

Abnormal right lower abdominal focal retention in the radioiodine (^{131}I) whole-body scan

Radyoiodot (^{131}I) tüm vücut tarama sintigrafisinde anormal sağ alt abdominal fokal retansiyon

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SUMMARY

Objective: Differentiated thyroid cancer (DTC) capture, organify iodine and have the ability to synthesize and release thyroglobulin. Because of this feature, DTCs can be treated with high doses of ^{131}I after total thyroidectomy. Whole body scan (WBS) with ^{131}I is a well-established method for the detection of metastatic or residual tumor sites in patients with differentiated thyroid cancer. False-positive radioiodine uptake has been reported in many organ systems. Our aim in the present study was to investigate whether an 'uncommon focal retention of radioactivity in right lower abdominal region' which we coincide only in woman patients in whole body scan with ^{131}I was a physiological finding.

Method: A total of 405 consecutive patients with DTC who all were referred for either post-ablation or diagnostic whole body scan with ^{131}I , were included in the the present study.

Results: A focal retention of radioactivity in right lower abdominal region was observed in 22 patients (5.4%) out of 405, in whom 14 patients had further radiological investigations. This group's mean age was 44 ± 13 years, ranging between 24 to 66 years. All patients were female. False positive contamination sources were clarified by careful examination of patients and further images. Abdominal ultrasound or abdominal CT was performed 12 of patients, and 18F-FDG PET/CT to two patients. However, no clear reason was found to explain relating uptake foci.

Conclusion: We concluded that, a focal retention of radioactivity in right lower abdominal region in ^{131}I WBS would be a physiological uptake, however this finding needs clarification.

Keywords: Thyroid Cancer, radioiodine, ^{131}I , false-positive

ÖZET

Amaç: Diferansiye tiroid kanserleri (DTK) iyotu yakalama, organifiye ve sentez etme ve tiroglobulin (Tg) salma yeteneğine sahiptir. Bu özelliğinden dolayı, DTK'ler total tiroidektomi sonrası yüksek doz radyoaktif iyot I-131 ile tedavi edilebilir. I-131 ile tüm vücut tarama diferansiye tiroid kanserli hastalarda metastatik veya rezidüel tümör alanlarının deteksiyonu için iyi yapılandırılmış bir yöntemdir. Yanlış pozitif radyoaktif iyot tutulumu birçok organ sistemi için rapor edilmiştir. Bizim bu çalışmamızın amacı I-131 ile tüm vücut taramada sadece kadın hastalarda rastladığımız "sağ alt abdominal bölgede sıradışı fokal radyoaktivite retansiyonu" bulgusunun fizyolojik olup olmadığını araştırmaktır.

Yöntem: Mevcut çalışmaya, I-131 ile ablasyon sonrası ablasyon sonrası veya tanısal amaçlı tüm vücut tarama için gönderilen ardışık total 405 DTK'li hasta dahil edildi.

Bulgular: Toplam 405 hastanın 22'sinde (%5,4) sağ alt abdominal alanda radyoaktivitenin fokal retansiyonu gözlemlendi, 14 hastada ileri radyolojik inceleme yapıldı. Bu grubun yaş ortalaması 44 ± 13 yıl ve yaş aralığı 24-66 yıl idi. Tüm hastalar kadındı. Yanlış pozitif kontaminasyon kaynakları ek görüntülemelerin ve hastaların dikkatli incelenmesiyle açığa kavuştu. Hastaların on ikisinde

abdominal ultrasonografi veya abdominal BT ve iki hastada 18F-FDG PET/BT yapıldı. Bununla birlikte bu fokal tutulumu açıklayacak gerçek bir neden bulunmadı.

Sonuç: I-131 tüm vücut tarama sintigrafisinde, sağ alt abdominal alandaki fokal radyoaktivite retansiyonu fizyolojik olabilir, bununla birlikte bu bulgunun açıklanmaya ihtiyaç olduğu sonucuna varılmıştır.

