

IOTA Terminology, Simple Descriptors and Simple Rules

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Ovarian pathology

- Classification system for ovarian pathology
- Standardisation of terminology – IOTA
- IOTA Simple Descriptors (pattern recognition)
- Prediction of malignancy – IOTA Simple Rules
- Worked examples
- Quiz

Ovarian cysts and tumours

Normal
ovary

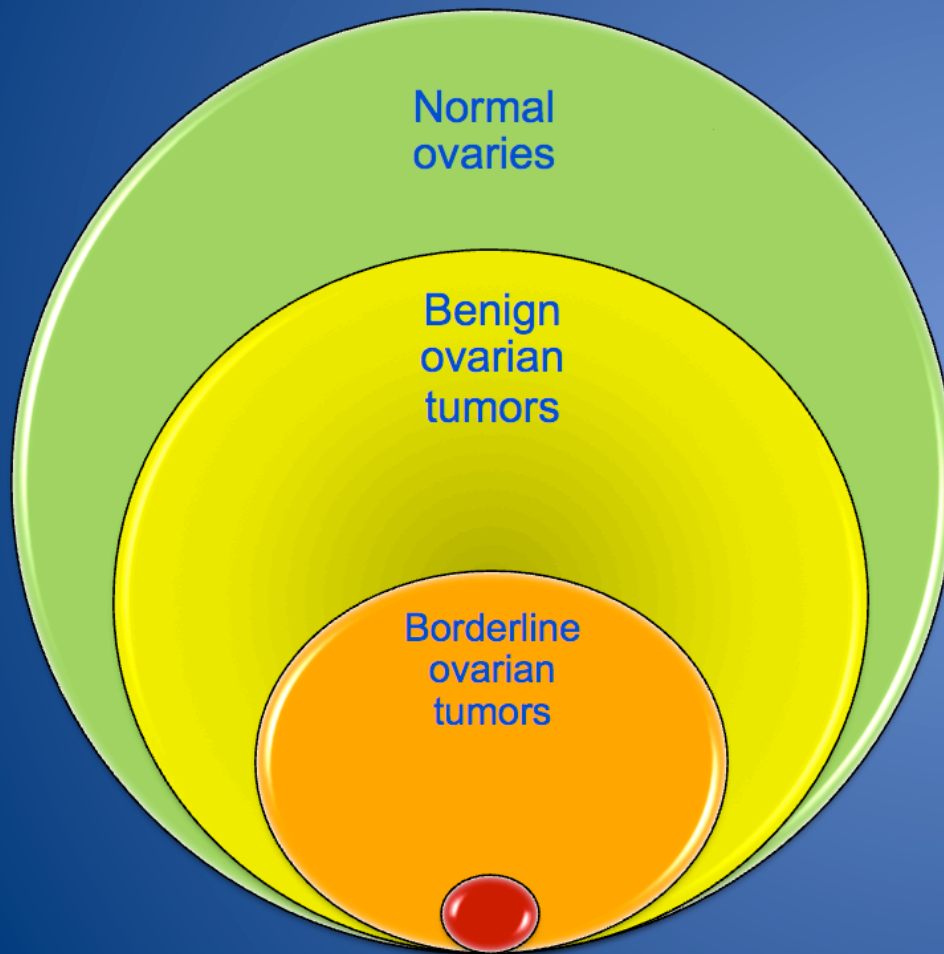
Functional
cyst

Benign
tumor

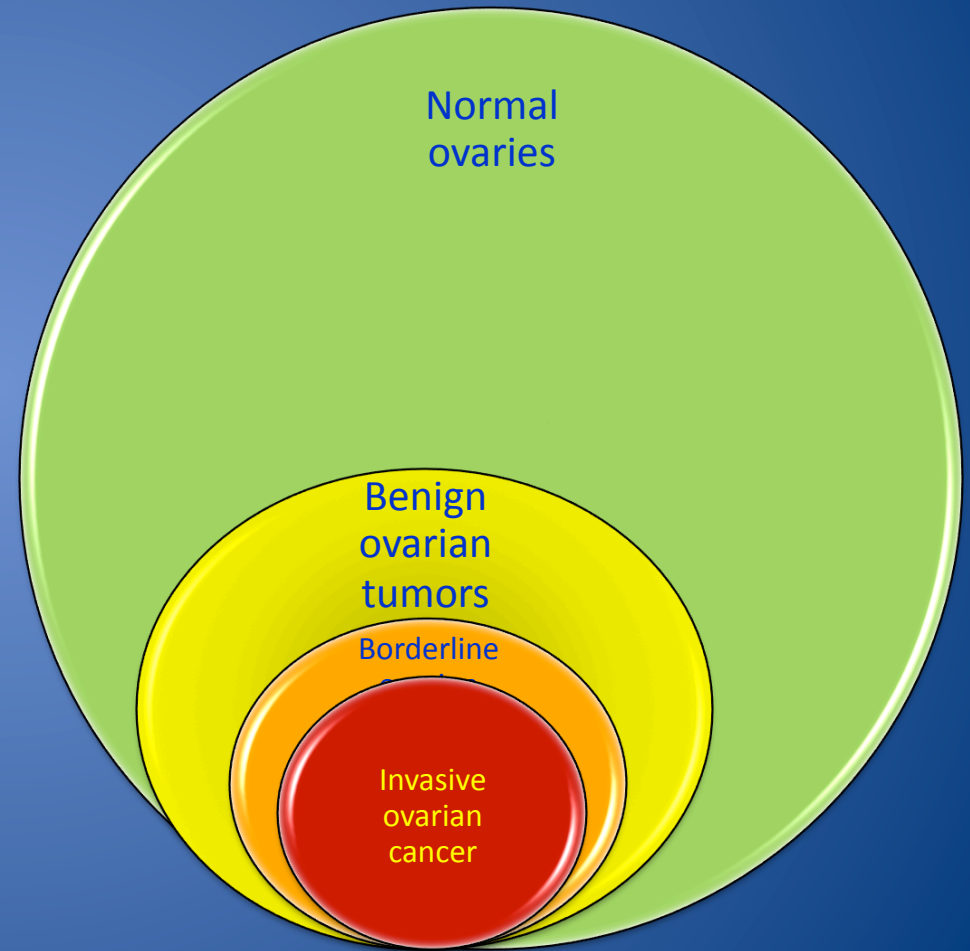
Borderline
tumor

Invasive
tumor

Premenopausal vs postmenopausal women



Invasive ovarian cancer

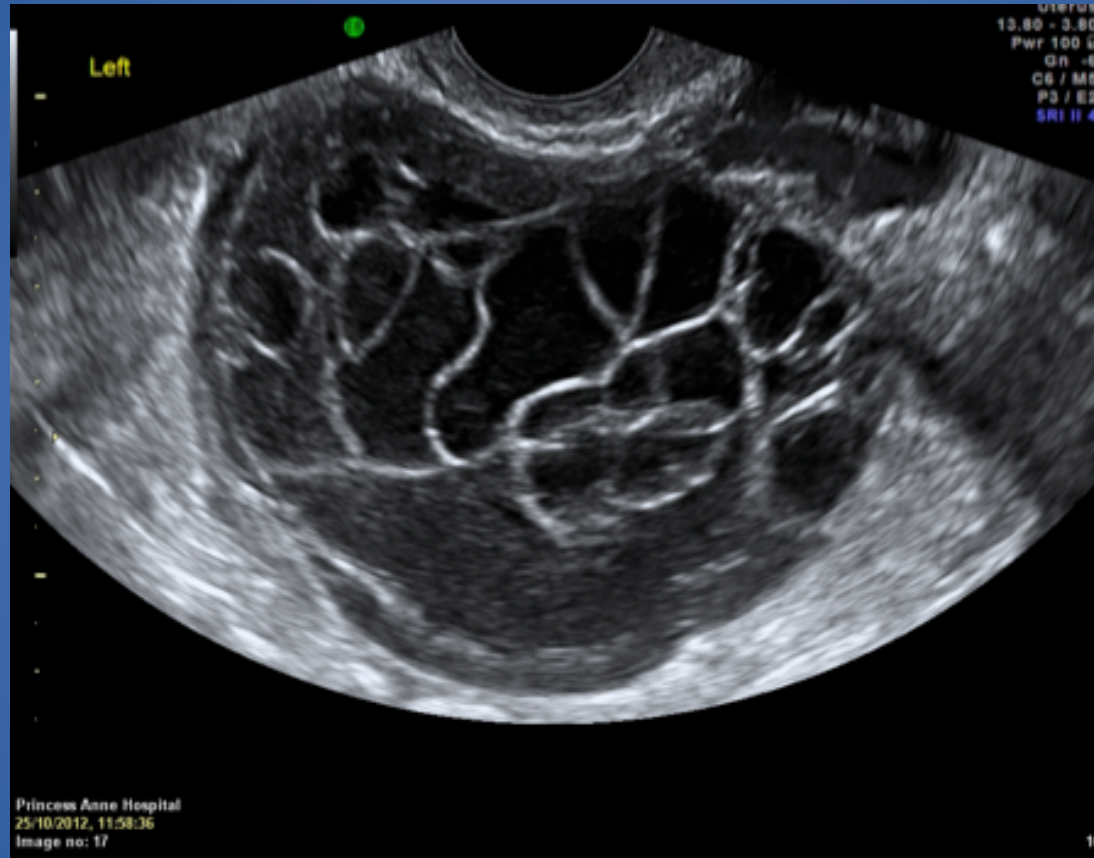


IOTA

The report really matters

- Is it benign or malignant?
- Simple cyst
- Complex cyst
- Can we do better?

How to report this abnormality?



By the end of this presentation you will be able to report this!

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Classification system for adnexal masses

- Benign ovarian
- Benign non-ovarian
- Primary malignant ovarian
- Secondary malignant ovarian

Classification system for adnexal masses

BENIGN OVARIAN:

- Polycystic ovaries
- Functional cysts
- Endometriomas
- Serous cystadenoma
- Mucinous cystadenoma
- Mature teratoma
- Fibroma (rare, can cause Meig's syndrome: ascites and pleural effusion)
- Thecoma (very rare, can secrete oestrogen and progesterone)

Classification system for adnexal masses

BENIGN NON-OVARIAN:

- Paratubal cyst
- Hydrosalpinges
- Tubo-ovarian abscess
- Peritoneal pseudocysts
- Appendiceal abscess
- Diverticular abscess
- Pelvic kidney

Classification system for adnexal masses

PRIMARY MALIGNANT OVARIAN

- Epithelial carcinoma
 - Borderline
 - Serous cystadenocarcinoma (commonest ovarian cancer, 50% malignancies)
 - Mucinous cystadenocarcinoma (10% ovarian malignancies)
 - Borderline variant is pseudomyxoma peritonei – exclude appx primary
 - Endometrioid carcinoma (25% ovarian malignancies)(associated with endometrial ca in 20%)
 - Clear cell carcinoma (<10% ovarian malignancies)
- Germ cell tumour
 - Malignant teratoma
 - Dysgerminoma
- Sex-cord tumour
 - Granulosa cell tumour (secretes oestrogen)

Classification system for adnexal masses

SECONDARY MALIGNANT OVARIAN

- 10% of ovarian malignancy

Predominantly:

- breast
- gastrointestinal carcinoma (Krukenberg tumour)

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Standardisation of terminology

- IOTA group
- Terms and definitions of adnexal pathology
- TRANSVAGINAL ULTRASOUND

Ultrasound Obstet Gynecol 2000; 16: 500–505.

Terms, definitions and measurements to describe the sonographic features of adnexal tumors: a consensus opinion from the International Ovarian Tumor Analysis (IOTA) group

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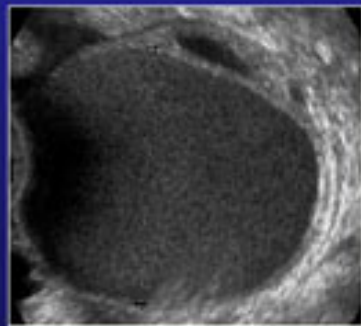
KEYWORDS: Ultrasonography, Color Doppler imaging, Ovary, Definitions, Standardization

IOTA definitions

- Unilocular, unilocular-solid, multilocular, multilocular-solid or solid
- Cyst contents – anechoic, low level, ground glass, haemorrhagic or mixed
- Solid material or papillary structures or wall irregularity (presence and size)
- Vascularity
- Shadows
- Ascites

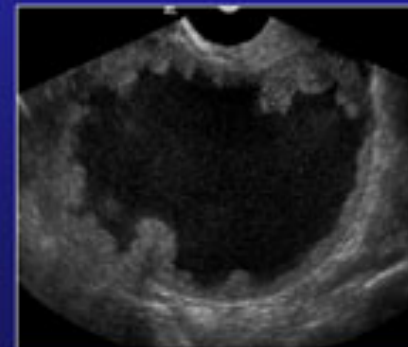
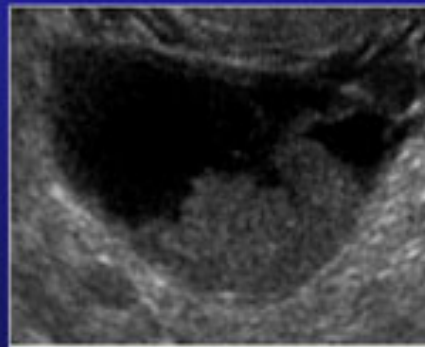
Unilocular

