Check for updates

Ultrasound Obstet Gynecol 2026
Published online in Wiley Online Library (wileyonlinelibrary.com). **DOI:** 10.1002/uog.70368.
This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

Ultrasonography (IOTA-ADNEX) *vs* magnetic resonance imaging (ADNEX MR) for diagnosing ovarian cancer in high-risk patients: a prospective study

I. M. DUEHOLM HJORTH[1,2], A. LEDGER[3], C. MØLLER[2], B. H. BECH[4], T. VAN DEN BOSCH[3,5] and O. MOGENSEN[1,2]

[1]*Department of Clinical Medicine, Aarhus University (AU), Aarhus, Denmark;* [2]*Department of Gynecology and Obstetrics, Aarhus University Hospital (AUH), Aarhus, Denmark;* [3]*Department of Development and Regeneration, Katholieke Universiteit Leuven (KU Leuven), Leuven, Belgium;* [4]*Department of Public Health, Aarhus University (AU), Aarhus, Denmark;* [5]*Department of Gynecology and Obstetrics, University Hospitals Leuven (UZ Leuven), Leuven, Belgium*

KEYWORDS: adnexal disease; cancer early diagnosis; diagnostic imaging; magnetic resonance imaging; ovarian cancer; ovarian cysts; ovarian neoplasms; postmenopausal; premenopausal; ultrasonography

ABSTRACT

Objectives *To systematically validate and compare ultrasonography, using the ultrasound-based International Ovarian Tumor Analysis – Assessment of Different NEoplasias in the adneXa (IOTA-ADNEX) model, with magnetic resonance imaging (MRI), using the MRI-based ADNEX MR scoring system, as second-line imaging modalities for estimating the risk of adnexal malignancy in patients identified as being at risk of malignancy on first-line ultrasound examination.*

Methods *This was a prospective, single-center diagnostic accuracy study designed as a head-to-head comparison. All patients referred to a tertiary referral center at Aarhus University Hospital, Aarhus, Denmark, for suspected adnexal malignancy on first-line imaging between May 2021 and December 2022 were offered second-line diagnostic testing. This comprised both a systematic expert ultrasound examination, including IOTA-ADNEX risk estimation, and a systematic MRI scan with ADNEX MR scores assigned by expert radiologists. The imaging assessments were performed prospectively, with ultrasound examiners and radiologists blinded to the results of other imaging modalities and to the reference standard (tumor outcome). The reference standard was a histopathological diagnosis of the primary adnexal mass or, in a small number of cases, clinical follow-up. Borderline tumors, invasive adnexal malignancy and metastases to the adnexa were grouped as malignancies. Diagnostic performance of the IOTA-ADNEX model, ADNEX MR scoring system and CA 125 for predicting malignancy was evaluated using the area under the receiver-operating-characteristics curve (AUC), and AUCs were compared using DeLong's test. Diagnostic metrics were estimated at clinically relevant cut-offs and scores. Agreement between modalities was assessed for the identification of morphological features and overall risk estimation using Cohen's kappa statistics, intraclass correlation coefficients (ICC) and Bland–Altman plots. For the IOTA-ADNEX model, calibration and the ability to discriminate between tumor subtypes were evaluated.*

Results *The included cohort comprised 342 patients (342 lesions analyzed). In the final cohort, 78.1% of patients were postmenopausal and the overall prevalence of malignancy was 58.8%. The AUC for distinguishing patients with benign tumors from those with malignant tumors was 0.96 (95% CI, 0.94–0.98) for the IOTA-ADNEX model (with or without CA 125) compared with an AUC of 0.93 (95% CI, 0.91–0.96) for ADNEX MR. Agreement between ultrasound and MRI ranged from moderate to substantial for key morphological features ($\kappa = 0.46–0.75$) and from good to excellent for lesion-size measurements (ICC = 0.78–0.92). The IOTA-ADNEX model performed similarly to the ADNEX MR scoring system regardless of lesion morphology or size. The IOTA-ADNEX model had good calibration. Furthermore, its multinomial discriminative ability between tumor subtypes was generally high, although performance was reduced when distinguishing borderline tumors from Stage-I invasive malignancy (AUC, 0.71 (95% CI, 0.56–0.82)).*

Conclusions *The IOTA-ADNEX model and ADNEX MR scoring system demonstrated comparable diagnostic accuracy for differentiating benign from malignant adnexal masses in this study. Results appeared to be*

Correspondence: Dr I. M. Dueholm Hjorth, Palle Juul Jensens Boulevard 99, 8200 Aarhus, Denmark (e-mail: imhjorth@gmail.com)

Accepted: 25 September 2026

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

consistent when stratified by lesion morphology. Both modalities may be used for second-line assessment of masses deemed at risk of malignancy in the first-line ultrasound examination, depending on resources in specific centers. © *2026 The Author(s). Ultrasound in Obstetrics & Gynecology published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.*

INTRODUCTION

Accurate preoperative diagnosis is essential for planning the management of patients with adnexal masses[1,2]. When adnexal lesions are suspicious for malignancy on first-line ultrasound examination, patients should be offered referral for a second-line assessment to confirm, substantiate or refute the first-line findings[2–7]. Depending on the protocol of the center, the second-line examination may be expert ultrasonography or magnetic resonance imaging (MRI)[4,8–13]. Lesions deemed malignant based on imaging should be managed in gynecological oncology centers[14,15], whereas benign lesions may be managed conservatively[4,16–18] or with minimally invasive intervention to reduce morbidity and preserve fertility[19–21]. Furthermore, preoperative second-line assessment enables improved patient counseling and may help estimate the time, expertise and resources required for surgery. A previous randomized controlled trial has demonstrated better subsequent clinical management outcomes (i.e. fewer major surgeries and shorter hospital stays) when second-line ultrasound examinations are performed by ultrasound experts rather than non-expert examiners[22]. Decision-making at ultrasound or MRI can be supported by estimating the risk of malignancy using prediction models such as the Assessment of Different NEoplasias in the adneXa (ADNEX) model with ultrasound terms[23] according to the International Ovarian Tumor Analysis (IOTA) group (IOTA-ADNEX model)[4,24–27], or the international scoring system based on MRI features with diffusion-weighted imaging (DWI) (ADNEX MR scoring system)[28–30]. Ultrasound has exceedingly high resolution for the assessment of morphology, whereas MRI provides good soft-tissue contrast and, with DWI, allows indirect evaluation of tissue microstructure and cellularity.

Several guidelines recommend MRI for the second-line evaluation of masses identified to be at risk of malignancy on the first-line ultrasound examination[6,7,31,32]. However, MRI is not always available, is costly and resource-intensive and may cause anxiety and discomfort for patients[33]. A recent systematic review noted the absence of studies directly comparing standardized ultrasound and standardized MRI (i.e. IOTA-ADNEX *vs* ADNEX MR models) for differentiating between benign and malignant masses within the same patient population[34]. The few existing studies comparing MRI and ultrasound in the same patient cohort are relatively small, use mainly subjective assessment rather than standardized, reproducible diagnostic models and have yielded conflicting conclusions[13,34–43].

The main objective of this study was to validate and compare expert ultrasound using the IOTA-ADNEX model with MRI using the ADNEX MR scoring system, as second-line imaging modalities for differentiating benign from malignant adnexal lesions.

METHODS

Study design and setting

This was a prospective, single-center study of consecutively enrolled patients conducted from May 2021 to December 2022 at Aarhus University Hospital, Aarhus, Denmark, a tertiary referral center for gynecological oncology. All patients in the Central Denmark Region with suspected adnexal malignancy on first-line ultrasound are referred to this center. The study was a systematic head-to-head comparison of the IOTA-ADNEX model and the ADNEX MR scoring system that included all patients referred for second-line imaging owing to suspected adnexal malignancy on first-line ultrasound. The results of the first-line ultrasound examinations performed at the referring hospitals are described separately in a multicenter prospective study by our group[44]. The present study adheres to the Standards for Reporting Diagnostic Accuracy Studies (STARD) guidelines for reporting diagnostic accuracy studies and the Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis (TRIPOD) statement for reporting the development and validation of risk-prediction models (Appendices S1 and S2)[45,46]. The protocol was approved by the Central Denmark Region Ethical Committee as a quality improvement initiative (approval number: 1-10-72-1-21), and the study was registered in the internal registry of the Central Denmark Region and on ClinicalTrials.gov (NCT05842629). All patients provided written informed consent to participate. The study was conducted in accordance with the Declaration of Helsinki[47] and the European Union General Data Protection Regulation (GDPR).

Patient selection

Consecutive patients were referred to the onco-gynecological department at Aarhus University Hospital for further evaluation based on the results of a non-expert ultrasound examination performed in a general gynecological setting. Clinical suspicion of adnexal malignancy on first-line examination by non-expert ultrasound examiners was based on a Risk of Malignancy Index (RMI) ≥ 200 or, after consultation with the onco-gynecological department, on the suspicion of malignancy according to the ADNEX model ($> 5\%$ risk) or subjective ultrasound assessment. The inclusion criterion was referral for suspected new adnexal malignancy. Exclusion criteria were not providing informed consent, failure to attend and complete both examinations, previous or concurrent pelvic malignancy and a pre-existing diagnosis of malignant disease unrelated to the adnexal mass under investigation (except basal cell carcinoma of the skin), as well as concurrent pregnancy and age < 18 years.

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Index tests and imaging protocols

The second-line ultrasound examination and MRI scan were performed on the same day, prior to surgery, biopsy or surgical sampling.