Anahtar sözcükler: Tiroid Kanseri, radyoiodot, I-131, yanlış pozitif

INTRODUCTION

The overall prognosis in differentiated thyroid cancer (DTC) is one of the best among all cancers when treated adequately. Primary therapy of thyroid cancer is an adequate surgery: Total thyroidectomy and, if necessary, central or lateral lymph nodes dissection. Following thyroidectomy, therapy with radioiodine has been used both to ablate any remaining normal thyroid tissue, to treat the carcinoma and metastatic foci. Especially, papillary thyroid carcinoma is generally indolent but very frequently metastasizes to the cervical lymph nodes¹. Radioiodine therapy proved to be a safe and effective method to complete surgery². Its preventive role in DTC relapses has been shown, but debates continue whether it improves the survival rate³. Differentiated thyroid cancers retain the ability to trap iodine, and radionuclides of iodine can be used both for diagnostic and therapeutic purposes. The correct interpretation of radioiodine scans is critical in the appropriate management of patients with thyroid cancer. Indeed, false positive findings can be seen and atypical physiological uptake of ¹³¹I can mimic metastases. The contamination and inflammation should be kept in mind if a non physiological uptake of the radioiodine foci besides its known uptake region, is observed^{4,5}. Unless recognized as false positive, ¹³¹I uptake may result in diagnostic error and lead to administration of an unnecessary therapy dose and unnecessary radiological/nuclear medicine diagnostic examinations. Our aim in the present study was to investigate whether an 'uncommon focal retention of radioactivity in right lower abdominal region' which we observed in some patients, especially in woman, in whole body scan was whether a physiological finding.

MATERIAL AND METHODS

In the present study, patients who received high doses of ¹³¹I ablation therapy or diagnostic ¹³¹I scan performed six to eight

months after ablation, due to the known diagnosis of differentiated thyroid cancer (DTC) were included. This study was performed in accordance with the principles of the Declaration of Helsinki. None of patients used foods or drugs containing iodine at least 4 to 6 weeks before the WBS. Serum thyroglobulin (Tg), thyroid stimulating hormone (TSH), antithyroglobulin antibody (anti-Tg Ab) levels measured at the time of the diagnostic ¹³¹I scan after adequate thyroxine withdrawal or rhTSH (recombinant TSH). Each patient fasted for at least 4-6 h before imaging. Anterior and posterior whole body scans were obtained 24th and 48th hours following oral administration of 185 MBq (5 mCi) ¹³¹I or 7-8th days following oral administration of high dose (3.7 GBq-100mCi) ¹³¹I. Whole body scans were obtained with a single-head gamma camera in whole-body scanning mode using a high energy parallel hole collimator with a 20% energy window. The patients had a proper bowel preparation with laxatives two days prior the examination. Menstruation status was interrogated and none of the patients was in the menstruation period during the scanning.

RESULTS

Image of 405 patients were analyzed in the present study. Twenty two patients had "uncommon focal retention of radioactivity in right lower abdominal region" in radioiodine WBS (5.4%). There were 187 patients, having whole body scans with high dose ¹³¹I ablation therapy, and 218 patients with diagnostic whole body scans with ¹³¹I. Of those having whole body scans after high dose, 146 were female and 41 were male. There were 185 female and 33 male patients in the diagnostic whole body scanning with ¹³¹I group. Twenty two patients had focal retention of radioactivity in right lower abdominal region. Eight patients without diagnostic imaging were excluded from the study. The study group consisted of 14 female patients with

a mean age of 44 ± 13 years, (ranging from 24 to 66 years). According to the histopathological results, all patients had papillary carcinoma and 8 (57%) patients had classic variant, 4 (29%) patients had follicular variant, 2 (14%) patients had oncocytic variant. Median tumor size was 17.5 mm (range: 3-30 mm). Serum anti-Tg levels were normal in all patients except a patient (patient no: 11). Serum anti-Tg Ab level decreased during follow-up of this patient. Without or with residual normal thyroid tissue and abnormal right lower abdominal uptake was detected all cases in the whole body scan. Even though the patients had a proper bowel preparation the previous night with laxatives (phenolphthalein) the ^{131}I focal uptake persisted unchanged after two days (Figure 1). False positive contamination sources were clarified by careful examination of patients and further images. Radiological examination was made after ^{131}I ablation therapy between 3 weeks-3 months. Abdominal ultra-

sound or abdominal CT was performed in 12 patients and, 18F-FDG PET/CT in two patients. Descriptive, histopathological characteristics and radiological abdominal examination results of patients are given in Table 1. Parapelvic cyst of right kidney was found in one patient (patient no: 10). On the other hand, the parapelvic cyst was found in the left kidney in another patient (patient no: 3), in whom however, no pelvic radioiodine uptake was observed. At follow-up, all of patients of with residual thyroid tissue were with no clinical or biochemical evidence of disease except one patient who had serum Tg levels <10 ng/mL and a negative diagnostic ^{131}I whole body scan. Abdominal CT was normal in this patient, but servical lymph node metastases were detected (patient no: 14). The serum Tg level was low and/or metastases were not detected at follow-up diagnostic WBS so surgical intervention was not do in any patient.

