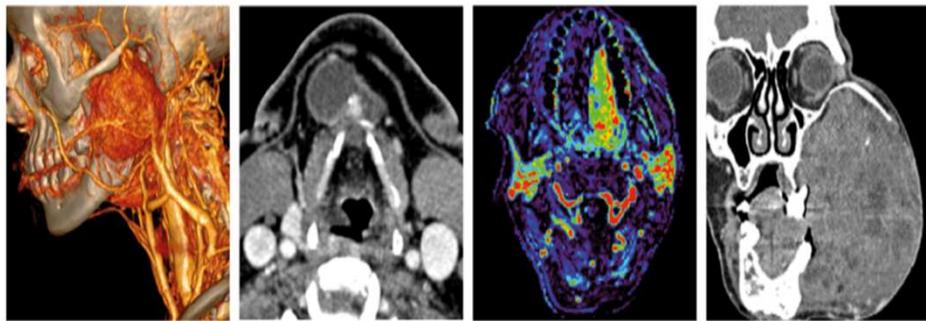


XVIII CURSO NACIONAL DE NEURORRADIOLÓGÍA

RADIOLOGÍA DE CABEZA Y CUELLO



31 de marzo - 1 de abril de 2022 | Barcelona

Manejo radiológico del nódulo tiroideo

Víctor Pérez Riverola
UDIAT-CD. Hospital Universitari Parc Taulí.
Sabadell (Barcelona)



Nódulo tiroideo: conceptos generales

Muy frecuentes



Prevalencia = 48-68%

Benignos

>>>

Malignos



Riesgo M = 5-10%

Buen Pronóstico



Sv 20 años > 90-95%

Mortalidad estable últimos 25 años

Ross DS. Nonpalpable thyroid nodules: managing an epidemic. J Clin Endocrinol Metab 2002; 87:1938–1940

Mazzaferri EL. Management of a solitary thyroid nodule. N Engl J Med 1993; 328:553–559

<https://seer.cancer.gov/statfacts/html/thyro.html>

Clasificación Histológica del Nódulo Tiroideo

Nódulos Benignos no neoplásicos

Hiperplasia nodular: nódulo adenomatoso o coloide, degeneración quística o hemorrágica

Pseudonódulos inflamatorios: tiroiditis de Hashimoto

Neoplasias Benignas

Adenoma Folicular

Adenoma Folicular de cels Hürtle

NIFTP *

* *Non-invasive follicular thyroid neoplasm with papillary-like nuclear features* (lesión premaligna o de bajo potencial de malignidad)

Neoplasias Malignas

Carcinoma Papilar (CPT) 75-80%

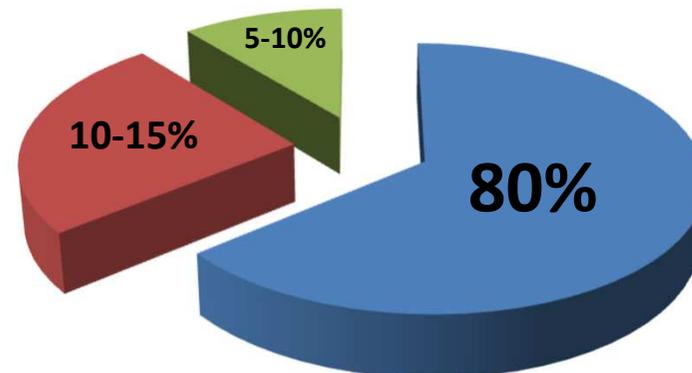
Carcinoma Folicular (CFT) 10-20%

Carcinoma Medular (CMT) 3% MEN-2

Carcinoma pobremente diferenciado 1%

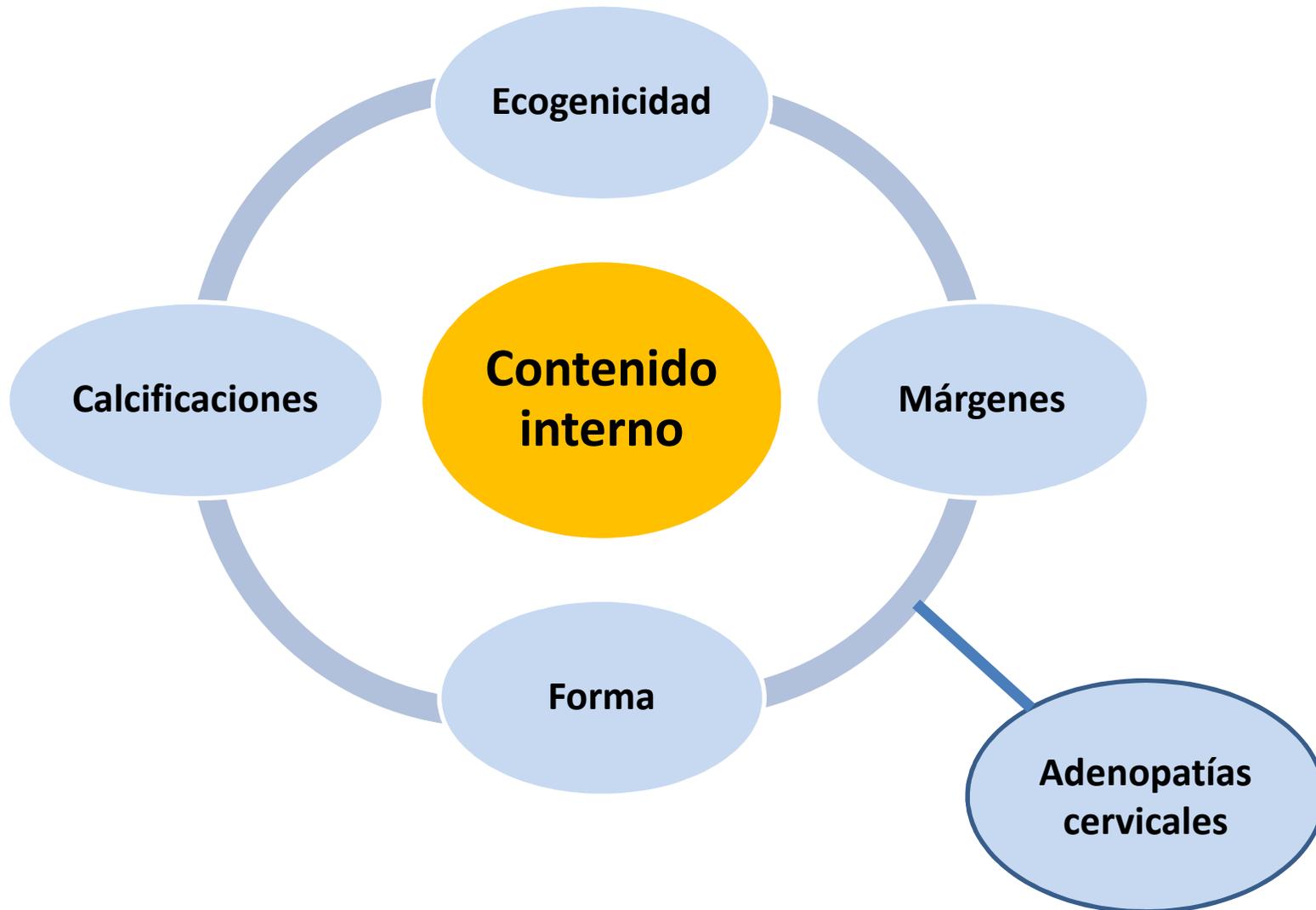
Carcinoma indiferenciado o anaplásico 1%

CE, Linfoma o Metástasis <1%

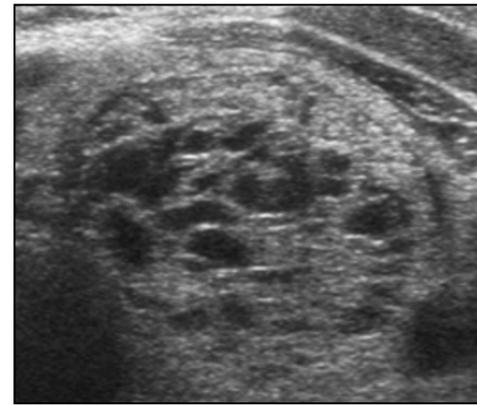
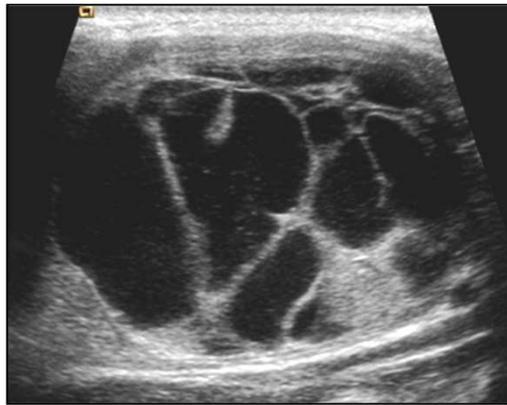
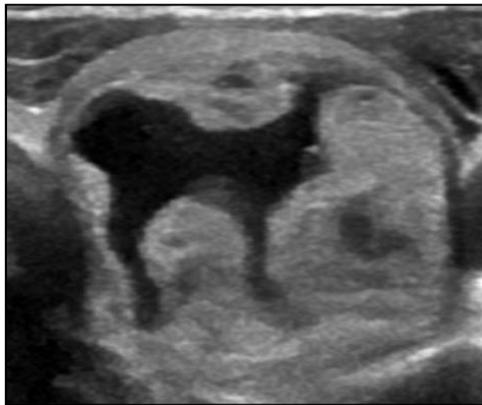
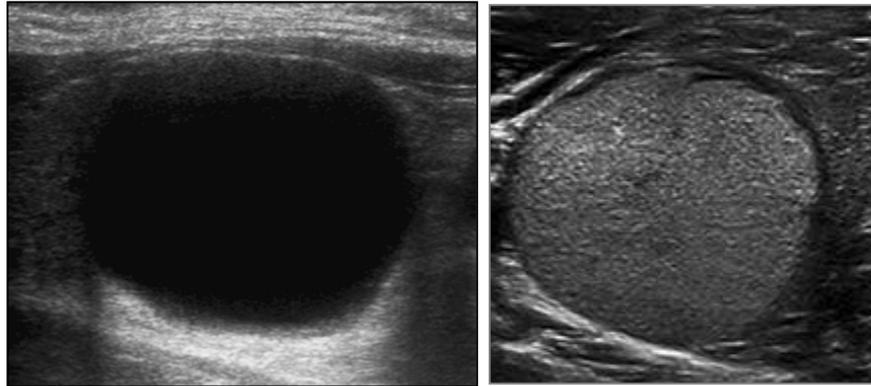