Ultrasound (IOTA-ADNEX)

An IOTA-certified medical doctor (I.M.D.H.) with a special interest in gynecological ultrasound performed the ultrasound examinations using a Voluson E10 ultrasound machine (GE Healthcare, Zipf, Austria) with a transvaginal probe (4–9 MHz) and a transabdominal probe (2–8 MHz). At least 10 representative videoclips, with and without Doppler, together with three-dimensional (3D) volumes of the uterus and adnexa, as well as pelvic and abdominal overview images, were systematically acquired using transvaginal and transabdominal ultrasonography and saved in Astraia software (Astraia GmbH, Munich, Germany). Ultrasound findings were reported using a form for systematic classification of ultrasound features according to the IOTA terminology[23,48] (Appendix S3) and were integrated and saved in the patient file. Additionally, the IOTA-ADNEX risk estimates for probabilities of benign, borderline, Stage-I cancer, Stage-II–IV cancer and secondary metastatic tumors were calculated automatically in the form. Previous studies have shown good interobserver agreement for most variables included in the ADNEX model[49,50]. Within 1 week after imaging, the recorded videoclips, images and 3D volumes were reviewed by an IOTA-certified ultrasound examiner (M.D.) with European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) Level-III expertise[51], who confirmed the original ultrasound assessments without modification. All ultrasound examinations and assessments were performed prospectively, with examiners (I.M.D.H., M.D.) blinded to the results of other imaging modalities and to the reference standard (tumor outcome). Details of the IOTA-ADNEX model, along with IOTA-ADNEX formulae, are provided in Appendix S4.

Magnetic resonance imaging (ADNEX MR)

MRI was carried out using a 1.5-Tesla (T) or 3-T scanner (Siemens Healthineers, Erlangen, Germany), with a Body 18 coil. Patients were scanned with an empty bladder, and 1 mL of glucagon was administered intramuscularly prior to initiation of the scan to reduce artifacts caused by intestinal movements.

The MRI protocol included T1-weighted and T2-weighted sequences, as well as axial DWI with a 6-mm slice thickness and a b-value of 1000 s/mm^2, with calculation of corresponding apparent diffusion coefficient (ADC) values.

T2-weighted sequences (slice thickness, 4–5 mm) were acquired in axial and sagittal planes. An axial 3D T1-weighted Dixon VIBE sequence was used to scan the small pelvis and adnexal masses. The upper abdomen was included in the scan when the adnexal mass extended outside the small pelvis. No gadolinium-based contrast agents were administered, in accordance with the protocols of the local department of radiology owing to concerns for patient safety and potential side effects of gadolinium, time and resource limitations and the center's experience of similar diagnostic performance using contrast- and non-contrast MRI. Moreover, this represents a feasible, non-invasive diagnostic MRI technique. This study employed diffusion-weighted MRI with the ADNEX MR scoring system, without administration of contrast. In accordance with a previously reported model[30], true diffusion restriction was defined qualitatively as high signal intensity on high b-value DWI images and low signal intensity on an ADC map. Signal intensity of the solid tissue on T2-weighted MRI was defined relative to skeletal muscles. Two radiologists (E.M., B.B.) specializing in pelvic MRI prospectively and independently described the MRI findings systematically. Any discrepancies between their assessments were resolved by adjudication. A standardized form (Appendix S5) was used, in which morphological features and signal intensities, subjective assessment and scoring of the adnexal lesions using the ADNEX MR model (Appendix S6) were recorded and used to estimate risk categories analogous to IOTA-ADNEX risk estimates. The evaluation was performed blinded to the results of the other diagnostic tests, and, by design, to the tumor outcome (reference standard).

CA 125

Serum levels of CA 125 (analyzed using electrochemiluminescence immunoassay, reported in kU/L) were measured routinely at the time of diagnosis of the adnexal mass (within 14 days of second-line imaging, before surgery).

Reference standard

The reference standard was a histopathological diagnosis of the primary adnexal mass following surgical excision, biopsy or cytology; the latter served as a sufficient reference standard only when it confirmed malignancy originating from the female genitalia. Twenty-four patients diagnosed with a benign tumor on imaging did not undergo surgery; these patients were managed expectantly owing to a low risk of malignancy determined on both expert ultrasound and expert MRI, together with being asymptomatic and/or the presence of patient comorbidities. The patients who were managed expectantly were followed up with ultrasound and clinical examinations for at least 1 year from the completion of imaging; the tumors of these patients were considered benign if no progression in imaging features or other signs of malignancy were observed within 1 year of follow-up. All histopathological specimens underwent centralized histopathological review by pathologists specialized in gynecological histopathology. Histopathological outcomes were classified according to the World Health Organization criteria[52], and the stage of malignancy for primary adnexal malignancy

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

was determined according to the International Federation of Gynecology and Obstetrics (FIGO) classification[53] when surgery was performed without prior chemotherapy. Otherwise, the stage of malignancy was determined by onco-gynecologists based on available imaging and histopathological results. When more than one histopathological diagnosis was made for the same mass, or if several masses were present, the reference standard was based on the worst tumor outcome in terms of patient prognosis (i.e. first invasive malignancy prioritized if present, followed by borderline ovarian tumors, followed by benign histopathological diagnoses). If several benign lesions were present, the primary/top diagnosis recorded in the histopathology report and electronic medical journal (i.e. A-diagnosis) was used. The reference standard (tumor outcome) was determined blinded to the results of the ultrasound and MRI examinations (index tests).

Data management

Ultrasound and MRI data were recorded prospectively. Data collection and management were handled in accordance with the GDPR using Research Electronic Data Capture (REDCap; https://project-redcap.org/), a secure web application for building and managing online surveys and databases[54,55]. Index test data were retrieved from the patient files and transferred to the secure REDCap database along with data on patient symptoms, surgeries, treatment decisions, histopathology and follow-up data.

Statistical analysis

The sample size calculation is described in Appendix S7. The study was powered prospectively to detect a difference in specificity using a McNemar framework, under the hypothesis that MRI would demonstrate increased specificity for detecting malignancy at a fixed sensitivity. A predefined statistical analysis plan was followed.

For the primary analysis, the reference standard for each mass was dichotomized as benign or malignant. Malignant lesions were defined as primary invasive adnexal malignancy, primary ovarian borderline tumors or metastases to the adnexa, in accordance with the protocols of the IOTA-ADNEX and ADNEX MR development studies (Appendices S4 and S6) as well as current international consensus recommendations for the management of ovarian malignancy[56,57]. To construct 2×2 contingency tables, true-positive, false-positive, true-negative and false-negative findings were determined by dichotomizing ADNEX MR scores at ≥ 2, ≥ 3, ≥ 4 or $= 5$, as defined in the original model development study. Likewise, IOTA-ADNEX risk estimates were dichotomized at $\geq 10\%$, $\geq 20\%$, $\geq 30\%$, $\geq 40\%$, $\geq 50\%$ or $\geq 75\%$, with values at or above each threshold classified as malignant. Diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value were calculated for each of the abovementioned thresholds. Receiver-operating-characteristics (ROC) curves were constructed to determine the performance of the IOTA-ADNEX model with or without CA 125, the ADNEX MR model and CA 125 alone for predicting malignancy. For the ordinal ADNEX MR score (categories 2–5), the categories were plotted as categorical points of sensitivity as a function of 1 – specificity on the graph. The area under the ROC curve (AUC) was calculated with 95% CI. Pairwise comparisons of AUCs were performed using DeLong's test[58]. For the IOTA-ADNEX model, calibration curves were constructed using locally estimated scatterplot smoothing (LOESS), and observed-to-expected ratios were calculated[59,60]. Misclassified cases were analyzed descriptively. There were no missing data for the 342 included patients.

Agreement between ultrasound and MRI was assessed using Cohen's kappa statistics for nominal variables and weighted kappa for ordinal variables. The Landis and Koch scale was followed for interpreting kappa statistics (poor, < 0; slight, 0–0.20; fair, 0.21–0.40; moderate, 0.41–0.60; substantial, 0.61–0.80; almost perfect, 0.81–1.00)[61]. To assess agreement for continuous variables (i.e. lesion size and size of the largest solid component), Bland–Altman plots were computed to detect systematic bias, and the intraclass correlation coefficient (ICC) was used to evaluate consistency between the imaging modalities. ICC was interpreted according to Koo and Li (poor, < 0.50; moderate, 0.50–0.75; good, > 0.75–0.90; excellent, > 0.90)[62].

A secondary analysis was performed for the combined use of imaging methods, in which an ADNEX MR score of ≥ 4 or an IOTA-ADNEX (without CA 125) risk estimate of $\geq 10\%$, $\geq 20\%$, $\geq 30\%$, $\geq 40\%$ or $\geq 50\%$ indicated a positive index test.

In a prespecified subgroup analysis, AUCs were evaluated in subgroups defined by sonographic lesion characteristics (solid ($\geq 80\%$ solid), yes or no; size of solid component ≥ 2 cm, yes or no; largest diameter ≥ 10 cm, yes or no).

Lastly, a sensitivity analysis of the diagnostic performance of IOTA-ADNEX and ADNEX MR models, excluding the patients managed expectantly, was performed.

