Diagnosis of thyroid disorders

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Thyroid

- Thyroid is single, endocrine gland situated in the lower part of the neck, in front of the trachea, weigh 20 g
- Upper limit of normal thyroid volume is around 18 ml
Development of the thyroid

Parafollicular or C-cells

They are formed from ultimobrachial body which is made from the epithelium of the fourth pharyngeal pouch. Ultimobrachial body is incorporated in the thyroid lobes and from it are formed C-cells.

Follicular cells

They are formed from endodermal epithelium in the bottom of the pharyngeal bowel, on the border of the anterior 2/3 and posterior 1/2 base of the tongue (foramen cecum).
A. Thyroid gland is developed from the epithelial outgrowth in the middle of the pharynx, caudal from the medial tongue lump. B. Position of the thyroid gland in adults. Discontinuous line represents migration path of thyroid basis.
Schematic representation of positions of ductus thyreogossal cysts: they are most often found near hyoid bone, but they are always near central line of the neck.
Ectopic – lingual thyroid
Tc-99m-perthechnetate scintigram
Ectopic – lingual thyroid

I-131 scintigram: SPECT/CT of the neck and planar whole body scintigram
Ectopic – lingual thyroid
Ultrasound: coronal and sagittal cross-section
Ectopic – lingual thyroid
Normal and aberrant locations of thyroid tissue
What is this?
Dual Ectopic Thyroid Gland
Sonography and Scintigraphy of Lingual and Sublingual Thyroid
Vinko Marković, MD, PhD,* Gordana Glavina, MD, Davor Eterović, PhD,* Ante Punda, MD, PhD,* and Dubravka Brdar, MD*
Dual Ectopic Thyroid Gland - ultrasonography and scintigraphy
Dual Ectopic Thyroid Gland

Marković et al
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Histology and pathohistology

- Functional unit of the thyroid is follicle, oval or round bag (sac) filled with colloid content, coated with one layer of squamose or cuboid epithelia cells
- Colloid – thyroglobulin molecule to which thyroid hormones are attached to
- In the normal gland size of the follicles ranges from 200-300 µm, while some of them can be larger than half mm
Thyroid hormones

T4 TYROSINE - TETRAIODOTYRONINE

\[
\begin{align*}
&\text{HO} \\
&\text{O} \\
&\text{I}^{3'} \\
&\text{I}^{3} \\
&\text{CH}_2 - \text{CH} - \text{COOH} \\
&\text{NH}_2
\end{align*}
\]
Thyroid hormones

T3  3,5,3’ – THREE-IODOTYRONINE

\[
\begin{align*}
\text{HO} & \quad \text{O} & \quad \text{CH}_2-\text{CH- COOH} \\
5' & \quad 5 & \quad \text{NH}_2 \\
3' & \quad 3 & \\
\end{align*}
\]
Thyroid hormones

Monoiodotyrosine (MIT)

Diiodotyrosine (DIT)

3,5,3',5'-Triiodothyronine (T3)

3,3',5'-Triiodothyronine (Reverse-T3)

3,5,3',5'-Tetraiodothyronine (L-thyroxine) (T4)
Regulation of function and synthesis of thyroid hormones

Hypothalamus
  TRH

Pituitary
  TSH

Thyroid
  T3+T4

Transporting proteins
  (globulin TBG (75%), prealbumin TBPA (5-20%), albumin (5-20%))

Periferal conversion (PTU)

FT4  FT3

1. Iodide is **transported actively** into the thyroid by thyroid-iodide pump; competitive blockers: **thiocyanate, perchlorate**

2. **Iodide oxidation** (iodide from the blood is oxidated to neutral iodine $I_2$) and then bounded to the tyrosine part of the thyreoglobulin molecule (**organification**) forming MIT and DIT – **blocked by tiamamide**

3. **Coupling**: two molecules of DIT into T4 and one molecule of MIT and one molecule of DIT into T3 – **blocked by tiamamide**

Synthesis of T3 (10%), T4 (90%)

Thyreoglobulin

4. Proteolysis of Tg and release of hormones into the circulation

100-200 µg iodine  → 100-200 µg T3+T4
Metabolism of thyroid hormones

- Daily production of T4 = 130 nmol (100 µg): 30 % is converted into T3 (40 nmol), 40 % is converted into inactive rT3 (50 nmol); rest is metabolized by different metabolic pathways, mostly by conjugation with sulphates and glucuronide acid (around 20% of T4 is excreted by stool as glucuronide conjugate) and by oxidative deamination.