Hegedüs L. N Engl J med 351;17 2004

Caracterización ecográfica



Caracterización ecográfica: contenido interno

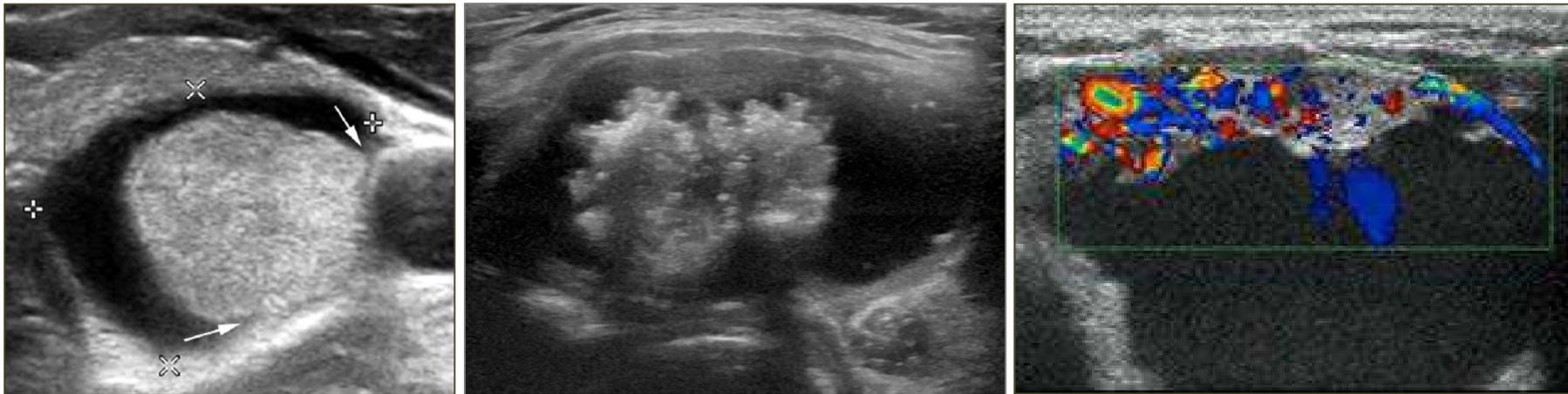


- La mayoría de carcinomas tiroideos son SÓLIDOS.
- Hasta un 10-13% de los CPT tienen componente quístico intranodular (2,5-6% pred quísticos)

Caracterización ecográfica: nódulos mixtos

Signos ecográficos de sospecha en nódulos mixtos. Valoración del componente sólido mural :

1. Nódulo excéntrico de ángulos agudos
2. Nódulo excéntrico de márgenes lobulados o irregulares
3. Componente sólido mural con microcalcificaciones y/o señal doppler aumentada



Bonavita JA et al. Pattern recognition of benign nodules at ultrasound of the thyroid: which nodules can be left alone?

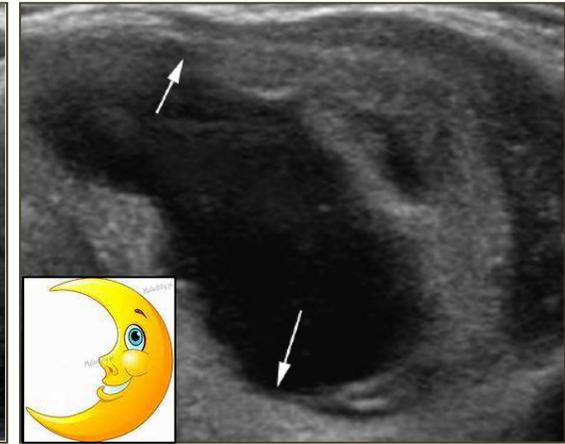
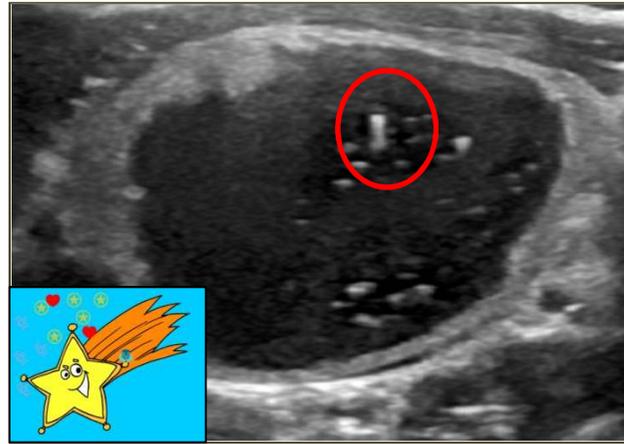
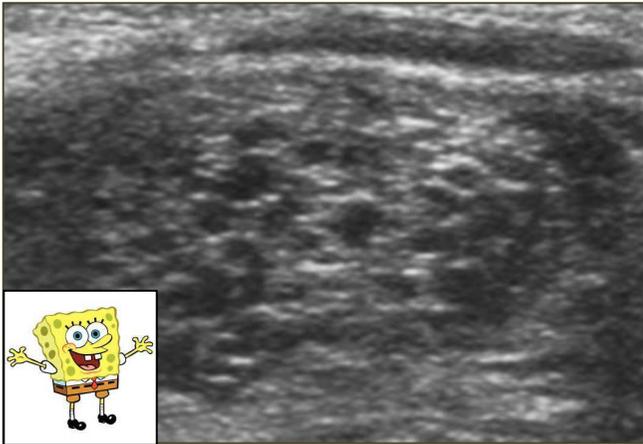
Kim D.W et al. Sonographic Differentiation of Partially Cystic Thyroid Nodules: A Prospective Study.

Tessler FN et al. Thyroid Imaging Reporting and Data System (TI-RADS): A User's Guide. Radiology. 2018 Apr;287(1):29-36.

Caracterización ecográfica: nódulos mixtos

Signos ecográficos de benignidad:

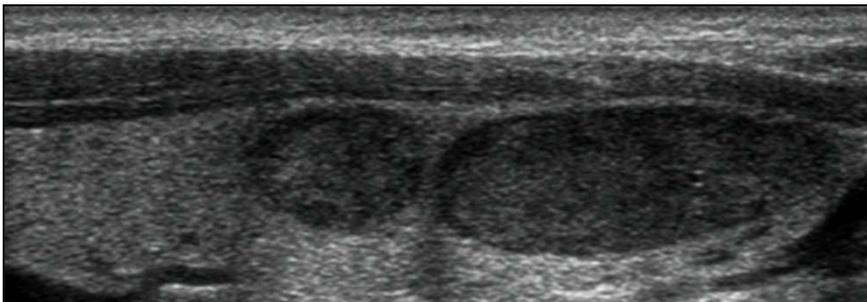
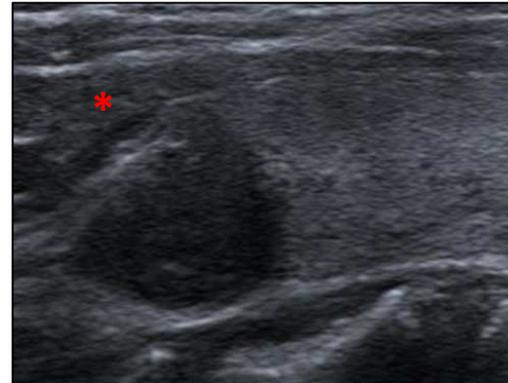
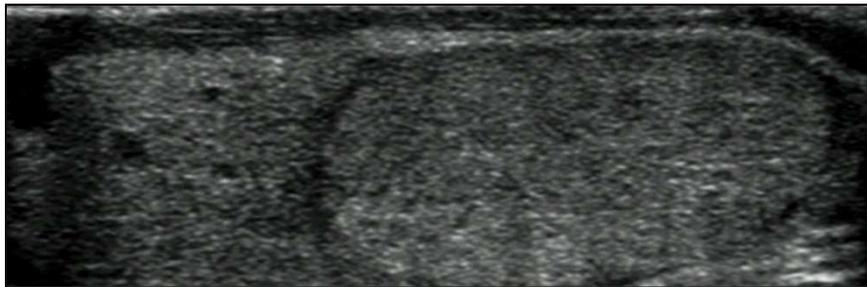
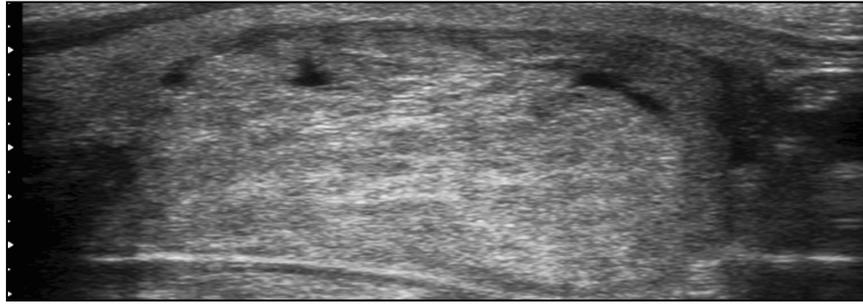
1. Patrón esponjiforme (“*honeycomb*”): microquístico y septos finos
2. Focos ecogénicos en “cola de cometa” dentro del contenido quístico: cristales coloide denso
3. Área sólida mural concéntrica: ángulos oblicuos y márgenes lisos



Bonavita JA et al. Pattern recognition of benign nodules at ultrasound of the thyroid: which nodules can be left alone? AJR 2009;193:207-213.

