THE USE OF CONTRAST ENHANCED ULTRASOUND (CEUS) FOR THYROID NODULE CLASSIFICATION

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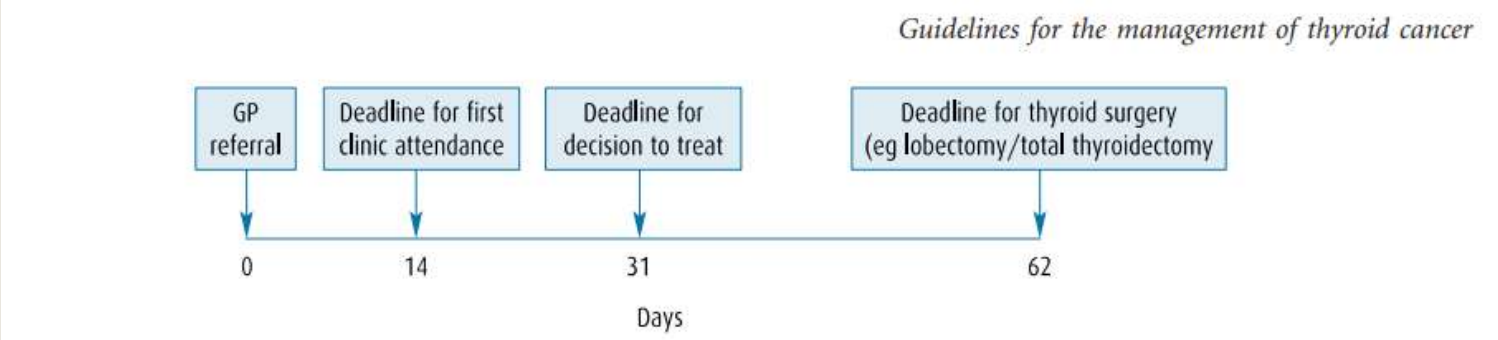
BMUS 2024

AGENDA

- Current gold standard for thyroid nodule classification
- Ultrasonographic diagnosis
- Introduction to CEUS for thyroid nodules
- Literature review
- Alternative contemporary advance
- Summary