- Daily production of T3 = 50 nmol (33,5 µg): 40 nmol (80%) by extrathyroid conversion from T4, and 10 nmol (20%) by intrathyroid production [5 nmol (10%) by synthesis and 5 nmol (10%) by intrathyroid conversion from T4]; overall 90% of T3 is formed by conversion from T4.
Transport of thyroid hormones in the blood

Thyroid hormones in the blood are bounded to:

**TBG** - thyroxine binding globulin, Thyreopexin: 75% T4 and 75% T3

**TBPA** - thyroxine binding prealbumin, Transthyretin,

  TTR: 20% T4 and 5% T3

**HSA** - human serum albumin: 5% T4 and 20% T3

  Free thyroxine (FT4) = 0.03% T4
  Free thriiodotyronine (FT3) = 0.3% T3

  \[ T_4 \quad \text{and} \quad T_3 \]

T3 biologically active hormone, T4 prohormone.
Hyper- and hypo-thyroxaemia

*Increased TBG (hyperthryoxinaemia)*: pregnancy, estrogens, opioid drugs, 5-fluorouracil.

*Decreased TBG (hypothyroxinaemia)*: chronic disease, malnutrition, nephrotic syndrom, liver disease, corticosteroids, androgens.

*Decreased transthyretine (hypothyroxinaemia)*: acute and chronic disease, liver disease, nephrotic syndrom, malnutrition.

*Decreased albumin (hypothyroxinaemia)*: chronic disease, liver disease, nephrotic syndrom, malnutrition.
Thyroid hormones metabolism

- T3 is further metabolized by deiodination on the internal ring into 3,3’T2 (di-iodotyrosine).

- rT3 is further metabolized by deiodination on the external ring also into 3,3’T2 (di-iodotyrosine).

- Deiodination on the external ring transforming prohormon T4 into active hormon T3, while deiodination on the internal ring inactivates thyroid hormones (T4 into rT3, and T3 into 3,3’T3)
Three enzymes catalyze deiodination of thyroid hormones: deiodinase type 1 (D1), type 2 (D2) and type 3 (D3)

D1 is most commonly expressed in liver, kidneys and thyroid

Deiodination on the external ring of thyroxine, T₄ → T₃ and rT₃ → 3,3′T₂, but also on the internal ring T₄ → T₃

Deiodination on the internal ring of different derivates of iodotyronine because of reutilisation of iodine

D1 provides forming of plasmatic T₃, and is therefore main source of circulating T₃

D1 activity in hyperthyroidism is increased (that reduces concentration of T₄ which leads to less arrival to the tissue and smaller cellular conversion of T₄ into T₃).

D1 activity in hypothyroidism is decreased (insures for higher concentration of tissue T₄ and therefore more T₃)
D2- deiodinase type 2

- D2 is most commonly expressed in CNS, pituitary and brown adipose tissue (BAT), as well as in thyroid and skeletal muscles
- Deiodination can be performed only on the external ring of T4 (T4 → T3).
- D2 catalysis transformation of T4 to T3 in the cells
- D2 activity is increased in hypothyroidism and decreased in hyperthyroidism
- D2 insures that brain, pituitary and BAT have adequate quantities of T3 in different functional states
D3- deiodinase type 3

- **Inactivates thyroid hormones** – has only the ability for deiodination on the internal ring, T4 $\rightarrow$ rT3 and T3 $\rightarrow$ 3,3’T2.

- High activity of D3 is found in the brain, placenta, gravid uterus and fetal tissues, as well as in the skin, liver and bowel.

- Expression of D3 is much higher in fetal tissues than in adult tissues.

- D3 activity is increased in hyperthyroidism, and decreased in hypothyroidism.

- D3 prevents too much exposure of the fetus and the brain to the triiodothyronine (T3).
Deiodinase

- Hyperthyroidism: D1 activity overcome

- Hypothyroidism: D2 activity overcome

- “Low T3 syndrome” in nonthyroid diseases (low T3, increased rT3 and normal FT4): decreased D1 activity in the liver and induced D3 activity in the liver, skeletal muscles and other tissues)
Deiodinase – pharmacological influence

- Some drugs can interfere with peripheral conversion of T4 to T3:
  
  - PTU: specific, uncompetitive inhibitor of D1.
  
  - Iopodate and iopanic acid are competitive D1 inhibitors.
  