UNILOCULAR CYST



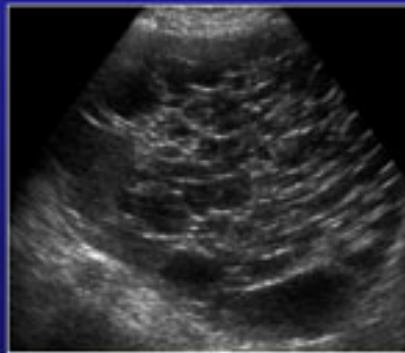
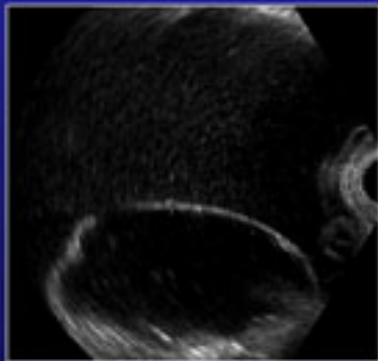
Unilocular-solid

UNILOCULAR-SOLID CYST



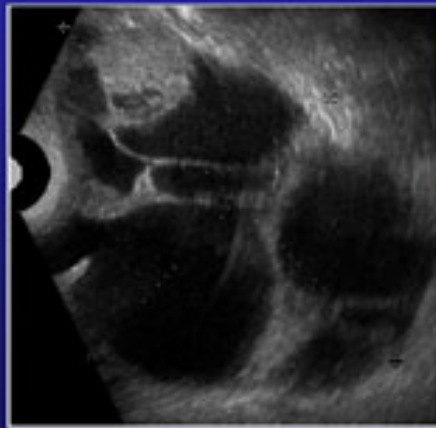
Multilocular

MULTILOCULAR CYST



Multilocular-solid

MULTILOCLULAR SOLID CYST

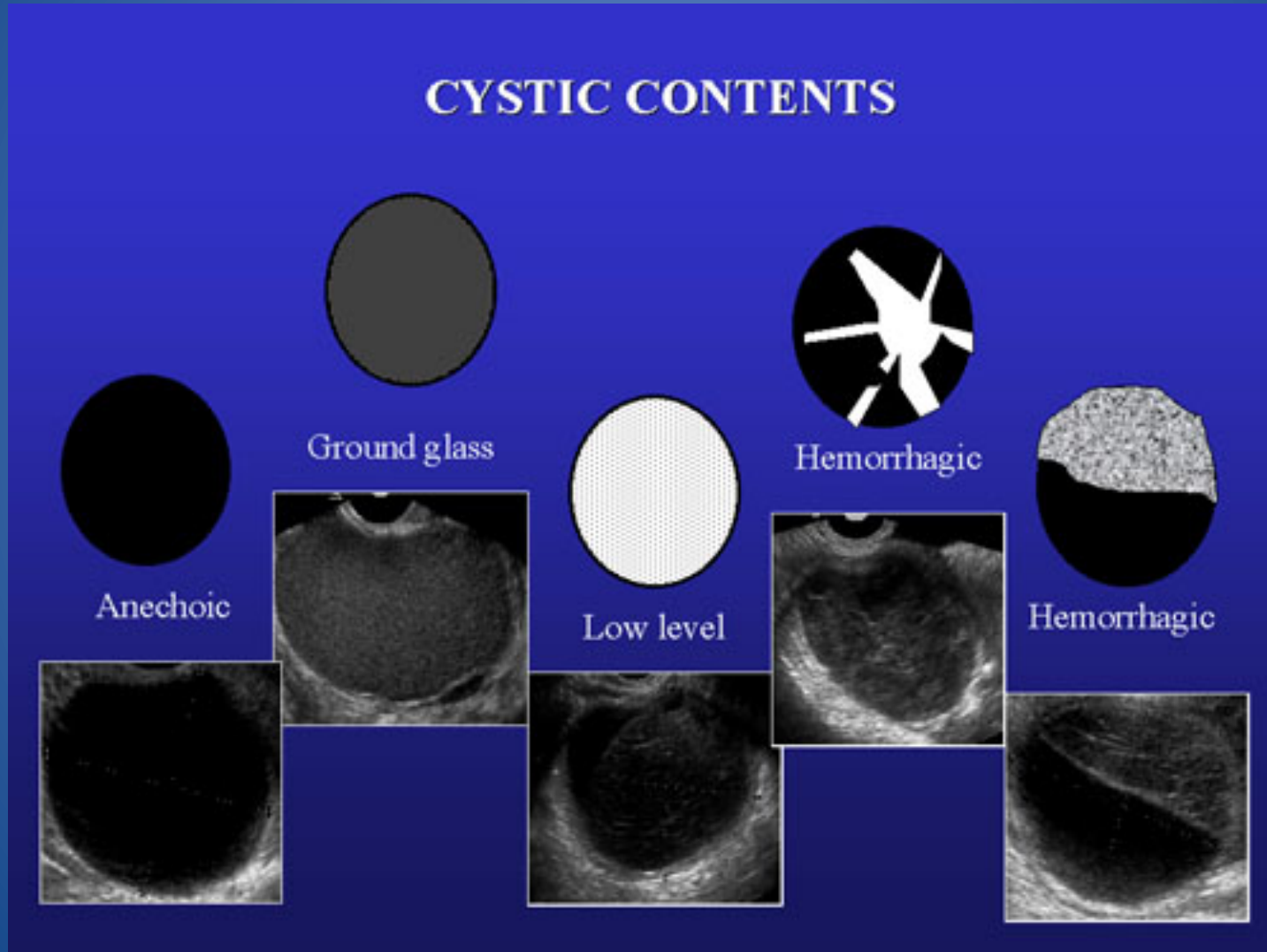


Solid

SOLID TUMORS



Cystic contents



Mixed cystic contents

CYSTIC CONTENTS



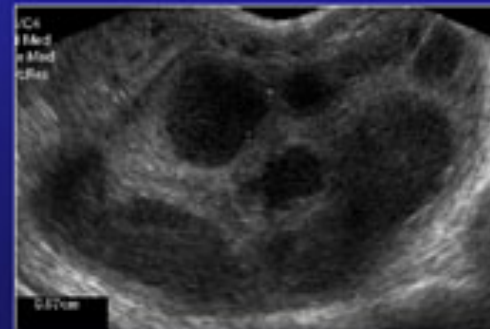
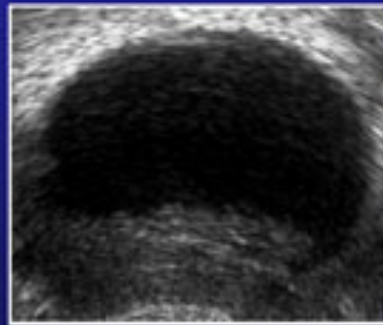
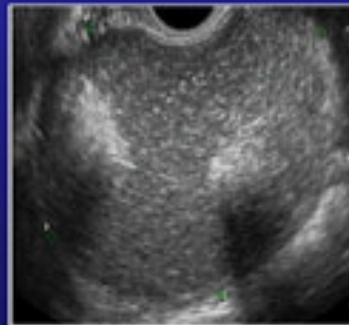
Mixed



Mixed (fat-fluid level)

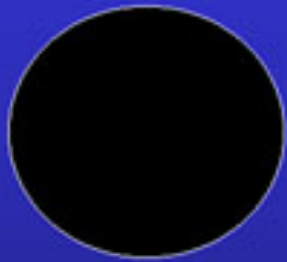


Mixed (abscess)

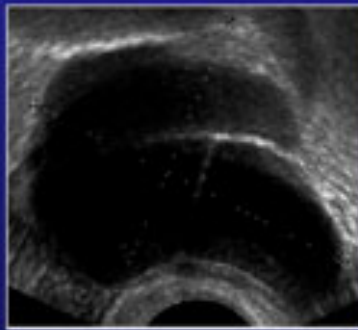
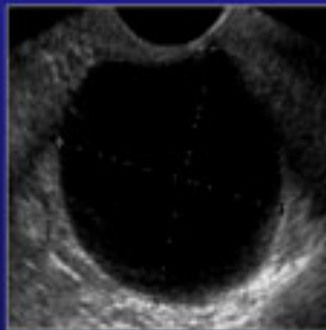


Internal wall of the cyst

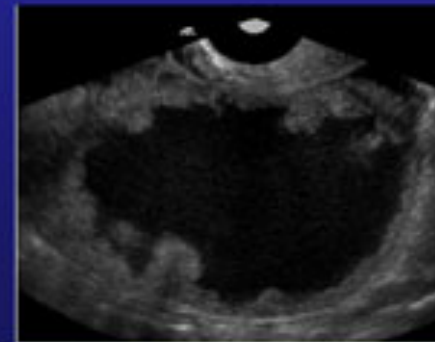
INTERNAL WALL OF THE CYST



Smooth, regular

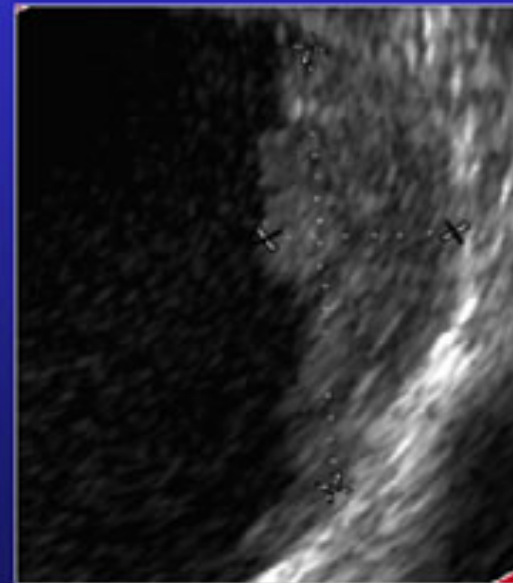
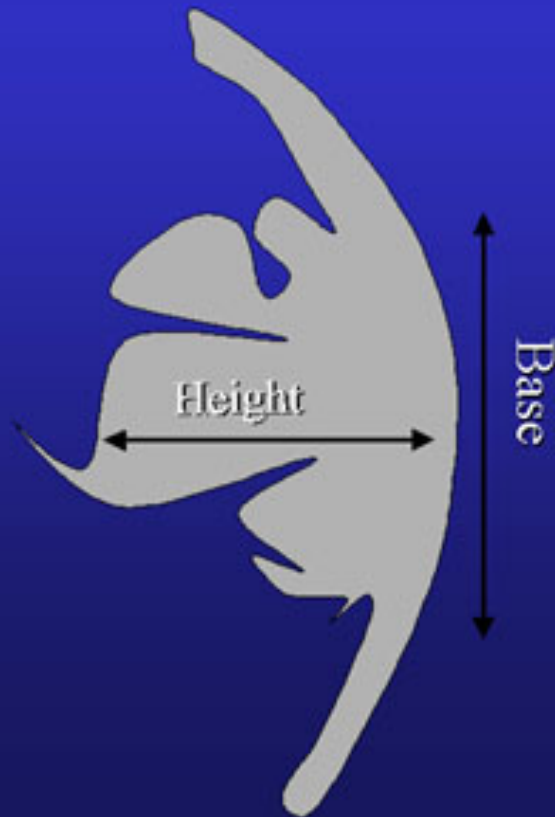


Irregular



Papillary projection >3 mm

SOLID PAPILLARY PROJECTION: CORRECT MEASUREMENT



IOTA definitions

- Solid component – structure that has echogenicity suggestive of tissue
BUT the white ball of a dermoid is not solid tissue and blood clot or mucin is not solid tissue
- If protrusion >3 mm = papillary projection (count as solid component)
If < 3 mm = irregularity
- Irregular – means an irregular internal wall OR irregular outer contour of a solid lesion
- Ascites – fluid outside POD

Vascularity score

- Colour Doppler or Power Doppler (more sensitive)
- PRF 0.3
- Velocity scale 3-6 cm/sec
- Balance 220
- Adjust Doppler gain to just below artefact level

- No flow = 1
- Minimal flow = 2
- Moderate flow = 3
- Strong flow throughout = 4

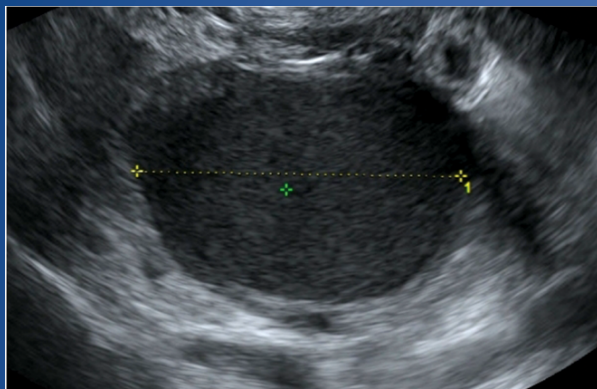
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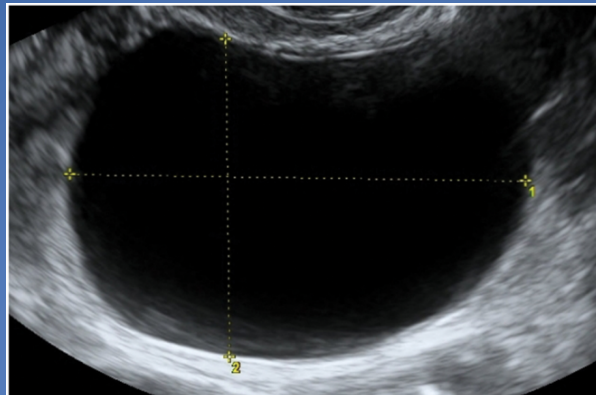
Simple Descriptors