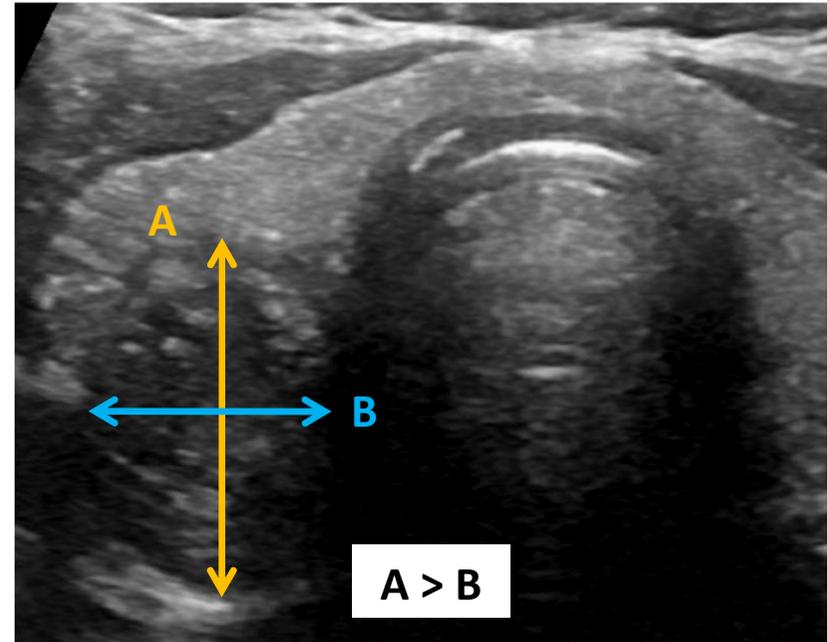
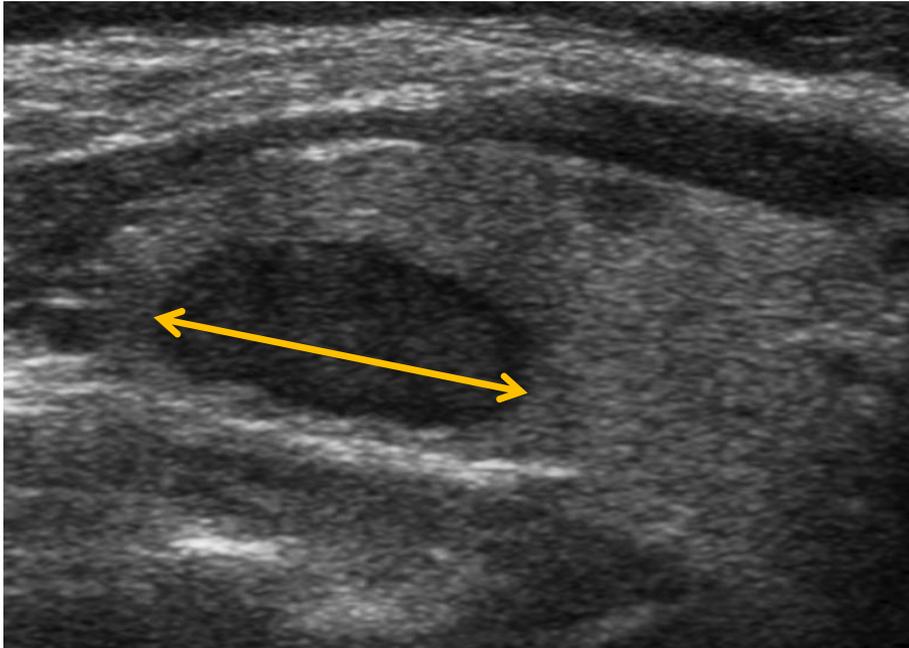
Kim D.W et al. Sonographic Differentiation of Partially Cystic Thyroid Nodules: A Prospective Study. AJNR Am J Neuroradiol 31:1961– 66

Caracterización ecográfica: ecogenicidad



- La mayoría de carcinomas tiroideos son HIPOECOICOS (>80%).
- **Marcada hipocogenicidad:** signo alta sospecha malignidad.

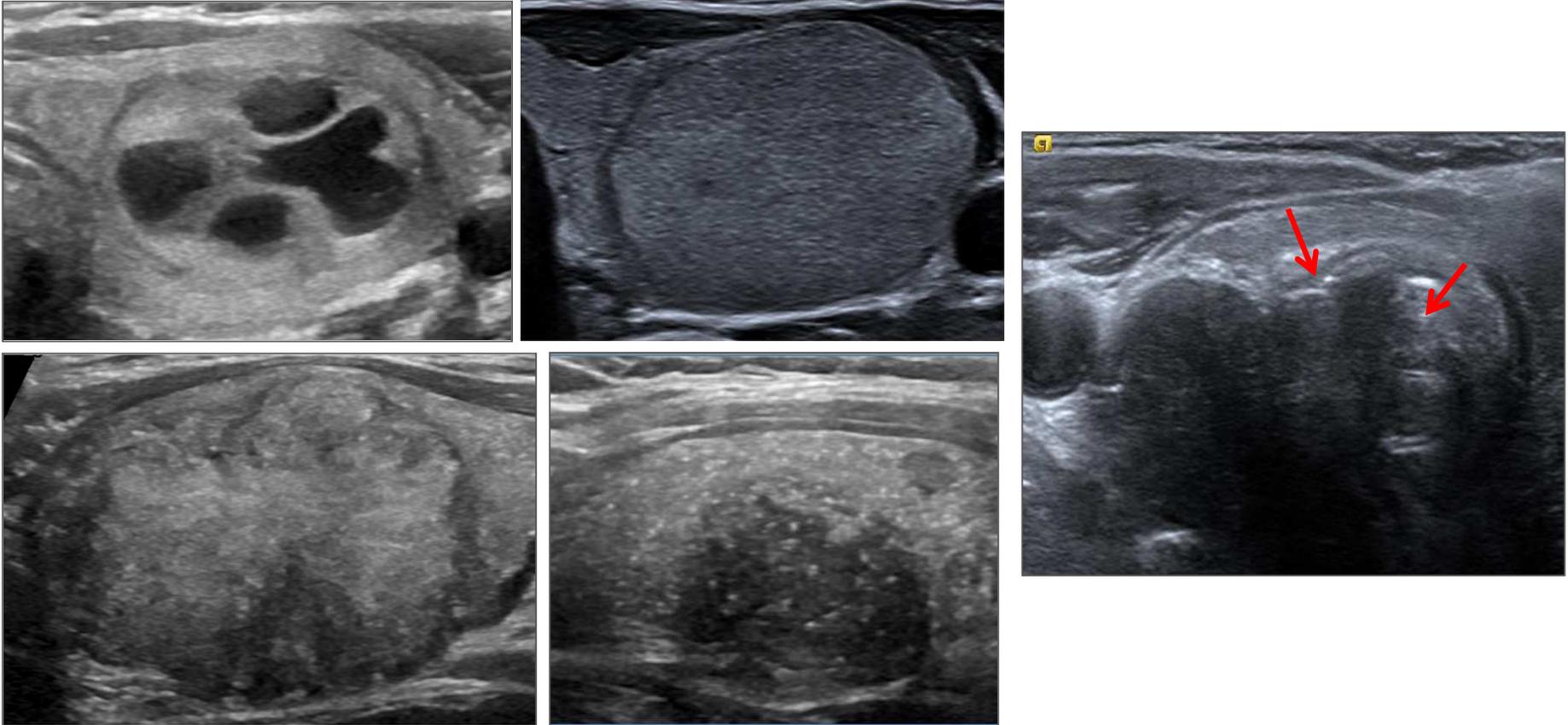
Caracterización ecográfica: forma



“taller than wide”

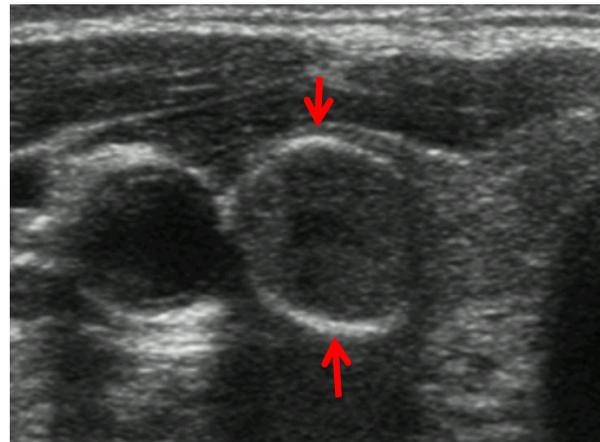
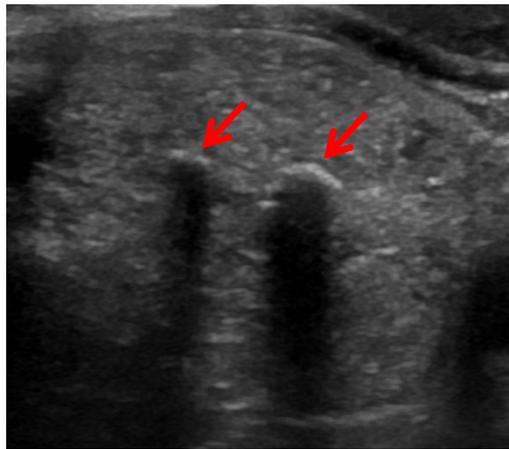
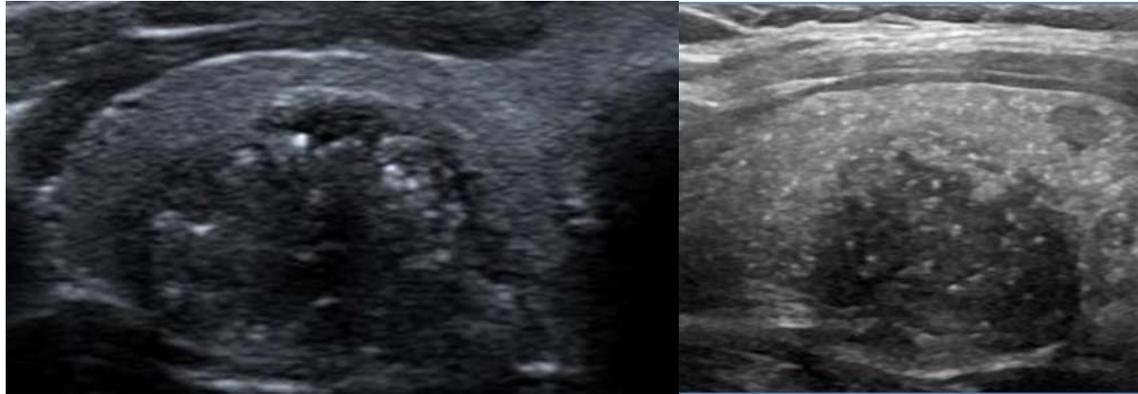
- “Taller than wide”: signo alta sospecha malignidad

