

# Nomenclature of individual ultrasound characteristics

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## Summary

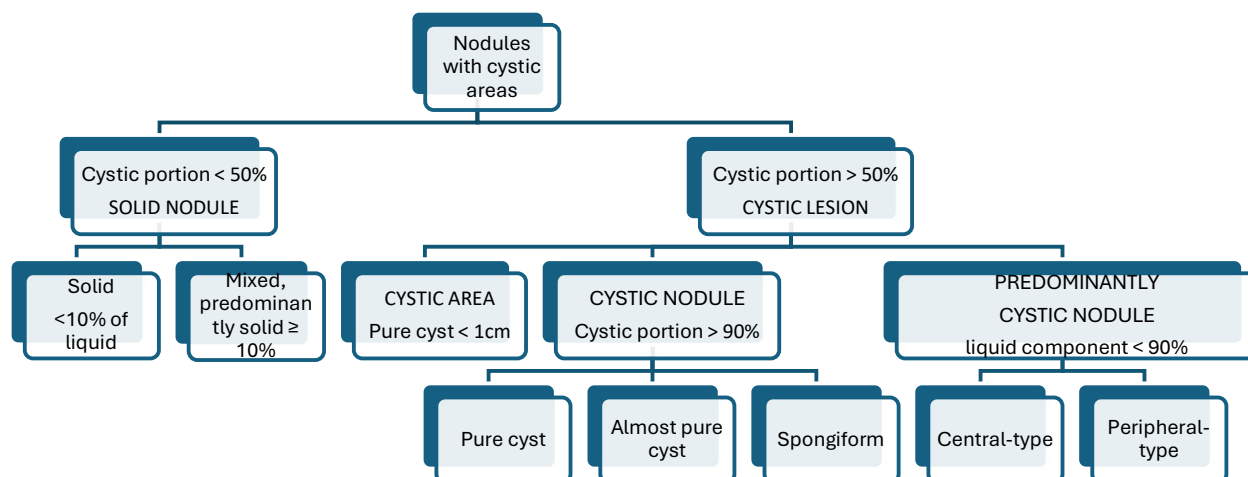
I updated the previous document with the suggestions of the 2023 ETA Guideline on Nodular goiter – **these are highlighted with red in the text**. In this respect, primarily the Supplementary material is remarkable and I encourage everybody to read this. You can find it here: <https://etj.bioscientifica.com/view/journals/etj/12/5/ETJ-23-0067.xml>.

**The ETA 2023 Guideline acknowledged that the ultrasonographer can face difficulties with ascertaining the presence of features with high suspicion and suggested classifying these nodules as EU-TIRADS 4.**

## Composition

This feature relies on the presence of cystic areas and on the ratio of cystic and solid parts of the nodule. The term 'mixed' can be used if the nodule has both cystic and solid areas and the ratio of these components exceeds 5% measured in surface.

Types of nodules according to their composition (see Figure 1)



The subtype of a mixed nodule should be always defined before aspiration.

## Considerations

### Cystic area

This term is not used in literature. I suggest using the cystic area for normally occurring dilated macrofollicles which are normal finding in the thyroid. These structures can reach even 1 cm in diameter and have no solid area. The use of 'nodule' for such normally occurring lesions would be inappropriate and could cause unnecessary anxiety for the patient.

### Spongiform area and spongiform nodule

We speak of spongiform areas if this is composed of tiny cystic areas divided by fibrous tissue and lacking solid parts. According to the suggestion of the European Thyroid Association, a spongiform nodule must be composed entirely of spongiform areas.

### Pure cyst

To use this term according to the ETA, the nodule can have neither any solid area nor any wall thickening. Other societies are satisfied with less than 5% of solid areas.

### Central-type (concentric) vs. peripheral-type (eccentric) cystic nodule

In the former, the solid part runs all along the inner wall of the cyst in a concentric position along the cyst wall. In the event of peripheral-type cysts, the solid part is in contact with the cyst wall only at one part of the lesion and the position of the solid part is eccentric.

