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Clues to the diagnosis of borderline ovarian tumours: An imaging guide

Ana Sofia Alves [a,*], Ana Félix [b], Teresa Margarida Cunha [c]

[a] Department of Radiology, Hospital de São José, Centro Hospitalar Universitário de Lisboa Central, Lisbon, Portugal
[b] Department of Pathology, Instituto Português de Oncologia de Lisboa Francisco Gentil, NOVA Medical School, Lisbon, Portugal
[c] Department of Radiology, Instituto Português de Oncologia de Lisboa Francisco Gentil, Lisbon, Portugal

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ABSTRACT

Borderline Ovarian Tumours (BOTs) are an interesting subset of epithelial neoplasms defined histologically by atypical epithelial proliferation without stromal invasion. These tumours typically affect young women in the reproductive age group and have a good prognosis.

Although ultrasonography is the primary screening imaging technique in the evaluation of any suspected adnexal mass, grey-scale and colour Doppler have limited value in characterizing BOTs. Thus, a pelvic magnetic resonance imaging (MRI) is recommended for further characterization on account of its multiplanar capabilities, excellent soft-tissue contrast and high spatial resolution.

BOTs histological subtypes display specific features on MRI that are useful in differential diagnosis. However, the final diagnosis and staging of BOTs require pathologic evaluation after surgical excision.

Therefore, the purpose of this review is to describe, illustrate and compare the imaging characteristics of the different subtypes of BOTs – serous, mucinous and seromucinous – focusing on MRI, as well as to correlate with pathology findings considering the recent 2020 World Health Organization (WHO) classification, in order to improve the accuracy of preoperative diagnosis and facilitate optimal patient management.

1. Introduction

Ovarian epithelial tumours are classified as benign, borderline, or malignant.

Borderline Ovarian Tumours (BOTs) are a heterogeneous group of neoplasms characterized by atypical epithelial proliferation without stromal invasion [1]. They have an intermediate behaviour between benign cystadenomas and carcinomas, and account for 10%–20% of all epithelial tumours of the ovary [2].

Although these tumours have been referred to by different terms, borderline tumour is currently the recommended designation by the 2020 World Health Organization (WHO) Classification of Tumours: Female Genital Tumours [3]. According to the 2020 WHO classification, there are six histological subtypes (serous, mucinous, seromucinous, endometrioid, clear cell and Brenner), of which serous and mucinous are the most frequent [2,3].

The current hypothesis for the development of ovarian neoplasms is the existence of two distinct pathways. One follows a stepwise transformation from a benign tumour to borderline and finally to a malignant tumour, and the other arises *de novo* without any known pre-invasive lesion [3,4]. As this continuous tumour progression may exist, ovarian carcinoma can occur with borderline tumour in the same histologic specimen at diagnosis [3,5].

The clinical presentation of BOTs is non-specific, as for other adnexal masses. The most common presenting symptom is pelvic or abdominal pain. Nevertheless, patients may be asymptomatic [6], and tumours can be detected incidentally on pelvic examination or imaging performed for another indication.

Data on specific risk factors linked to BOTs is limited [7,8]. An association has been established with BRAF and KRAS genetic mutations [3].

The CA 125 tumour marker does not appear to be useful in the detection of BOTs [9].

Although these tumours can occur in women of all ages, they are more frequently found in young women. The mean age at diagnosis is approximately ten years earlier than that of women with ovarian cancer [2,6], and they carry a better prognosis. Thus, an accurate preoperative identification of patients with potential borderline tumours is of utmost importance for determining the proper surgical strategy.

* Corresponding author at: R. José António Serrano, 1150-199 Lisboa, Portugal.
E-mail address: sofiafalves92@gmail.com (A.S. Alves).

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2. Imaging evaluation

Ultrasonography is the first-line imaging modality for the diagnosis of adnexal masses [10]. Any mass should be assessed for septations, mural nodules, and Doppler vascularity.

In cases of an indeterminate ovarian tumour on transabdominal and transvaginal ultrasonography, a pelvic magnetic resonance imaging (MRI) is recommended. MRI is the most accurate non-invasive technique, combining features from morphologic and functional sequences to characterize an adnexal mass [2,11]. The acquisition protocol (Table 1) is usually performed with 1.5 T and 3 T magnets using sagittal T2-weighted (T2W) sequence of the pelvis, a pair of T1W and T2W sequences covering the adnexal mass in the same orthogonal plane with similar slice thickness, axial diffusion-weighted imaging (DWI) with a high b value (1000 s/mm^2), and T1W dynamic contrast-enhanced (DCE) study with fat saturation. If the mass demonstrates high signal intensity on T1-weighted image (T1WI), an axial fast spin-echo (FSE) fat-suppressed (FS) T1W sequence should be performed. If there are doubts whether the mass belongs to the ovary or to the uterus, an axial plane of the ovary FSE FS T1W, an axial plane of the ovary FSE T2W and an axial plane of the ovary T1W DCE study with fat saturation should be performed, noting that these axial planes of the ovary correspond to the parallel plane of the endometrial cavity [11,12].

It is recommended to include in the report a malignancy risk score (ADNEX MR/O-RADS) and a histopathological hypothesis [2].

CT is helpful for pretreatment staging and prediction of surgically "difficult to resect" disease [4].

3. Borderline ovarian tumours

BOTs are usually large, round or oval tumours with well-defined margins. These tumours are either purely cystic, predominantly cystic with papillary projections or nodules or, less commonly, mixed cystic-solid or even solid tumours [6]. There is usually a distinct demarcation between the cystic and solid components. An ipsilateral normal ovary and no infiltration of the surrounding organs help in the preoperative characterization of BOTs [6,13].