Statistical analysis was performed using Stata version 17.0 (StataCorp LLC, College Station, TX, USA) and R version 4.4.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

A total of 380 patients were referred to Aarhus University Hospital with suspected adnexal malignancy from May 2021 to December 2022 (Figure 1). Twelve patients who were unable to attend the examinations owing to logistical constraints or comorbidities or who did not provide consent were excluded. Therefore, 368 patients were eligible for inclusion. Subsequently, 25 (6.8%) patients were excluded because they were unable to complete the systematic MRI scan owing to anxiety ($n = 9$), a pacemaker ($n = 6$), pain ($n = 3$), abdominal circumference ($n = 1$) or other reasons ($n = 6$). We excluded one further

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

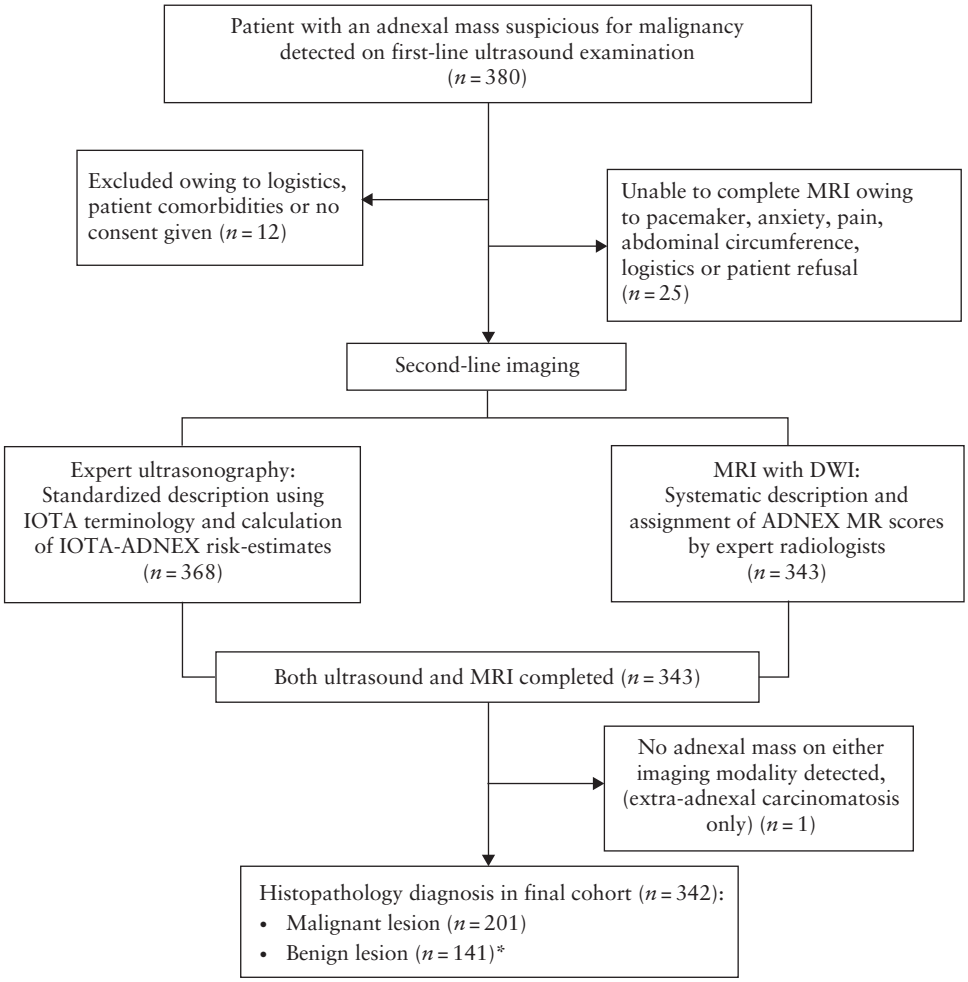


Figure 1 Flowchart showing inclusion of participants referred for second-line imaging after detection of adnexal mass suspicious for malignancy on first-line ultrasound who underwent both ultrasound and magnetic resonance imaging (MRI) examinations for second-line assessment. *Tumor outcome was obtained by follow-up confirming a benign outcome with no progression in 24 patients who were managed expectantly. ADNEX, Assessment of Different NEoplasias in the adneXa; ADNEX MR, MRI scoring system for adnexal masses; DWI, diffusion-weighted imaging; IOTA, International Ovarian Tumor Analysis.

patient with only extra-adnexal carcinomatosis, in whom an adnexal mass was not visualized on either of the second-line imaging assessments. The final study cohort consisted of 342 women who completed both a systematic MRI scan and an expert ultrasound examination. Patients were referred from secondary referral hospitals in general gynecological settings ($n = 265$), from non-gynecological hospital departments ($n = 37$), private gynecological clinics ($n = 21$) or following direct contact from a primary care physician ($n = 19$). Tumor outcome was obtained by surgical excision in 252 patients, biopsy in 54 patients, cytology in 12 patients and through follow-up confirming a benign outcome with no progression in 24 (7.0%) patients who were managed expectantly.

The histopathological outcome of the primary adnexal lesion in each patient and the FIGO stage of the malignancies are shown in Table 1 and Table S1, respectively. Malignancy was diagnosed in 201 (58.8%) patients, of whom 30 had a borderline ovarian tumor and 14 had metastatic malignancy. Table 2 presents an overview of patient characteristics, IOTA-ADNEX ultrasound features and ADNEX MR classification according to the reference standard. The median age was 65.6 (interquartile range, 53.4–74.1) years, and most patients were postmenopausal (267/342 (78.1%)).

Diagnostic performance of IOTA-ADNEX *vs* diffusion-weighted MRI (without contrast) using ADNEX MR

The diagnostic performance of IOTA-ADNEX (with and without CA 125), ADNEX MR and CA 125 alone is compared in Figure 2, with ADNEX MR score cut-offs shown as categorical points. The AUC of IOTA-ADNEX (with or without CA 125) for distinguishing patients with benign tumors from those with malignant tumors was 0.96 (95% CI, 0.94–0.98), compared with 0.93 (95% CI, 0.91–0.96) for ADNEX MR. The difference in AUC between IOTA-ADNEX without CA 125 and ADNEX MR was 0.023 (95% CI, −0.002 to 0.048). CA 125 alone had an AUC of 0.79 (95% CI, 0.74–0.84), while IOTA-ADNEX with or without CA 125 had similar AUCs. The results were consistent in the sensitivity

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 1 Histopathological outcome (final diagnosis) of primary adnexal lesion in each patient referred for second-line imaging owing to suspected adnexal malignancy

Outcome	*All patients (n = 342)*
Benign	141 (41.2)
Managed expectantly without suspicion of malignancy*	24 (7.0)
Mature teratoma	10 (2.9)
Fibroma	14 (4.1)
Serous cystadenoma/unspecified non-physiological ovarian cyst	15 (4.4)
Mucinous cystadenoma	10 (2.9)
Seromucinous cystadenoma	1 (0.3)
Serous cystadenofibroma	16 (4.7)‡
Mucinous cystadenofibroma	2 (0.6)
Endometriotic cyst	11 (3.2)
Fibrothecoma	8 (2.3)
Brenner tumor (benign)	6 (1.8)
Simple cyst (not otherwise specified)	8 (2.3)
Adenofibroma	1 (0.3)
Struma ovarii	4 (1.2)
Inflammation/infection	6 (1.8)
Other†	5 (1.5)
Malignant	201 (58.8)
Borderline ovarian tumor	30 (8.8)
Serous	18 (5.3)
Mucinous	10 (2.9)
Seromucinous	2 (0.6)
Invasive adnexal malignancy	157 (45.9)
Epithelial	
Serous adenocarcinoma incl. STIC	108 (31.6)§
Mucinous adenocarcinoma	12 (3.5)
Endometrioid adenocarcinoma	3 (0.9)
Clear-cell adenocarcinoma	11 (3.2)
Brenner tumor (malignant)	1 (0.3)
Low or undifferentiated carcinoma	3 (0.9)
Carcinosarcoma	4 (1.2)
Ovarian carcinoma (unspecified)	3 (0.9)
Other	
Granulosa-cell tumor	5 (1.5)
Germ-cell carcinoma	1 (0.3)
Squamous-cell carcinoma	2 (0.6)
Carcinoid tumor of the ovary	1 (0.3)
Thyroid carcinoma in a mature teratoma	1 (0.3)
Adenocarcinoma signet-ring goblet cell	1 (0.3)
Sarcoma	1 (0.3)
Metastasis to the adnexa	14 (4.1)

Data are presented as *n* (%). *Followed-up for at least 1 year with sequential clinical and imaging examinations with no signs of malignancy. †Including schwannoma, bizarre leiomyoma and endometriosis, and three cases of uterine leiomyoma. ‡One case also demonstrated ectopic adrenal tissue. §Two cases were low grade serous adenocarcinoma. incl., including; STIC, serous tubal intraepithelial carcinoma.

analysis which excluded the 24 patients managed expectantly (Table S2).

Table 3 presents the diagnostic metrics of IOTA-ADNEX (without CA 125) and ADNEX MR at various cut-off values. The estimated diagnostic metrics using IOTA-ADNEX with CA 125 were similar and are provided in Table S3. The sensitivity of IOTA-ADNEX without CA 125 at a cut-off of 30% was 96% (95% CI, 92–98%), with a corresponding specificity of 73% (95% CI, 65–80%). Comparable with this, ADNEX MR at a cut-off score of 4 demonstrated a sensitivity of 96% (95% CI, 92–98%) and a specificity of 76% (95% CI, 68–83%) (Table 3). IOTA-ADNEX without CA 125 at a cut-off of 10% had a sensitivity of 99% (95% CI, 96–100%) with a specificity of 50% (95% CI, 41–58%). In comparison, ADNEX MR at a cut-off score of 3 had a sensitivity of 100% (95% CI, 98–100%) with a specificity of 42% (95% CI, 34–50%). Accuracy increased for IOTA-ADNEX (with or without CA 125) up to a cut-off of 50% and for ADNEX MR up to a cut-off score of 4. At a cut-off of 50%, IOTA-ADNEX without CA 125 had an accuracy of 89% (95% CI, 85–92%), while ADNEX MR at a cut-off score of 4 had an accuracy of 87% (95% CI, 83–91%). We found comparable specificity between ADNEX MR at a cut-off score of 5 and IOTA-ADNEX without CA 125 at 75%, with higher sensitivity for IOTA-ADNEX. The observed risks of malignancy at ADNEX MR scores of 3, 4 and 5 were 15.8%, 65% and 97%, respectively (Table 3).