- Certain abnormalities are really obvious:
 - PATTERN RECOGNITION
- Endometrioma
- Benign cystic teratoma - dermoid
- Simple cyst or cystadenoma
- Functional cyst eg haemorrhagic cyst
- Malignant tumour with ascites

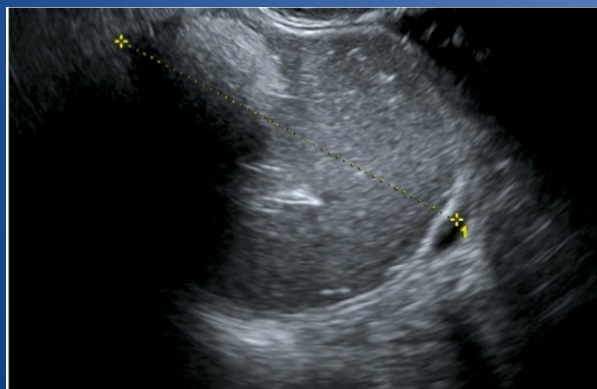
Simple Descriptors of an ovarian mass used to make a diagnosis



BD1: Unilocular tumor with ground glass echogenicity in premenopausal woman (suggestive of endometriosis)



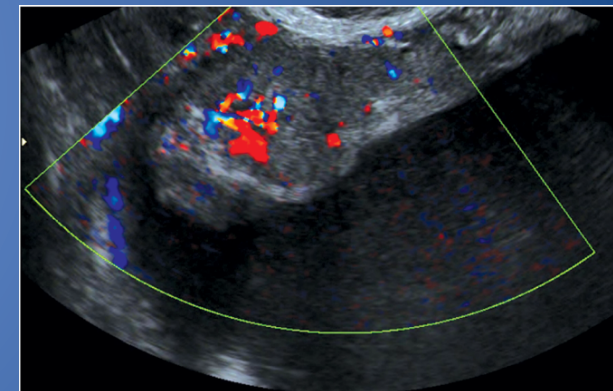
BD3: Unilocular tumor with regular walls and max diameter of the lesion < 10 cm (suggestive of simple cyst or cystadenoma)



BD2: Unilocular tumor with mixed echogenicity and acoustic shadows in premenopausal woman (suggestive of benign cystic teratoma)



BD4: Remaining unilocular tumor with regular walls



MD1: Tumor with ascites and at least moderate color Doppler blood flow in postmenopausal woman

BD, benign descriptor; MD, malignant descriptor.

When Simple Descriptors do not apply:

- If the mass is not instantly recognisable
- and Simple Descriptors do not apply:
 - Then apply Simple Rules

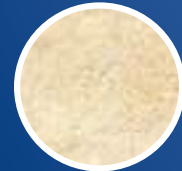
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Benign or malignant? Potential tests

- Clinical examination
- Colour Doppler Imaging: PI or RI?
- Morphologic scoring systems (80+)
- Serum CA 125, other markers (HE4...)
- Risk of malignancy index (RMI)
- Computer models (logistic regression + other)
- Subjective assessment (pattern recognition)
- Simple ultrasound-based rules

Morphologic Classification (n=1066)



<u>Type of tumor</u>	<u>N</u>	<u>Malign.</u>	<u>%</u>
1.Unilocular cyst	313	2	0.6
2.Unilocular solid	132	44	33
3.Multilocular cyst	196	20	10
4.Multilocular solid	284	116	41
5.Solid tumor	136	84	62

Ultrasound Obstet Gynecol 2008; 31: 681–690

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Simple ultrasound-based rules for the diagnosis of ovarian cancer

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***Department of Obstetrics and Gynecology, Malmö University Hospital, Lund University, Malmö, Sweden*

KEYWORDS: color Doppler imaging; ovarian neoplasms; ultrasonography

Simple ultrasound rules to distinguish between benign and malignant adnexal masses before surgery: prospective validation by IOTA group

Dirk Timmerman, professor in obstetrics and gynaecology,¹ Lieveke Ameye, postdoctoral researcher in biostatistics,² Daniela Fischerova, consultant gynaecologist,³ Elisabeth Epstein, associate professor in obstetrics and gynaecology,⁴ Gian Benedetto Melis, professor in obstetrics and gynaecology,⁵ Stefano Guerriero, associate professor in obstetrics and gynaecology,⁵ Caroline Van Holsbeke, consultant gynaecologist,⁶ Luca Savelli, consultant gynaecologist,⁷ Robert Fruscio, consultant gynaecologist,⁸ Andrea Alberto Lissoni, consultant gynaecologist,⁸ Antonia Carla Testa, assistant professor in gynaecology,⁹ Joan Veldman, research fellow in gynaecology,¹ Ignace Vergote, professor in obstetrics and gynaecology,¹ Sabine Van Huffel, professor in biomedical data processing,² Tom Bourne, consultant gynaecologist,¹⁰ visiting professor in obstetrics and gynaecology,¹ Lil Valentin, professor in obstetrics and gynaecology¹¹

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doi:10.1136/bmj.c6839

BMJ | ONLINE FIRST | bmj.com

BMJ 2010

WHAT IS ALREADY KNOWN ON THIS TOPIC

Preoperative characterisation of adnexal tumours determines the management of the patient, and appropriate management determines the prognosis

Subjective assessment of ultrasound examination is the most reliable method to distinguish between benign and malignant adnexal masses before surgery, but it requires expertise

Simple rules have been proposed to discriminate between benign and malignant masses, but they require external validation

WHAT THIS STUDY ADDS

The simple rules were conclusive in about 75% of adnexal masses

When conclusive, they performed as well as subjective assessment by an experienced examiner for discrimination between benign and malignant masses

Their use may change clinical practice by providing an accurate instant classification of most adnexal masses while reducing the number of patients that need to be referred for expert scanning

Simple ultrasound-based rules for the diagnosis of ovarian cancer

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and L. VALENTIN**

Rules for predicting a malignant tumor (M-rules)

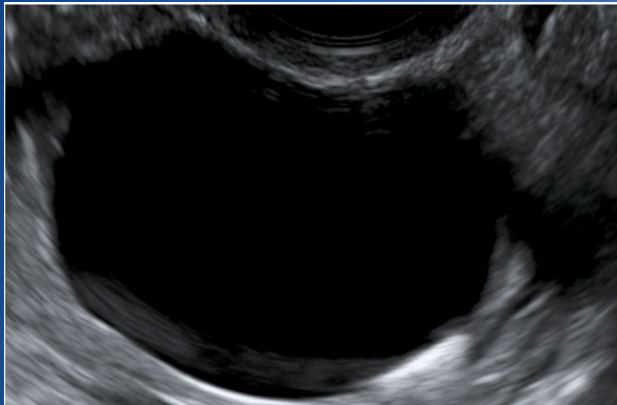
- M1 Irregular solid tumor
- M2 Presence of ascites
- M3 At least four papillary structures
- M4 Irregular multilocular solid tumor with largest diameter ≥ 100 mm
- M5 Very strong blood flow (color score 4)

Rules for predicting a benign tumor (B-rules)

- B1 Unilocular
- B2 Presence of solid components where the largest solid component has a largest diameter < 7 mm
- B3 Presence of acoustic shadows
- B4 Smooth multilocular tumor with largest diameter < 100 mm
- B5 No blood flow (color score 1)

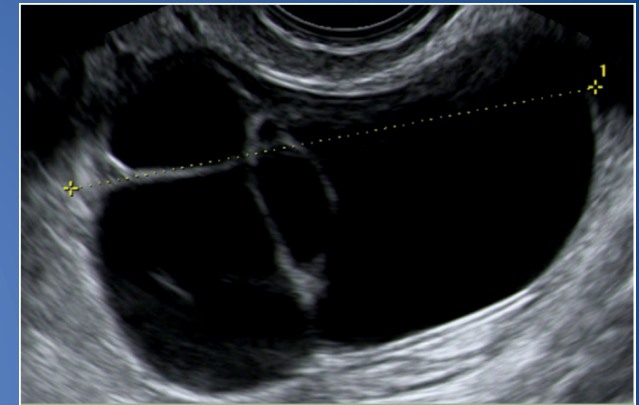
Simple Rules

FEATURES of a benign mass (B-features)

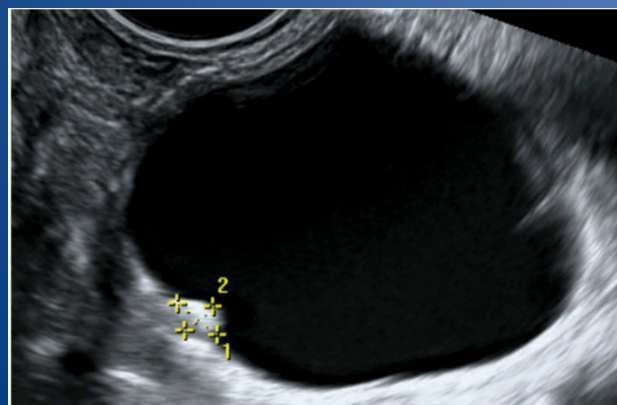


B1: Unilocular cyst

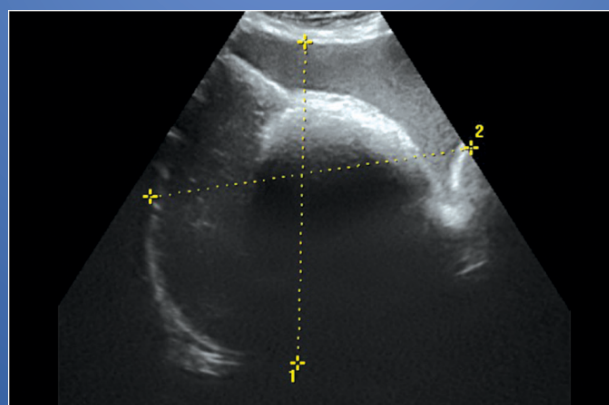
A mass is classified as benign if at least one B-feature is present and no M-features are present



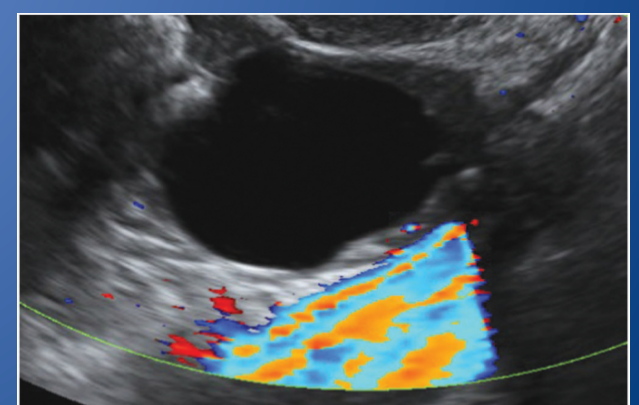
B4: Smooth multilocular tumor, with largest diameter < 100 mm



B2: Presence of solid components, with largest diameter < 7 mm



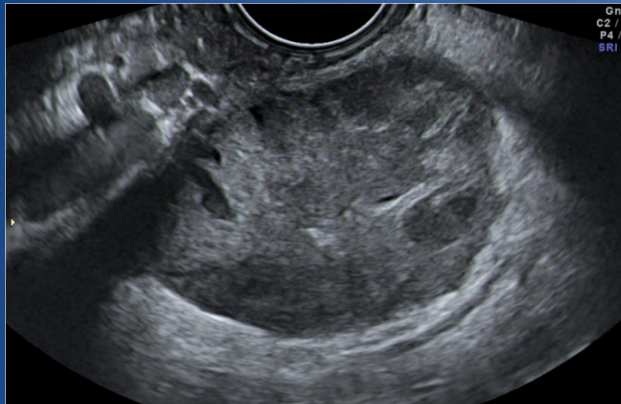
B3: Presence of acoustic shadows



B5: No blood flow (color score 1)

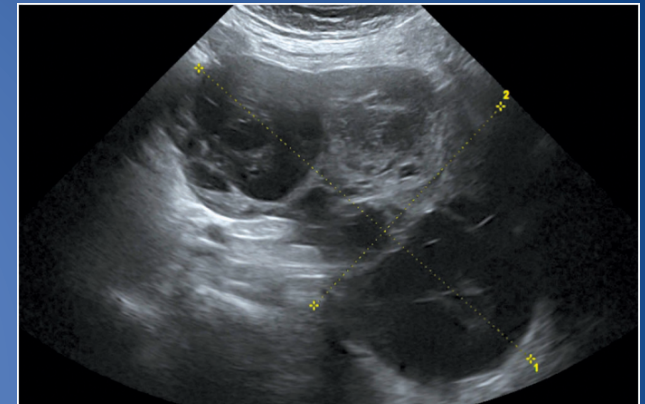
Simple Rules

FEATURES of a malignant mass (M-



M1: Irregular solid tumor

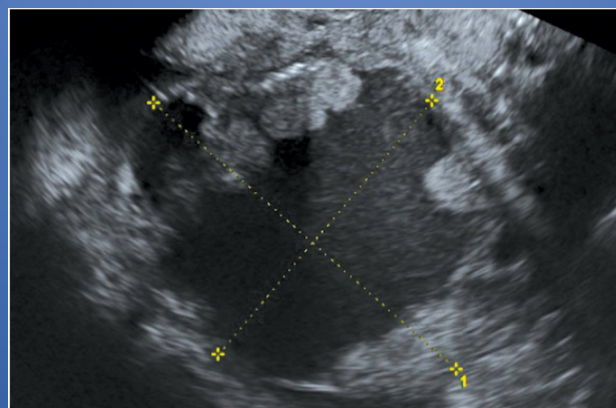
A mass is classified as malignant if at least one M-feature is present and no B-features are present



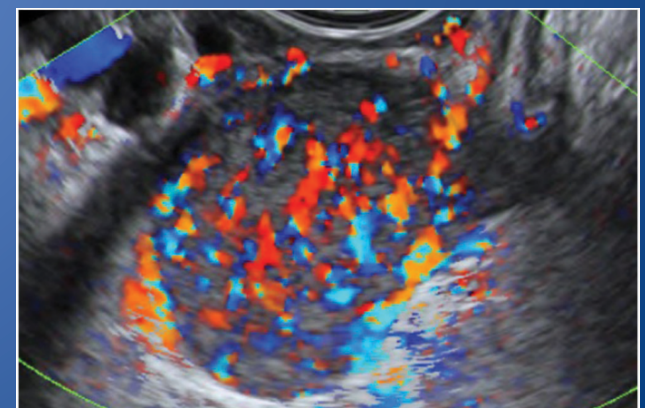
M4: Irregular multilocular solid tumor with largest diameter ≥ 100 mm



M2: Presence of ascites



M3: At least four papillary structures



M5: Very strong blood flow

Simple Rules

- **Rule 1:** If **one or more M features** are present in absence of B feature(s), the mass is classified as **malignant**.
- **Rule 2:** If **one or more B features** are present in absence of M feature(s), the mass is classified as **benign**.
- **Rule 3:** If **both M features and B features** are present, or if no B or M features are present, the result is **inconclusive** and a second stage test is recommended.