GOLD STANDARD FOR THYROID NODULE CLASSIFICATION

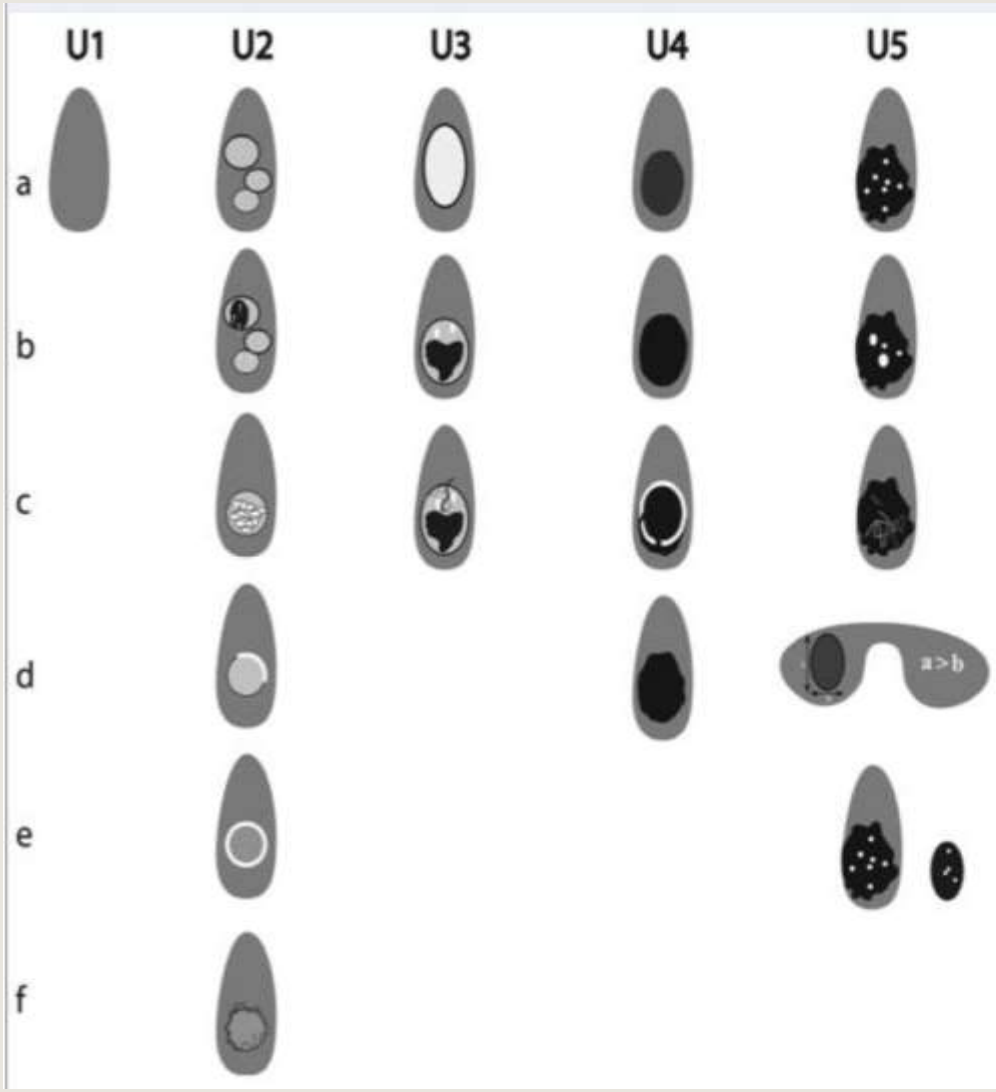


- Ultrasound scan +/-FNA
- Rapid On-Site Evaluation (ROSE) or Remote ROSE if available

(BMJ best practice, 2023; BMUS, 2023; BTA Perros et al., 2014; NICE, 2020; NICE, 2023; Martyn and Wheeldon, 2024)

