

INCIDENTAL APPEARANCE OF EMPTY RADIONUCLIDE THYROID SCANS IN PATIENTS ON REGULAR HEMODIALYSIS

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A b s t r a c t: In patients on regular end-stage dialysis the phenomenon of empty thyroid radionuclide scan was often seen. Thyroid function of 41 patients was not warrantly disturbed. They were not receiving medication known to influence thyroid function. Iodine urine level increased over 20 microg/dl Γ in 53%. The dialysat contained in the stock-solution 5–10 mgr KI/Kg NaCl which caused a nearly total blockade of the thyroid uptake of $Tc-99mO_4$. The phenomenon of empty scan was detected by chance when the gland was imaged in a procedure of locating parathyroid glands with Thallium-201.

End-stage patients on hemodialysis have increased iodide levels with tendency to thyroid hypofunction. We found a patient (1921) with an opposite thyroid condition – hyperfunction after 3 years of hemodialysis with dialysat unauthorized containing potassium iodide. Dialysat should be iodide-free as prescribed by the Pharmacopea. The precarious iodine balance in end-stage renal insufficiency should not be disturbed by additional iodide input through the dialytic procedure.

Key words: thyroid scan, hemodialysis, iodine deficiency.

In patients on hemodialysis for end-stage renal disease thyroid scans appeared unexpectedly empty because of drastically reduced uptake-rate of the radionuclide (TcO_4-99m). Technetium scanning of the thyroid was intended to visualize the shape of the gland in order to use subsequently. Thallium-201 was used in a second (dual isotopes) procedure to locate the parathyroid glands looking for hypertrophy or adenomateous degeneration after long-term dialysis treatment.

Scanographic non-appearance of the gland is usually observed when the „iodine pump“ of the thyroid is blocked by a variety contaminants and factors. In our

practice this is often seen after prolonged thyroxine treatment which suppresses secretion of the thyroid-stimulating hormone (TSH) or by massive contamination of the thyroid with iodine, particularly after injection of X-ray contrast media. We followed this unusual phenomenon seen several times on the gamma-camera investigating random patients on long-term dialysis. Urinary iodine excretion in end-stage patients on hemodialysis and iodine content in dialysate were measured.

Material and method

1. Forty-two patients of both sexes aged 56–64 undergoing ambulatory chronic intermittent hemodialysis were studied. Urine was collected spontaneously for iodine measurement. The patients had no history of thyroid disease or were receiving no medication known to influence thyroid function. None of the patients was overtly hypothyroid or thyrotoxic.

2. Iodine measurement at the Department of chemistry, Faculty of Natural Sciences of the University „St. Cyril & Methodius“, Skopje, Macedonia. Duplicate probes of urine or specimens were wet ashed in a strong acid concentration. The cerium-arsenic technique recommended by the WHO and UNESCO was used (1). Several control urines were sent by Prof. Dr. Dunn's laboratory. The results coincided with the standards of the iodine laboratory in Charlottenburg, Department of Public Health, Virginia, USA.

Iodine in dialysate was measured with the same method in diluted specimens 1 : 10, 20, 30 diluted with fluid used for hemodialysis deionized and filtered by reverse osmosis according to the standard procedure. We examined dialysates from different pharmaceutical producers labeled A, B, C, D, E which consisted of all types currently used for hemodialysis.

All specimens were examined in triplicate probes.

3. Scanographic imaging was routinely done 10 min. after intrav. injection fresh pertechnetate (generator eluted with saline, CIS – International, France) with a dose of 3 mCi (111 MBq), collimator for middle energy with planar Siemens camera.

Results

Figure 1 (A, B, C) presents empty-scans after injection of 3 mCi, 111 MBq pertechnetate-Tc-99m. On the left site is a control scan with the same product and doses. The image of the thyroid in these patients submitted to regular hemodialysis is practically invisible (A, B, C) in comparison to the normal control scan (D).