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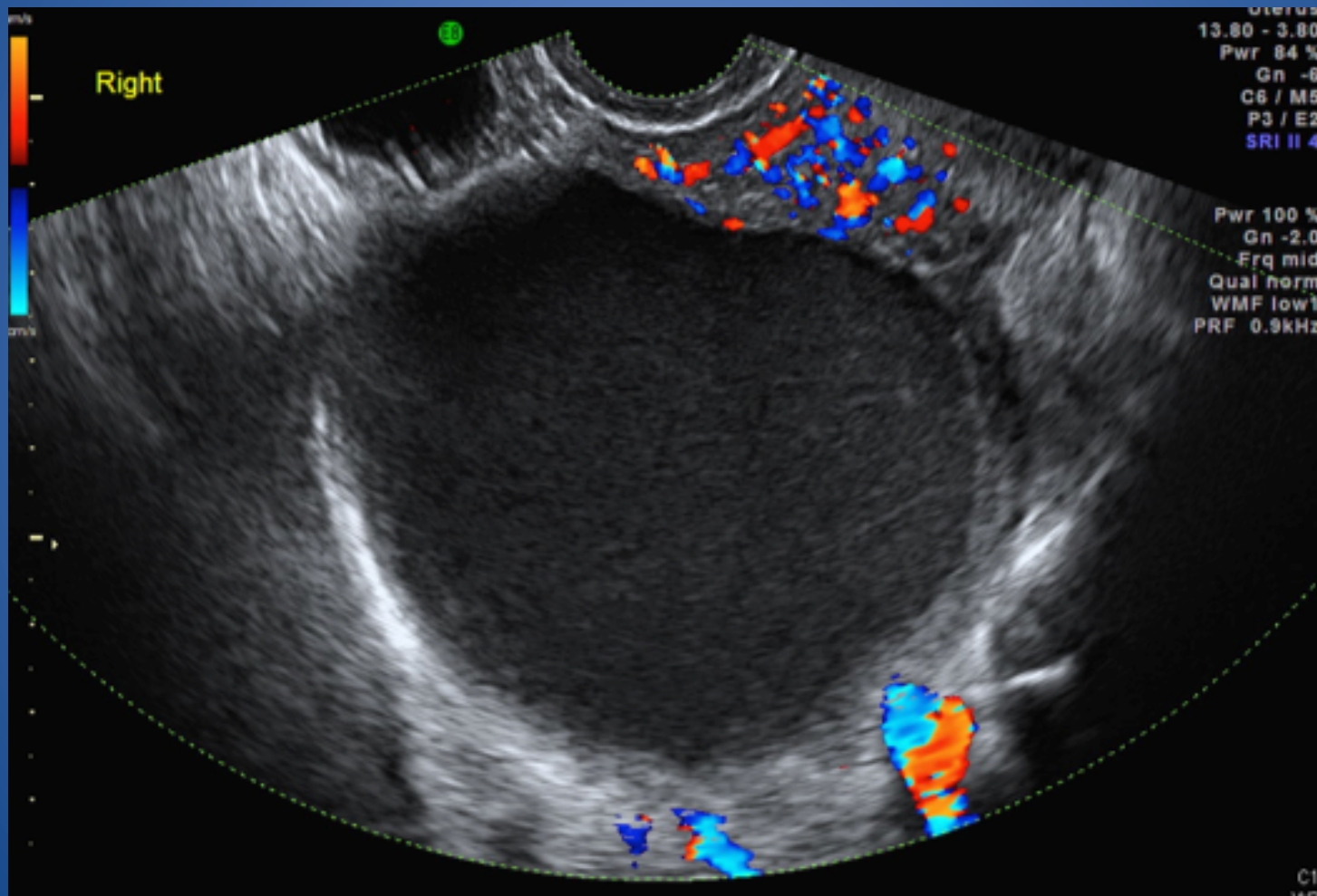
Worked examples — as a group

Use the sheet with the Simple Rules

- Look at the mass and describe it using IOTA criteria
- Simple Descriptors / pattern recognition – is it obvious?
- If not - apply Simple Rules
- Decide whether benign, uncertain or malignant
- Suggest histological diagnosis

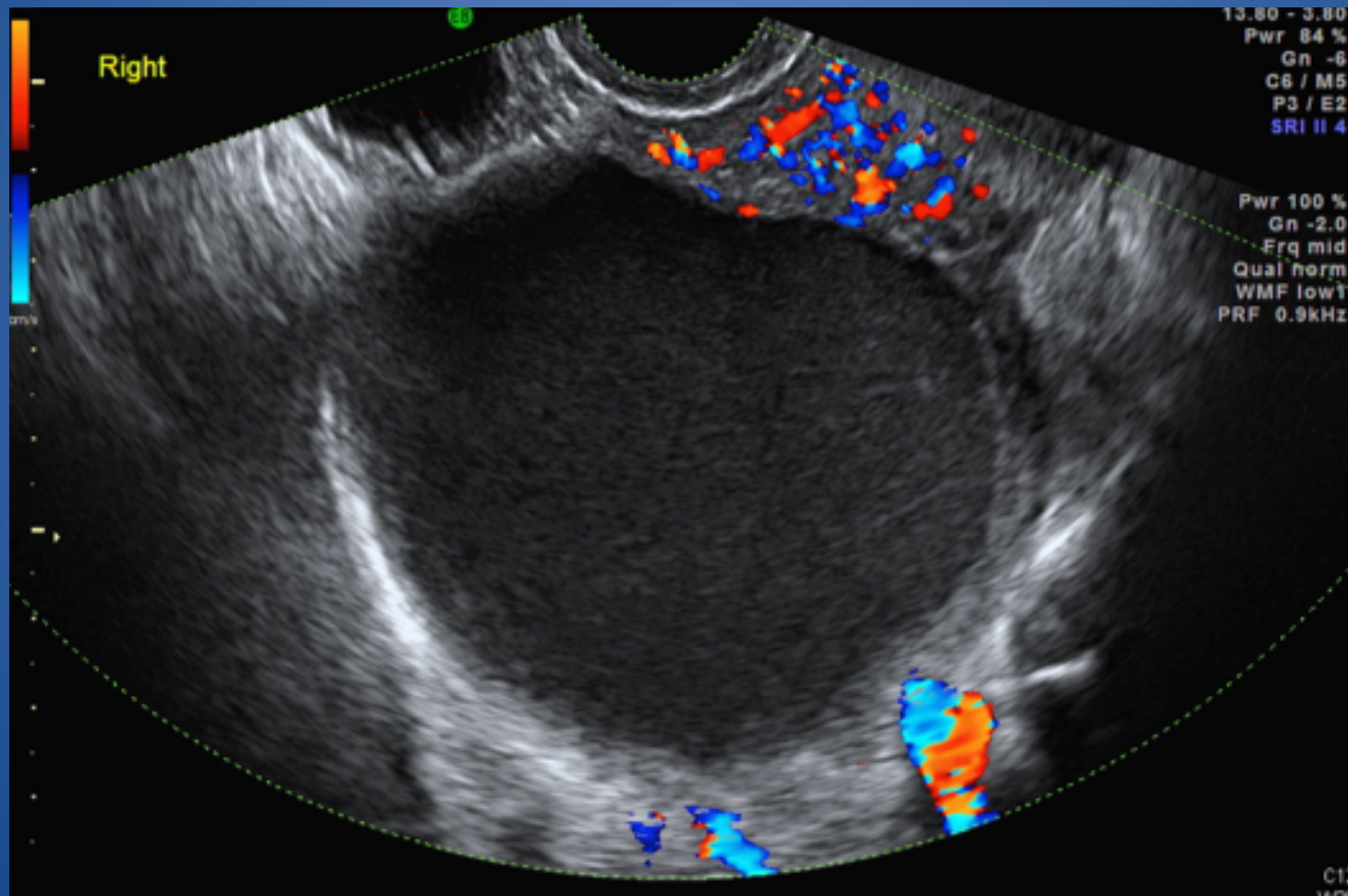
Simple descriptors / Pattern recognition