(Martyn and Wheeldon, 2024)

BTA U GRADING (BTA., 2014)…



U1. Normal.

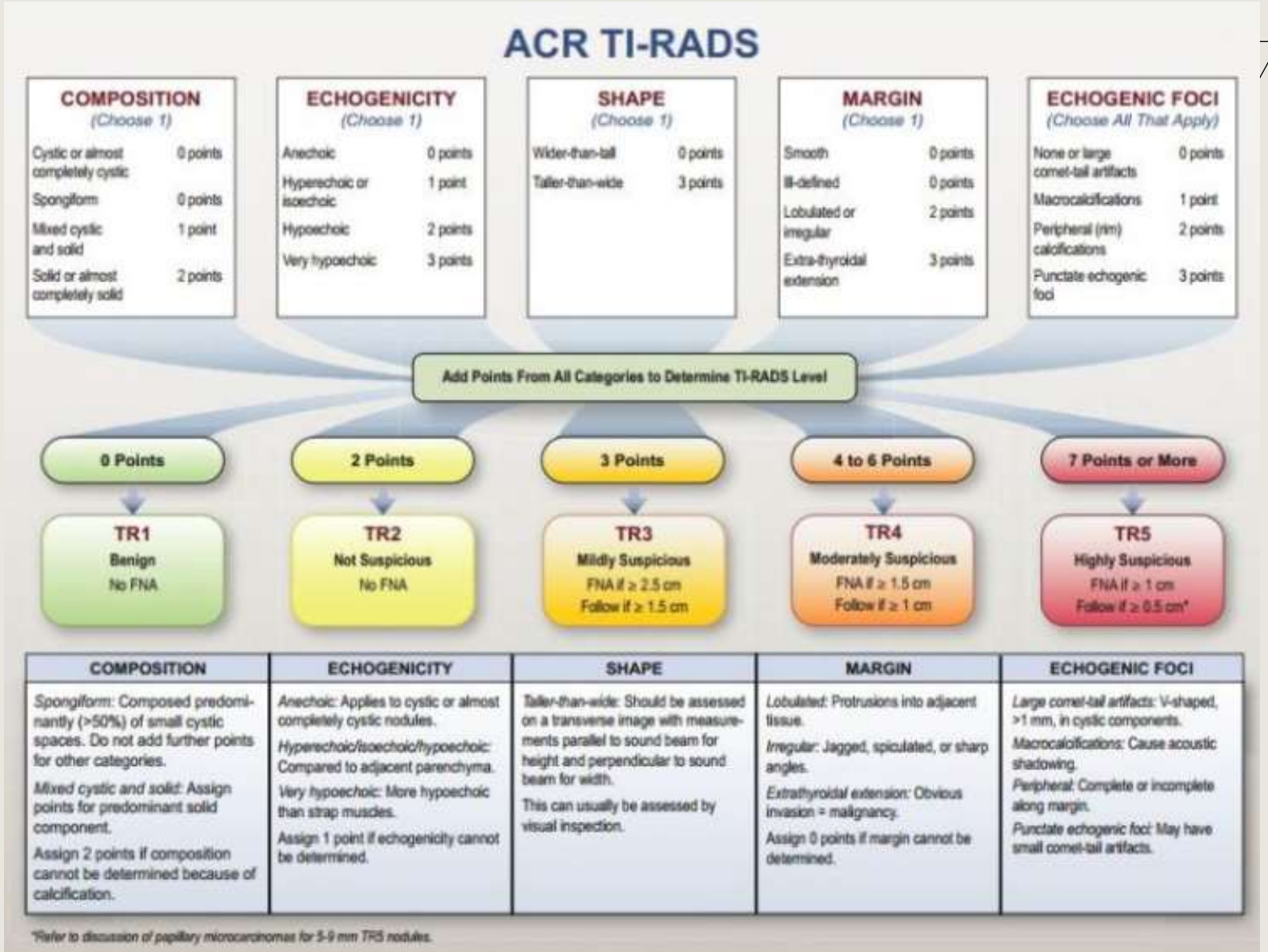
U2. Benign:
(a) halo, iso-echoic / mildly hyper-echoic
(b) cystic change +/- ring down sign (colloid)
(c) micro- cystic / spongiform
(d & e) peripheral egg shell calcification
(f) peripheral vascularity.