This justified the examination of iodine excretion in patients on regular ambulatory hemodialysis and the measurement of iodine in dialytic fluid. Table 1 presents randomly collected urine specimens from patients: from three different collectives on regular hemodialysis. Groups I, II, III in several cases presented unusual elevation of iodine level, the results of group IV are patients on hemodialysis performed in 1997

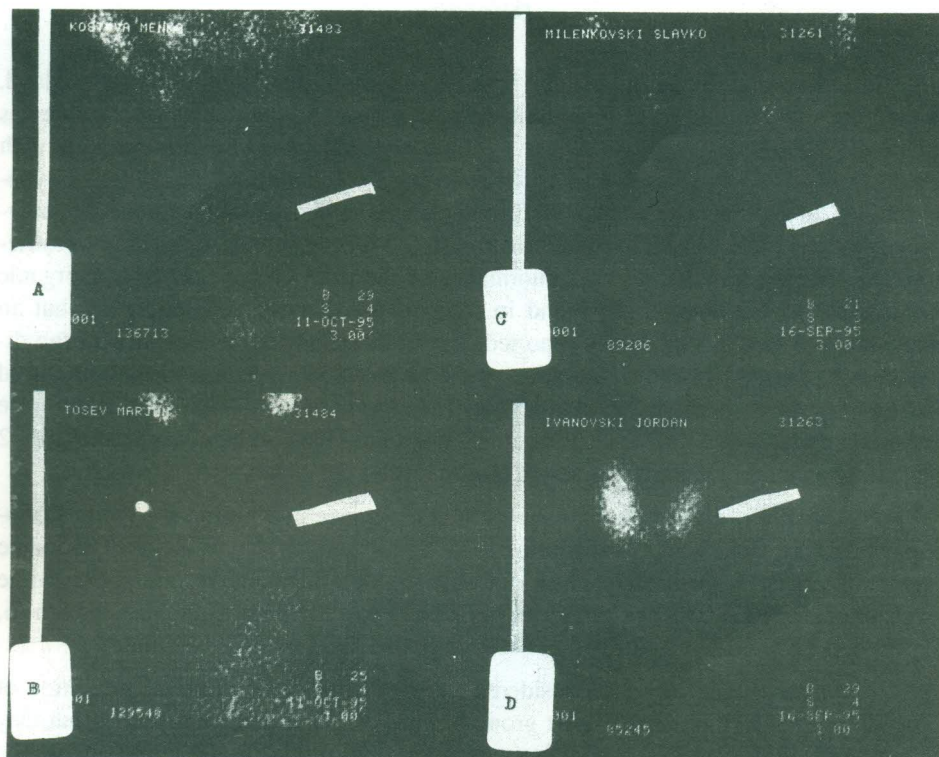


Figure 1 – A, B, C, D

Empty thyroid scan after i.v. injection of 3 mCi (111 MBq) Tc-99m-O₄ in scan A, B, C. Patients on regular hemodialysis for end-stage renal insufficiency. The uptake-rate almost reduced in the thyroid, but small quantities of Tc-99m seen in salivary glands. Scan D is from a normal person: thyroid is clearly visible with the typical butterfly appearance.

Thyroid location marked with arrow.

after the partial introduction of new hemodialytic fluid without iodine. As seen in Table 2 in groups I–III hemodialytic fluid contained iodized salt 10 mg KI/Kg NaCl.

In group I high levels of iodine over 20 microg/dl are present in 7 of 17 cases, in group II in 10 of 11 cases, in group III from 14 cases on increased level of iodine was seen in 5. The last group IV used iodine containing old and new dialytic fluid iodine free. Out of 30 cases elevation of iodine excretion is present in 4. The usual upper mark of iodine excretion in urine in our population seldom exceeds 15 microg/dl. For a safe evaluation the mark of 20 microg/dl was presumed to be indicative for high values of iodine excretion in urine.

