other side none of the patients after ^{131}I -therapy showed up a localization indicating a metastases even 25 % had a retention value of more than 3 %. Looking just at the retention values the possiblitiy of disorders cannot be excluded of certainty but regarding the three-dimensional distribution in addition a decision between localization and dislocalization is possible (Fig.3). So the physiological or pathological meaning of the retention value can be easily interpreted without further investigations by a gammacamera where much higher dosis (20 mCi) is applicated.



Linear profile scan 1 h after administration

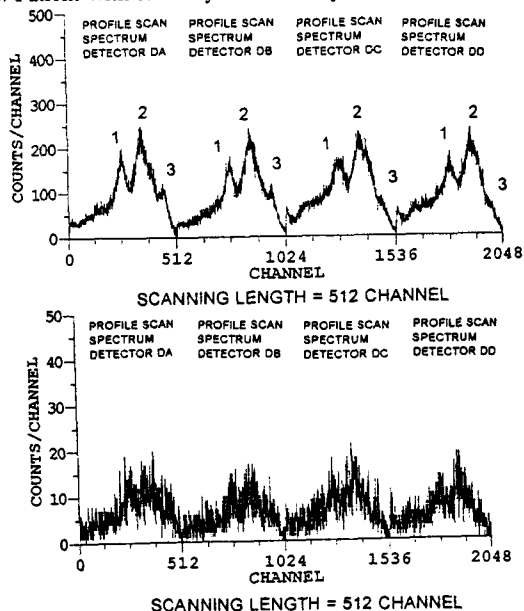
- 1 bladder
- 2 stomach
- 3 region of the neck



Linear profile scan 72 h after administration

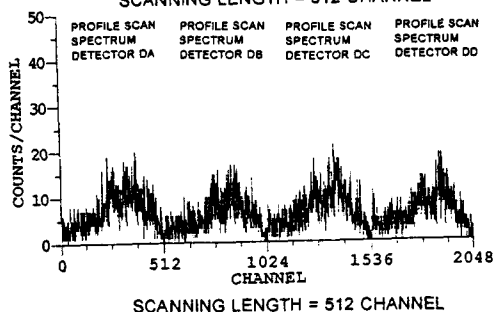
- 3 region of the neck
- localization**

Fig.2. Patient with total thyroidectomy before ^{131}I -therapy, retention value: 2.32 %.



Linear profile scan 1 h after administration

- 1 bladder
- 2 stomach
- 3 region of the neck



Linear profile scan 72 h after administration

dislocalization

Fig.3. Patient with total thyroidectomy after ^{131}I -therapy, retention value: 7.58 %.

REFERENCES

1. A method to localize small activities in the human body by a whole-body counter, G. Greifeneder, H. Aiginger, F. Steger, E. Unfried, L. Riedlmayer, H. Bergmann, IRPA 9, Vienna, abstract no.: 90455