Misclassified cases

An overview of misclassified cases at different thresholds showed that the majority (65.8% (25/38) with IOTA-ADNEX cut-off of 30%; 64.7% (22/34) with an ADNEX MR cut-off score of 4) of false-positive cases were benign solid tumors and that most of the missed malignancies were borderline ovarian tumors (55.6% (5/9) with IOTA-ADNEX cut-off of 30%; 66.7% (6/9) with an ADNEX MR cut-off score of 4) or rare tumors (Table S4). Several of the false-positive cases were characterized by the presence of degeneration or the concomitant presence of two types of benign tumor. Degenerated benign tumors comprised 13/22 false-positive solid tumors at the ADNEX MR cut-off score of 4, and 9/18 false-positive solid tumors at the IOTA-ADNEX cut-off of 40%.

Size and tumor type

A stratified analysis (Figure 3) showed that ADNEX MR and IOTA-ADNEX without CA 125 had similar performance regardless of lesion diameter (≥ 10 cm or < 10 cm), presence of a larger solid component (≥ 2 cm or < 2 cm) and whether the lesions were solid ($\geq 80\%$ solid tissue) or not.

Agreement between ultrasound and diffusion-weighted MRI (without contrast)

IOTA-ADNEX without CA 125 (cut-off of 10%) and ADNEX MR (cut-off score of 3) had moderate agreement ($\kappa = 0.59$ (95% CI, 0.48–0.70)) for diagnosing a mass as malignant or benign. IOTA-ADNEX without CA 125 (cut-off of 40%) and ADNEX MR (cut-off score of 4) had substantial agreement for classifying masses as malignant or benign ($\kappa = 0.69$ (95% CI, 0.61–0.77)). Agreement was also substantial for the presence of ascites

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 2 Patient characteristics and ultrasound and magnetic resonance imaging (MRI) features of primary adnexal lesion on second-line imaging, overall and according to histopathological outcome (final diagnosis)

Characteristic	*All patients* (n = *342*)	*Benign* (n = *141*)	*Malignant* (n = *201*)
Age (years)	65.6 (53.4–74.1)	59.4 (42.8–70.9)	68.5 (57.9–75.5)
Menopausal status			
Premenopausal	75 (21.9)	47 (33.3)	28 (13.9)
Postmenopausal	267 (78.1)	94 (66.7)	173 (86.1)
CA 125 (kU/L)	110 (32–520)	37 (19–95)	283 (70–963)
Ultrasound features			
Largest diameter (mm)	100 (60–153)	85 (60–140)	110 (60–160)
Number of loculi			
0–10	274 (80.1)	118 (83.7)	156 (77.6)
> 10	68 (19.9)	23 (16.3)	45 (22.4)
Solid component			
No solid component	45 (13.2)	41 (29.1)	4 (2.0)
Solid component present	297 (86.8)	100 (70.9)	197 (98.0)
Diameter of largest solid component (mm)*	50.0 (22.0–88.0)	21.5 (12.0–66.3)	60 (38.0–90.0)
Number of papillary projections (if solid component present)			
0	124/297 (41.8)	51/100 (51.0)	73/197 (37.1)
1	60/297 (20.2)	29/100 (29.0)	31/197 (15.7)
2	22/297 (7.4)	8/100 (8.0)	14/197 (7.1)
3	17/297 (5.7)	5/100 (5.0)	12/197 (6.1)
≥ 4	74/297 (24.9)	7/100 (7.0)	67/197 (34.0)
Presence of ascites			
No ascites	228 (66.7)	131 (92.9)	97 (48.3)
Ascites	114 (33.3)	10 (7.1)	104 (51.7)
Presence of acoustic shadows			
No acoustic shadows	201 (58.8)	38 (27.0)	163 (81.1)
Acoustic shadows	141 (41.2)	103 (73.0)	38 (18.9)
MRI features			
Non-adnexal lesion	3 (0.9)	3 (2.1)	0 (0)
Specific benign type (endometrioma, dermoid, fibroma)	56 (16.4)	56 (39.7)	0 (0)
Indeterminate (solid tissue present)	57 (16.7)	48 (34.0)	9 (4.5)
Suspicious for malignancy (suspicious solid tissue)	86 (25.1)	30 (21.3)	56 (27.9)
Highly suspicious for malignancy (suspicious solid tissue and presence of metastases)	140 (40.9)	4 (2.8)	136 (67.7)

Data are given as median (interquartile range), *n* (%) or *n*/*N* (%). *Calculated for 297 patients with present solid component.

(κ = 0.75 (95% CI, 0.67–0.82)) and number of loculi (weighted κ = 0.68 (95% CI, 0.61–0.75)), moderate for the presence of a solid component (κ = 0.46 (95% CI, 0.36–0.57)) and substantial for classifying lesions as solid (κ = 0.71 (95% CI, 0.63–0.79)) (Table S5). Regarding the largest diameter of the lesion, agreement between ultrasound and MRI was classified as excellent (ICC, 0.92 (95% CI, 0.90–0.94)). The ultrasound measurement of a lesion was, on average, 6.7 mm larger than the MRI measurement. Ultrasound and MRI had good agreement on the size of the largest solid component (ICC, 0.78 (95% CI, 0.72–0.83)). The Bland–Altman analysis for the solid component diameter showed a mean deviation of 8.63 (95% CI, 5.12–12.13) mm, with ultrasound measurements being systematically larger than MRI measurements.

Combined performance of IOTA-ADNEX without CA 125 and ADNEX MR models for predicting malignant histopathological outcome

The combined sensitivity of ultrasound and MRI, using an IOTA-ADNEX risk cut-off of 40%, or an ADNEX MR score of at least 4 to indicate a positive test, was 98% (95% CI, 94–99%), with a specificity of 67% (95% CI, 59–75%) (Table 4). This combination achieved an accuracy of 85% (95% CI, 81–89%). Combining an ADNEX MR score cut-off of 4 with IOTA-ADNEX cut-off of 10% resulted in a sensitivity of 100% (95% CI, 98–100%) and specificity of 45% (95% CI, 37–54%) for the detection of malignancy.

Pairwise discriminative ability of IOTA-ADNEX

IOTA-ADNEX demonstrated good discriminative ability between specific tumor types in this high-risk cohort, notably for differentiating between benign and borderline cases, as well as between benign and Stage-I invasive malignancy (Table 5). However, the discriminative performance of IOTA-ADNEX (with or without CA 125) was lower for distinguishing between borderline and Stage-I invasive malignancy (AUC, 0.71 (95% CI, 0.56–0.82)). The performance of IOTA-ADNEX, particularly without CA 125, was also reduced in discriminating between Stage-II–IV invasive primary adnexal malignancy *vs* metastasis to the adnexa. The ADNEX MR scoring system does not provide stratified risk estimates for specific tumor subtypes.

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

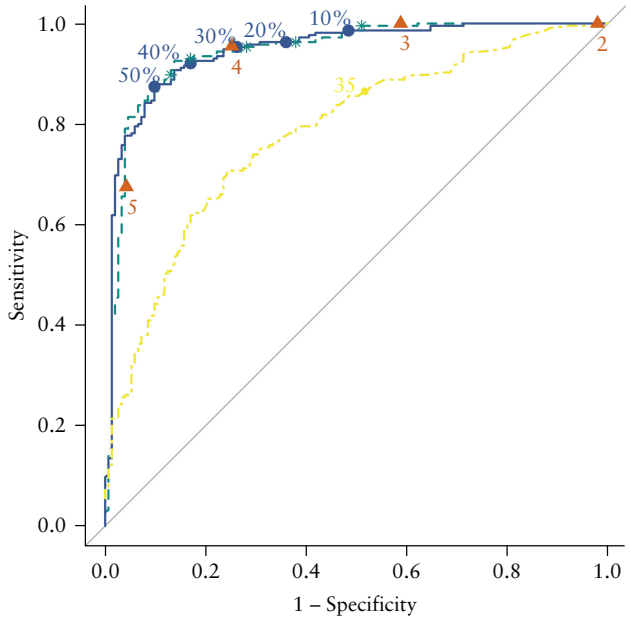


Figure 2 Receiver-operating-characteristic (ROC) curves of second-line imaging modalities for differentiating between benign and malignant adnexal lesions in patients deemed at high risk of adnexal malignancy on first-line imaging. ROC curves represent prediction of malignancy using IOTA-ADNEX with serum CA 125 (- - - -) and IOTA-ADNEX without CA 125 (——) models on ultrasound, categorical ADNEX MR scoring system (▲) on magnetic resonance imaging (MRI) and serum CA 125 alone (·——·). Risk of malignancy cut-offs are indicated for each model: ✳, IOTA-ADNEX with CA 125; ●, IOTA-ADNEX without CA 125; ▲, ADNEX MR categorical scores; ●, serum CA 125 (35 kU/L). ADNEX, Assessment of Different NEoplasias in the adneXa; ADNEX MR, MRI scoring system for adnexal masses; IOTA, International Ovarian Tumor Analysis.