  - Corticosteroids and beta-blockers also inhibit peripheral conversion of T4 to T3, by unknown mechanisam.
  
  - Amiodaron and it’s metabolit desethyl-amiodarone: also inhibit D1 deiodinase activity and by that reduce T3 levels.
Deiodinase

- Tissues critically dependent of T3, like brain, have expressed D2 activity and by that they ensure T3 despite the possible variations in serum concentration levels of T3 (for example in hypothyroidism).

- D2 protects brain from hypothyroidism, and D3 from hyperthyroidism.

- Tissues that can balance fast T4 are liver and kidneys.

- After the balance is achieved, half-life of T4 is 7 days, and T3 1 day
Deiodinase

- Deiodinases have possibility to increase or decrease influence of thyroid hormones by working as a very important mechanism that can vary hormone levels in different tissues.

- Deiodinases can modulate in different ways hormone status of different tissues in states of iodine deficiency, thyreotoxicosis or hypothyroidism.

- The entire thyroid hormones’ metabolism can be observed through the effectiveness of cellular supply of nuclear T3.
# Deiodinase activity

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
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<tbody>
<tr>
<td>Hyperthyroidism</td>
<td>increased</td>
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<tr>
<td>Hypothyroidism</td>
<td>decreased</td>
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Thyroid hormones effects

Primary effect is expressed on the cellular nucleus where by bounding to receptors they cause expression of different genes, and further increase in protein synthesis and enzymatic activity.

Some thyroid hormone’s activity on the cellular metabolism is mediated by activity on cellular membrane, endoplasmatic reticulum and mitochondria.

Thyroid hormones regulate growth, development and metabolism.

In adults their action is primary metabolic: they regulate overall production of energy and traffic of all the important substrates: proteins, carbohydrates, fat, hormones and vitamins.
Diagnosis of thyroid diseases
DIAGNOSIS OF THYROID DISEASES

1. Anamnesis and clinical exam
2. Blood analysis (in vitro tests)
3. Thyroid ultrasonography
4. Thyroid scintigraphy
5. Radionuclide examination
6. Fine-needle aspiration cytology
7. Radiological testing
Anamnesis (History)

Symptoms of hypothyroidism

Symptoms of hyperthyroidism

Thyroid enlargement, neck swelling, difficulty of swallowing or breathing, pain, eye symptoms and signs...
Clinical examination

- Inspection
- Thyroid palpation
- Heart rate
- Skin state
- Tremor
- Eye signs,....
Thyroid palpation
Thyroid palpation
Goiter (struma)
World health organisation division (WHO)

- **Grade 0:** No goiter: hardly palpable and visible (or unpalpable or unvisible)
- **Grade IA:** clearly palpable, but unvisible with neck extension
- **Grade IB:** clearly palpable and visible with complete neck extension (head thrown). This stage involves nodular thyroid, even if the thyroid itself isn’t enlarged
- **Grade II:** clearly visible when the head in normal position (palpation isn’t necessery for diagnosis)
- **Grade III:** thyroid seen from the distance (palpation isn’t neccesery for diagnosis)
Revised goiter classification

Grade 0  Not enlarged by inspection or palpation
Grade 1  palpable goiter, but not seen when head and neck are in normal position (thyroid isn’t visible by inspection). This category includes thyroid nodules in normal size gland).
Grade 2  thyroid visible when head is in normal position or enlarged thyroid by palpation.

What is nodul?

- Inspection: thyroid formation-lump
- Palpation: formation of different consistency
- Ultrasound: formation of different echostructure or formation of the same echostructure but separated from the rest of the thyroid by hypoechogenic border (rim)
- Scintigram: formation of different function
Inspection and palpation

Ultrasound

Scintigraphy
Diagnosis with *in vitro* tests

- TSH
- T3, T4, FT3, FT4
- Tg, Calcitonin, TBG, protein bounded iodine
- TSH receptor - antibodies, Tg-Ab, and TPO-Ab
- Urine iodine
Ultrasound examination of the thyroid

- Ultrasound echos are formed on the border of different sound resistance tissues, mainly on the border of solid tissue and colloid.
- Normal thyroid: homogeneity allocated echos which are, in regard to the muscles, denser and of higher amplitudes – normoechogenic or isoechogenic image.
ULTRASOUND OF NORMAL THYROID

Ultrasound image of normal thyroid (normoechogenic), left-longitudinal axis, right- cross-section.
ULTRASOUND EXAMINATION OF THE THYROID

Both thyroid lobes and isthmus are shown in longitudinal, cross-section and inclined sections (three dimensions).