Caracterización ecográfica: márgenes



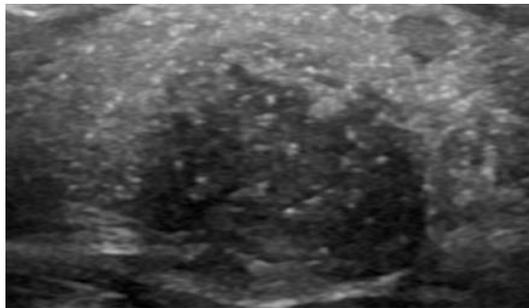
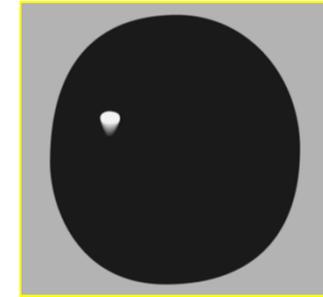
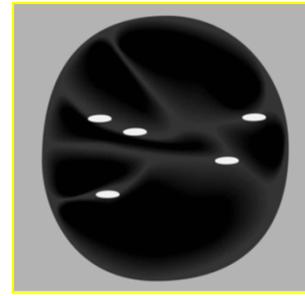
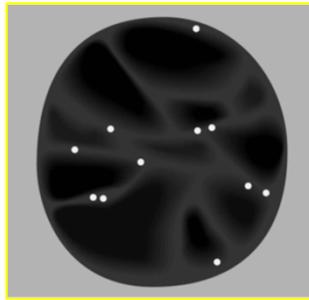
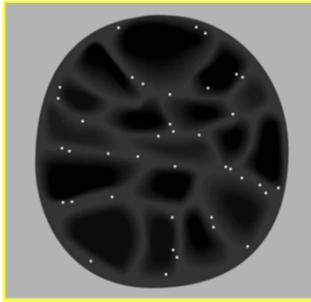
- Márgenes irregulares o lobulados: signo alta sospecha malignidad
- Extensión extratiroidea: carcinoma anaplásico (infiltración estructuras vecinas)

Caracterización ecográfica: calcificaciones



- Microcalcificaciones: signo alta sospecha malignidad.
- Macrocalcificaciones: riesgo de malignidad controvertido en la literatura.
- Calcificaciones periféricas "en cáscara de huevo": variable. Signo de sospecha = **disrupción de la calcificación**.

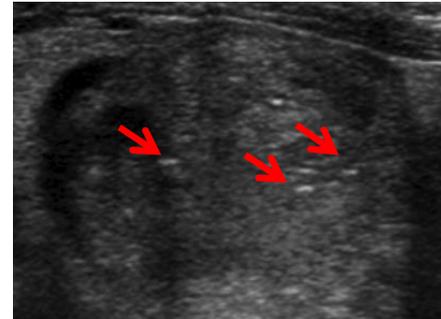
Caracterización ecográfica: focos ecogénicos puntiformes



Microcalcificaciones: psammoma



Focos inespecíficos



Focos lineales: interfases



Cola de cometa: coloide denso

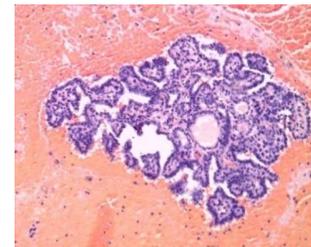
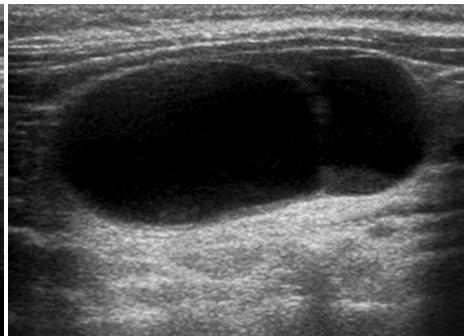
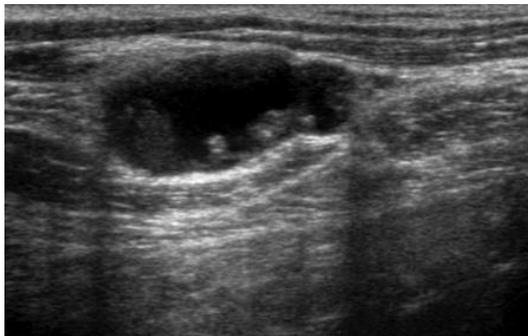
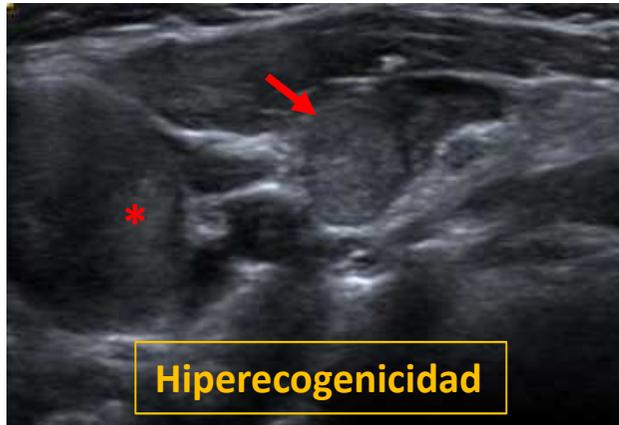
PUNTO CLAVE

- La presencia de una “cola de cometa” en un componente nodular sólido no es signo concluyente de benignidad.
- Riesgo de M = 27% en nódulos hipoeoicos con focos en “cola de cometa corta”.

Beland MD, et al. J Ultrasound Med. 2011 Jun;30(6):753-60.

Malhi H, et al. Echogenic foci in thyroid nodules: significance of posterior acoustic artifacts. AJR 2014;203:1310-6.

Caracterización ecográfica: Adenopatías metastásicas



Citología. Papanicolaou
100x. Bloque celular
con papilas.

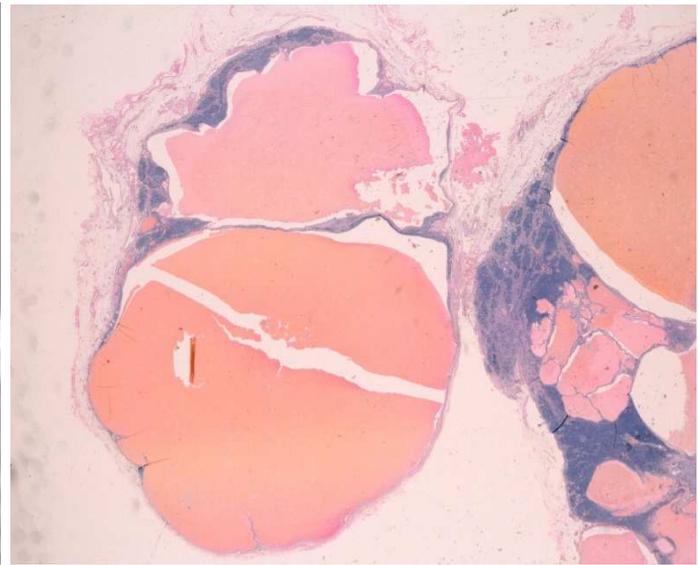
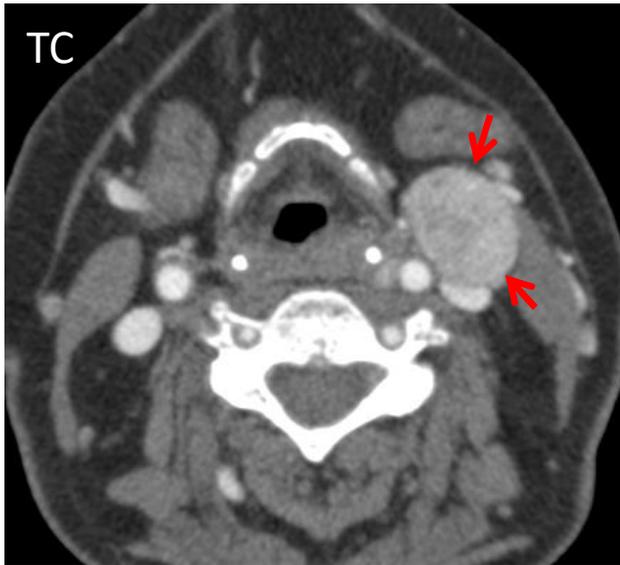