U3. Indeterminate/Equivocal:
(a) homogenous, hyper-echoic (markedly), solid, halo (follicular lesion).
(b) ? hypo-echoic, equivocal echogenic foci, cystic change
(c) mixed/central vascularity.

U4. Suspicious:
(a) solid, hypo-echoic (cf thyroid)
(b) solid, very hypo-echoic (cf strap muscle)
(c) disrupted peripheral calcification, hypo-echoic
(d) lobulated outline

U5. Malignant
(a) solid, hypo-echoic, lobulated / irregular outline, micro-calcification. (? Papillary carcinoma)
(b) solid, hypo-echoic, lobulated/irregular outline, globular calcification (? Medullary carcinoma)
(c) intra-nodular vascularity
(d) shape (taller >wide) (AP>TR)
(e) characteristic associated lymphadenopathy

TI-RADS (ACR TESSLER ET AL., 2017)



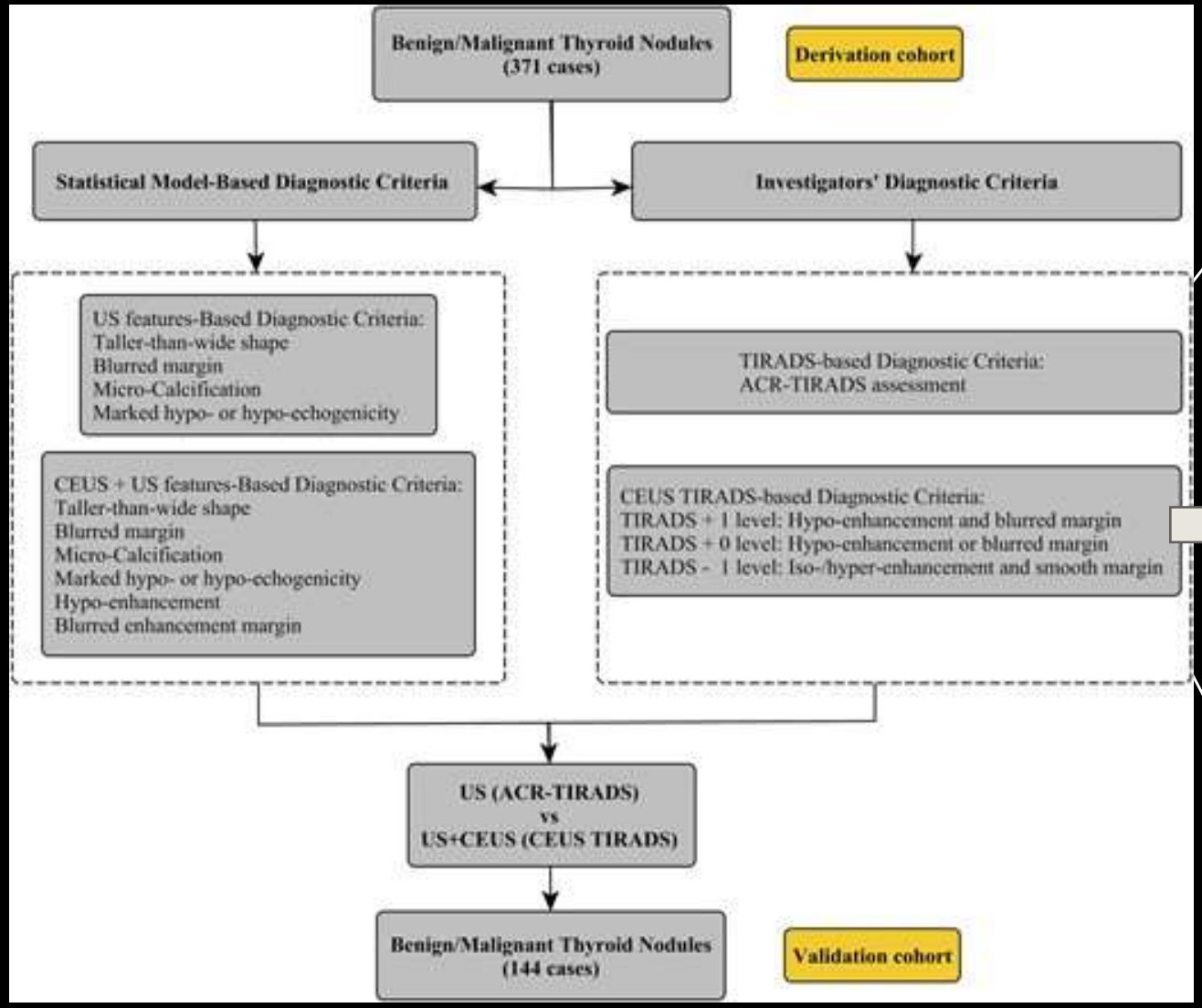
CONTRAST ENHANCED ULTRASOUND

- Safer than CT and MRI contrast as the microbubbles are quickly breathed out with no effect on organ performance and no radiation involved
- Sulphur hexafluoride (microbubbles) injected into a vein
- The microbubbles reflect the sound waves more clearly as they course through blood stream
- Useful information found in how quickly an area of interest perfuses and the pattern of perfusion
- Current main uses are for liver and kidneys in the UK
- Recent studies have successfully utilised for thyroid nodules

(RADZINA ET AL., 2021; EMEDZ, 2024; BMUS, 2023)

(EMEDZ, 2024)

EXAMPLE CEUS SCORING SYSTEM (LI ET AL, 2023)