premenopausal



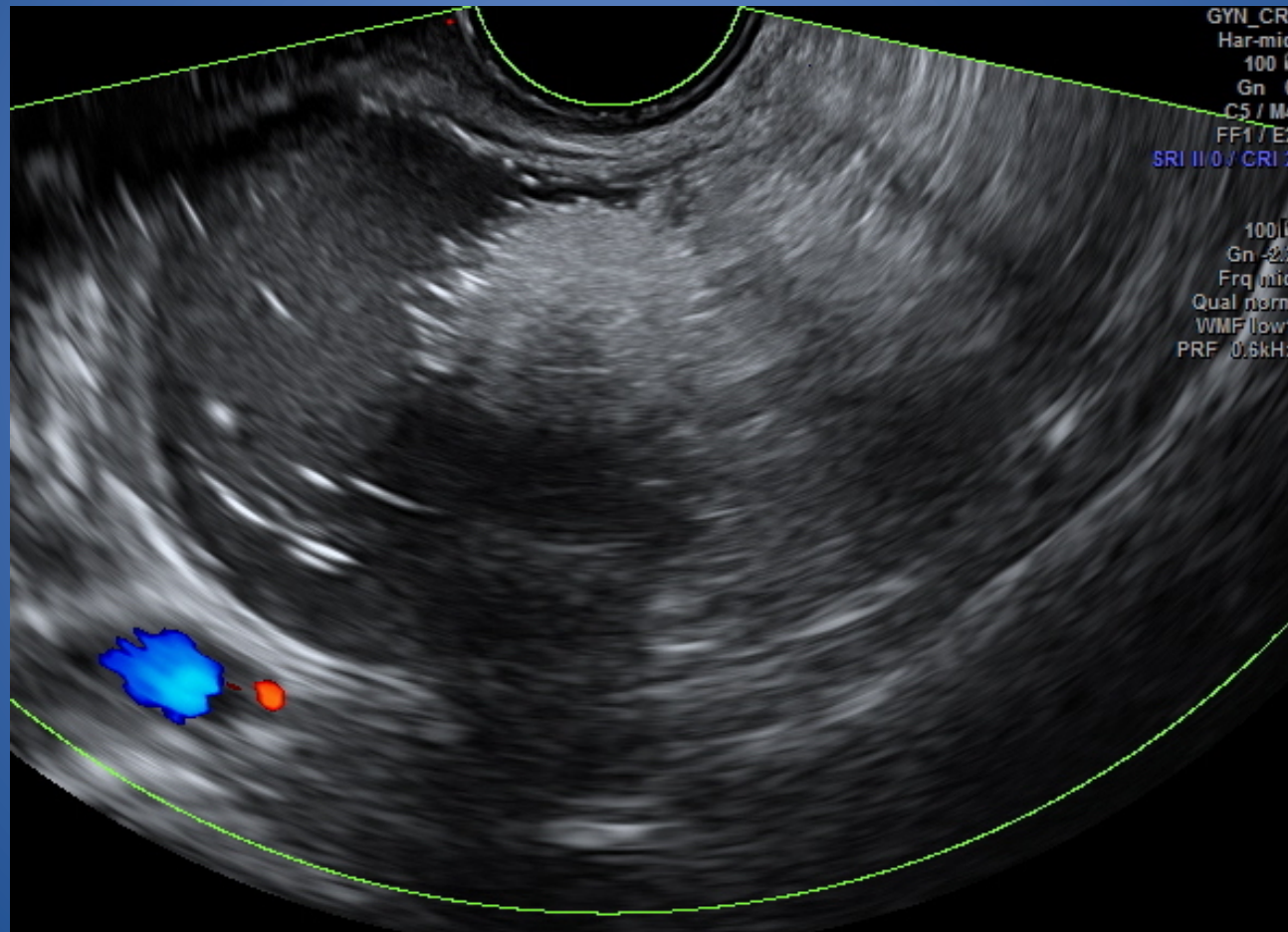
Endometrioma

unilocular, ground glass echogenicity, premenopausal



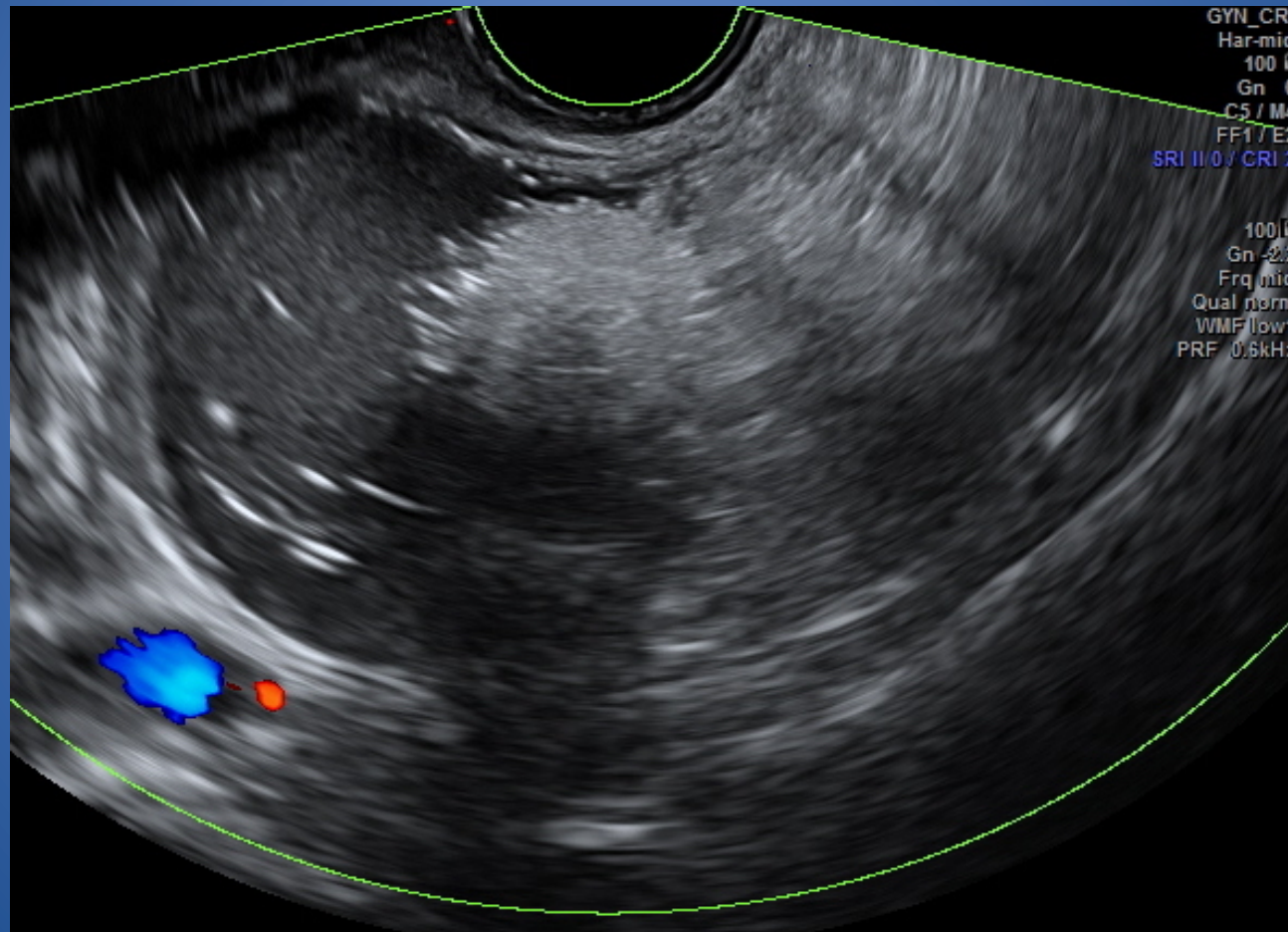
Simple descriptors /Pattern recognition

premenopausal



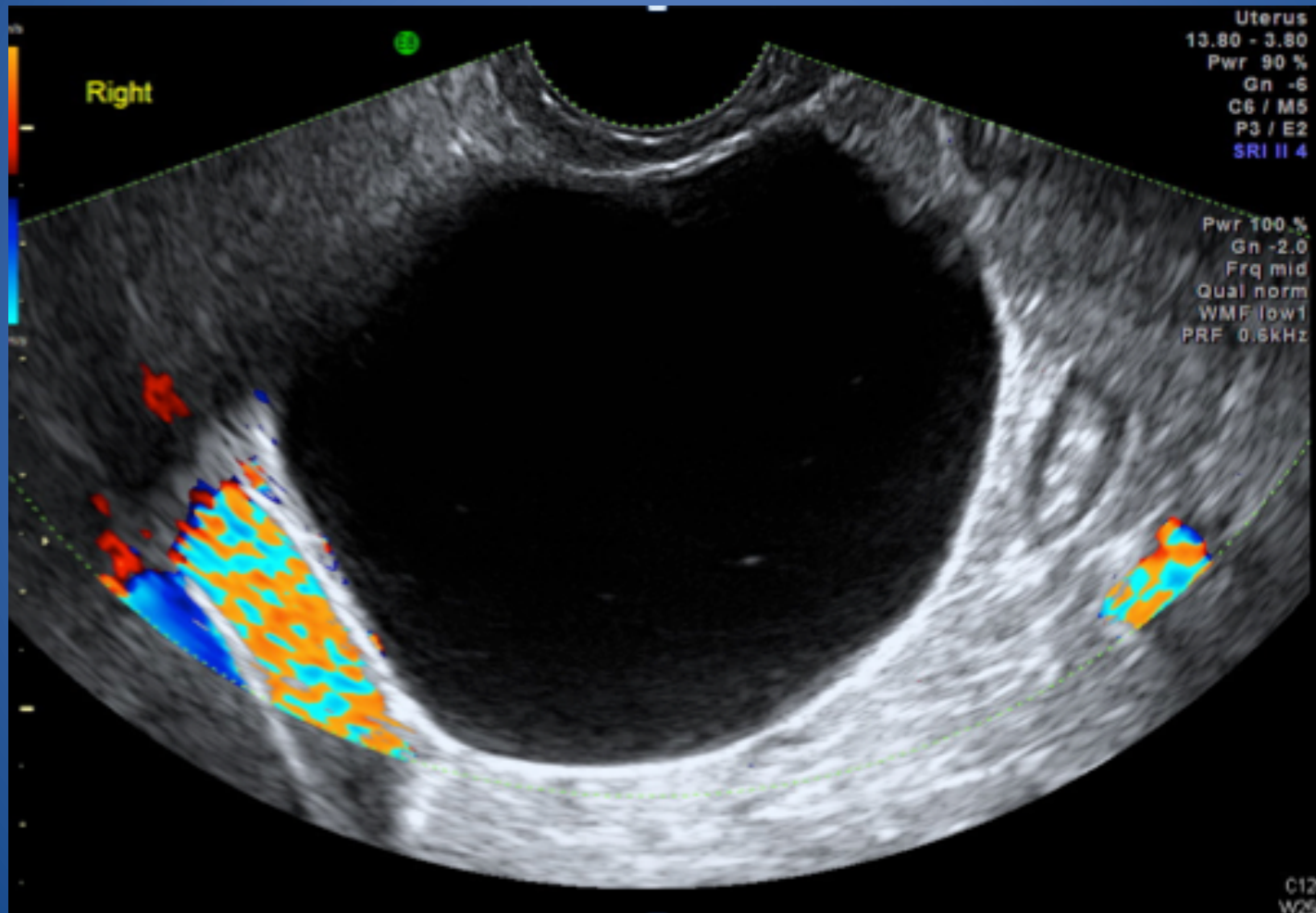
Dermoid

unilocular, mixed echoes, shadows, premenopausal



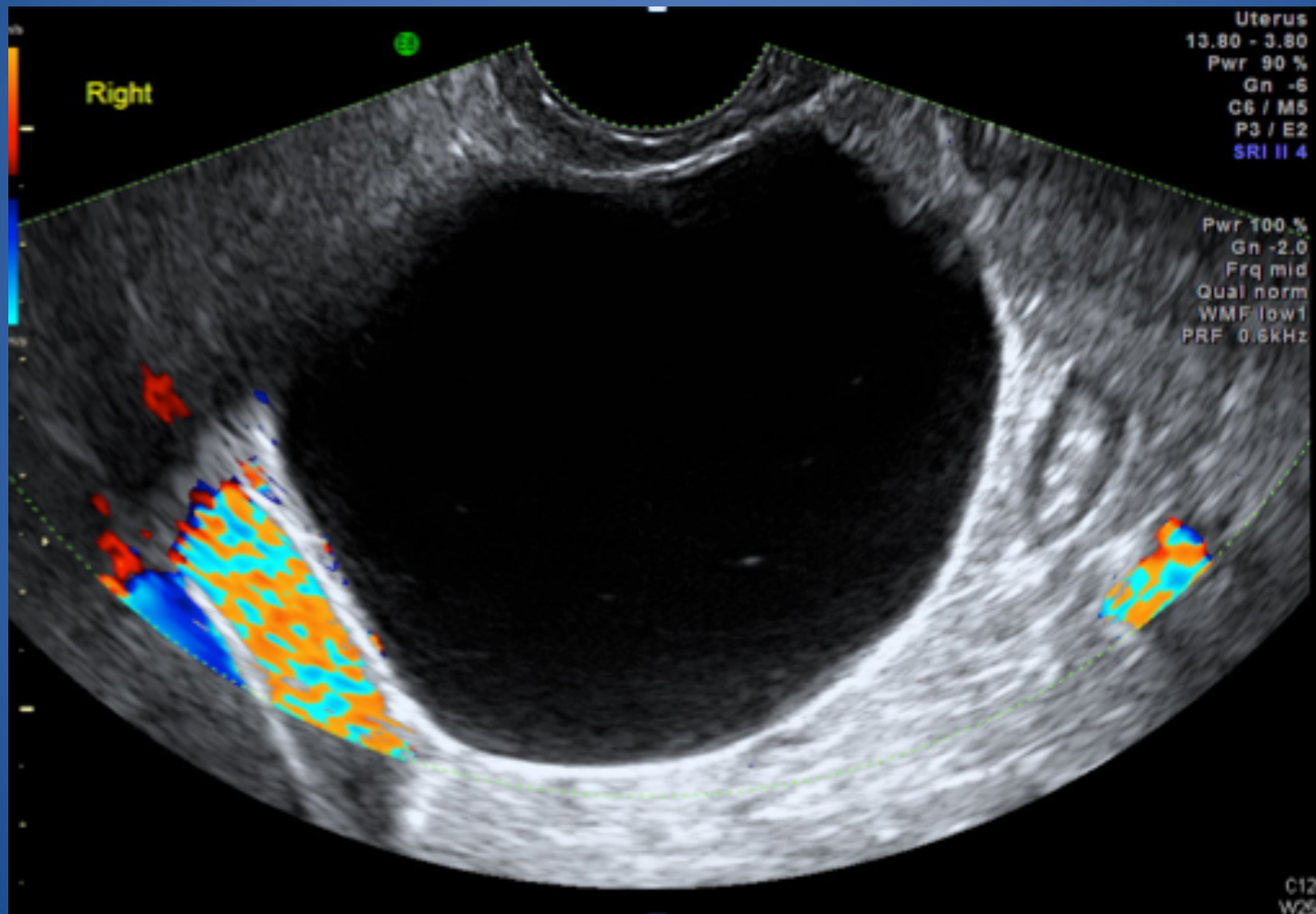
Simple descriptors /Pattern recognition

<10 cm



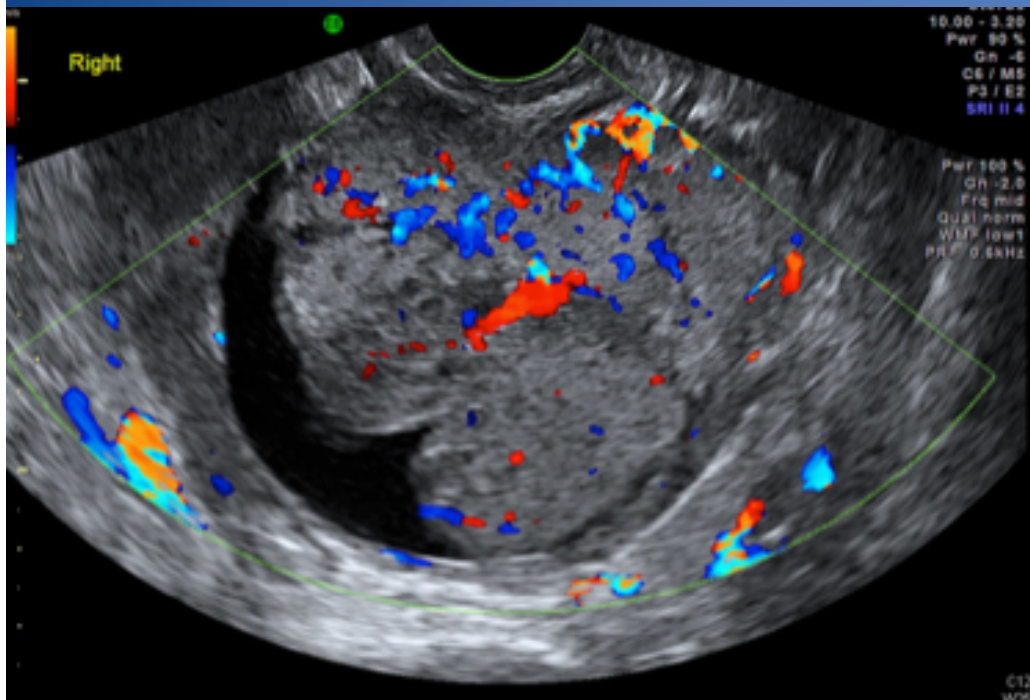
Serous cystadenoma

unilocular, regular walls, <10 cm



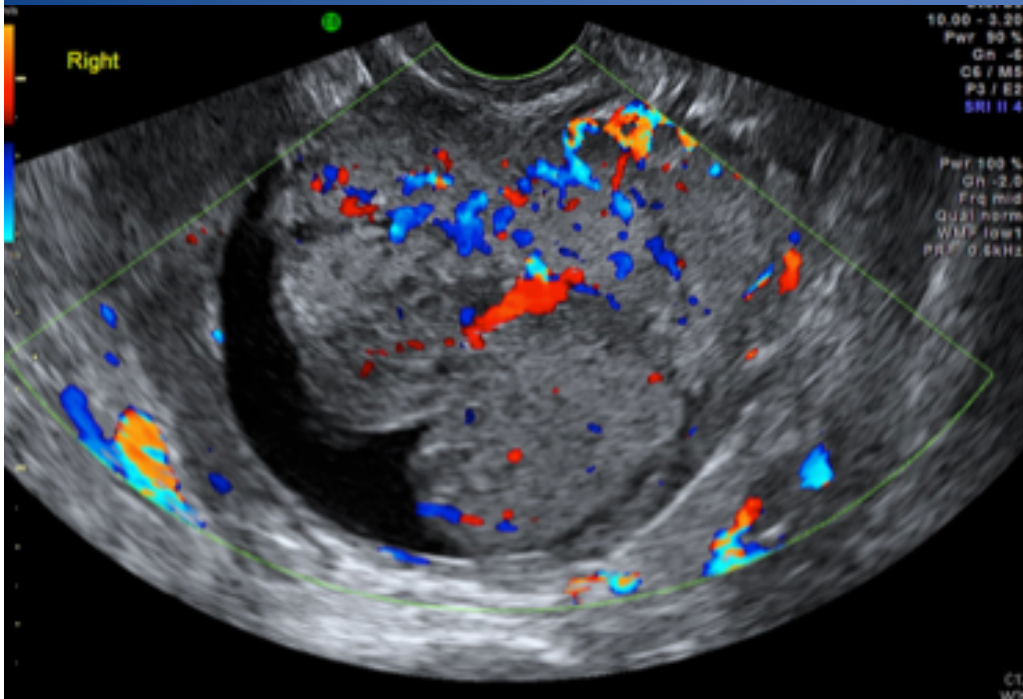
Simple descriptors / Pattern recognition

postmenopausal



Stage 4 ovarian carcinoma with ascites

tumour with at least moderate blood flow, ascites, postmenopausal

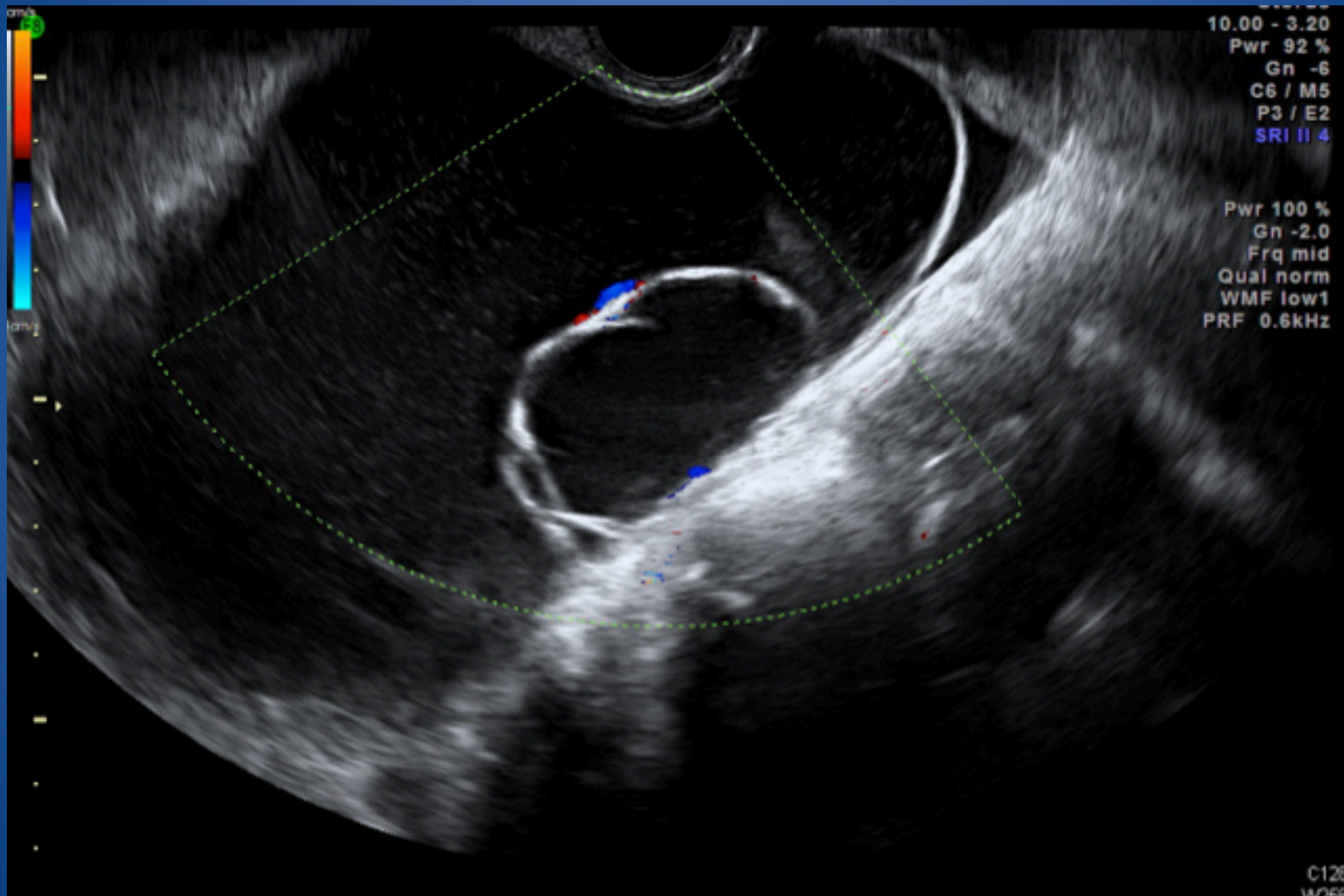


Examples where Simple Descriptors / easy pattern recognition do not apply....

- Apply Simple Rules