## Echogenicity

This feature relies on the grey scale level of the solid part of the nodule. Traditionally we compare this to two reference tissues, to the strap muscle running ventral to the thyroid and to the non-nodular part of the lobe.

Types of nodules according to echogenicity (see Table 1)

Types	Reference tissue	Handling in the protocols	Grouping in TIRADS <sup>1</sup>	Grouping in TIRADS <sup>2</sup>
Hyperechoic	Normal thyroid	Iso/hyperechoic	Iso/hyperechoic	Iso/hyperechoic
Isoechoic				
Minimally hypoechoic		Minimally/moderately hypoechoic	Minimally/moderately hypoechoic	Hypoechoic
Moderately hypoechoic				
	Strap muscle			
Deeply or very hypoechoic		Deeply hypoechoic	Deeply hypoechoic	

## Considerations

### Heterogeneous nodule

Can be used only for those nodules which have both hypoechoic and iso/hyperechoic parts. A nodule can be a dominantly hypoechoic (with an iso/hyperechoic minority part) or dominantly iso/hyperechoic one (with a hypoechoic minority part). According to the EU TIRADS, heterogeneous echogenicity of the solid component, the presence of any hypoechoic tissue classifies the nodule as intermediate risk, i.e., a dominantly iso/hyperechoic nodule must be classified as an EU TIRADS 4 lesion.

It is not exactly defined what proportion the part in the minority must reach to be called heterogeneous. **The 2023 ETA Guideline suggests that the largest contiguous part of the minority component should be significant, e.g. 'at least 5 mm'.**

### The strap muscle as reference tissue

It is not defined in literature which part of the muscle tissue should be considered. I suggest for reference tissue that part of the muscle fiber which low adipose tissue content.

**According to the proposal of the 2023 ETA Guideline, the muscle fiber with low adipose tissue content should be the reference tissue.**

### How to define the normal thyroid as reference tissue in hypoechoic thyroids?

There is no clear solution for this situation in literature. If we consider the hypoechoic (diseased) non-nodular part as reference for normal thyroid, we should describe this in our report. (E.g., compared to the moderately hypoechoic thyroid the nodule is...) The other, more consistent approach if we compare the nodule's echogenicity to an imagined healthy thyroid, like how we otherwise establish that the non-nodular part is hypoechoic.

**In a hypoechoic thyroid the 2023 ETA Guideline recommended the healthy, normal thyroid as the reference tissue and not the diseased extranodular part of the actual patient.**

## Intranodular echogenic figures

Types of intranodular echogenic figures (see Table 2)

Type	Origin	Presentation	Size
<b>Normal connective tissue</b>			
	Normal architecture of the thyroid	Synchronous presence of hyperechogenic lines and granules	Granule around 1 mm, line 3-30 mm
<b>Proliferation of connective tissue</b>			
	Proliferation of connective tissue	Synchronous presence of hyperechogenic lines and granules	Granule around 1 mm, line 3-30 mm
<b>Comet-tail artifact</b>			
	Colloid crystal	A hyperechogenic granule with a dorsal fading and narrowing tail	Granule 0.5-1.5 mm, tail 0-4 mm
<b>Back wall figures</b>			
	Optical artifact caused by posterior back wall enhancement	Hyperechogenic granule and line in the dorsal wall of a cystic area	1-30 mm
<b>Microcalcification</b>			
	Microcalcification and probably hyperplastic papillary structures	Bright hyperechogenic granule	Max. 1 mm
<b>Macrocalcification</b>			
	Coarse calcification	Irregular, thick bright line (not always found) Dorsal acoustic shadow (always present)	2 mm-several cm

## Considerations

### Microcalcification

This is an exclusion diagnosis. Those echogenic spots belong to this group which are (1) less than 1 mm in diameter and correspond (2) neither to comet-tail artifacts (3) nor to back wall figures (4) nor to connective tissue.

If we have any doubt whether a hyperechoic spot is not microcalcification, then our doubt must be described in the medical report.