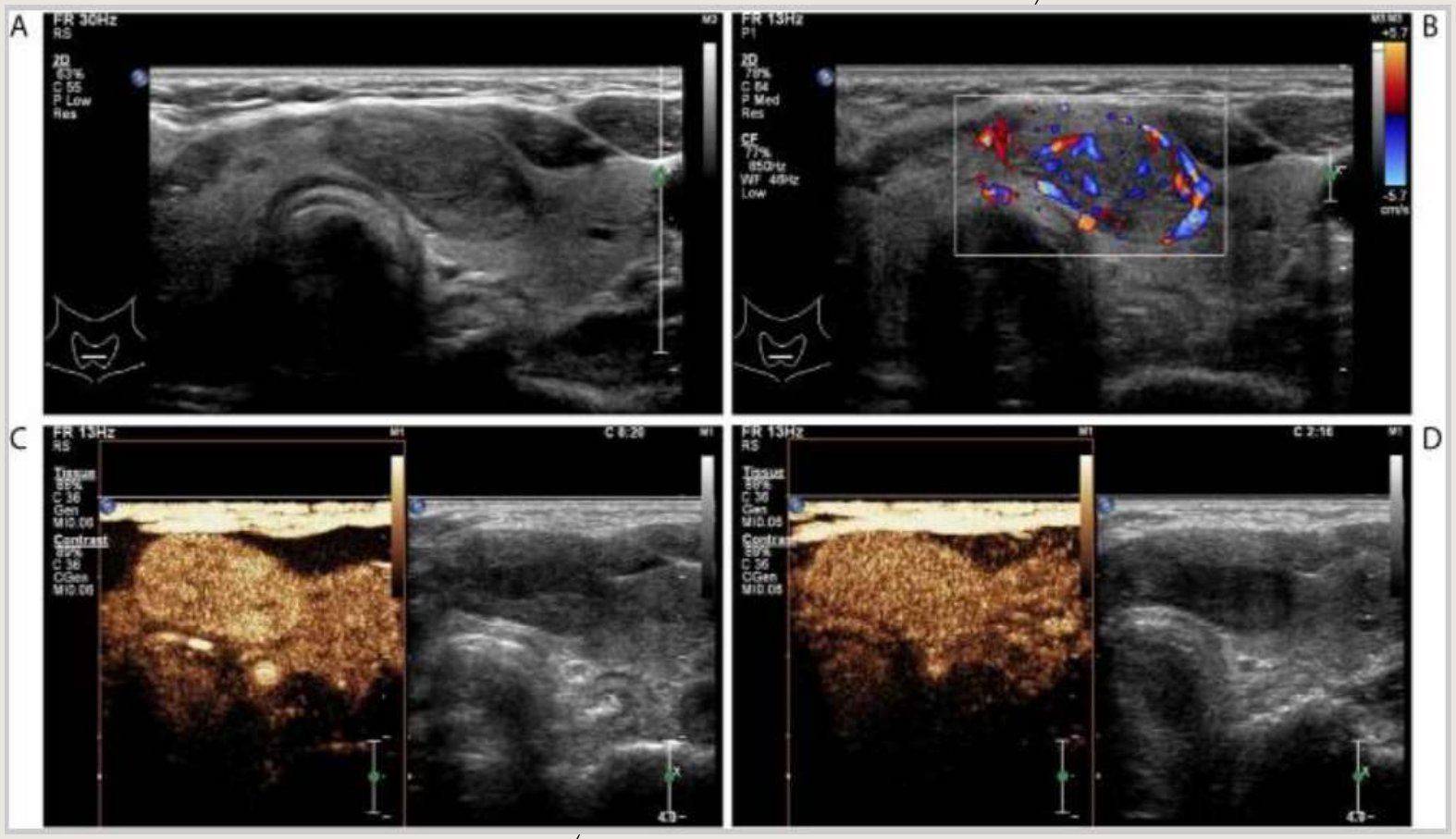
CEUS TIRADS	The CEUS diagnostic criteria
ACR TIRADS + 1 level	Hypo-enhancement and blurred enhanced margin
ACR TIRADS + 0 level	Hypo-enhancement or blurred enhanced margin
ACR TIRADS − 1 level	Iso-/hyper-enhancement and smooth enhanced margin

ULTRASOUND IMAGES OF CEUS FOR A THYROID NODULE - EXAMPLE CASE (WANG ET AL, 2021)