Analasys: size

- echostructure
- present of nodule
- relationship to the other structures on the neck and orientiational neck examination
Cross-section through the neck
Transverse image of the right thyroid lobe. Note the compressed internal jugular vein (IJV) lateral to the common carotid artery (CCA) (A) compared with the distended internal jugular vein (B) when the patient performs a Valsalva maneuver. Also well seen are the thyroid gland (THY), tracheal rings (TR), the sternocleidomastoid muscle (SCM), and the omohyoid (OH), sternohyoid (SH), and sternothyroid (ST) muscles all separated by a fascial layer (arrows).
THYROID SIZE

Normal dimension:
length 4-5 cm
width 1.5-2 cm
thickness 1-1.5 cm

Isthmus thickness up to 0.3 cm

Thyroid volume **10-15-18 ml**

Thyroid weight \( Tw(\text{gr}) = 1.06 \times V(\text{ml}) \)

**Thyroid volume:** according to formula for ellipsoid vol. (for each lobe) \( V = \frac{\pi}{6} abc = \frac{abc}{2} \)

\[ \pi / 6 = 0.523 \]
ECHOSTRUCTURE

Isoechogenic image
Homogeneous image
Hypoechogenic image
Unechogenic image
Hyperechogenic image
Cyst
Calcification
Untreated diffuse toxic goiter

Because of increased cells proliferation and relatively empty follicules, there are less borders of which the ultrasound is reflected, and therefore less echoes reflected back to the ultrasound probe.

Accordingly, untreated diffuse toxic goiter is shown more or less hypoechogenic.
Ultrasonography of diffuse toxic goiter

Hypoechogenic image of the thyroid in Mb. Basedow, left – longitudinal section, right – cross-section
Diffuse changes

1. Diffuse goiter,
2. Struma lymphomatosa,
3. Diffuse toxic goiter,
4. Thyroiditis subacuta
NODULAR CHANGES
Number, size, echostructure, location

1. Cyst or cystic-degenerative changes
2. Solitar nodule - hypoechogenic, isoechogenic, degeneratively changed (benigne goiter)
3. Nodular (multinodular) goiter
4. Nodule in struma lymphomatosa,
NODULAR CHANGES

tumors – adenomas, carcinomas
Hypoechogenic nodule with irregular border

Hypoechogenic lymph node
Ca. papillare
Ca. papillare
Echogenic features suspected for malignancy

Hypoechogenic

Microcalcifications

No hypoechogenic edges, irregular borders

Intranodular vascularization

Regional lymphadenopathy
*Color Doppler can help decide on which lymph node to perform US guided fine needle aspiration.

Functional assessment of thyroid tissue by using color-doppler in hyperthyroidism.
Flow stages on CD

Stage 1 – Minimal internal vascularization without periferal ring

Stage 2 – Periferal vascularization (>25% perimeter of the nodule), without or with minimal internal flow.

Stage 3 – Periferal vascularization with little to medium internal flow.

Stage 4 – High internal vascularization with or without periferal ring.
Orientational neck examination

Metastatic lymph node

Papillary ca
Lymph node metastasis on both sides of jugular vein
Enlarged - patologic neck lymph nodes
Enlarged – patologic neck lymph nodes and medial neck cyst
Medial neck cyst (cyst of ductus thyreoglossus)
Thyroid scintigraphy

$^{99m}$Tc - accumulation image

$I^{131}$ - accumulation and iodine organification image

*gamma camera, pin-hole collimator
Indications for thyroid scintigraphy

• Solitary or multiple nodules (nodular goiter): warm – cold nodules; especially with suppressed TSH.

• Follicular tumor on fine needle aspiration.

• Suspected subacute thyroiditis.

• After partial (multinodular goiter) and total thyroidectomy (carcinoma).

• Ectopic thyroid, evaluation of substernal thyroid tissue.

“Warm or hot” nodule(s) are benign (extremely rarely malignant).