Bioquímica:
Tiroglobulina

TG: **675.000** ng/ml
Normal: 0,83 – 68 ng/ml

Caracterización TC/RM: Adenopatías metastásicas

CARCINOMA PAPILAR DE TIROIDES



Cortesía de la Dra. M^a Rosa Bella.
CSPT. Sabadell

Signos ecográficos de alta sospecha de malignidad

PUNTO CLAVE

Ningún SES es pgm de malignidad pero tienen elevada sensibilidad forma conjunta

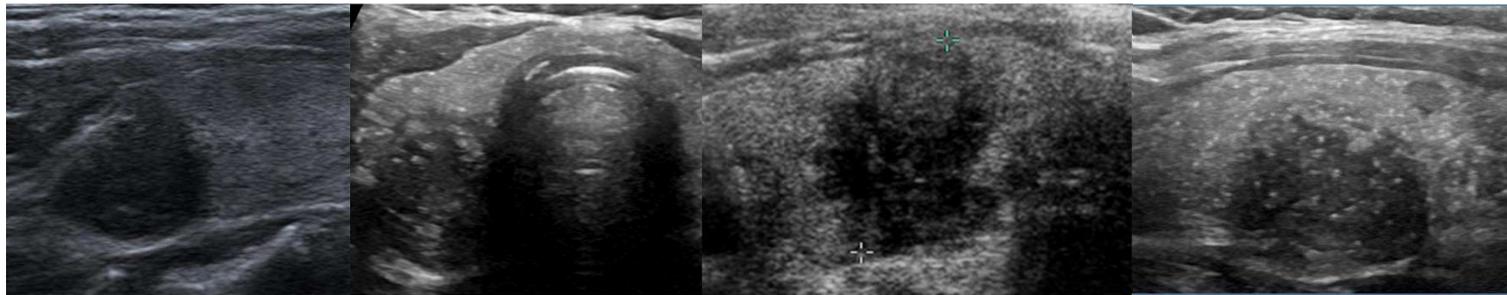


Table 3

Diagnostic Accuracy of US Findings for Malignant Nodules

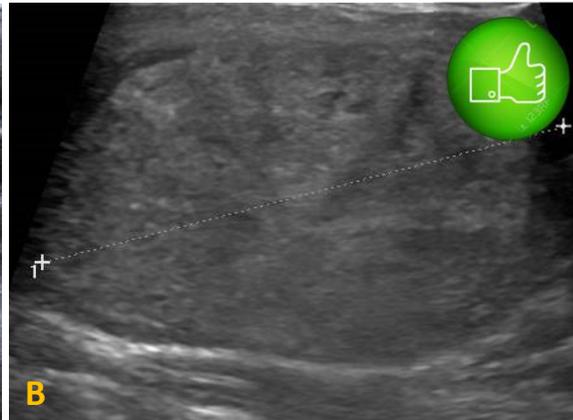
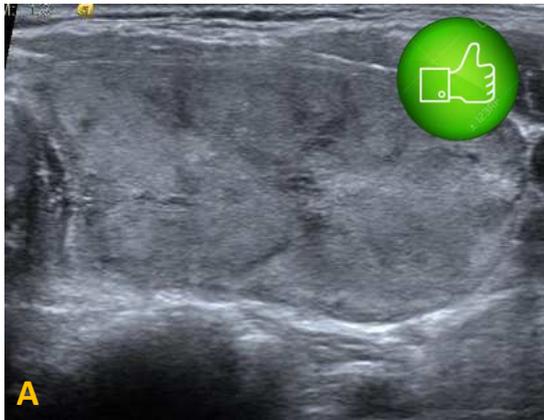
Characteristic	Sensitivity (%)	Specificity (%)	Negative Predictive Value (%)	Positive Predictive Value (%)
Taller-than-wide shape	40.0 (144/360)	91.4 (447/489)	67.4 (447/663)	77.4 (144/186)
Spiculated margin	48.3 (174/360)	91.8 (449/489)	70.7 (449/635)	81.3 (174/214)
Marked hypoechoogenicity	41.4 (149/360)	92.2 (451/489)	68.1 (451/662)	79.7 (149/187)
Hypoechoogenicity and marked hypoechoogenicity	87.2 (314/360)	58.5 (286/489)	86.1 (286/332)	60.7 (314/517)
Microcalcification	44.2 (159/360)	90.8 (444/489)	68.8 (444/645)	77.9 (159/204)
Macrocalcification	9.7 (35/360)	96.1 (470/489)	59.1 (470/795)	64.8 (35/54)
One of five malignant findings (marked hypoechoogenicity)	83.3 (300/360)	74.0 (362/489)	85.8 (362/422)	70.3 (300/427)

Moon W-J. et al. Benign and Malignant Thyroid Nodules: US Differentiation-Multicenter Retrospective Study. Radiology 2008

Limitaciones de la ecografía en las lesiones foliculares

PUNTO CLAVE

La ausencia de signos ecográficos de sospecha NO descarta malignidad



- A. Hiperplasia nodular
- B. Adenoma folicular
- C. Carcinoma folicular
- D. Carcinoma papilar variante folicular

TI-RADS (2009-2017)

An Ultrasonogram Reporting System for Thyroid Nodules Stratifying Cancer Risk for Clinical Management

Eleonora Horvath, Sergio Majlis, Ricardo Rossi, Carmen Franco, Juan P. Niedmann, Alex Castro, and Miguel Dominguez

Thyroid ©2015 American Thyroid Association DOI: 10.1089/thy.2015.0020

2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer

<http://dx.doi.org/10.3348/kjr.2016.17.3.370>
pISSN 1229-6929 · eISSN 2005-8330
[Korean J Radiol 2016;17\(3\):370-395](#)

ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee

Franklin N. Tessler, MD, CM^a, William D. Middleton, MD^b, Edward G. Grant, MD^c, Jenny K. Hoang, MBBS^d, Lincoln L. Berland, MD^e, Sharlene A. Teefey, MD^f, John J. Cronan, MD^g, Michael D. Beland, MD^h, Terry S. Desser, MDⁱ, Mary C. Frates, MD^g, Lynwood W. Hammers, DO^{h,i}, Ulrike M. Hamper, MD^j, Jill E. Langer, MD^k, Carl C. Reading, MD^l, Leslie M. Scoutt, MD^m, A. Thomas Stavros, MDⁿ

European Thyroid Association Guidelines for Ultrasound Malignancy Risk Stratification of Thyroid Nodules in Adults: The EU-TIRADS

Gilles Russ^a Steen J. Bonnema^b Murat Faik Erdogan^c Cosimo Durante^d
Rose Ngu^e Laurence Leenhardt^a

2017 ACR TI-RADS

ACR TI-RADS J Am Coll Radiol. 2017 May;14(5):587-595.

COMPOSITION (Choose 1)	ECHOGENICITY (Choose 1)	SHAPE (Choose 1)	MARGIN (Choose 1)	ECHOGENIC FOCI (Choose All That Apply)
Cystic or almost completely cystic: 0 points	Anechoic: 0 points	Wider-than-tall: 0 points	Smooth: 0 points	None or large comet-tail artifacts: 0 points
Spongiform: 0 points	Hyperechoic or isoechoic: 1 point	Taller-than-wide: 3 points	Ill-defined: 0 points	Macrocalcifications: 1 point
Mixed cystic and solid: 1 point	Hypoechoic: 2 points		Lobulated or irregular: 2 points	Peripheral (rim) calcifications: 2 points
Solid or almost completely solid: 2 points	Very hypoechoic: 3 points		Extra-thyroidal extension: 3 points	Punctate echogenic foci: 3 points

Add Points From All Categories to Determine TI-RADS Level



COMPOSITION	ECHOGENICITY	SHAPE	MARGIN	ECHOGENIC FOCI
<i>Spongiform</i> : Composed predominantly (>50%) of small cystic spaces. Do not add further points for other categories. <i>Mixed cystic and solid</i> : Assign points for predominant solid component. Assign 2 points if composition cannot be determined because of calcification.	<i>Anechoic</i> : Applies to cystic or almost completely cystic nodules. <i>Hyperechoic/isoechoic/hypoechoic</i> : Compared to adjacent parenchyma. <i>Very hypoechoic</i> : More hypoechoic than strap muscles. Assign 1 point if echogenicity cannot be determined.	<i>Taller-than-wide</i> : Should be assessed on a transverse image with measurements parallel to sound beam for height and perpendicular to sound beam for width. This can usually be assessed by visual inspection.	<i>Lobulated</i> : Protrusions into adjacent tissue. <i>Irregular</i> : Jagged, spiculated, or sharp angles. <i>Extrathyroidal extension</i> : Obvious invasion = malignancy. Assign 0 points if margin cannot be determined.	<i>Large comet-tail artifacts</i> : V-shaped, >1 mm, in cystic components. <i>Macrocalcifications</i> : Cause acoustic shadowing. <i>Peripheral</i> : Complete or incomplete along margin. <i>Punctate echogenic foci</i> : May have small comet-tail artifacts.