- Hypoechoic nodule
- Wider than tall
- Internal and peripheral vascularity

U-grading = 3

TI-RADS = 4

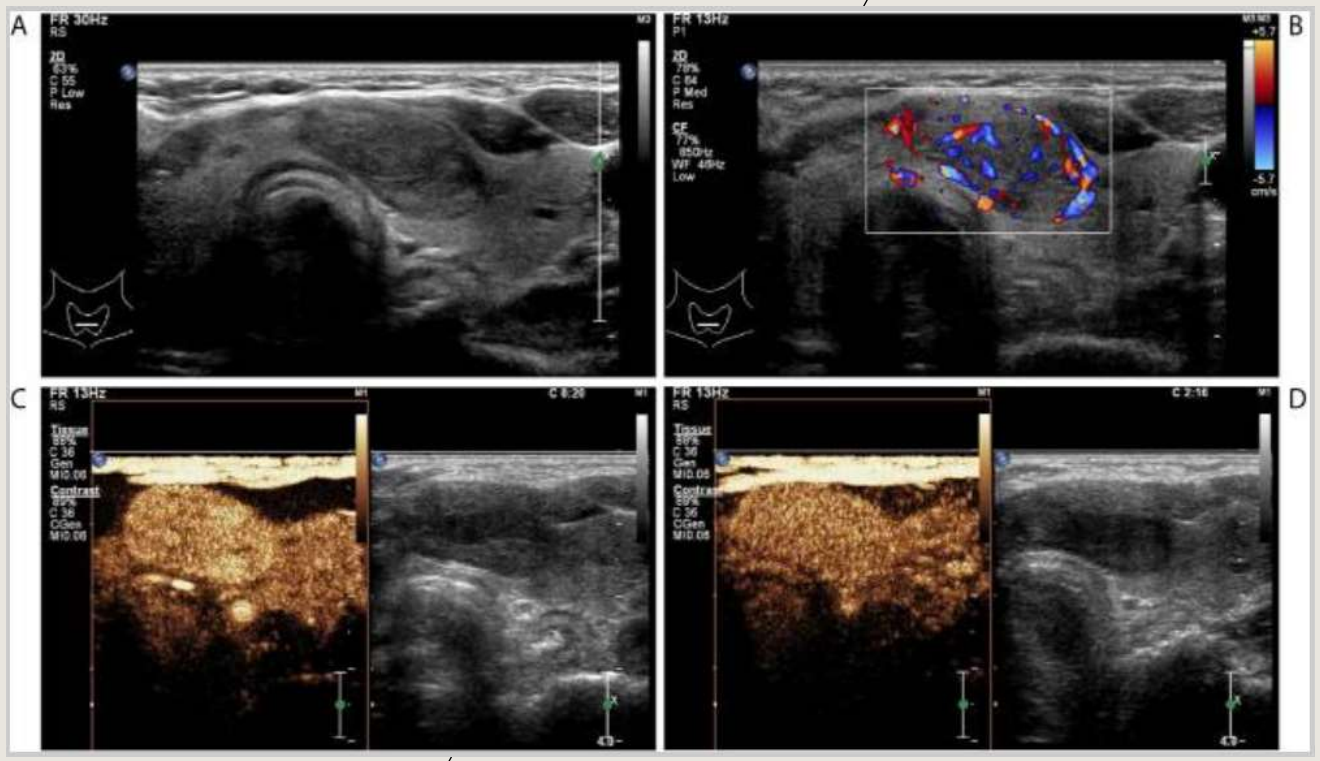


ULTRASOUND IMAGES OF CEUS FOR A THYROID NODULE - EXAMPLE CASE (WANG ET AL, 2021)

CEUS shows late wash-out, signifying benignity

CEUS score of - 1 (hyper enhancement and smooth enhanced margin)