### Punctate echogenic figures

This term was introduced by the ACR TIRADS and includes microcalcification and short comet-tail artifact. The cause for this new term was that microcalcification is indeed a misnomer in thyroid ultrasound. Microcalcification is a pathological finding and is found almost exclusively in papillary cancer and many other echogenic spots have a similar appearance in ultrasound. To avoid the very often unfounded use of microcalcification, the ACR suggested the use of this term.

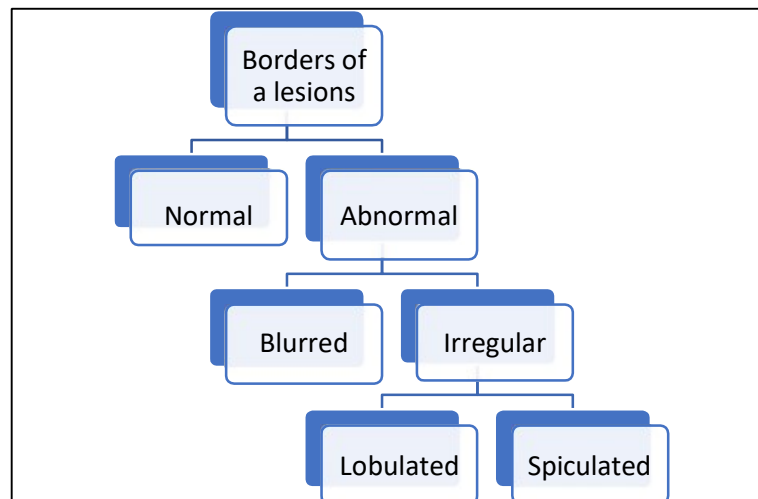
### Comet-tail artifact

The typical form is found in the cystic portion of a mixed or cystic lesion and has a typical narrowing tail. The finding of even a single typical comet-tail artifact makes very unlikely that the lesion is malignant.

## Nodule's borders

The irregular borders together with the irregular shape and ultrasound signs of extrathyroidal extension rely on the invasive nature of papillary thyroid cancer.

Types of nodules' borders (see Figure 2)



## Considerations

### Irregular border

This includes only lobulated and spiculated margins. **According to the suggestion of the 2023 ETA Guideline, 'the distance between the most protruding part of the nodule and the rest of it must be at least 2 mm' to consider the borders as irregular.**

### Blurred or ill-defined borders

Although this is not included among irregular borders and therefore, this feature is not considered as suspicious finding in any TIRADS system, ill-defined borders should not be neglected because this significantly increases the likelihood of malignancy.

### Avoiding some pitfalls

Nodule' borders always refer to the **outer** borders of a **single pathological** nodule.

Irregularities between solid and cystic parts of a mixed nodule do not count.

Irregular boundaries between iso/hyperechoic and hypoechoic parts of a heterogeneous nodule, also should not be considered as irregular borders.

Irregular borders of a mass composed of multiple nodules can be challenging. If irregularity is caused only by the grapes-like presentation of multiple small lesions next to each, then this should not be **considered** as pathological.

Hypoechoic discrete areas of Hashimoto's thyroiditis frequently have irregular surface. However, these discrete areas which can be found in more than 90% of Hashimoto's cases are not pathological nodules. So, again, in such patterns we should not call the borders irregular in the context of TIRADS classification.

The borders of a mixed nodule should be judged always before aspiration. The borders not infrequently became lobulated after the aspiration of cystic fluid. This has no relevance.

## Nodule's shape

Types of nodules' shape (see Table 5)

Type	Feature	In which plane is it measured?
<b>Regular</b>	Width > Depth Length > Depth	Transverse Longitudinal
<b>Round</b>	Width = Depth	Transverse
<b>Taller-than-wide</b>	Width < Depth	Transverse
<b>Taller-than-long</b>	Length < Depth	Longitudinal

## Considerations

How to judge the nodule shape?

We do not need to measure but only visually judge and compare the largest diameters of a nodule. We should compare not a diameter in a single section but the largest diameters.

How to handle taller-than-long shape?

Although not all TIRADS include this kind of nonparallel orientation among suspicious findings, there is minimal if any uncertainty about the fact that taller-than-long shape is equally important to taller-than-wide shape.