“Cold” nodules – malignancy risk 5-8%.
Nodular goiter – for differentiation of functional (warm, hot) from afunctional (cold) nodules.
Selective activity accumulation -
Hot and warm nodule on scintigraphy
Selective activity accumulation -
Warm or hot scintigraphic nodules
Scintigraphic “cold” nodule – fine needle aspiration cytology
Scintigraphic “cold” nodule – fine needle aspiration cytology
Multinodular goiter – to select the nodule for fine needle aspiration cytology
Atypical findings
Fine needle aspiration cytology – follicular tumor:

a) “cold” nodule on scint.
   - extirpation

a) “warm” nodule on scint.
   - observation

b) “hot” nodule
   - therapy
Suspected subacute thyroiditis – dif.dg. – „empty scintigram“
After partial thyroidectomy
Imaging of thyroid remnant after “total” thyroidectomy for thyroid ca. - I-131 scintigraphy
Thyroid isn’t shown (agenesis, thyreoidectomy, subacute thyreoiditis, high iodine input)
Lingual thyroid
Lingual thyroid
Preoperative Tc-99m-Pertechnetate Scan Visualization of Gross Neck Metastases From Microcarcinoma Papillare and Another Papillary Carcinoma of Tall Cell Variant Scintigraphically Presented Like Small Warm Nodule in Graves Disease Patient.

Markovic, Vinko; MD, PhD; Eterovic, Davor; Punda, Ante; MD, PhD; Pesutic-Pisac, Valdi; MD, PhD; Kuna, Tihomir; PhD, DDS

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FIGURE 1. Tc-99m-pertechnetate pinhole scintigraphy showed a homogeneous distribution of activity in the thyroid with small, warm nodule in the upper pole of the left lobe and 3 gross metastatic nodules on the left side of the neck. The upper 2 metastatic nodules showed equally intensive accumulation of Tc-99m-pertechnetate in comparison with thyroid tissue with less intensive accumulation in the lowest nodule.
I’m not a rabbit. I’m a substernal goiter!
Radionuclide examination – Diagnostic tests

* I-131 thyroid accumulation, uptake test
* Perchlorate test
* TRH test
* TSH test
* Supression test
Radionuclide examinations

**I-131 accumulation ("uptake" test)**

- Patient is orally given radioiodine dose (10 \( \mu \)Ci; 370 kBq I-131) and after 2 h, 4 h, 24 h and 48 h percentage of the given dose, accumulated in the thyroid, is measured:
  
  a) Difference between hyperthyroidism and hypothyroidism.

  b) Difference between hyperthyroidism and thyreotoxicosis of different causes.

  c) Determining effective \( T_{1/2} \) for calculating therapeutic dose of radioiodine.
Examples of thyroidal RAIU curves under various pathological conditions. Note the prolonged uptake in renal disease due to decreased urinary excretion of the isotope and the early decline in thyroidal radioiodide content in some patients with thyrotoxicosis associated with a small but rapidly turning over intrathyroidal iodine pool.
Radionuclide examinations
Perchlorate test

I-131 accumulation in thyroid is measured 2 hours after the diagnostic dose of I-131, and after that 1 g of potassium perchlorate is given orally and then accumulation measure is repeated after 30 and 60 minutes.

Normaly accumulation of I-131 isn’t reduced or is reduced till 10%.

Reduction greater then 10% shows organification defect (there is output, “wash-out” of nonorganificated iodine out of the thyroid): congenital enzymatic defect, acquired deffect (autoimmune thyroiditis, hypothyroidism caused by overload of iodine, tionamide therapy, after radioiodine therapy of hyperthyroidism or after surgery).
i. v. 400 µg TRH, TSH in 0, 15, 30 and 60 min.

TRH test

Differentiation of:
1. hypothalamic from pituitary hypothyroidism
2. evidence of thyroid autonomy - thyreotoxicosis latens
Radionuclide examinations

Thyreotropin stimulating test (TSH)- I-131 accumulation measuring repeated after im. given TSH.

Normaly or in patients with pituitary hypothyroidism there is increase in 24-h accumulation for ≥50% in regard to first measure, while there is no increase in primary hypothyroidism.

TSH stimulation and scintigraphy:

1. enabled sc. visualization of supressed thyroid tissue in toxic adenoma,
2. detection and therapy of functional metastasis of thyroid carcinoma,
3. determining existence of functional thyroid tissue in patients on supstitutional- supressive therapy, but without its discontinuation
Radionuclide examinations

**Supression test** – repeated accumulation of I-131 measure 14 days after taking 200 µg of thyroxine or after seven days after taking 75-100 µg of threeiodotironin.

Normally there is ≥50% decrease in regard to first measurement.