Diagnosis = **Follicular adenoma**



LITERATURE SELECTION PROCESS

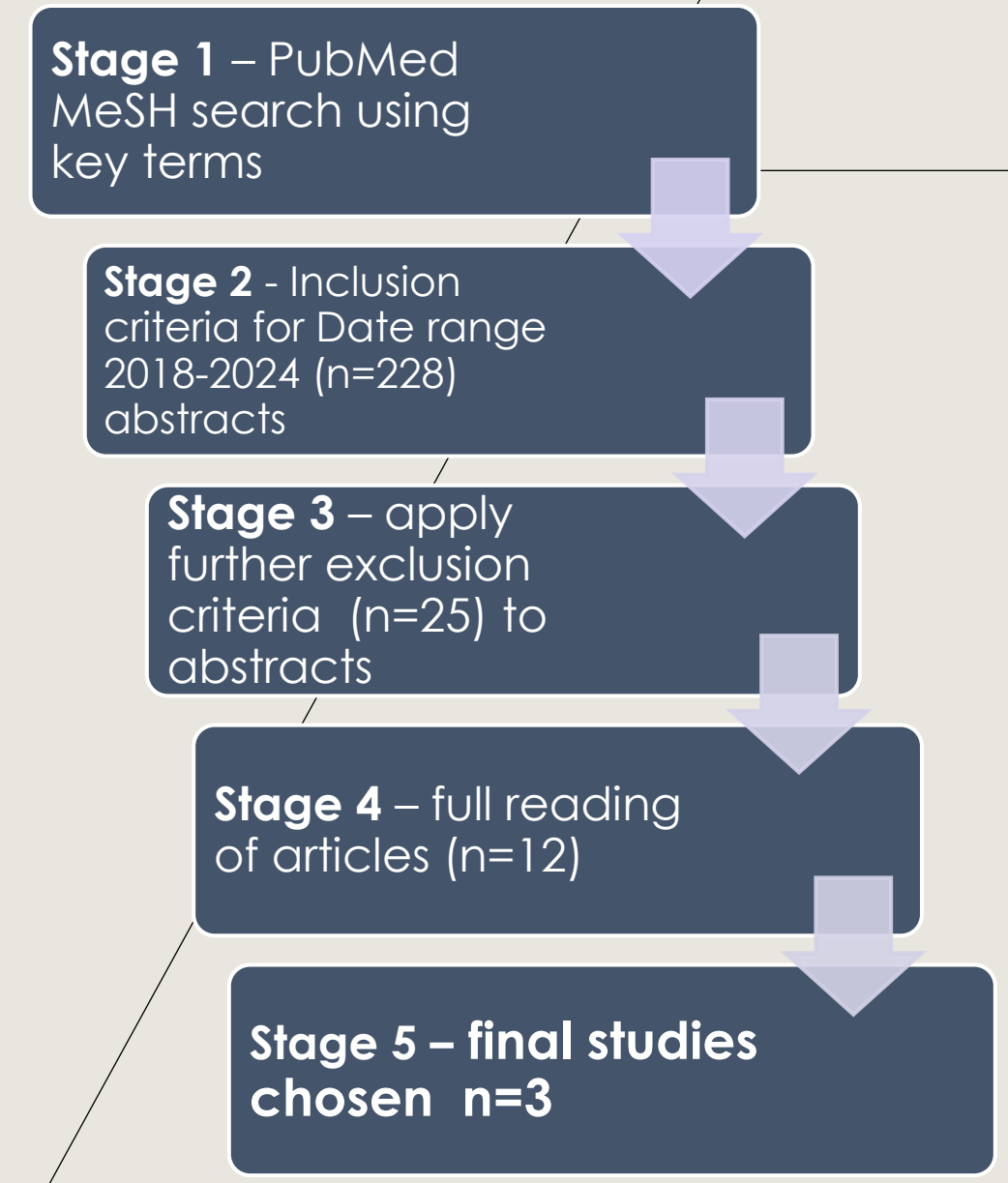
MeSH search with Medline and PubMed

Key terms: “CEUS, Contrast enhanced ultrasound, thyroid, ultrasound, nodules”

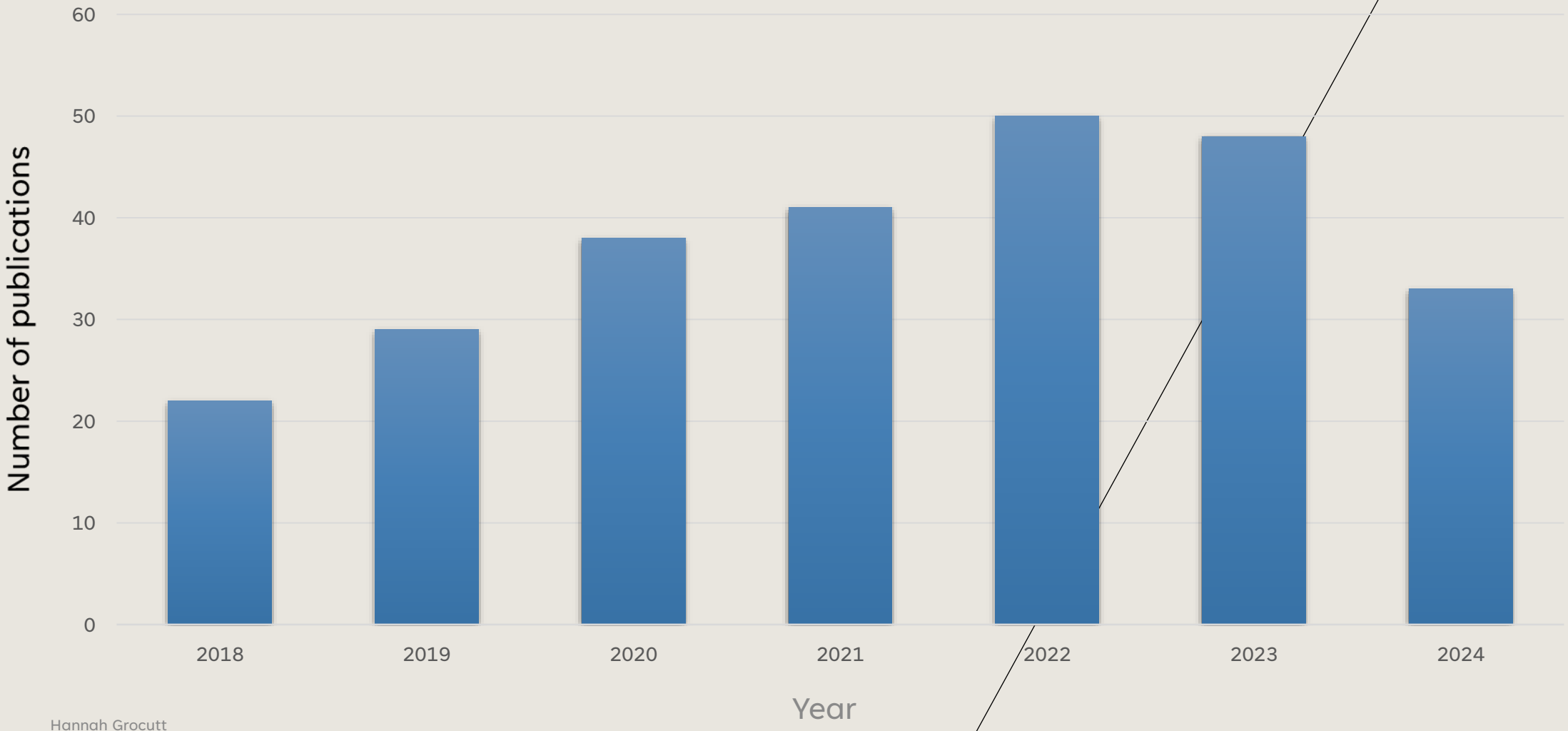
LITERATURE SEARCH PROCESS
(AVEYARD, 2023)