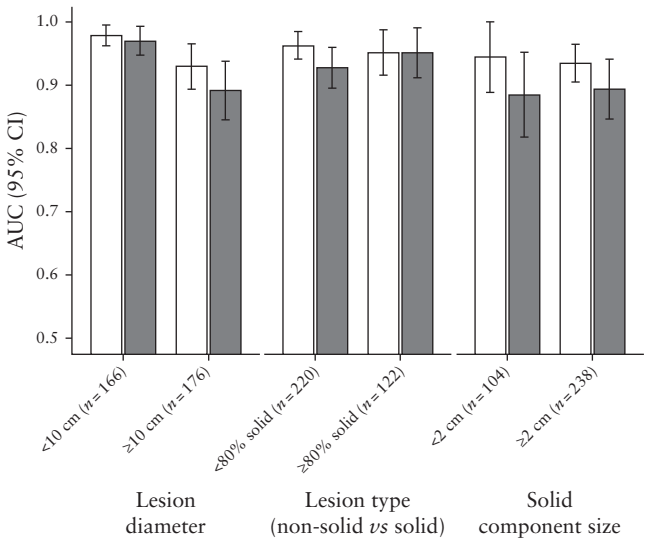


Figure 3 Areas under the receiver-operating-characteristics curve (AUCs) for the IOTA-ADNEX without serum CA 125 (□) and ADNEX MR (■) models, with 95% CI, for differentiating benign from malignant adnexal lesions, stratified by lesion morphology on ultrasound examination. ADNEX MR, magnetic resonance imaging scoring system for adnexal masses; IOTA-ADNEX, International Ovarian Tumor Analysis – Assessment of Different NEoplasias in the adneXa.

IOTA-ADNEX calibration

IOTA-ADNEX was well calibrated up to a risk of malignancy of approximately 40%. In patients with a risk > 40%, IOTA-ADNEX underestimated the risk of malignancy in this high-risk setting. Furthermore, IOTA-ADNEX without CA 125 was slightly better calibrated than IOTA-ADNEX with CA 125 (Figure 4, Figure S1). The observed-to-expected ratio for IOTA-ADNEX without CA 125 was 1.032 (95% CI, 0.945–1.128), slightly underestimating the risk. In contrast, for IOTA-ADNEX with CA 125 it was 0.989 (95% CI, 0.905–1.081), slightly overestimating the risk.

Comparison with model development cohorts

Our cohort had a larger proportion of postmenopausal patients (78.1%) than in the cohorts used for the development of the ADNEX MR (35.8%) and IOTA-ADNEX (41.1%) models (Table S6)[26,28]. The prevalence of malignancy was higher in our study (58.8%) than in the IOTA-ADNEX (32.6%), and ADNEX MR (18.8% (reported as 62/329 lesions)) development studies. Imaging findings in our study included more frequent solid components, larger solid components, more papillary projections and a higher frequency of acoustic shadows compared with findings reported in the development studies.

DISCUSSION

Expert ultrasound using the IOTA-ADNEX model and expert diffusion-weighted MRI (without contrast) using the ADNEX MR scoring system demonstrated comparable and high diagnostic performance in distinguishing malignant from benign adnexal masses in high-risk patients referred for second-line assessment with suspected adnexal malignancy. MRI and ultrasound were generally in agreement on morphological features. On either modality, most misclassified masses were solid, rare or borderline tumors. IOTA-ADNEX provided well-calibrated risk estimates. However, its ability to distinguish between subtypes of malignancy was reduced when differentiating borderline tumors from Stage-I invasive malignancy.

This study included a large, unselected consecutive cohort of patients deemed to be at risk of malignancy by first-line ultrasound, representative of clinical practice in onco-gynecological or imaging specialist centers and minimizing selection bias. Standardized, prospectively described imaging features using IOTA criteria for both ultrasound and MRI, combined with the use of internationally validated models with high reproducibility, enabled a systematic, head-to-head comparison of the two modalities. Moreover, bias was minimized by blinding the examiners to the findings from other imaging modalities and clinical outcomes. The completeness of the data further strengthens the validity of the study. Our study population included challenging lesions and had a relatively

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 3 Estimated diagnostic performance of the IOTA-ADNEX without CA 125 model and ADNEX MR scoring system for predicting malignant adnexal lesions at selected cut-offs

Modality (cut-off)	*Sensitivity (%)*	*Specificity (%)*	*PPV (%)*	*NPV (%)*	*Accuracy (%)*	*LR+*	*LR−*
ADNEX without CA 125 (10%)	99 (96–100)	50 (41–58)	74 (68–79)	97 (90–100)	79 (74–83)	1.97 (1.67–2.32)	0.02 (0.00–0.08)
ADNEX without CA 125 (20%)	97 (93–99)	62 (54–70)	79 (73–83)	93 (85–97)	82 (78–86)	2.57 (2.07–3.18)	0.06 (0.03–0.12)
ADNEX without CA 125 (30%)	96 (92–98)	73 (65–80)	83 (78–88)	92 (85–96)	86 (82–90)	3.54 (2.70–4.66)	0.06 (0.03–0.12)
ADNEX without CA 125 (40%)	93 (88–96)	83 (76–89)	89 (83–93)	89 (82–93)	89 (85–92)	5.44 (3.77–7.84)	0.09 (0.05–0.15)
ADNEX without CA 125 (50%)	88 (83–92)	91 (85–95)	93 (89–96)	84 (77–90)	89 (85–92)	9.55 (5.68–16.07)	0.13 (0.09–0.19)
ADNEX without CA 125 (75%)	77 (70–82)	98 (94–100)	98 (95–100)	75 (68–81)	85 (81–89)	36.01 (11.72–110.60)	0.24 (0.19–0.31)
ADNEX MR (score of 2)*	100 (98–100)	2 (0–6)	59 (54–65)	100 (29–100)	60 (54–65)	1.02 (1.00–1.05)	0.00 (0.00–0.89)
ADNEX MR (score of 3)†	100 (98–100)	42 (34–50)	71 (65–76)	100 (94–100)	76 (71–80)	1.72 (1.49–1.98)	0.00 (0.00–0.04)
ADNEX MR (score of 4)‡	96 (92–98)	76 (68–83)	85 (80–89)	92 (86–96)	87 (83–91)	3.96 (2.95–5.32)	0.06 (0.03–0.11)
ADNEX MR (score of 5)§	68 (61–74)	97 (93–99)	97 (93–99)	68 (61–74)	80 (75–84)	23.85 (9.04–62.96)	0.33 (0.27–0.41)

Data in parentheses are 95% CI. Risk of malignancy at each ADNEX MR score was 0% (*), 15.8% (†), 65% (‡) and 97% (§). Positive (PPV) and negative (NPV) predictive values depend on prevalence. ADNEX MR, magnetic resonance imaging scoring system for adnexal masses; IOTA-ADNEX, International Ovarian Tumor Analysis – Assessment of Different NEoplasias in the adneXa; LR+, positive likelihood ratio; LR−, negative likelihood ratio.

Table 4 Combined diagnostic performance of ultrasound and magnetic resonance imaging (MRI) using IOTA-ADNEX and ADNEX MR models for predicting malignant adnexal lesions

Cut-off	*Sensitivity (%)*	*Specificity (%)*	*PPV (%)*	*NPV (%)*	*Accuracy (%)*	*LR+*	*LR−*
ADNEX MR score ≥ 4 or IOTA–ADNEX ≥ 10%	100 (98–100)	45 (37–54)	72 (67–77)	100 (94–100)	77 (73–82)	1.83 (1.58–2.13)	0.00 (0.00–0.04)
ADNEX MR score ≥ 4 or IOTA–ADNEX ≥ 20%	99 (96–100)	53 (45–62)	75 (69–80)	97 (91–100)	80 (75–84)	2.12 (1.77–2.52)	0.02 (0.00–0.07)
ADNEX MR score ≥ 4 or IOTA–ADNEX ≥ 30%	99 (96–100)	61 (52–69)	78 (73–83)	97 (90–99)	83 (79–87)	2.53 (2.05–3.11)	0.02 (0.01–0.08)
ADNEX MR score ≥ 4 or IOTA–ADNEX ≥ 40%	98 (94–99)	67 (59–75)	81 (75–86)	95 (89–98)	85 (81–89)	2.99 (2.36–3.79)	0.04 (0.02–0.09)
ADNEX MR score ≥ 4 or IOTA–ADNEX ≥ 50%	97 (94–99)	72 (63–79)	83 (78–88)	94 (88–98)	87 (82–90)	3.42 (2.63–4.45)	0.04 (0.02–0.09)

Data in parentheses are 95% CI. ADNEX MR, MRI scoring system for adnexal masses; IOTA–ADNEX, International Ovarian Tumor Analysis – Assessment of Different NEoplasias in the adneXa; LR+, positive likelihood ratio; LR−, negative likelihood ratio; NPV, negative predictive value; PPV, positive predictive value.

large proportion of borderline tumors compared with the ADNEX MR development study[28], non-contrast-MRI study[30] and IOTA-ADNEX development study[26] (8.8% borderline tumors in the present study *vs* 3.6%, 4.0% and 5.7%, respectively). Most benign tumors in our study (71% (100/141)) were described as having a solid component on second-line ultrasonography.