## Ultrasound signs of extrathyroidal spread

These signs rely on the integrity of the pseudocapsule of the thyroid and the contours of the nodule.

### Kinds of thyroid' pseudocapsule

Continuous

Not visible

Discontinuous

### Kinds of nodule's contours

Normal contour means that the nodule is all along covered by thyroid tissue.

Abutting contour means that the nodule is in close contact with the outer surface of the thyroid.

Bulging contour means that the nodule protrudes into anatomical structures outside the thyroid.

Risk of extrathyroidal extension in relation to nodule's contour and thyroid' capsule (See Table 3)

Capsule	Contour		
	Non-abutting	Abutting but not bulging	Abutting and bulging
Continuous	Negligible	Very low	Very low
Discontinuous	Negligible	Consider minimal ETE	Consider gross ETE

## Considerations

Ultrasound has quite good diagnostic performance regarding the minimal degree of extrathyroidal spread, however, the positive predictive value of US (PPV) is only around 50% regarding the gross extrathyroidal extension.

According to the newest, 8<sup>th</sup> TNM classification minimal ETE has no role in the staging while gross ETE deeply influences the further management of patients.

The newest TNM classification states that gross extrathyroidal extension can be based either on preoperative ultrasound, intraoperative surgical or postoperative macroscopic pathological finding, so microscopic evaluation has no role in the judgement. This places a huge and considering the 50% PPV, a clearly unfounded responsibility on the ultrasonographer. Only in completely clear (and extremely rare in everyday practice) cases can it be described on the ultrasound that a macroscopic ETE is present, because a mistake can affect the patient's further treatment and prognosis assessment.

Ultrasound signs of ETE are used in two different meanings. First, for prediction of ETE. Second, as a suspicious finding irrespectively of ETE. The latter is backed by the observation that significantly more thyroid cancers present abutting contours compared with benign lesions.

## **Halo sign**

Halo is a sonolucent rim around a discrete thyroid lesion, best maintained for complete rim. This can correspond to fibrous capsule or to compressed thyroid tissue or to compressed vessels.

## **Controversial importance**

While halo is the sign with a huge negative predictive value for papillary and medullary cancer, this is the most frequently occurring feature of follicular cancers; in the latter halo corresponds to the capsule of the follicular tumor.

## **Nodule's vascularity**

### **Vascular patterns**

#### Appearance

##### Perinodular

Vascularity is observed at least 25% on the circumference of the nodule.

##### Intranodular

Vascular spots within the nodules

#### Classification according to the ETA guideline

Type 1 Neither perinodular nor intranodular flow can be detected

Type 2 Perinodular vascularity is present while intranodular is absent or only slight.

Type 3 Intranodular vascularity is marked while perinodular is only slight.

#### Comment

It is worth describing nodule' vascularity according to its appearance since colleagues are not necessarily aware of the classification. Moreover, guidelines use different classifications.