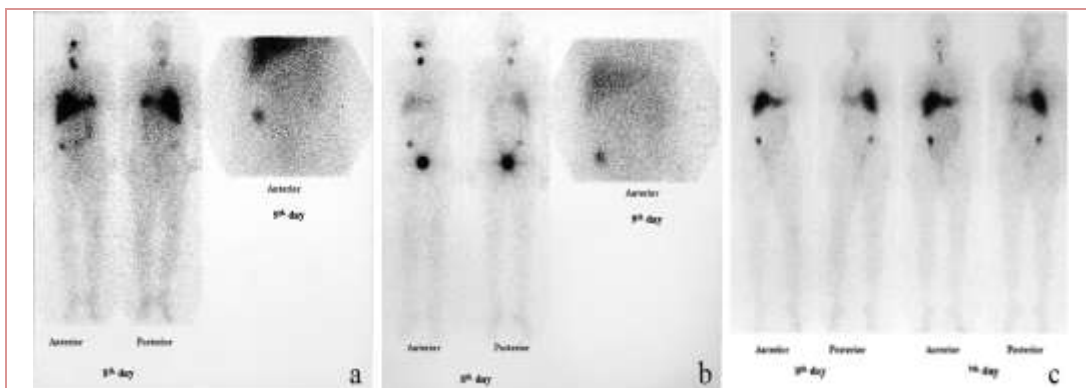


Figure 1 (a, b, c): Images of three different patients whom have been monitored focal uptake at the lower right abdominal region.

Table1: Clinicopathological characteristics and radiological examination results of patients.

Patient	Age	Pathology	Multifocality	Lymph node invasion	Tumor size (mm)	Abdomen US/CT/PET-CT
1-AA	30	Papillary (classic)	Present	Absent	7	Normal
2-NS	46	Papillary (classic)	Absent	Absent	3	Left ovarian cyst
3-KZ	45	Papillary (classic)	Absent	Absent	3	Parapelvic cyst of left kidney
4-RT	56	Papillary (classic)	Absent	Absent	2	Calculi of gallbladder
5-HE	47	Papillary (follicular)	Present	Absent	45	Normal
6-ST	39	Papillary (classic)	Absent	Absent	12	Normal
7-KK	64	Papillary (classic)	Present	Absent	20	Calculi of gallbladder
8-HV	40	Papillary (follicular)	Present	Absent	15	Normal
9-AT	37	Papillary (oncocytic)	Present	Present	10	Hepatosteatosi
10-ZS	66	Papillary (follicular)	Present	Absent	30	Parapelvic cyst of right kidney
11-SA	57	Papillary (follicular)	Absent	Absent	8	Normal
12-ID	24	Papillary (oncocytic)	Absent	Absent	2	Normal
13-GC	24	Papillary (classic)	Absent	Absent	28	Normal
14-NK	50	Papillary (classic)	Present	Present	20	Normal

DISCUSSION

Whole body scan with ^{131}I plays an important role in the management of patients with well-differentiated thyroid cancer. Multiple different false-positive scans can occur in the absence of residual thyroid tissue or metastases⁶. Careful history and radiological/clinical/laboratory evaluation help to avoid such diagnostic pitfalls. We have been observing focal right lower abdominal uptake especially female patients in ^{131}I WBS. We analyzed patients who were consulted up until now due to the continuity of this observation in some patients. And consequently, we saw that the finding which can not be explained with any pathology at the rate of 5.4, was not reported previously in the literature. We could not explain why patients were only women.

Radioiodine uptake in the salivary glands, oropharynx, nasopharynx, oesophagus, stomach, gastrointestinal tracts and urinary tracts should be acknowledged as physiological^{7,8}. Ash et al.⁹ reported that, the intense uptake along the periphery of the skull can be a physiologic variant. Also fixed prosthetic denture may be a cause of false-positive radioiodine uptake¹⁰. Radioiodine uptake in the breast tissue and with in the mammary gland has been described in both lactating and non-lactating women¹¹⁻¹⁶. Diffuse uptake is seen in the liver in most patients with functioning thyroid at the time of their post-therapy ^{131}I WBS. When hepatic metastases occur, they are virtually almost focal retention of radioactivity. But intrahepatic duct dilatation and chronic cholecystitis may cause such focal retention of radioactivity in the liver and may simulate metastases^{17,18}. Radioiodine is rarely concentrated by the normal gallbladder^{4,19}. Artfactual areas of radioiodine concentration are also common. These are most often caused by contamination of clothes or skin with urine, less often with saliva⁷. A radioiodine scan showing abnormal uptake outside the thyroid bed must be studied carefully and alternative reasons for the finding must be considered. A variety of reports of false positive ^{131}I WBS has demonstrated variety of causes such as benign serous cystadenoma of the ovary, large renal cyst, thymic hyperplasia,