 - three worked examples:

Example 1

<10cm



Example 1

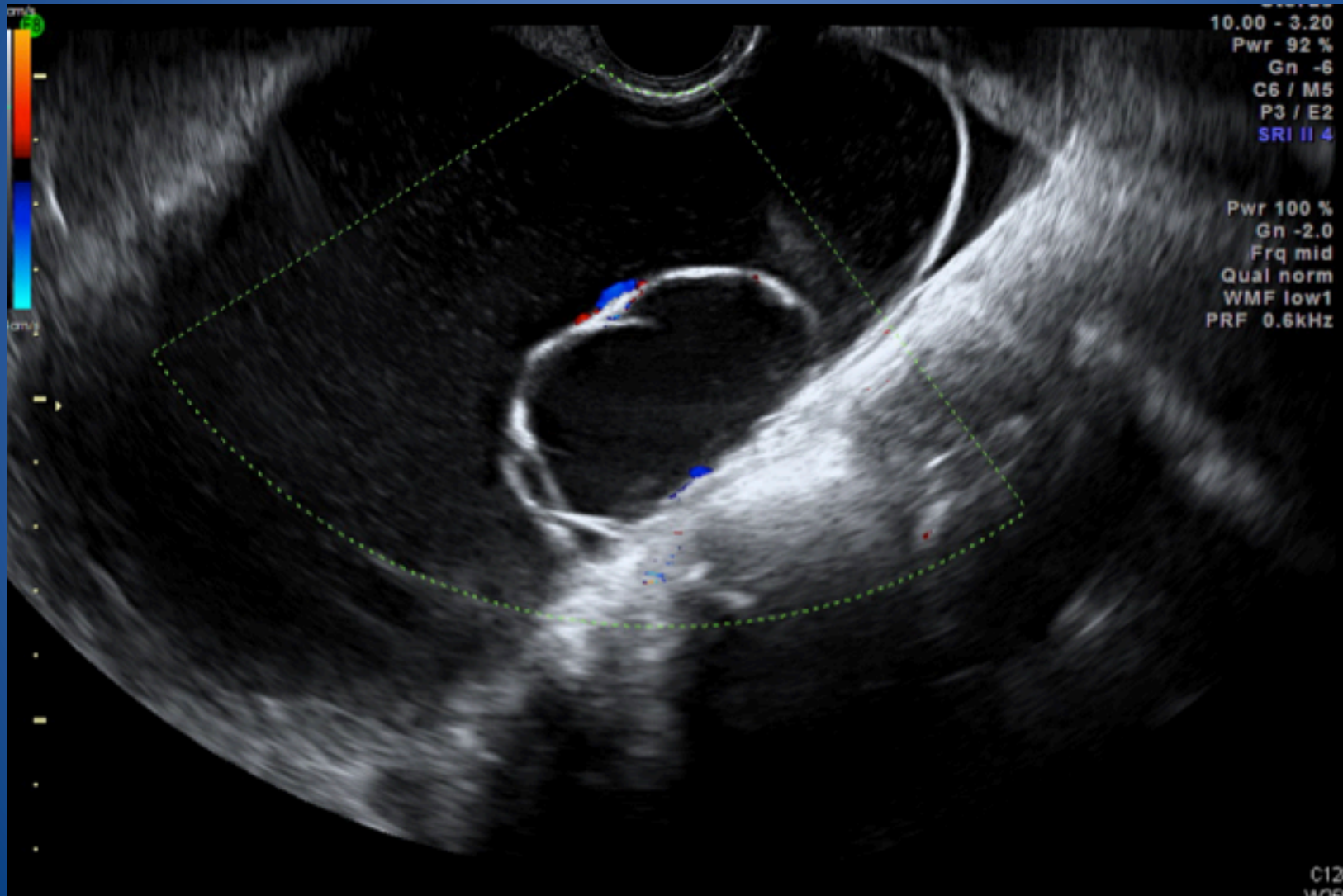
Diagnostic sieve

- IOTA description
 - Unilocular, unilocular-solid, **multilocular**, multilocular-solid or solid
 - Cyst contents – anechoic, **low level**, ground glass, haemorrhagic or mixed
 - Solid material or papillary structures or wall irregularity (presence and size) **NO**
 - Vascularity 1-4 **2**
 - Shadows **NO**
 - Ascites **NO**
- Simple Descriptors – do not apply
 - endometrioma / dermoid / simple cyst / haemorrhagic cyst / malignancy
- Simple rules
 - **Benign** - unilocular, **smooth multilocular tumor < 100 mm**, largest solid component diameter < 7mm, acoustic shadows, no blood flow (color score 1)
 - Malignant - Irregular solid tumor, Irregular multilocular-solid tumor ≥ 100 mm, ≥ 4 papillary structures, ascites, very strong blood flow (color score 4)
 - Uncertain