The generalization of our results may be limited to high-risk settings with experienced examiners of MRI and ultrasound. MRI was performed without contrast following current institutional practice. Our findings apply to non-contrast MRI; contrast-enhanced MRI might perform differently. Contrast-enhanced MRI is resource-demanding, may cause complications and adverse effects and is contraindicated in certain patient groups[63]. While dynamic contrast-enhanced MRI may add functional information, previous studies have demonstrated that most adnexal masses can be accurately characterized using non-contrast sequences, particularly when combining T1- and T2-weighted imaging with

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 5 Pairwise areas under the receiver-operating-characteristics curve (AUCs) of IOTA-ADNEX model with and without CA 125 for discriminating between subgroups of ovarian tumor outcome

	AUC (95% CI)	
Pairwise distinction	*IOTA-ADNEX without CA 125*	*IOTA-ADNEX with CA 125*
Benign *vs* borderline	0.91 (0.83–0.96)	0.91 (0.83–0.96)
Benign *vs* Stage-I invasive malignancy	0.93 (0.86–0.97)	0.92 (0.85–0.96)
Benign *vs* Stage-II–IV invasive malignancy	0.97 (0.93–0.98)	0.97 (0.94–0.98)
Benign *vs* metastasis to the adnexa	0.98 (0.87–1.00)	0.98 (0.87–1.00)
Borderline *vs* Stage-I invasive malignancy	0.71 (0.56–0.82)	0.71 (0.56–0.82)
Borderline *vs* Stage-II–IV invasive malignancy	0.92 (0.84–0.96)	0.93 (0.86–0.97)
Borderline *vs* metastasis to the adnexa	0.98 (0.82–1.00)	0.98 (0.83–1.00)
Stage-I *vs* Stage II–IV invasive malignancy	0.87 (0.78–0.93)	0.91 (0.82–0.95)
Stage-I invasive malignancy *vs* metastasis to the adnexa	0.96 (0.81–0.99)	0.96 (0.82–0.99)
Stage II–IV invasive malignancy *vs* metastasis to the adnexa	0.61 (0.45–0.75)	0.75 (0.60–0.86)

IOTA-ADNEX, International Ovarian Tumor Analysis – Assessment of Different NEoplasias in the adneXa.

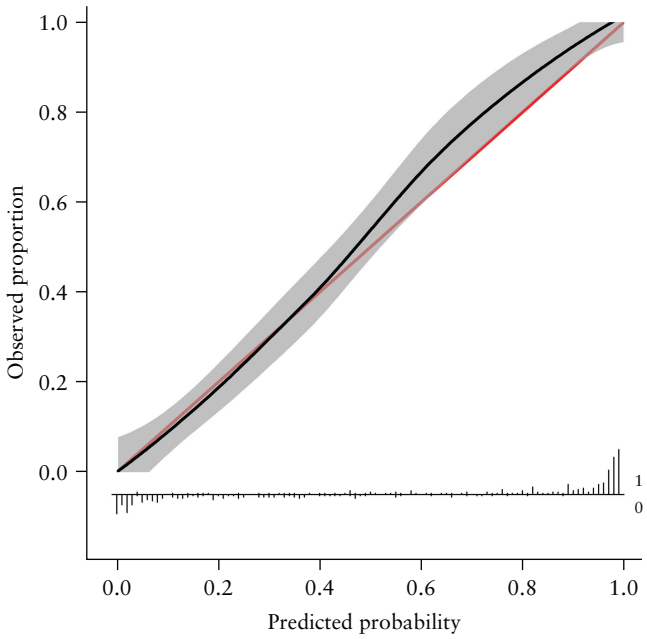


Figure 4 Calibration curve of IOTA-ADNEX without CA 125 model for prediction of malignancy in adnexal lesions ($n = 342$). ——, ideal; ——, flexible calibration (locally estimated scatterplot smoothing (LOESS)). IOTA-ADNEX, International Ovarian Tumor Analysis – Assessment of Different NEoplasias in the adneXa.

DWI[30,64]. Furthermore, the contrast enhancement-curve variable has shown inconsistent performance in validation studies[65–67]. The primary purpose of contrast in MRI is to characterize vascularity, permeability and microcirculation[68]. Likewise, the IOTA-ADNEX model does not include the functional ultrasound parameter, blood flow with Doppler, owing to subjectivity in interpreting color scores[69], nor does it incorporate contrast-enhanced ultrasound (CEUS). Future studies may evaluate how adding these promising tools for vascularity assessment (i.e. color Doppler, CEUS and contrast-enhanced MRI) may affect the classification of adnexal tumors. The inclusion of expectantly managed patients ($n = 24$) may have introduced differential verification bias, but excluding these patients did not alter the results.

The Ovarian-Adnexal Reporting and Data System (O-RADS) represents the American counterpart to ADNEX[70–72]. The O-RADS ultrasound system[73,74] is based on the IOTA datasets, while O-RADS MRI was developed in an external validation study of the ADNEX MR score[72]. Previous studies show concordance between O-RADS and IOTA-ADNEX[72,75], supporting the generalizability of our findings. One meta-analysis[76] and a recent study in 44 patients[42] comparing the use of O-RADS ultrasound and MRI systems found similar diagnostic performance for both techniques.

A recent systematic review highlighted the absence of head-to-head studies of IOTA-ADNEX and ADNEX MR within the same patients[34]. The review instead relied on indirect comparisons between separate IOTA-ADNEX and ADNEX MR studies[34]. Both models showed high pooled AUCs (0.97 (95% CI, 0.95–0.98) for IOTA-ADNEX and 0.98 (95% CI, 0.96–0.99) for ADNEX MR)[34]. The meta-analysis reported higher sensitivity for IOTA-ADNEX, consistent with our findings, but higher specificity for ADNEX MR. This may reflect differing MRI and ultrasound study populations. The few existing comparative diagnostic accuracy studies performed in the same patients used subjective assessment and, occasionally, IOTA LR2[39], IOTA Simple Rules[40] or non-validated morphological criteria, compared with subjective MRI assessment[36,39,40,77,78]. Subjective assessments increase interobserver variability and may limit generalizability compared with standardized methods. One study reported that subjective ultrasound assessment was more specific than subjective MRI assessment[13]. A Chinese study reported that IOTA-ADNEX, using a 15% risk cut-off, performed similarly to subjective MRI evaluation[41].

A low ADNEX cut-off in first-line triage may be needed to maximize sensitivity and facilitate the detection of early-stage malignancy[44,79]. Hence, reliable second-line diagnostics are required to improve specificity and limit overtreatment. The choice of second-line imaging modality may be influenced by examiner availability, reimbursement/health systems and logistical considerations. Ultrasound offers lower costs, shorter examination times and greater accessibility than MRI. Thus, our study may support second-line confirmatory imaging by an experienced

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

ultrasound examiner using IOTA-ADNEX. In a recent study, patients were more likely to prefer ultrasound examinations to MRI, but individual preferences varied[33]. The IOTA-ADNEX cut-off of 30% had high accuracy and yielded similar sensitivity and specificity to an ADNEX MR score of 4. The good calibration of IOTA-ADNEX underscores its usefulness for guiding decision-making, while also considering individual patient circumstances and priorities. MRI performed by radiologists specialized in pelvic MRI using ADNEX MR is an alternative option with similar diagnostic performance. In resource-limited settings, ultrasound may be the most cost-effective option.

This study did not identify any morphological subgroups in which ADNEX MR demonstrated a superior diagnostic performance. Our findings do not support the previously described recommendation to perform MRI for predominantly solid adnexal lesions, lesions with small solid components or lesions larger than 5–7 cm because of the presumed reduced accuracy of ultrasound for these lesion types[29]. MRI may be indicated when ultrasonography is limited by lesion location or adjacent anatomy[71], and for evaluating the resectability of advanced malignancies if ultrasound expertise is inadequate for this assessment[80,81]. IOTA-ADNEX achieved excellent diagnostic performance in distinguishing borderline from benign tumors but lacked precision in differentiating between Stage-I invasive malignancy and borderline tumors, and between metastasis to the adnexa and Stage-II–IV invasive malignancy. A stratified MRI-based risk score for distinguishing borderline from invasive tumors has yet to be developed. Our findings highlight the need for improved characterization of borderline tumors, solid tumors and rare tumor types.

To conclude, IOTA-ADNEX and ADNEX MR models performed equally well in diagnosing adnexal malignancy in consecutive patients referred for second-line imaging in our center. Our findings support using either ultrasound (with IOTA-ADNEX, with or without CA 125) or MRI (with ADNEX MR), when performed by experienced examiners, for second-line confirmatory assessment of adnexal masses deemed suspicious at first-line non-expert ultrasonography. Further optimization is needed to improve the assessment of solid, rare and borderline tumors.

ACKNOWLEDGMENTS

We are very grateful to the patients for participating, and to the Department of Gynecology and Obstetrics at Aarhus University Hospital for supporting the study. We are also thankful for the essential contributions from specialists in radiology with subspecialization in pelvic MRI, Dr Edvard Marinovskij and Dr Bettina Bak, as well as from a specialist in gynecology and obstetrics, Dr Margit Dueholm, Associate Professor, for their contributions to clinical MRI interpretation and classification and to ultrasound image review, respectively, as part of the management of the included patients, although they opted not to be co-authors. We thank the Department of Clinical Medicine at Aarhus University and the Danish Cancer Society for funding the study. Lastly, we acknowledge the valuable work of the IOTA and ADNEX MR research groups, on which this study is based.