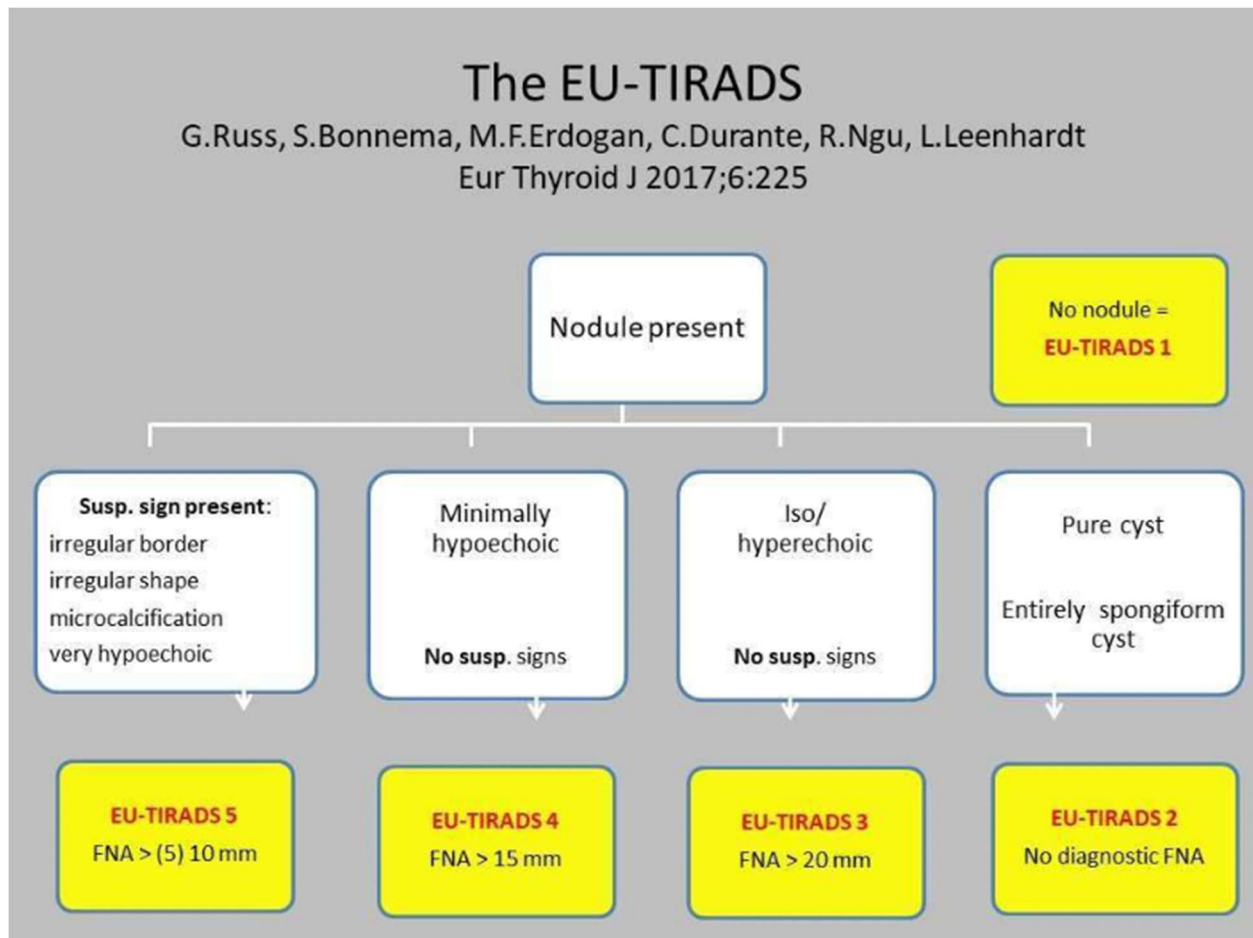
### **Considerations**

According to the general opinion, examining the circulation of the nodule adds very little to the diagnosis.

Despite the limited role in tumor diagnosis, vascularity remained an essential part of thyroid ultrasound. There are many special fields where vascularity has an important auxiliary role, e.g., differentiation of deeply hypoechoic structures, differential diagnostics of neck lymph nodes.

There is a special pattern, the lack of halo and perinodular vascularity, which makes follicular tumor unlikely even if the cytology results in follicular tumor or suspicion of follicular tumor (Bethesda 4 subgroup).

## The European TIRADS (see Figure 3)



### Comment

Although extrathyroidal spread and the presence of suspicious lymph nodes are not included in the TIRADS score, if they are present, FNA is mandatory.

## Final considerations

Suspicious of thyroid cancer? NOT. Suspicious only for papillary cancer!

Regarding all suspicious characteristics and halo sign, papillary thyroid cancer (PTC) behaves just the opposite as the second most common thyroid cancer, the follicular thyroid cancer (FTC). This difference is not only of statistical value but of practical relevance. Since PTC is 10-15 times more common than FTC, the characteristics of the former dominate our impression of thyroid cancer in a statistical sense. At the same time, it is extremely misleading that the reports forget to mention this circumstance and, in fact, mistakenly extend the characteristics of PTC cancer to all thyroid cancers.