In group IV the average of iodine in urine is 11 ± 1.6 microg/dl, median 9.8, many of the patients are in the range of iodine deficiency.

Discussion

Iodine is cleared from plasma primarily by the kidneys and the thyroid gland. In patients with chronic renal failure and in patients on chronic dialysis the iodine has shown elevated levels (2). Sato K. et al. found elevated iodine level in patients with renal dysfunction associated with hypothyroidism (3). Takeda S et al. (4) found hypothyroidism in patients on regular dialysis which he called "iodine induced hypothyroidism", TSH level was up to 40 microU/ml in 3.2% of his cases. After iodine restriction TSH levels normalized (4). Abnormality of the dialysis patients with anorganic and organic iodine levels were found in most of the dialysis population (5), but an empty thyroid scan has not been reported. We believe that iodine presence in the dialysate has contributed to the saturation of the thyroid iodine "pump" which produced this imaging phenomenon. Povidon-iodine (Betadine) contamination produced in the patient on dialysis of Gardner D. T. et al. (5) a similar effect which disappeared after 2 years in association with a fall in serum iodine levels.

The aim of this paper is to stress the importance of maintaining the prescriptions of dialysat fluid which is according to the Pharmacopea free of iodine. The iodine balance is precarious in patients on dialysis, in about 90% serum anorganic iodine levels are elevated in Japan, China's coast, USA where iodine consumption is high (6, 5). There is no significant correlation between iodine levels and thyroid function.

Although Gardner (5) considered his own finding of minimal inhibition of thyroid function in his hemodialytic group at least as uncertain, he suggests that they do not have significant hypothyroidism warranting thyroid hormone replacement. The work of Takeda, Sato and many other authors (3, 4) consider elevated TSH levels as a significant correlation of elevated iodine levels in regular dialysis and thyroid inhibition. A persistent Wolff-Chaikoff inhibitory effect of excess iodine appears to be the primary mechanism of thyroid dysfunction in susceptible individuals (3, 5).

Thyroid hyperfunction in hemodialysis is a rare incident. A large diffuse goiter associated with symptoms of hyperthyroidism in a female undergoing regular dialysis is referred by Niphanpudy J. R. et al. (7). We present a patient (J-31-85, 1921) with an empty thyroid scan with a goiter for over 20 years, seen in 1985 with a normal functioning nodose struma (thyroxine 90 nmol/l, pulse rate 88, since 1991 on regular dialysis for chronic renal failure. Thyroid function during third year of hemodialysis was normal (T-4-102 nmol/l), goiter with the same status. Five years later (1996) he was overt thyrotoxic: thyroxine 157, TSH suppressed under 0.1 IU/ml, 24 h uptake 24% dose, empty iodine scan (when hyperthyreosis started) and hypofixant in 1996. He refused treatment, puncture of the nodules were normal (Prof. G. Stavrić). Ultrasound showed nodus in the right site: 50 : 44 : 50 mm, nodus on the left site: 36 : 39 : 50 mm (Dr. Svetlana Miceva-Ristevska).

We often see hyperthyreotic conversion of nodose goiter in euthyreotic thyroid patients after iodine contamination with amidorone, X-ray contrast media and other iodine products.

Empty thyroid pertechnetate scan gave us the opportunity to find elevated iodine urine excretion in several end-stage patients on hemodialysis. The source of iodine contamination was the hemodialytic fluid prepared with iodinated salt 5–10 mg KI/Kg NaCl. After partial discontinuing this practice and introduction iodine-free dialysat, the excretion of iodine in urine diminished. Macedonia as a iodopenic area presenting a different urinary excretion rate of iodine, rarely over 15 microg/dl, whereas Japanese and USA inhabitants have an different iodine intake due to fish, dairy products, meat and bread containing iodine in the USA. The usual practice of iodine free dialysat according to the Pharmacopea in Europe and USA should be kept in iodine deficient areas, leaving the control of iodine supply to the classic system with food intake and control by the endocrinologist.