REFERENCES

1. Menon U, Gentry-Maharaj A, Burnell M, et al. Ovarian cancer population screening and mortality after long-term follow-up in the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS): a randomised controlled trial. *Lancet*. 2021;397(10290):2182-2193.
2. Dodge JE, Covens AL, Lacchetti C, et al. Management of a suspicious adnexal mass: a clinical practice guideline. *Curr Oncol (Toronto, Ont)*. 2012;19(4):e244-e257.
3. Fischerova D, Zikan M, Dundr P, Cibula D. Diagnosis, treatment, and follow-up of borderline ovarian tumors. *Oncologist*. 2012;17(12):1515-1533.
4. Timmerman D, Planchamp F, Bourne T, et al. ESGO/ISUOG/IOTA/ESGE Consensus statements on the pre-operative diagnosis of ovarian tumours. *Ultrasound Obstet Gynecol*. 2021;58(1):148-168.
5. Sadowski EA, Rockall AG, Maturen KE, Robbins JB, Thomassin-Naggara I. Adnexal lesions: Imaging strategies for ultrasound and MR imaging. *Diagn Interv Imaging*. 2019;100(10):635-646.
6. Practice Bulletin No. 174: evaluation and management of adnexal masses. *Obstet Gynecol*. 2016;128(5):e210-e226.
7. Avesani G, Panico C, Nougaret S, Woitek R, Gui B, Sala E. ESR Essentials: characterisation and staging of adnexal masses with MRI and CT-practice recommendations by ESUR. *Eur Radiol*. 2024;34(12):7673-7689.
8. Fischerova D, Pinto P, Burgetova A, et al. Preoperative staging of advanced ovarian cancer: comparison between ultrasound, CT and WB-DWI/MRI (ISAAC). *Ultrasound Obstet Gynecol*. 2021;59(2):248-262.
9. Pinto P, Moro F, Alcázar JL, et al. Prediction of non-resectability in tubo-ovarian cancer patients using Peritoneal Cancer Index – a prospective multicentric study using imaging (ISAAC study). *Gynecol Oncol*. 2024;191:132-142.
10. Fischerova D, Burgetova A. Imaging techniques for the evaluation of ovarian cancer. *Best Pract Res Clin Obstet Gynaecol*. 2014;28(5):697-720.
11. Garcia Prado J, González Hernando C, Varillas Delgado D, et al. Diffusion-weighted magnetic resonance imaging in peritoneal carcinomatosis from suspected ovarian cancer: diagnostic performance in correlation with surgical findings. *Eur J Radiol*. 2019;121:108696.
12. Mikkelsen MS, Petersen LK, Blaakaer J, et al. Assessment of peritoneal metastases with DW-MRI, CT, and FDG PET/CT before cytoreductive surgery for advanced stage epithelial ovarian cancer. *Eur J Surg Oncol*. 2021;47(8):2134-2141.
13. Chacon E, Arraiza M, Manzour N, et al. Ultrasound examination, MRI, or ROMA for discriminating between inconclusive adnexal masses as determined by IOTA Simple Rules: a prospective study. *Int J Gynecol Cancer*. 2023;33(6):951-956.
14. Maringe C, Walters S, Butler J, et al. Stage at diagnosis and ovarian cancer survival: evidence from the International Cancer Benchmarking Partnership. *Gynecol Oncol*. 2012;127(1):75-82.
15. Woo YL, Kyrgiou M, Bryant A, Everett T, Dickinson HO. Centralisation of services for gynaecological cancers – a Cochrane systematic review. *Gynecol Oncol*. 2012;126(2):286-290.
16. AlcáZar JL, Castillo G, Jurado MA, GarcíA GLP. Is expectant management of sonographically benign adnexal cysts an option in selected asymptomatic premenopausal women? *Hum Reprod*. 2005;20(11):3231-3234.
17. Greenlee RT, Kessel B, Williams CR, et al. Prevalence, incidence, and natural history of simple ovarian cysts among women >55 years old in a large cancer screening trial. *Am J Obstet Gynecol*. 2010;202(4):373.e1-373.e9.
18. Froyman W, Landolfo C, De Cock B, et al. Risk of complications in patients with conservatively managed ovarian tumours (IOTA5): a 2-year interim analysis of a multicentre, prospective, cohort study. *Lancet Oncol*. 2019;20(3):448-458.
19. Rustamov O, Krishnan M, Roberts SA, Fitzgerald CT. Effect of salpingectomy, ovarian cystectomy and unilateral salpingo-oopherectomy on ovarian reserve. *Gynecol Surg*. 2016;13(3):173-178.
20. Lind T, Holte J, Olofsson JI, et al. Reduced live-birth rates after IVF/ICSI in women with previous unilateral oophorectomy: results of a multicentre cohort study. *Hum Reprod*. 2018;33(2):238-247.
21. Medeiros LR, Rosa DD, Bozzetti MC, et al. Laparoscopy versus laparotomy for benign ovarian tumour. *Cochrane Database Syst Rev*. 2009;2009(2):Cd004751.
22. Yazbek J, Raju SK, Ben-Nagi J, Holland TK, Hillaby K, Jurkovic D. Effect of quality of gynaecological ultrasonography on management of patients with suspected ovarian cancer: a randomised controlled trial. *Lancet Oncol*. 2008;9(2):124-131.
23. Timmerman D, Valentin L, Bourne TH, Collins WP, Verrelst H, Vergote I. Terms, definitions and measurements to describe the sonographic features of adnexal tumors: a consensus opinion from the International Ovarian Tumor Analysis (IOTA) Group. *Ultrasound Obstet Gynecol*. 2000;16(5):500-505.
24. Landolfo C, Ceusters J, Valentin L, et al. Comparison of the ADNEX and ROMA risk prediction models for the diagnosis of ovarian cancer: a multicentre external validation in patients who underwent surgery. *Br J Cancer*. 2024;130(6):934-940.
25. Wynants L, Timmerman D, Verbakel JY, et al. Clinical utility of risk models to refer patients with adnexal masses to specialized oncology care: multicenter external validation using decision curve analysis. *Clin Cancer Res*. 2017;23(17):5082-5090.
26. Van Calster B, Van Hoorde K, Valentin L, et al. Evaluating the risk of ovarian cancer before surgery using the ADNEX model to differentiate between benign, borderline, early and advanced stage invasive, and secondary metastatic tumours: prospective multicentre diagnostic study. *BMJ (Clin research ed)*. 2014;349:g5920.