Exclusion criteria applied in stage 3 and 4

- Meta analysis study
- Review based studies
- Sample size of < 200
- Specific nodules (e.g. mummified or isthmus)
- Studies utilising multiple imaging modalities
- CEUS for non-thyroid or non-nodular purposes



NUMBER OF PUBLICATIONS PER YEAR SINCE 2018, ON CEUS FOR THYROID (PUBMED, 2024)



THE LITERATURE...

LI ET AL, 2023

Contrast Enhancement Ultrasound Improves Diagnostic Accuracy for Thyroid Nodules: A Prospective Multicentre Study

RUAN ET AL, 2022

A Practical CEUS Thyroid Reporting System for Thyroid Nodules

ZHANG ET AL, 2018

The Value of Peripheral Enhancement Pattern for Diagnosing Thyroid Cancer Using Contrast-Enhanced Ultrasound

LITERATURE REVIEW

Paper & year	No of Authors	Affiliations and place of research	Cohort size	Scoring system	Type of study	Diagnostic accuracy CEUS	Diagnostic accuracy US alone	Sens/ spec	Unnecessary biopsy rate	Cases with diagnostic mismatch between CEUS and US
Li et al, 2023	15 (radiologists with more than 10 years US experience)	9 medical centres/ hospitals in China	515	TI-RADS and CEUS TI-RADS	Prospective double blinded Qualitative	90%	80%	NA	42%	17 cases incorrectly identified under ultrasound (3 false positives and 14 false negatives) All were correctly categorised under Contrast enhanced ultrasound.
Ruan et al, 2022	12 (11 radiologists, 1 head and neck surgeon)	3 university hospitals in China	756	TI-RADS and CEUS TI-RADS	Retrospective blinded Qualitative	95%	87%	NA	34% n=82	Not known
Zhang et al, 2018	6 (all radiologists)	1 hospital in China	240	TI-RADS	Prospective Double blinded Qualitative	96%	90%	97.6%/ 98.7%	38%	25 nodules 23 nodules (92%) misdiagnosed as malignant by conventional US which were diagnosed correctly by CEUS

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CONCLUSION

- Each study found higher accuracy for diagnosis of malignant nodules with CEUS than with ultrasound alone
- Useful for categorising more urgent referrals
- Reduce need for unnecessary FNA
- Useful for follow up after treatment
- CEUS is more time consuming and more expensive than conventional US
- Standardisation through further research is required
- This review is not generalisable to UK due to lack of studies

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This presentation underwent an accessibility assessment and no concerns were found