Relying on suspicious characteristics (of PTC) in our judgement on cytology, can lead to overlooking FTCs. This risk is much higher in Europe compared with North America, Australia, or Southeast Asia because of the higher prevalence of FTC in Europe.

Describe the reality

Despite the surprisingly low, occasionally only by chance interobserver agreement even among experts regarding all suspicious thyroid ultrasound characteristics, the wording of most guidelines is deceptive; they behave as if the judgement on ultrasound features would not share a significant degree of uncertainty.

Don't let yourself be fooled and don't fool others either! If you are uncertain about the assessment of something, write it down on the report.

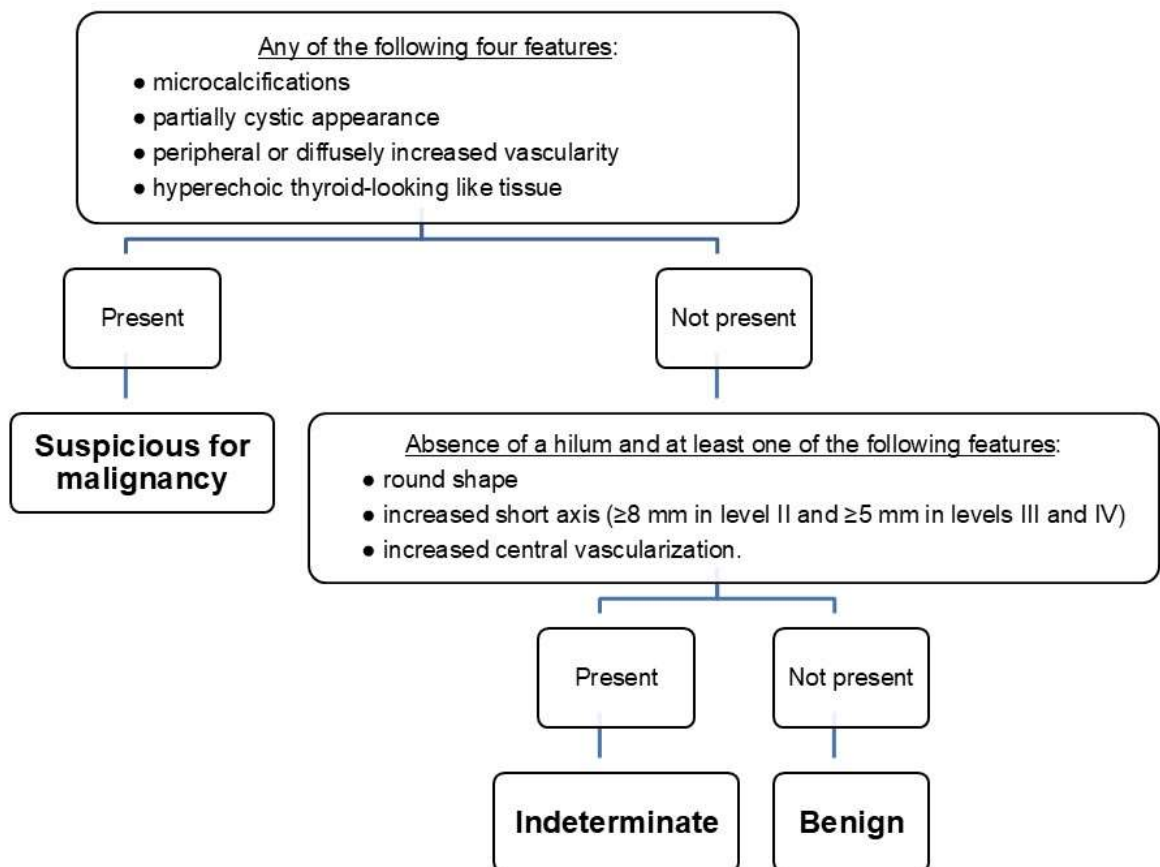
## About the neck lymph nodes

### When to assess neck lymph nodes?

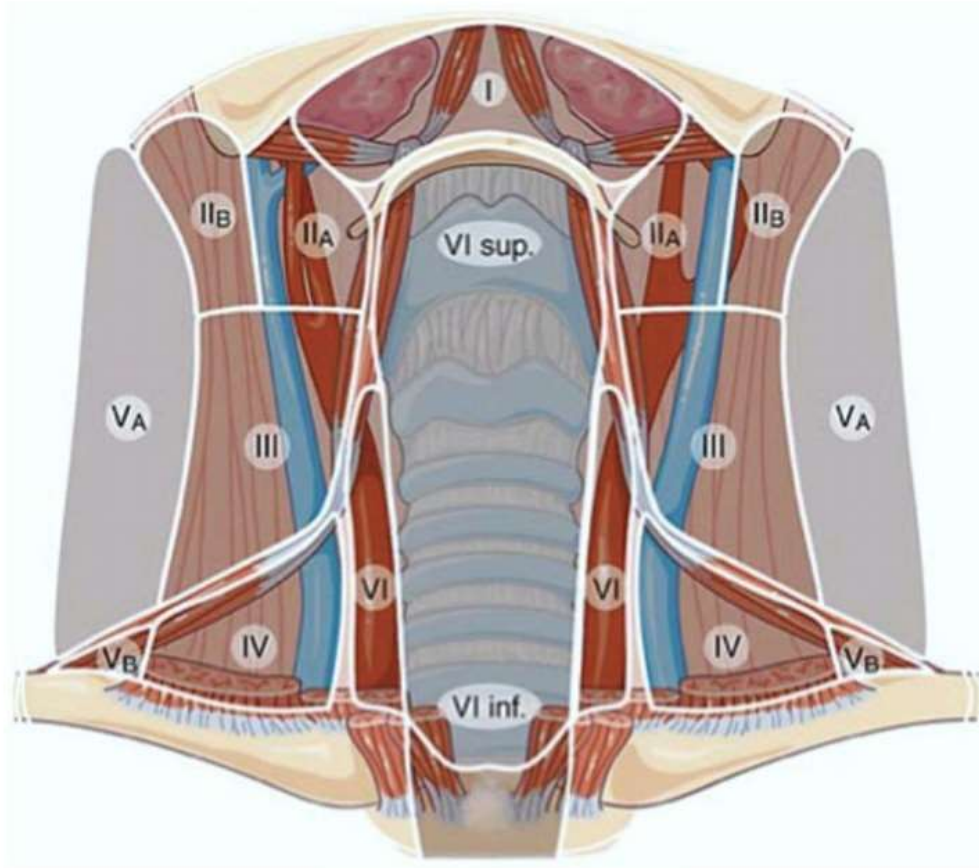
'US assessment of the lymph nodes is advised for all thyroid nodules but is mandatory for intermediate- and high-risk ones. In case of a suspicious lymph node of thyroid origin, FNA of the lymph node and FNA of the most suspicious thyroid nodule(s) should be performed.' (Quotation from the EU TIRADS publication.)

### Classification of the neck lymph nodes according to the European Thyroid Association

(Leenhardt L, Erdogan MF, Hegedus L, et al. 2013 European thyroid association guidelines for cervical ultrasound scan and ultrasound-guided techniques in the postoperative management of patients with thyroid cancer. *Eur Thyroid J.* 2013;2(3):147-159.)



## Neck regions



Specific US anatomic landmarks are used: level III LNs lie above the omo-hyoid muscle and level IV LNs below it. Separation between level II and III is the division of the common carotid artery in its two branches. (Leenhardt L, Erdogan MF, Hegedus L, et al. 2013 European thyroid association guidelines for cervical ultrasound scan and ultrasound-guided techniques in the postoperative management of patients with thyroid cancer. *Eur Thyroid J.* 2013;2(3):147-159.)

## **PARATHYROID**

A single consideration:

- The upper parathyroid is located usually dorsal to the middle third of the thyroid or above.
- The lower parathyroid is usually below the thyroid or less frequently dorsal to the lower third of the thyroid.