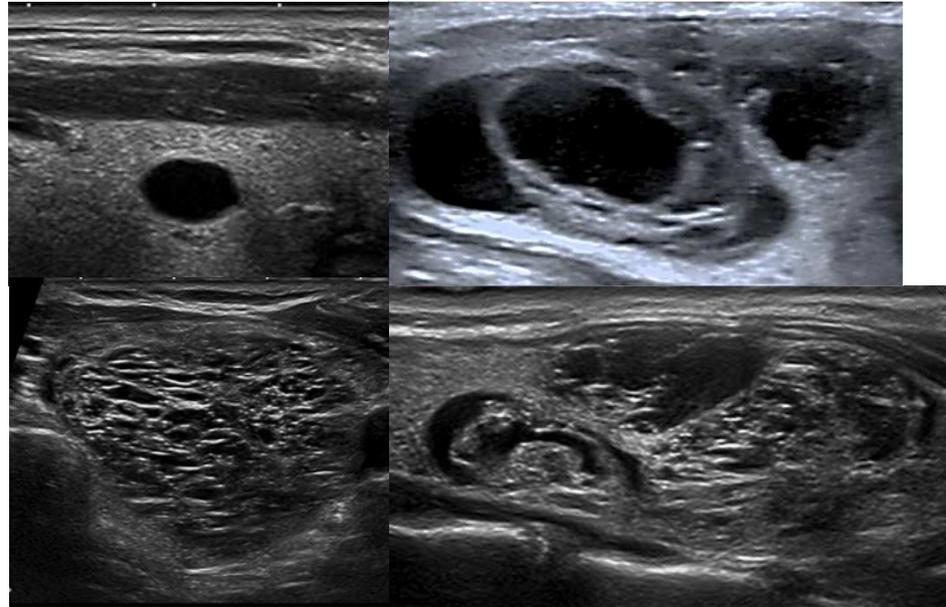
*Refer to discussion of papillary microcarcinomas for 5-9 mm TR5 nodules.

ACR TI-RADS 2017

TIRADS 1

(0 pt)

BENIGNO



NO PAAF

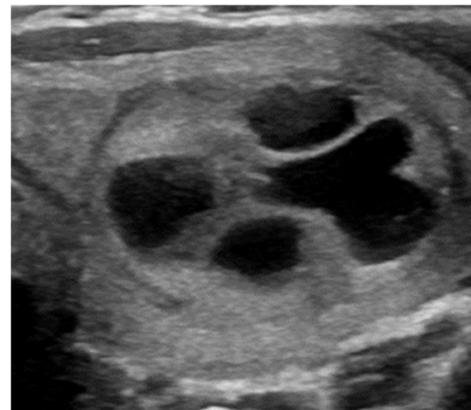
NO control

TIRADS 2

(2 pt)

**NO
SOSPECHOSO**

M: 1.5%



NO PAAF

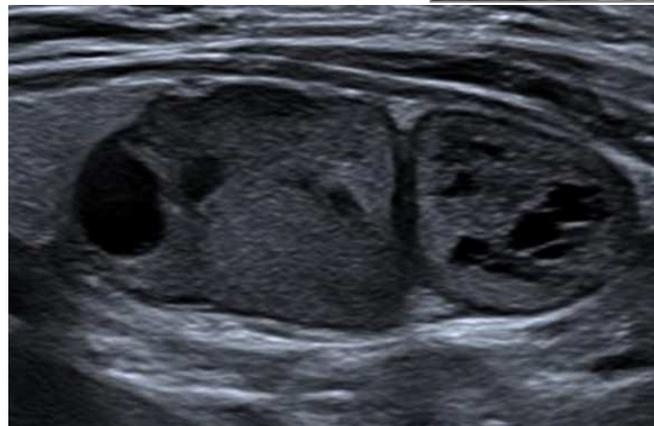
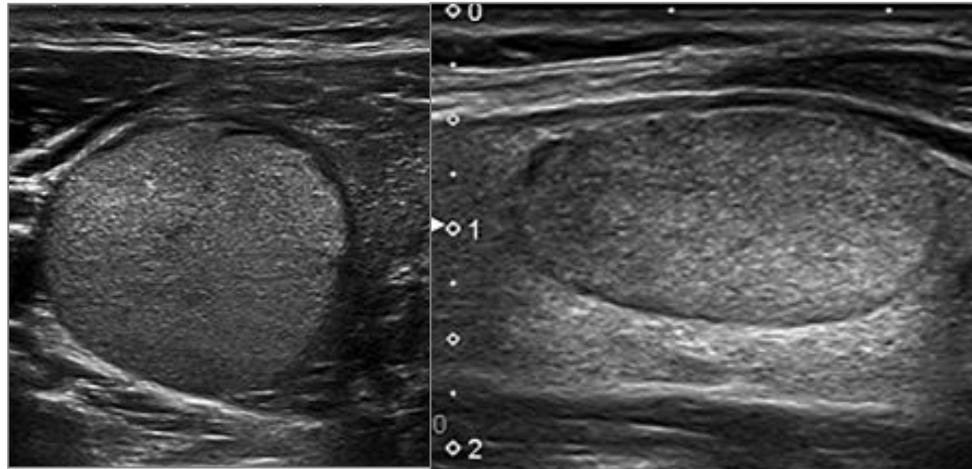
NO control

ACR TI-RADS 2017

TIRADS 3
(3 pt)

**BAJA
SOSPECHA**

M: 5%



PAAF \geq 25mm

Middleton WD, et al. Multiinstitutional Analysis of Thyroid Nodule Risk Stratification Using the American College of Radiology Thyroid Imaging Reporting and Data System. (2017) American Journal of Roentgenology. 208 (6): 1331-1341.

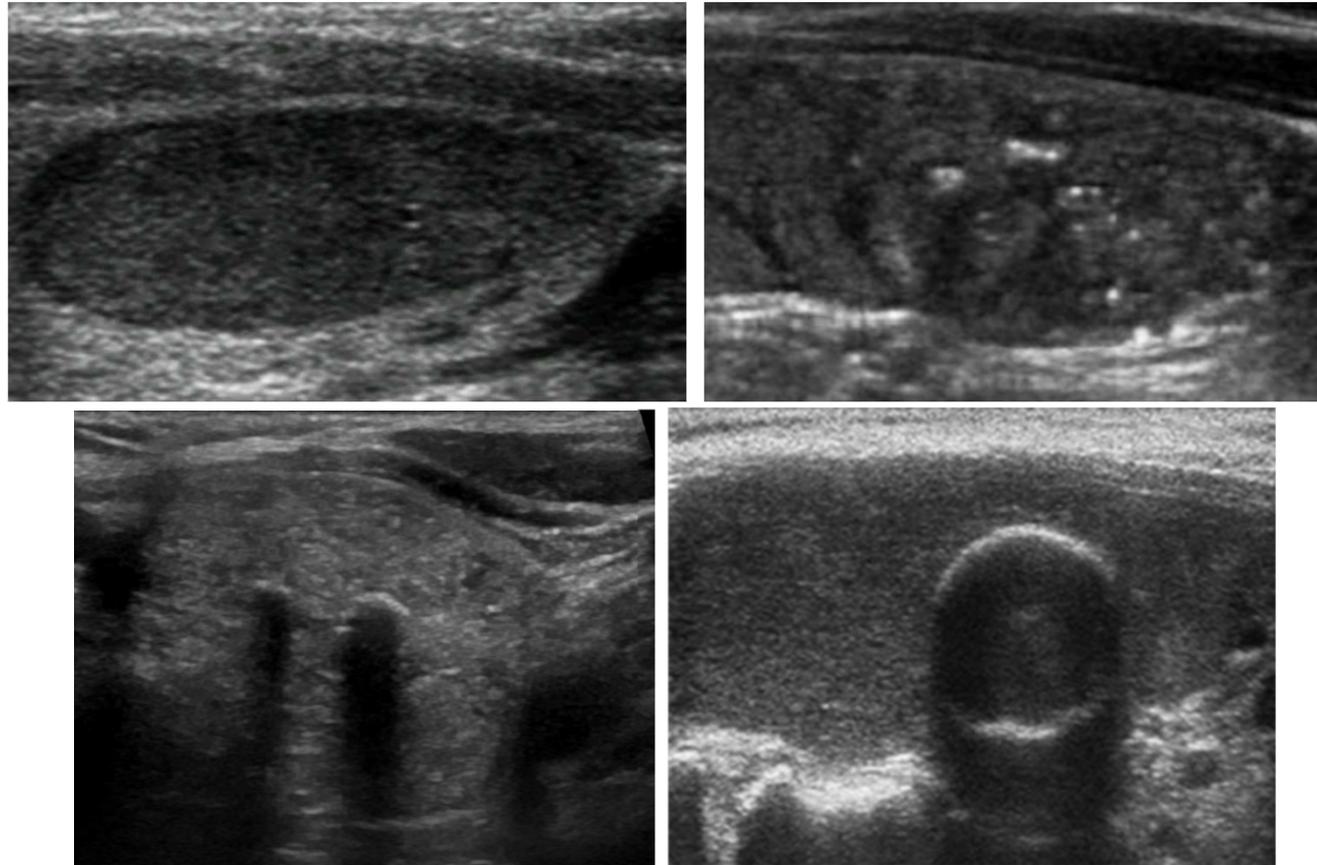
ACR TI-RADS 2017

TIRADS 4
(4-6 pt)

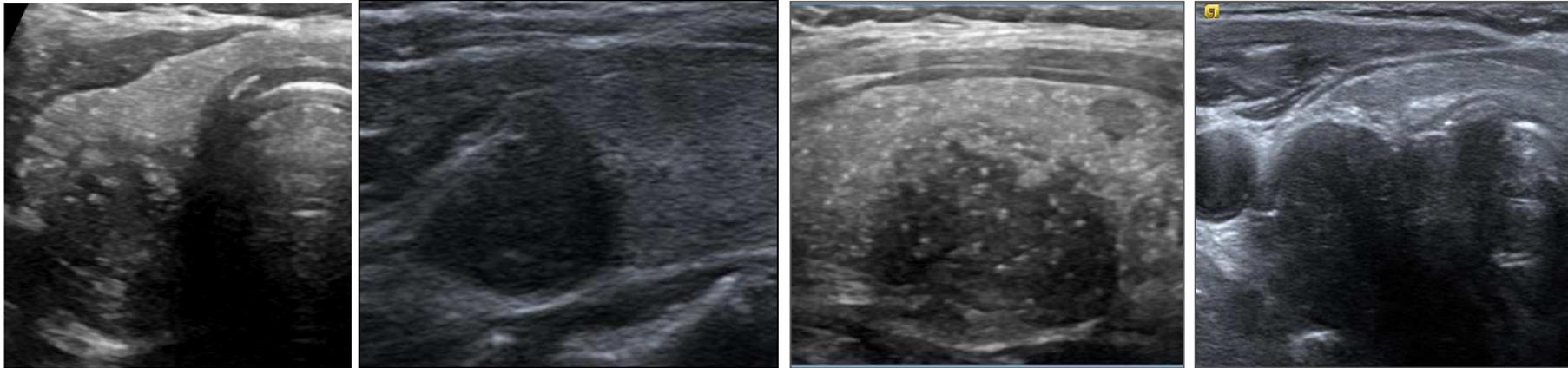
**SOSPECHA
MODERADA**

M: 9%

PAAF ≥ 15 mm



ACR TI-RADS 2017



TIRADS 5
(> 7 pt)