**Normal test excludes hyperthyroidism.**

Test is positive (so there is no supression in uptake) in Graves-Basedow disease, toxic adenoma and toxic multinodular goiter, euthyroid patients with Graves-Basedow disease, after therapy of hyperthyroidism, nontoxic multinodular goiter and sometimes in family of patients with Graves-Basedow disease.
SUPPRESSION TEST
Thyroid scintigraphy with 99mTc

Before LT4  14 days after taking 100 ug LT4
Ultrasound guided fine needle aspiration (FNA)

- First used by Holm and as. in 1975. god.

- Guided by ultrasound exact area of different echostructure can be punctured and aspirated.

- Ultrasound can help to determine to which organ lesion belongs to – important in lesions on the border of two organs.
Techincs for FNA

- Before aspiration skin on the neck must be cleaned from the gel and disinfected.

- Disinfected ultrasound probe is then placed on the neck above the lesion which is ment for aspiration.

- Ultrasound of the needle in the neck is observed on the monitor of ultrasound; when the top of the needle is in the wanted lesion aspiration is done (needle 22-23 gage – fine needle).

- This way - “free hand”, even lesions smaller then 2-3 mm can be aspirated.
Fine needle aspiration

Top of the needle enters the lesion
Indications for fine needle aspiration citology

Thyroid nodules

Nodules outside the thyroid (lymph nodes, neck tumors, parathyroid glands).

Thyroiditis - dif.dg.
Advantages of ultrasound guided fine needle aspiration

1. Visualization of pathologic lesions: definition of affiliation to certain organ and possibility to choose point for aspiration inside the lesion.
2. Reducing incidence of inappropriate material.
3. Enabling aspiration of unpalpable, small lesions up to 2 mm.
4. Early detection of possible complications (bleeding, perforation).
5. Good reproducibility.
Ethanol percutane therapy

• Autonomic functional thyroid tissue – adenoma, synthesizes and secretes thyroid hormones independently to TSH secretion.
• When hyperthyroidism syndroms appear (nodule usually bigger then 3 cm) they require therapy (surgical, radiiodine or percutane ethanol injection).
• Percutane ethanol therapy was first used in parathyroid adenomas and small hepatocellular carcinomas.
Ethanol percutane therapy - technic

- According to the volume of the nodule, volume of 96% ethanol for injection is calculated.

- Injection is made by 22G needle (0,7 mm), with max. volume up to 20 ml every 3-4 days.

- Color-doppler is used for verification of decreased nodule vascularity- circulation.
Echographic criterion suspected for malignancy:

- Hypoechogenic nodule
- Uneven contours

- small crumbly calcifications

FNAC is mandatory!
In patients with thyroid carcinoma examination of the lateral sides of the neck is mandatory.

Enlarged lymph nodes on the neck, especially if rounded, unhomogenic, isoechogetic or with cystic-degenerative changes are always suspected of metastasis and they must be punctuated.

Lymph node metastasis
Metastatic – isoechogenic lymph nodes
No need for FNAC:

- **all nodules** in multinodular goiter.

- **Small solitary nodules** (without ultrasound signes for malignancy) <1 cm.

- **Scintigraphic warm and hot nodules** (if not suspected for malignancy by ultrasound.).

- **Colloid cysts, cysts** <1,5 cm.

- If earlier aspiration finding was normal (benign) there is no need to repeat it.
• Assessment of thyreoglobulin, calcitonin and parathyroid hormon in thyroid nodule’s and neck nodule’s aspirations.

• Cytologic finding of thyroid nodule’s and neck nodule’s aspiration sometimes can be inconclusive.

• Punctuate is washed with 1 ml of physiological solution and thyreoglobulin, calcitonin and parathyroid hormon levels measured by usual methodes.
Radiological examination

X-ray of the trachea and soft tissues structures of the neck

- dislocation, compression, tracheomalacia of the trachea
- thyroid calcifications

CT, MR - rarely indicated examinations
X-ray examinations

Substernal goiter
CT, MR
Ectopic- intratracheal thyroid
CT, MR
Ectopic- intratracheal thyroid
Retrotracheal Secondary Intrathoracic Goiter Presenting as Cervical Thyroid Nodules on Ultrasonography

Vinko Marković,¹ ² Davor Eterović,¹ ² Ante Punda,¹ ² Dubravka Brdar,¹ Juroslav Roglić,³ and Zoran Slobodnjak⁴
Huge intrathoracic goiter in an asymptomatic patient

Vinko Marković¹, Ante Punda¹ and Nenad Ilić²

Thank you for your attention!