Table 1 – Табела 1

Iodine (Γ microg/dl) in urine of patients in end-stage renal disease on regular hemodialysis

GROUP	I 1994/5	II 1996	III 1996	IV 1997
Number of patients	17	11	13	30
IODINE DEFICIENT under 10 microg/dl	6 (35%)	1 (9%)	2 (15.3%)	16 (53.3%)
Γ INCREASED EXCRETION over 20 microg/dl	7 (41%)	10 (90.09%)	5 (38%)	4 (13%)
NORMAL Γ in urine	4 (23.5%)	0 (0%)	6 (46%)	10 (33%)

Patients in groups I, II and III regularly on hemodialysis were treated with dialysat (A, B, C and D) containing *iodine*. Patients in group IV were treated on hemodialysis with dialysat partim A, B, C, D and partim E (solution almost FREE of iodine).

DIALYSAT: generic chemicals according to the declaration of the producers: Na – 140 mmol, K – 2 mmol, K – 2 mmol, Ca – 1, 875 mmol, Mg – 0.5 mmol, Cl – 111.75 mmol, acetat – 35.0 mmol. Stock solution supplied in plastic containers of 1 OL was diluted before hemodialysis ex tempore with dionized and treated by reverse osmosis water in a proportion 1 : 32. Solutions under the label in this paper A, B, C, D contained iodine 5–10 mg KI/NaCl (the controls of iodized salt by the Institute for Public Health of Republic of Macedonia during the last 5 years fluctuated between 3–20 mg KI/Kg NaCl, median 4.9 mcrg KI/Kg NaCl).

Dialysat in use after 1 January 1997 with the same formula as above is FREE of iodine in the stock solution.

Label of stock solution in this paper A, B, C, D contained iodine, label E in this paper was almost free of iodine.

Table 2 – Табела 2

Γ in stock-solution	A	B	C	D	E
Undiluted (n=25)	Over 35 microg I/dl			1.8–10	
Dilution 1 : 10	10–23			0.5–0.8	
Dilution 1 : 20	6–20			0.4–0.7	
Dilution 1 : 30	4.4–8			0.14–0.5	

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Резиме

ПОЈАВУВАЊЕ НА ПРАЗЕН РАДИОНУКЛИДЕН СКЕН
КАЈ ПАЦИЕНТИ НА РЕГУЛАРНА ДИЈАЛИЗАБ. Богданов¹, Н. Ивановски², С. Ристевска², И. С. Таџер³¹Институт за хемија, Природно-математички факултет – Скопје²Медицински факултет – Скопје³Македонска академија на науките и уметностите – Скопје

Пациенти со хронична ренална инсуфициенција во т.н. краен стадиум, покажаа празен тироиден скен со Tc-99mO₄. Ваква „празна“ тироидеја е често последица на јодна контаминација или тотална блокада на секретацијата предизвикана од различни фактори. Испитувањата покажаа дека овие случаи на „празна“ тироидеја во трите испитани групи (41 пациенти), во поголем број случаи имаат високи вред-

ности на јод во урината. Испитувањето на дијализната течност покажа во концентратот контаминација со јод поради употребување на јодирана сол со количини 5–10 mcg KI/Kg натриум хлорид. Кај четвртата група од 30 пациенти, кои беа дијализирани и со дијализат без јод, урината покажа пониски вредности на јод, дури кај приличен број од таа популација јодната екскреција е во зоната на јодопенија.

Контаминацијата со јод кај еден дијализиран пациент, со години болен (1921) (од 1991–1996), провоцира токсичен аденом, што е многу ретко кај дијализираните, бидејќи тие повеќе развиваат хипотиреоза. Таа е опишана од јапонски и американски автори во регии каде што јодот во храната е во суфицит.

Клучни зборови: тироиден скен, хемодијализа, јоден дефицит.

Прифатено за печатење на 30 мај 1997 година.