ALTA SOSPECHA

M: 35%

PAAF \geq 10mm

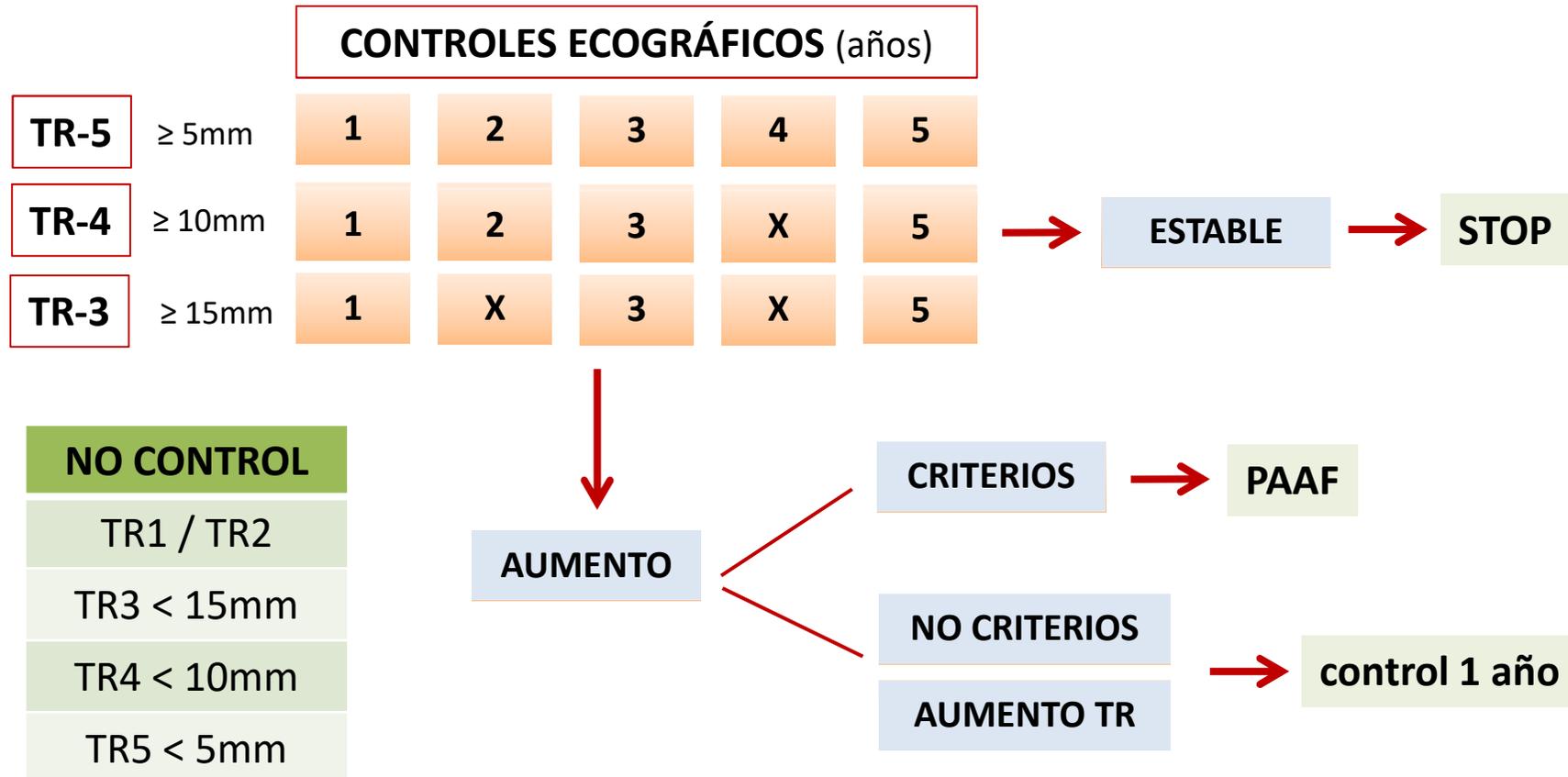
Crterios PAAF en TR5 de 5-9mm si (ATA 2015) :

1. Factores de Riesgo: RDT cervical / Sd cncer hereditario (MEN-2, Sd Cowden...)
2. Adenopatías sospechosas
3. Abombamiento de la cápsula tiroidea.



Seguimiento ecográfico nódulos no tributarios PAAF

No se recomiendan controles en periodos < 1 año



Bethesda System for Reporting Thyroid Cytopathology

The Bethesda System for Reporting Thyroid Cytopathology: Recommended Diagnostic Categories

I. **Nondiagnostic or Unsatisfactory**

- Cyst fluid only
- Virtually acellular specimen
- Other (obscuring blood, clotting artifact, etc)

II. **Benign**

- Consistent with a benign follicular nodule (includes adenomatoid nodule, colloid nodule, etc)
- Consistent with lymphocytic (Hashimoto) thyroiditis in the proper clinical context
- Consistent with granulomatous (subacute) thyroiditis
- Other

III. **Atypia of Undetermined Significance or Follicular Lesion of Undetermined Significance**

IV. **Follicular Neoplasm or Suspicious for a Follicular Neoplasm**

- Specify if Hürthle cell (oncocytic) type

V. **Suspicious for Malignancy**

- Suspicious for papillary carcinoma
- Suspicious for medullary carcinoma
- Suspicious for metastatic carcinoma
- Suspicious for lymphoma
- Other

VI. **Malignant**

- Papillary thyroid carcinoma
- Poorly differentiated carcinoma
- Medullary thyroid carcinoma
- Undifferentiated (anaplastic) carcinoma
- Squamous cell carcinoma
- Carcinoma with mixed features (specify)
- Metastatic carcinoma
- Non-Hodgkin lymphoma
- Other

Riesgo M *

I: 5-10 %

II: 0-3 %

III: 10-30%

IV: 25-40%

V: 50-75 %

VI: 97-99%

* si NIFTP = CA

Manejo post-PAAF: Bethesda

BETHESDA-I: INSUFICIENTE / NO SATISFACTORIO → REPETIR PAAF

- No es necesario esperar > 3 meses para evitar FP

BETHESDA-II: BENIGNIDAD → CONTROLES ECOGRÁFICOS (12-24 meses)

- Porcentaje de FN es muy bajo pero no inexistente (0-3%)
- Repetir PAAF si:
 - ✓ Aparición de algún SES
 - ✓ Crecimiento significativo del nódulo (>20% diámetro en al menos 2 ejes)

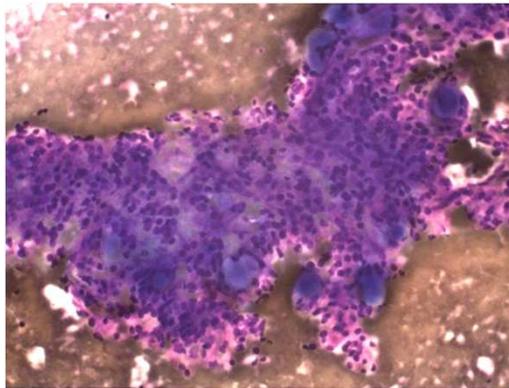
BETHESDA-V o VI: SOSPECHOSO DE MALIGNIDAD O MALIGNO → CIRUGÍA

- El tratamiento de elección es la cirugía: tiroidectomía total con linfadenectomía central y vaciamiento de los compartimentos laterales si se objetiva diseminación ganglionar en el estudio de extensión.

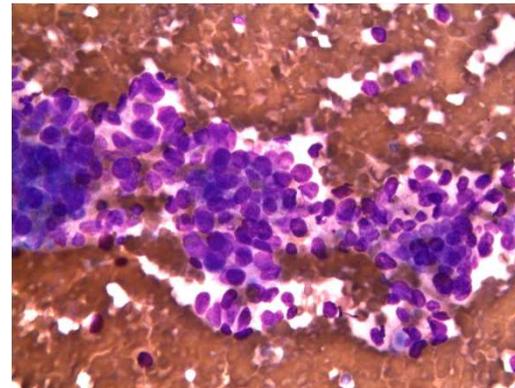
Manejo post-PAAF: Bethesda

BETHESDA-III: INDETERMINADO → Manejo variable:

1. Repetir PAAF
2. Biopsia (BAG): mejores resultados que PAAF en nódulos sólidos indeterminados
Na DG, et al. Thyroid 2012;22:468-75
3. Control ecográfico (1 año): nódulos de bajo riesgo ecográfico (TR3) y citopatológico
4. Cirugía (lobectomía):
 - ✓ Nódulos alta sospecha ecográfica malignidad
 - ✓ Diámetro > 4cm
 - ✓ Factores riesgo: RDT cervical o Hª Familiar
 - ✓ Mutación gen BRAF + : VPP > 99% para CPT (AUS)



FLUS



AUS

Cortesía de la Dra. Mª Rosa Bella.
CSPT. Sabadell

Manejo post-PAAF: Bethesda

- **Mutación gen BRAF (V600E):**

- Bastante frecuente y casi exclusiva del CPT
- Utilidad en nódulos B-III (AUS): resultado positivo = malignidad (VPP>99%) = cirugía
- No útil en lesiones foliculares; incluido el CPT variante folicular

Tavares C. et al. Genetic predictors of thyroid cancer outcome. *European Journal of Endocrinology* (2016) 174, R117–R126

Prevalence of BRAF mutations in thyroid neoplasms: BRAF mutations are unique to papillary thyroid cancers

	BRAF ^{V599E}
PTC	28/78 (35.8%)
Follicular adenoma	0/14
Follicular carcinoma	0/10
Hürthle cell adenoma	0/12
Hürthle cell carcinoma	0/10

Edna T. Kimura et al. *CANCER RESEARCH* 63, 1454–1457, April 1, 2003.