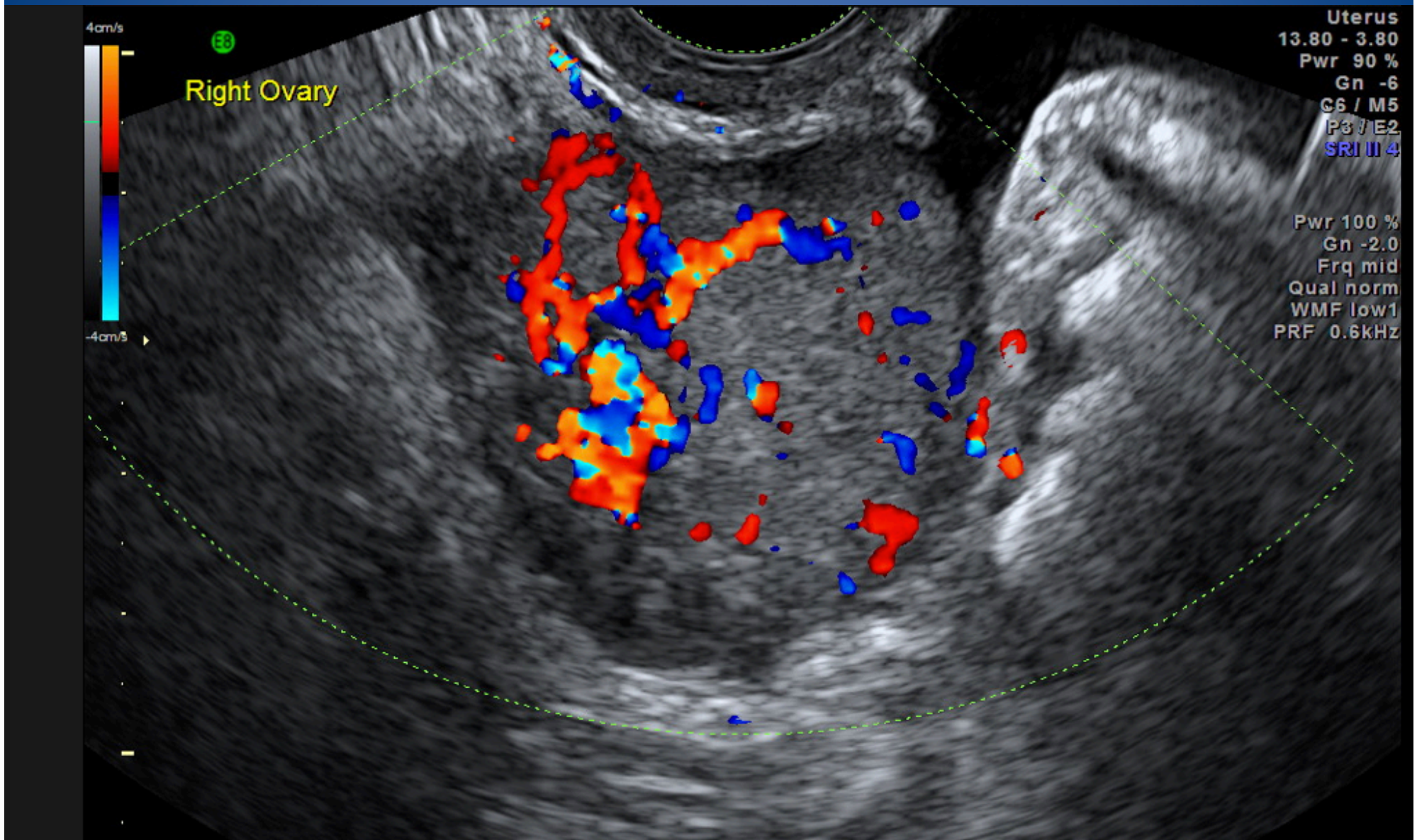
Example 1

Simple rules: BENIGN

Mucinous cystadenoma



Example 2



Example 2

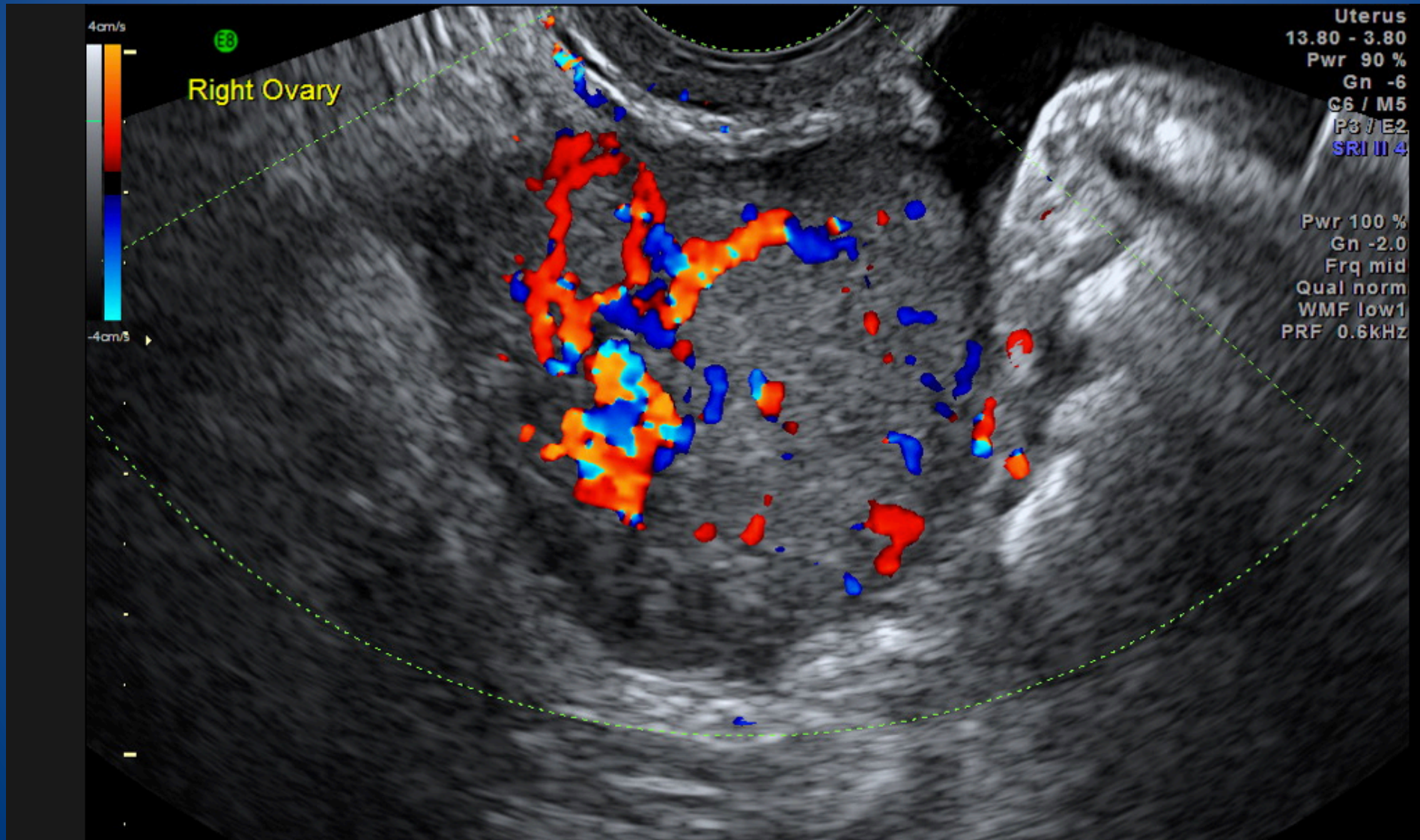
Diagnostic sieve

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 - Unilocular, unilocular-solid, multilocular, multilocular-solid or **solid**
 - Cyst contents – anechoic, low level, ground glass, haemorrhagic or mixed
 - Solid material or papillary structures or wall irregularity (presence and size)
 - **Vascularity** 1-4 **4**
 - Shadows **NO**
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 - Uncertain

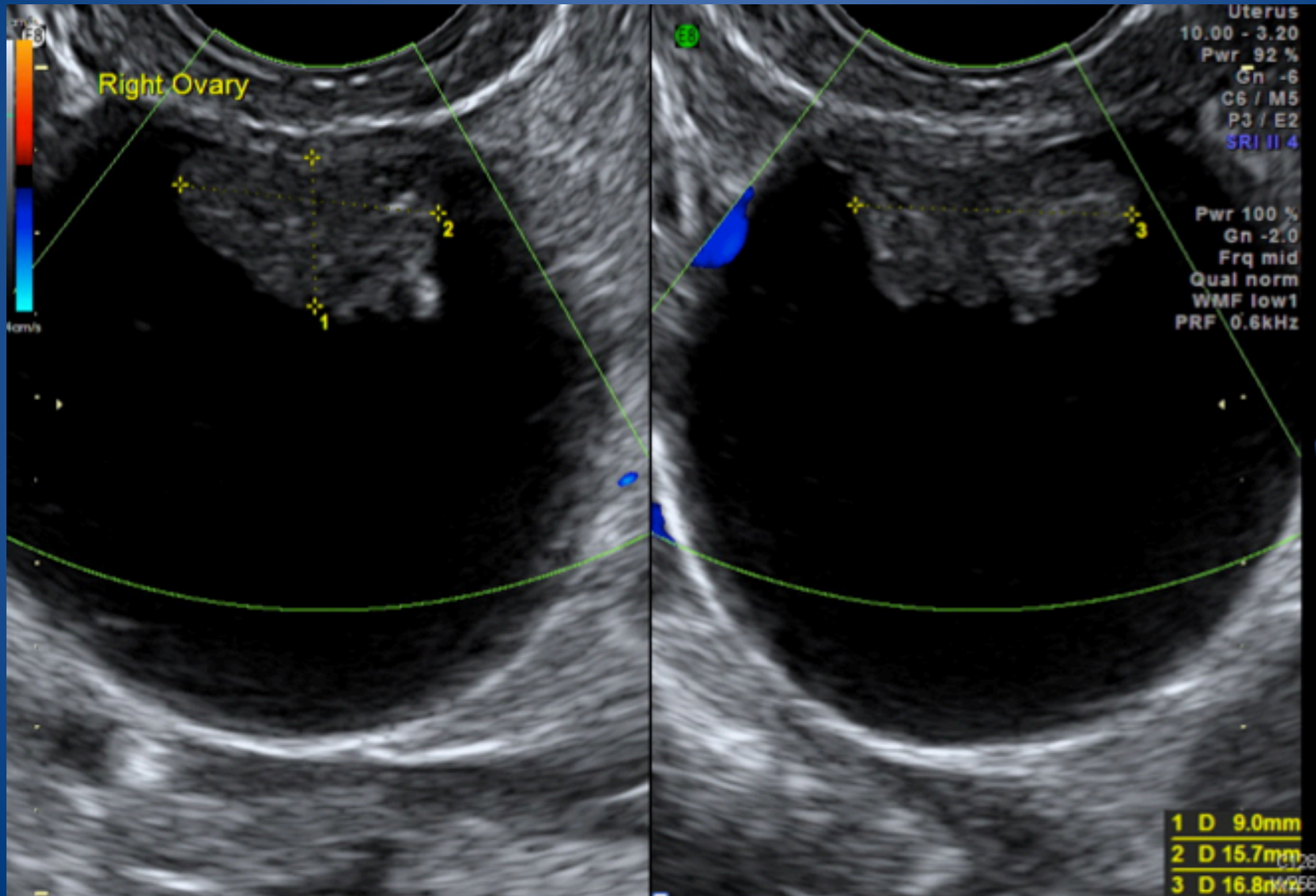
Example 2

Simple rules: MALIGNANT

Metastasis from bowel primary



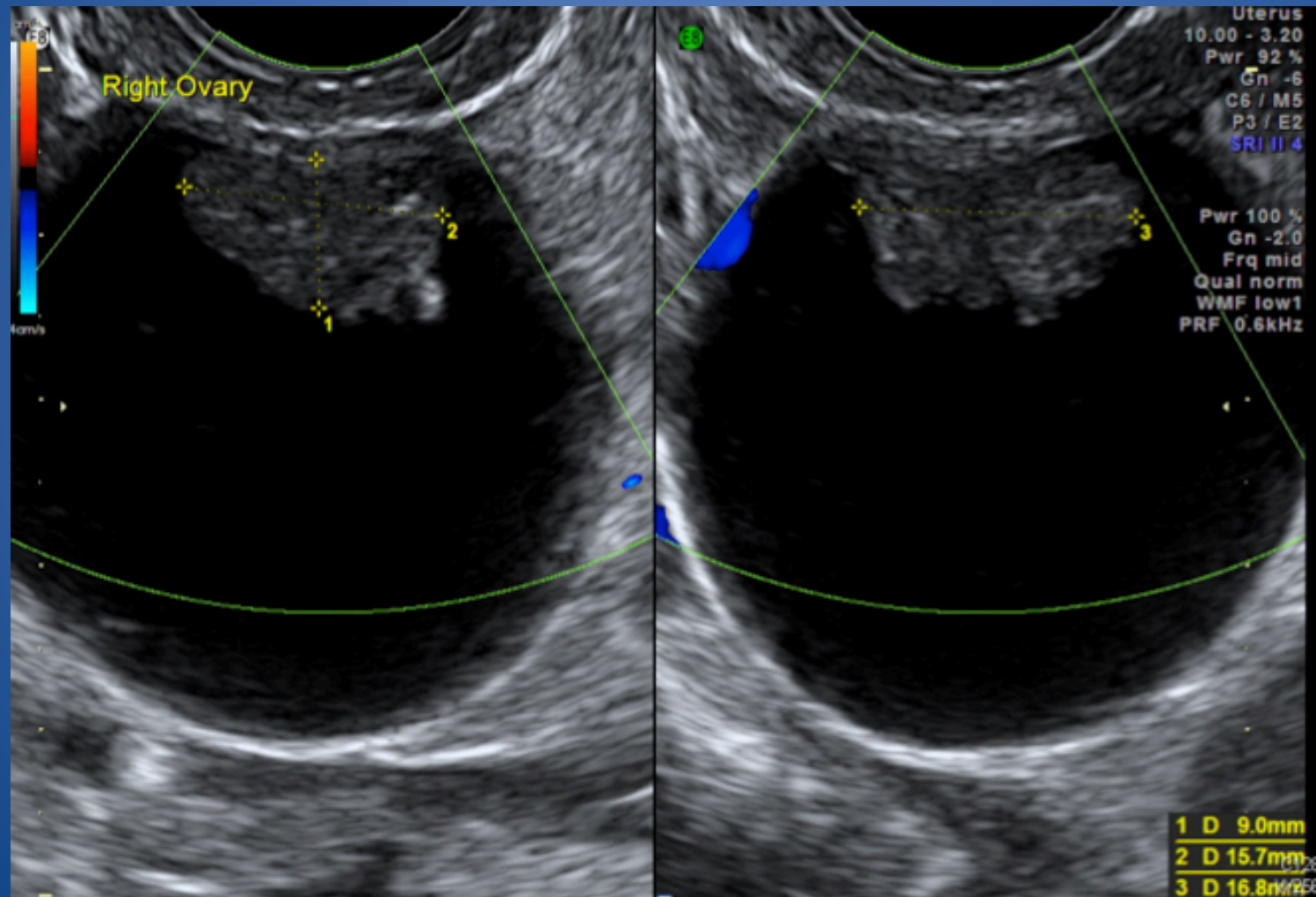
Example 3



Example 3

Simple rules: UNCERTAIN

Borderline ovarian tumour



Ovarian pathology

- Classification system for ovarian pathology
- Standardisation of terminology – IOTA
- IOTA Simple Descriptors (pattern recognition)
- Prediction of malignancy – IOTA Simple Rules
- Worked examples
- Quiz