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

27. Van Calster B, Valentin L, Froyman W, et al. Validation of models to diagnose ovarian cancer in patients managed surgically or conservatively: multicentre cohort study. *BMJ (Clin Res ed)*. 2020;370:m2614.
28. Thomassin-Naggara I, Aubert E, Rockall A, et al. Adnexal masses: development and preliminary validation of an MR imaging scoring system. *Radiology*. 2013;267(2):432-443.
29. Sadowski EA, Robbins JB, Rockall AG, Thomassin-Naggara I. A systematic approach to adnexal masses discovered on ultrasound: the ADNEx MR scoring system. *Abdominal Radiol (New York)*. 2018;43(3):679-695.
30. Sahin H, Panico C, Ursprung S, et al. Non-contrast MRI can accurately characterize adnexal masses: a retrospective study. *Eur Radiol*. 2021;31(9):6962-6973.
31. Abelone Sakse AR, Hartwell D, Kallfa E, et al. Håndtering af Ovarie Cyster, opdateret/supplerende guideline. Accessed August 25, 2020. https://static1.squarespace.com/static/5467abcce4b056d72594db79/t/58ed3a3ddb29d654c6cd634c/1491941952677/Cysteguideline.pdf
32. Ovarian cancer: recognition and initial management (CG122) - NICE UK. National Institute for Health and Care Excellence (NICE) endorsed by NHS England. Updated October 02, 2023. Accessed May 01, 2024, 2024. https://www.nice.org.uk/guidance/cg122/resources/ovarian-cancer-recognition-and-initial-management-pdf-35109446543557
33. Pinto P, Valentin L, Borčinová M, et al. Patient satisfaction with ultrasound, whole-body CT and whole-body diffusion-weighted MRI for pre-operative ovarian cancer staging: a multicenter prospective cross-sectional survey. *Int J Gynecol Cancer*. 2024;34(6):871-878.
34. Cui L, Xu H, Zhang Y. Diagnostic accuracies of the ultrasound and magnetic resonance imaging ADNEX scoring systems for ovarian adnexal mass: systematic review and meta-analysis. *Acad Radiol*. 2022;29(6):897-908.
35. Reuter M, Steffens JC, Schüppler U, et al. Critical evaluation of the specificity of MRI and TVUS for differentiation of malignant from benign adnexal lesions. *Eur Radiol*. 1998;8(1):39-44.
36. Rieber A, Nüssle K, Stöhr I, et al. Preoperative diagnosis of ovarian tumors with MR imaging: comparison with transvaginal sonography, positron emission tomography, and histologic findings. *AJR Am J Roentgenol*. 2001;177(1):123-129.
37. Huber S, Medl M, Baumann L, Czembirek H. Value of ultrasound and magnetic resonance imaging in the preoperative evaluation of suspected ovarian masses. *Anticancer research. Jul-Aug*. 2002;22(4):2501-2507.
38. Sohaib SA, Mills TD, Sahdev A, et al. The role of magnetic resonance imaging and ultrasound in patients with adnexal masses. *Clin Radiol*. 2005;60(3):340-348.
39. Shimada K, Matsumoto K, Mimura T, et al. Ultrasound-based logistic regression model LR2 versus magnetic resonance imaging for discriminating between benign and malignant adnexal masses: a prospective study. *Int J Clin Oncol*. 2018;23(3):514-521.
40. Crestani A, Theodore C, Levaillant JM, et al. Magnetic resonance and ultrasound fusion imaging to characterise ovarian masses: a feasibility study. *Anticancer Res*. 2020;40(7):4115-4121.
41. Hu Y, Chen B, Dong H, et al. Comparison of ultrasound−based ADNEX model with magnetic resonance imaging for discriminating adnexal masses: a multi-center study. *Front Oncol*. 2023;13:1101297.
42. Siddhartha N, Nimbal V, Lamani PU, Halkude T, Kolekar P. A comparison study of magnetic resonance imaging and ultrasonography in the evaluation of ovarian lesions with an emphasis on ovarian adnexal reporting and data system. *Cureus*. 2025;17(5):e83858.
43. Kinkel K, Lu Y, Mehdizade A, Pelte MF, Hricak H. Indeterminate ovarian mass at US: incremental value of second imaging test for characterization – meta-analysis and Bayesian analysis. *Radiology*. 2005;236(1):85-94.
44. Hjorth IMD, Bech BH, Ledger A, et al. Prospective external validation of ADNEX and RMI for estimating risk of malignancy in adnexal masses in general gynecological settings: Danish multicenter study. *Ultrasound Obstet Gynecol*. 2026;68(2):256-269.
45. Cohen JF, Korevaar DA, Altman DG, et al. STARD 2015 guidelines for reporting diagnostic accuracy studies: explanation and elaboration. *BMJ Open*. 2016;6(11):e012799.
46. Collins GS, Reitsma JB, Altman DG, Moons K. Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD): the TRIPOD Statement. *BMC Med*. 2015;13(1):1.
47. World medical association declaration of helsinki: ethical principles for medical research involving human participants. *Jama*. 2025;333(1):71-74.
48. Timmerman D, Valentin L, Testa AC, et al. Terms, definitions and measurements to describe the sonographic features of adnexal tumors: updated consensus opinion from the International Ovarian Tumor Analysis (IOTA) Group. *Ultrasound Obstet Gynecol*. 2026;67(5):702-724.
49. Sladkevicius P, Valentin L. Intra- and interobserver agreement when describing adnexal masses using the International Ovarian Tumor Analysis terms and definitions: a study on three-dimensional ultrasound volumes. *Ultrasound Obstet Gynecol*. 2013;41(3):318-327.
50. Zannoni L, Savelli L, Jokubkiene L, et al. Intra- and interobserver agreement with regard to describing adnexal masses using International Ovarian Tumor Analysis terminology: reproducibility study involving seven observers. *Ultrasound Obstet Gynecol*. 2014;44(1):100-108.
51. Committee EEaPS,Valentin L, Irving H, et al. Minimum Training Requirements for the Practice of Medical Ultrasound in Europe. EFSUMB European Federation of Societies FOR Ultrasound in Medicine and Biology 'Building a European Ultrasound Community'. 2024 https://efsumb.org/wp-content/uploads/2020/12/2009-04-14apx3.pdf
52. WHO Classification of Tumours Editorial Board. *Female Genital Tumours. WHO Classification of Tumours*. Vol 4. 5th ed. International Agency for Research on Cancer (IARC); 2020.
53. Prat J. Staging classification for cancer of the ovary, fallopian tube, and peritoneum. *Int J Gynecol Obstet*. 2014;124(1):1-5.
54. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) – a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381.
55. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: Building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208.
56. Colombo N, Sessa C, du Bois A, et al. ESMO–ESGO consensus conference recommendations on ovarian cancer: pathology and molecular biology, early and advanced stages, borderline tumours and recurrent disease. *Ann Oncol*. 2019;30(5):672-705.
57. Ledermann JA, Matias-Guiu X, Amant F, et al. ESGO–ESMO–ESP consensus conference recommendations on ovarian cancer: pathology and molecular biology and early, advanced and recurrent disease. *Ann Oncol*. 2024;35(3):248-266.
58. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. *Biometrics*. 1988;44(3):837-845.
59. Van Calster B, Nieboer D, Vergouwe Y, De Cock B, Pencina MJ, Steyerberg EW. A calibration hierarchy for risk models was defined: from utopia to empirical data. *J Clin Epidemiol*. 2016;74:167-176.
60. De Cock B, Nieboer D, Van Calster B, Steyerberg EW, Vergouwe Y. The CalibrationCurves package: assessing the agreement between observed outcomes and predictions. 2023 https://cran.r-project.org/package=CalibrationCurves
61. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33(1):159-174.
62. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med*. 2016;15(2):155-163.
63. The Royal College of Radiologists. Guidance on gadolinium-based contrast agent administration to adult patients. 2019 Accessed April 17, 2025. https://www.rcr.ac.uk/our-services/all-our-publications/clinical-radiology-publications/guidance-on-gadolinium-based-contrast-agent-administration-to-adult-patients/
64. Moradi B, Aghasi M, Rahmani M, et al. Unenhanced magnetic resonance imaging for the evaluation of sonographically indeterminate ovarian and adnexal masses. *Radiol Brasil*. 2025;58:e20240032.
65. Pereira PN, Sarian LO, Yoshida A, et al. Accuracy of the ADNEX MR scoring system based on a simplified MRI protocol for the assessment of adnexal masses. *Diagn Interven Radiol (Ankara, Turkey)*. 2018;24(2):63-71.
66. Sasaguri K, Yamaguchi K, Nakazono T, et al. External validation of ADNEX MR SCORING system: a single-centre retrospective study. *Clin Radiol*. 2019;74(2):131-139.
67. Rizzo S, Cozzi A, Dolciami M, et al. O-RADS MRI: a systematic review and meta-analysis of diagnostic performance and category-wise malignancy rates. *Radiology*. 2023;307(1):e220795.
68. Thomassin-Naggara I, Bazot M, Daraï E, Callard P, Thomassin J, Cuenod CA. Epithelial ovarian tumors: value of dynamic contrast-enhanced MR imaging and correlation with tumor angiogenesis. *Radiology*. 2008;248(1):148-159.
69. Van Calster B, Van Hoorde K, Froyman W, et al. Practical guidance for applying the ADNEX model from the IOTA group to discriminate between different subtypes of adnexal tumors. *Facts, Views Vision ObGyn*. 2015;7(1):32-41.
70. Sadowski EA, Maturen KE, Rockall A, et al. Ovary: MRI characterisation and O-RADS MRI. *Br J Radiol*. 2021;94(1125):20210157.
71. Thomassin-Naggara I, Poncelet E, Jalaguier-Coudray A, et al. Ovarian-Adnexal Reporting Data System Magnetic Resonance Imaging (O-RADS MRI) score for risk stratification of sonographically indeterminate adnexal masses. *JAMA Network Open*. 2020;3(1):e1919896.
72. Dabi Y, Rockall A, Sadowski E, et al. O-RADS MRI to classify adnexal tumors: from clinical problem to daily use. *Insights Imaging*. 2024;15(1):29.
73. Andreotti RF, Timmerman D, Benacerraf BR, et al. Ovarian-adnexal reporting lexicon for ultrasound: a white paper of the ACR ovarian-adnexal reporting and data system committee. *J Am College Radiol: JACR*. 2018;15(10):1415-1429.
74. Andreotti RF, Timmerman D, Strachowski LM, et al. O-RADS US risk stratification and management system: a consensus guideline from the ACR ovarian-adnexal reporting and data system committee. *Radiology*. 2020;294(1): 168-185.
75. Timmerman S, Valentin L, Ceusters J, et al. External validation of the Ovarian-Adnexal Reporting and Data System (O-RADS) lexicon and the international ovarian tumor analysis 2-step strategy to stratify ovarian tumors into O-RADS risk groups. *JAMA Oncol*. 2023;9(2):225-233.
76. Zhang Q, Dai X, Li W. Systematic review and meta-analysis of O-RADS ultrasound and O-RADS MRI for risk assessment of ovarian and adnexal lesions. *AJR Am J Roentgenol*. 2023;221(1):21-33.
77. Nam EJ, Yun MJ, Oh YT, et al. Diagnosis and staging of primary ovarian cancer: correlation between PET/CT, Doppler US, and CT or MRI. *Gynecol Oncol*. 2010;116(3):389-394.
78. Grab D, Flock F, Stöhr I, et al. Classification of asymptomatic adnexal masses by ultrasound, magnetic resonance imaging, and positron emission tomography. *Gynecol Oncol*. 2000;77(3):454-459.
79. Sundar S, Agarwal R, Davenport C, et al. Risk-prediction models in post-menopausal patients with symptoms of suspected ovarian cancer in the UK (ROCkeTS): a multicentre, prospective diagnostic accuracy study. *Lancet Oncol*. 2024;25(10):1371-1386.
80. Roze JF, Hoogendam JP, van de Wetering FT, et al. Positron emission tomography (PET) and magnetic resonance imaging (MRI) for assessing tumour resectability in advanced epithelial ovarian/fallopian tube/primary peritoneal cancer. *Cochrane Database Syst Rev*. 2018;10(10):Cd012567.
81. Fischerova D, Pinto P, Alcázar Zambrano JL, et al. Comparison of ultrasound with computed tomography and whole-body diffusion-weighted MRI in prediction of surgical outcome using ESMO-ESGO criteria in patients with tubo-ovarian carcinoma: prospective ISAAC study. *Ultrasound Obstet Gynecol*. 2025;67(2): 207-219.

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:

Appendix S1–S2 STARD (Appendix S1) and TRIPOD (Appendix S2) checklists.

Appendix S3 Systematic form for reporting ultrasound findings.

Appendix S4 Further details on IOTA-ADNEX model with formulae for IOTA-ADNEX with CA 125 and without CA 125.

Appendix S5 Systematic form for reporting magnetic resonance imaging findings.

Appendix S6 ADNEX MR scoring system.

Appendix S7 Sample-size calculation.

Table S1 Classification of primary adnexal malignancy in cohort according to International Federation of Gynecology and Obstetrics (FIGO) stage.

Table S2 Sensitivity analysis for diagnostic performance of IOTA-ADNEX and ADNEX MR in 318 patients with reference standard based on histopathology.

Table S3 Estimated diagnostic performance of the IOTA-ADNEX with CA 125 model and ADNEX MR scoring system for predicting malignant adnexal lesions at selected cut-offs.

Table S4 Misclassified cases (false-positive and false-negative cases) when using ultrasound and MRI for predicting malignancy.

Table S5 Agreement in risk assessments and characterization of morphological features between ultrasound and magnetic resonance imaging.

Table S6 Descriptive statistics of predictor variables in the model development datasets and in current dataset.

Figure S1 Calibration curve of IOTA-ADNEX with CA 125 model for prediction of malignancy in adnexal lesions.

© 2026 The Author(s). *Ultrasound in Obstetrics & Gynecology* published by John Wiley & Sons Ltd on behalf of International Society of Ultrasound in Obstetrics and Gynecology.

14690705, 0, Downloaded from https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.70368 by Capes, Wiley Online Library on [01/11/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License