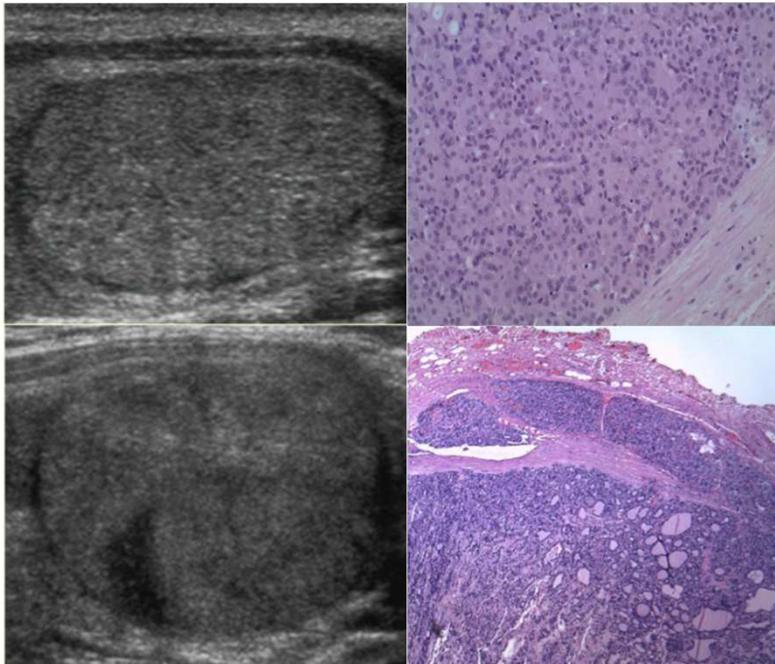
	Benign (%)	Cancer (%)
Total	168 (65)	90 (35)
BRAF mutation		
Positive	0 (0)	8 (8.8)
Negative	168 (100)	82 (91.2)
NRAS mutation		
Positive	9 (5.4)	22 (24.4)
Negative	159 (94.6)	68 (75.6)
Hypoechogenicity		
Positive	109 (64.8)	53 (58.8)
Negative	59 (35.1)	37 (41.1)
Microcalcifications		
Present	17 (10.1)	40 (44.4)
Absent	151 (89.9)	50 (55.6)
Irregular margin		
Present	2 (1.2)	22 (24.4)
Absent	166 (98.8)	68 (75.6)
Taller than wide		
Present	9 (5.3)	24 (26.6)
Absent	159 (94.7)	66 (73.4)

De Napoli, L. et al. *Thyroid* vol 26, Number 3, 2016

Manejo post-PAAF: Bethesda

BETHESDA-IV: NEOPLASIA FOLICULAR o SOSPECHOSO DE NF → CIRUGÍA

- Grupo de riesgo intermedio de malignidad (25-40%)
- El diagnóstico citológico no discrimina entre neoplasia folicular benigna o maligna.
- Cirugía de entrada. Únicamente el estudio de la pieza quirúrgica, y en especial de la invasión capsular y/o vascular permite diferenciar entre adenoma y carcinoma.
- Tiroidectomía total o lobectomía? Consensuar en comité y con el paciente.



PUNTO CLAVE

La PAAF y la BAG no discriminan entre neoplasia folicular benigna o maligna.

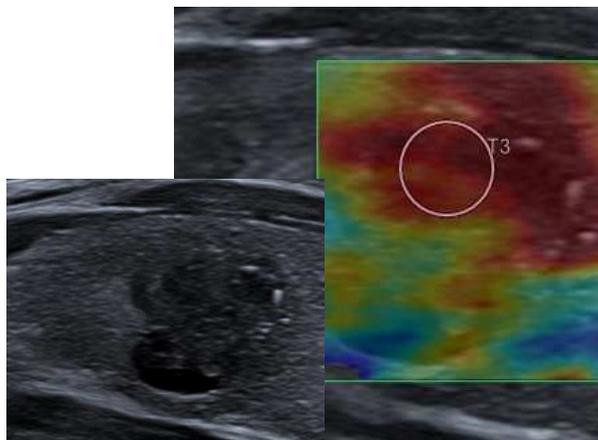
Adenoma Folicular

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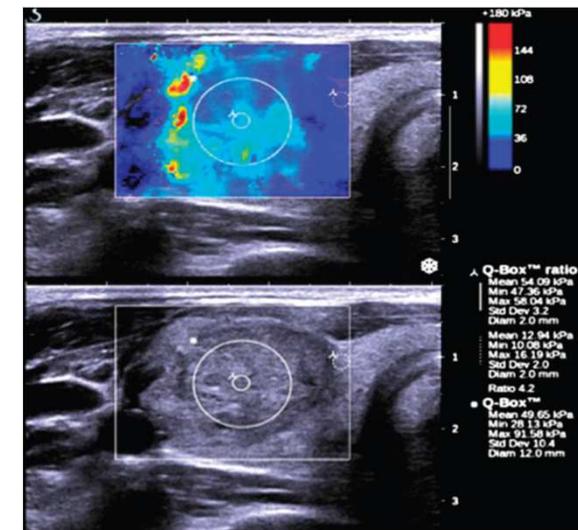
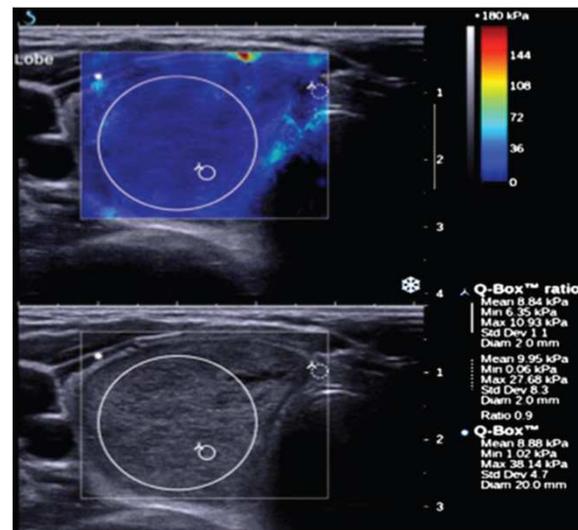
Carcinoma Folicular

Papel de la Elastografía (SWE)

- Shear-Wave Elastography (SWE): valores cuantitativos de la dureza del tejido nodular o índice de Elasticidad (IE).
- Diversos estudios han demostrado valores de IE significativamente mayores en nódulos malignos. Valores umbrales IE = 62-66 kPa.
Veyrieres JB, et al. Eur J Radiol. 2012 Dec;81(12):3965-72. / Kim H, et al. Eur Radiol. 2013 Sep;23(9):2532-7.
- Samir AE. et al han propuesto un valor umbral de IE (22.3 kPa) como predictor de malignidad en lesiones foliculares indeterminadas. S=82% y E=88%



IE = 82.6 kPa (CPT)

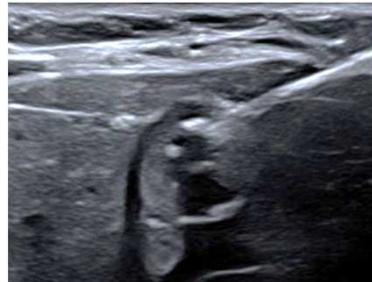
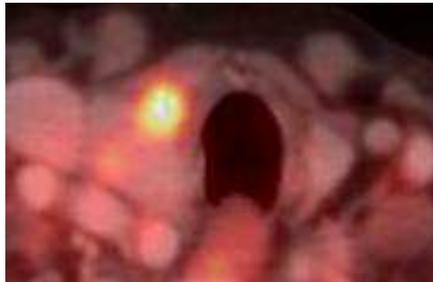


Samir AE, Dhyani M, Anvari A, et al. Radiology. 2015 Nov;277(2):565-73.

Papel de los estudios moleculares

- **Mutación gen TERTp (C228T):**

- Específica de malignidad (VPP > 99%). No exclusiva del CPT.
- Baja frecuencia (5-10% lesiones malignas)
- Utilidad en sospecha de neoplasia folicular (B-IV):
 - HUPT (retrospectivo): 25% de los B-IV que fueron malignos
 - Útil en la decisión quirúrgica (lobectomía vs tiroidectomía total)
- Indicativa de peor pronóstico: comportamiento más agresivo (invasión extratiroidea, M1, recurrencia, degeneración a anaplásico, poca respuesta a radioyodo)



Bethesda IV

TERTp +

Tiroidectomía total:
CFT invasor

Manejo del incidentaloma tiroideo en PET-FDG

Prevalencia incidentaloma tiroideo en PET-FDG= **5.6%**

de Leijer JF, et al. Front Endocrinol (Lausanne). 2021

- Mayor riesgo de malignidad, aunque la mayoría no son malignos.
- Riesgo M = **32-39%** (80% son CPT)
- SUV max > 6 (p<0,001)



Eco dirigida en todas las captaciones focales PET-FDG



TSH N o ↑



PAAF si nódulo $\geq 10\text{mm}$ (ATA 2015)

Eco dirigida en todas las captaciones focales gammagrafía-Tc (MIBI)



PAAF según criterios ecográficos TIRADS