QUIZ

Use the sheet with the Simple Rules

- Look at the mass and describe it using IOTA definitions
- Apply Simple Descriptors (pattern recognition)
- Apply Simple Rules
- Decide whether benign, uncertain or malignant
- Suggest histological diagnosis

Sheet with Simple Rules

	IOTA FEATURES				
Benign features	<u>Unilocular cyst</u>		Malignant features	Irregular solid tumour	
	Largest solid component <7 mm			<u>Ascites</u>	
	Acoustic shadows			At least four papillary structures	
	Smooth <u>multilocular</u> tumour <100 mm			Irregular <u>multilocular-solid</u> tumour >100 mm	
	No blood flow (1+)			Very strong blood flow (4+)	

- Rule 1: If one or more M features are present in absence of B feature, mass is classified as malignant.
- Rule 2: If one or more B features are present in absence of M feature, mass is classified as benign.
- Rule 3: If both M features and B features are present, or if no B or M features are present, result is inconclusive

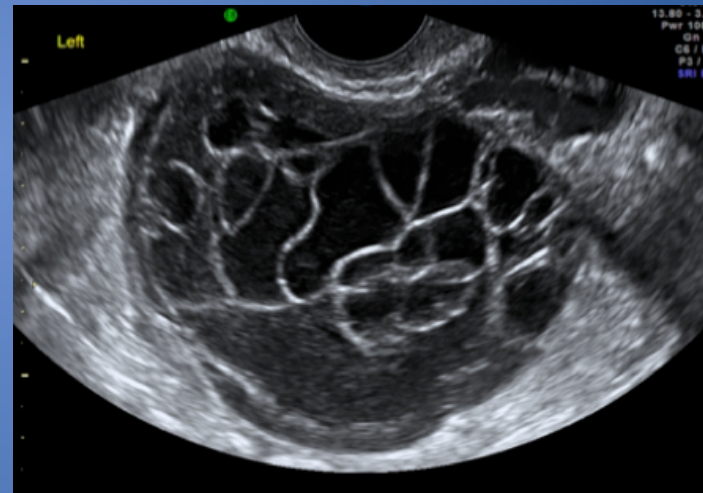
Simple rules: benign / uncertain / malignant

- There will be 10 images for the quiz with worked answers

Conclusion

- Apply IOTA terminology and Simple Rules to all adnexal masses, keep a record and chase the histology

– were you right?



- Simple or complex

VERSUS

- IOTA criteria, Simple Descriptors and Simple Rules – a comprehensive and informative report

To sum up

- Careful history
- Systematic scan – don't panic when there are many separate abnormalities
- Use the IOTA classification to describe the lesion
- Apply Simple Descriptors (pattern recognition)
- Apply Simple Rules
- (apply other models eg LR2, ADNEX)
- Clear report
 - Benign / uncertain / malignant
 - Suggested histology
- Chase the histology – were you right?

Resources

- IOTA – papers, courses, apps (risk calculators), conferences

<http://www.iotagroup.org>

- ISUOG – papers, journal club slides
- GE poster

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Improving strategies for diagnosing ovarian cancer: a summary of the International Ovarian Tumor Analysis (IOTA) studies

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KEYWORDS: biomarkers; decision support techniques; logistic models; ovarian neoplasms; ultrasonography

IOTA website

The screenshot shows a web browser window with the URL `homes.esat.kuleuven.be/~sistawww/biomed/iota/index.php/iota-info`. The browser's address bar and tabs are visible at the top. The website content includes a navigation menu on the left with links for Home, IOTA info, Certified Members, Congresses, and Software. Below this is a 'Members area' with a login form containing fields for 'User Name' and 'Password', a 'Remember Me' checkbox, and a 'Log in' button. There are also links for 'Forgot your password?' and 'Forgot your username?'. The main content area features a large header for 'IOTA 2013 International Ovarian Tumour Analysis' and a section titled 'Information about IOTA' which provides a detailed description of the group's history and current research activities.

IOTA 2013 International Ovarian Tumour Analysis

[Home](#)
[IOTA info](#)
[Certified Members](#)
[Congresses](#)
[Software](#)

Members area

User Name

Password

Remember Me

[Log in](#)

[Forgot your password?](#)
[Forgot your username?](#)

Information about IOTA

The International Ovarian Tumor Analysis (IOTA) group was formed in 1999 by Dirk Timmerman, Lil Valentin and Tom Bourne. Its first aim was to develop standardised terminology, and in 2000 IOTA published a consensus statement on terms, definitions and measurements to describe the sonographic features of adnexal masses that is now widely used today. IOTA now comprises one of a portfolio of studies examining many aspects of gynaecological ultrasonography and early pregnancy within a network of contributing centres throughout the world that are co-ordinated from KU Leuven.

Having agreed on standardised terminology the principal IOTA investigators prospectively studied a large cohort of patients with a persistent adnexal mass in several different clinical centres. This database and the close involvement of the civil engineering department at KU Leuven has enabled both previously developed prediction models to be tested and novel prediction models to be developed and externally validated. In this way IOTA has been able to refine the optimal approach to characterize adnexal pathology preoperatively.

Currently IOTA is engaged in several new studies. The group are studying the long-term behaviour of expectantly managed adnexal pathology (IOTA phase 5). This will answer important questions about complications and malignant transformation in masses that are left in situ. A number of studies are being carried out on masses that currently are difficult to classify even for the most experienced examiner. These studies involve the use of vascular imaging, proteomics, novel biomarkers and MRI to name but a few (IOTA phase 3). Finally a clinical trial is taking place in London (IOTA phase 4) to evaluate the performance of IOTA prediction models and rules in the hands of examiners with different levels of experience and training.

IOTA apps

IOTA models

Select your model

Lr1

Lr2

Simple rules

IOTA 2013
International Ovarian Tumour Analysis

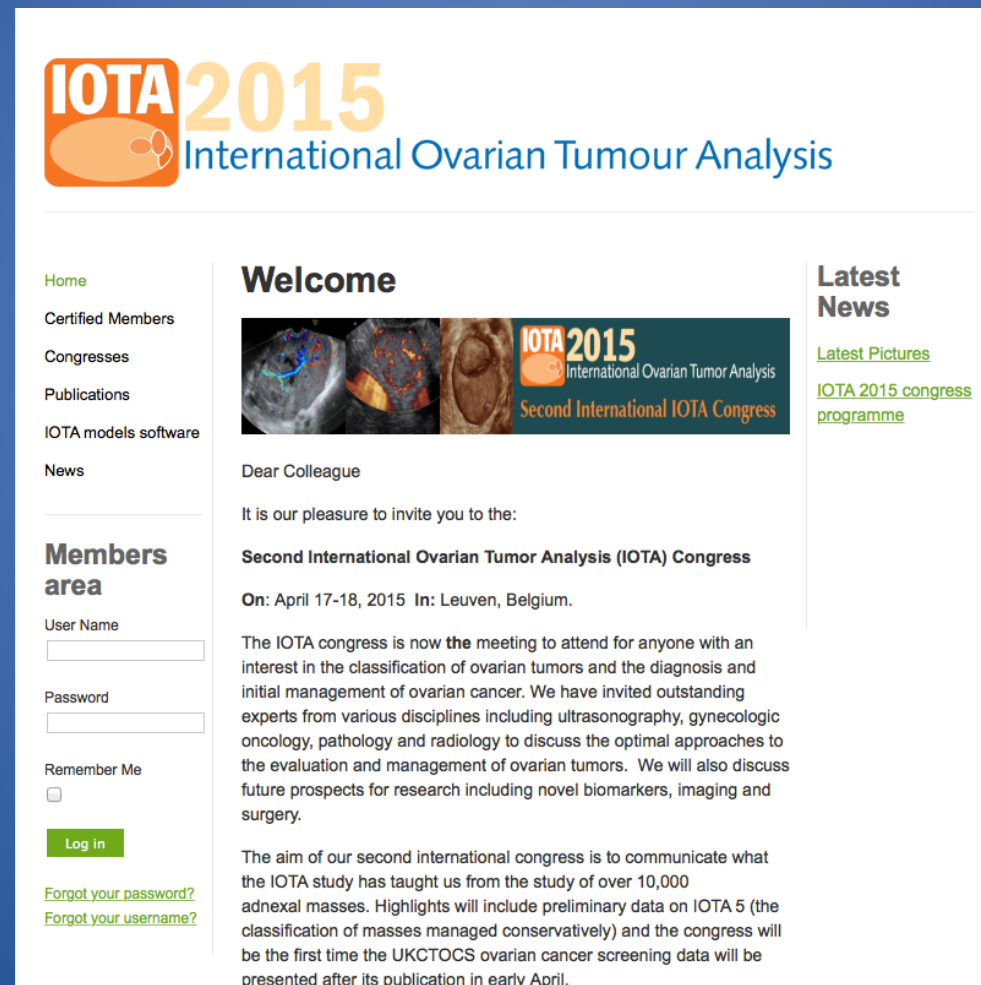
IOTA apps

Back Simple rules Info

Irregular solid tumor	<input type="checkbox"/> OFF
Presence of ascites	<input type="checkbox"/> OFF
At least four papillary structures	<input type="checkbox"/> OFF
Irregular multilocular-solid tumor with largest diameter $\geq 100\text{mm}$	<input type="checkbox"/> OFF
Strong blood flow	<input type="checkbox"/> OFF
Unilocular cyst	<input type="checkbox"/> OFF
Presence of solid components, where the largest solid component has a diameter $< 7\text{mm}$	<input type="checkbox"/> OFF
Presence of acoustic shadows	<input type="checkbox"/> OFF
Smooth multilocular tumor with largest diameter $< 100\text{mm}$	<input type="checkbox"/> OFF
No blood flow	<input type="checkbox"/> OFF

IOTA website

<http://www.iotagroup.org>



The screenshot shows the homepage of the IOTA 2015 website. At the top left is the IOTA 2015 logo, which includes the text 'IOTA 2015' in a stylized font and 'International Ovarian Tumour Analysis' below it. The main content area is divided into three columns. The left column contains a navigation menu with links for Home, Certified Members, Congresses, Publications, IOTA models software, and News. Below this is a 'Members area' with a login form containing fields for 'User Name' and 'Password', a 'Remember Me' checkbox, and a green 'Log in' button. There are also links for 'Forgot your password?' and 'Forgot your username?'. The middle column features a 'Welcome' section with a banner image showing ultrasound and pathology slides, and a text block that reads: 'Dear Colleague', 'It is our pleasure to invite you to the:', 'Second International Ovarian Tumor Analysis (IOTA) Congress', 'On: April 17-18, 2015 In: Leuven, Belgium.', 'The IOTA congress is now the meeting to attend for anyone with an interest in the classification of ovarian tumors and the diagnosis and initial management of ovarian cancer. We have invited outstanding experts from various disciplines including ultrasonography, gynecologic oncology, pathology and radiology to discuss the optimal approaches to the evaluation and management of ovarian tumors. We will also discuss future prospects for research including novel biomarkers, imaging and surgery.', and 'The aim of our second international congress is to communicate what the IOTA study has taught us from the study of over 10,000 adnexal masses. Highlights will include preliminary data on IOTA 5 (the classification of masses managed conservatively) and the congress will be the first time the UKCTOCS ovarian cancer screening data will be presented after its publication in early April.' The right column is titled 'Latest News' and contains links for 'Latest Pictures' and 'IOTA 2015 congress programme'.

GE Poster

GE Healthcare



Simple ultrasound-based features for the diagnosis of ovarian cancer.

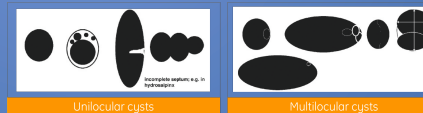
Ultrasound Obstet Gynecol 2008;31:681-90

Features for predicting a malignant tumor (M-features)			Features for predicting a benign tumor (B-features)		
M1	Irregular solid tumor		B1	Unilocular	
M2	Presence of ascites		B2	Presence of solid components where the largest solid component has a diameter < 7mm	
M3	≥ 4 papillary structures		B3	Presence of acoustic shadows	
M4	Irregular multilocular solid tumor with largest diameter ≥ 100 mm		B4	Smooth multilocular tumor with largest diameter < 100 mm	
M5	Very strong blood flow (color score 4)		B5	No blood flow (color score 1)	

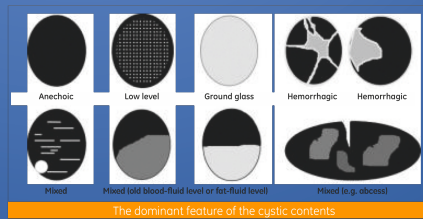
- If **one or more M-features apply** in the absence of a B-feature, the mass is classified as malignant.
- If **one or more B-features apply** in the absence of a M-feature, the mass is classified as benign.
- If **both M-features and B-features apply**, the mass cannot be classified.
- If **no features are present**, the mass cannot be classified.

IOTA terms

Ultrasound Obstet Gynecol 2000;16:500-5



www.gehealthcare.com



THANK YOU