pleural effusion, posttraumatic superficial scabs, calcified gallstone, diverticulum, hiatal hernia, mucinous cyst in external genitalia, ovarian cystadenofibroma, foreign body granuloma located in gluteal adipose tissue²⁰⁻²⁹. Distant metastases develop frequently in lung in thyroid cancer. Lung metastases are usually functional and avid iodine. Tsai et al³⁰. showed that a false positive pulmonary uptake may be seen due to bronchiectasis. Also a false positive uptake in lung has been reported as tuberculosis, inflammatory lung disease, acute respiratory tract infection, pectus excavatum, fungal infection, bronchogenic cyst and lung cancer in the literature³¹⁻³⁶. Radioiodine accumulation has been reported in a variety of malign or benign cancers such as gastric adenocarcinoma, falx meningioma, liver cavernous hemangioma and mature teratoma³⁷⁻⁴⁰. In the literature, also it is reported that false positive radioiodine uptake can be seen in parapelvic renal cyst²⁸. There was parapelvic cyst in our two patients (one of them in the right kidney, the other one in the left kidney). But there was not radioiodine uptake in the patient who was observed to have parapelvic cyst in the left kidney. However, the retention of radioiodine in right lower abdominal region was not in the kidney localization in our cases. Sioka et al.⁴¹ reported that intense focal uptake of ^{131}I in the right iliac fossa due to bowel scar presumably resulting from a complicated appendectomy 31 years ago.

Colon metastases of thyroid cancer are not expected. Meckel's diverticulum and abdominal wall mesh can be induce false positive uptake in the colon. But, relating conditions were not detected in further radiological investigations of our cases. Radioiodine accumulation in the bowel is a physiologic and very common finding. Therefore laxatives are used before ^{131}I WBS. Radioiodine accumulation is probably due to transport of radioiodine into the intestine from the mesenteric circulation and biliary excretion of the metabolites of radioiodinated thyroglobulin. Bowel activity usually is diffuse and mild and, its being replaced is observed during the follow-up in ^{131}I WBS. Whereas, activity retention was fixed in right lower abdominal region and focal in our cases. Nevertheless, false

positive benign lesions in ^{131}I WBS should be interpreted with reliable anatomic imaging methodologies to differentiate from true metastases. Recently, several studies have suggested that diagnostic and post-therapeutic ^{131}I single photon emission computed tomography (SPECT-CT) images are clinically useful because of their ability to improve diagnostic accuracy in DTC patients for physiologic uptake and metastases⁴². Due to the absence of SPECT/CT in our clinic, we followed our patients with other imaging modalities for differential diagnosis.

Sodium/iodide symporter (NIS) protein may mediate iodide transport in the gastrointestinal tract⁴³. NIS is an integral membrane protein that mediates the active transport of iodine. Extrathyroidal tissues, such as stomach, salivary glands, lacrimal glands, pituitary gland, pancreas, testis, mammary gland, gastric mucosa, colonic mucosa, ovary, prostate, adrenal glands, heart, thymus, omentum, gallbladder, placenta and lung to have the NIS protein expression and the organs can physiologically take up iodine⁴⁴⁻⁴⁶. Normal colon epithelial cells exhibited plasma NIS membrane immunoreactivity⁴⁵. Altorjay et al.⁴⁷ reported that, NIS expression was absent or markedly decreased in case of intestinalization or malignant transformation of the gastric mucosa, but no NIS expression in colon was detected. However, the focal NIS staining observed in the direct vicinity of gastric tumors. They explained that NIS expression may be focal than widespread along the large bowel. Perhaps focal uptake in our female patients, can be a physiologic condition related to the NIS. But unfortunately it was not possible to investigate such an invasive procedures in our study to understand exact mechanism of radioiodine uptake in the right lower abdominal region.

We concluded that, a focal retention of radioactivity in right lower abdominal region (may be caecum) in ^{131}I whole body scan would be a physiological uptake, however this finding should be further explored.

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