Peritoneal implants are present in 10% of borderline tumours. Ascites is an equivocal finding, as it may be present in as many as 43% of patients with borderline tumours [4,6]. These findings are more common in the serous subtype of BOTs.

Although various criteria have been put forward to distinguish benign from malignant ovarian tumours, the semi-quantitative multiphase DCE MRI helps to discriminate between benign, borderline and malignant ovarian tumours. This technique is based on time-intensity curves of the solid component within the adnexal tumour and of the external myometrium during multiphase DCE MRI. Then, using the myometrial enhancement as a reference, three types of enhancement curves can be identified, which correlate with benign, borderline, and malignant tumours [14] (Fig. 1).

A type 1 time-intensity curve is characterized by a gradual uptake of contrast and is more frequently associated with benign lesions. A type 2 time-intensity curve reflects an early uptake of gadolinium – but less than myometrium – followed by a plateau and is typical of borderline lesions (Fig. 2). A type 3 time-intensity curve demonstrates an avid and early contrast uptake, followed by washout, and this is most commonly encountered in malignant tumours [15,16].

DWI is also helpful in differentiating benign from malignant ovarian tumours [4]. Several studies evaluated specific apparent diffusion coefficient (ADC) values in distinguishing borderline from malignant ovarian tumours. The mean and minimum ADC value of the solid tissue of BOTs is significantly higher than that of malignant tumours [17–19]. However, there is no established absolute ADC cut-off value to discriminate between them due to differences in magnetic field strengths of the MRI scanners, as well as imaging protocols and techniques [4,17–19].

A. Serous borderline ovarian tumour

Serous borderline ovarian tumour (SBOT) is the most common histologic subtype, comprising 65% of all borderline tumours [4]. The median age of presentation is 50 years [3]. These tumours harbour somatic mutations of BRAF or KRAS [3].

Serous borderline ovarian tumours are divided into the classic serous borderline tumour and the micropapillary/cribriform subtype [3].

Histologically, they are characterized by epithelial proliferation with hierarchical branching papillae or micropapillary/cribriform pattern, low-grade cytology, with no stromal invasion (Fig. 3) [3].

SBOT often occurs bilaterally (Fig. 4), and generally measures greater than 5 cm in size [3,13].

These tumours can present as mainly cystic, solid, and mixed solid and cystic. The papillary projections are common to all three types [13] and can be exophytic, endophytic or mixed. These papillary projections on T2WI have an internal low signal intensity branching pattern and an intermediate to high signal intensity nodular outline (Fig. 5).

Table 1
MRI protocol for characterization of indeterminate adnexal masses.

MRI protocol for characterization of indeterminate adnexal masses (adapted from ESUR recommendations 2017)
Sagittal T2W sequence of the pelvis (4 mm/0.4 mm)
T1W and T2W sequences covering the mass in the same orthogonal plane (axial or coronal) (4 mm/0.4 mm)
Axial DWI with a high b value (1000 s/mm^2) (4 mm/0.4 mm)
T1W DCE study with fat saturation (2 mm)
Option 1: If the mass demonstrates high signal intensity on T1WI
→ Axial FSE FS T1WI (4 mm/0.4 mm)
Option 2: If doubts whether the mass belongs to the ovary or to the uterus
→ Axial plane of the ovary FSE FS T1W (4 mm/0.4 mm)
→ Axial plane of the ovary FSE T2W (4 mm/0.4 mm)
→ Axial plane of the ovary T1W DCE study with fat saturation (2 mm)
Note: Axial plane of the ovary corresponds to the parallel plane of the endometrial cavity (perfect coronal plane of the body of the uterus)

ESUR – European Society of Urogenital Radiology; T2W – T2-weighted; DWI – diffusion-weighted imaging; DCE – dynamic contrast-enhanced; T1WI – T1-weighted image; FSE FS T1W – fast spin-echo fat-suppressed T1-weighted.

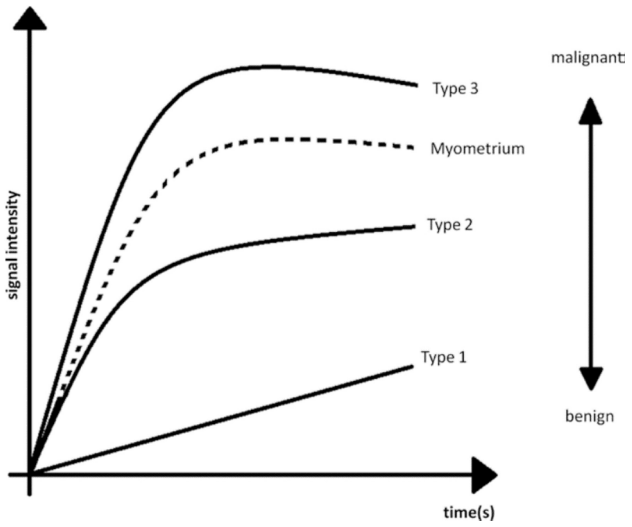

Fig. 1. Time-intensity curves. Time-intensity curves are acquired from the solid component within the adnexal lesion and from the external myometrium during multiphase DCE MRI. A type 1 time-intensity curve is more frequently associated with benign lesions. A type 2 time-intensity is typical of borderline lesions. A type 3 time-intensity curve is most commonly encountered in malignant tumours (adapted from *MRI and CT of the Female Pelvis*).

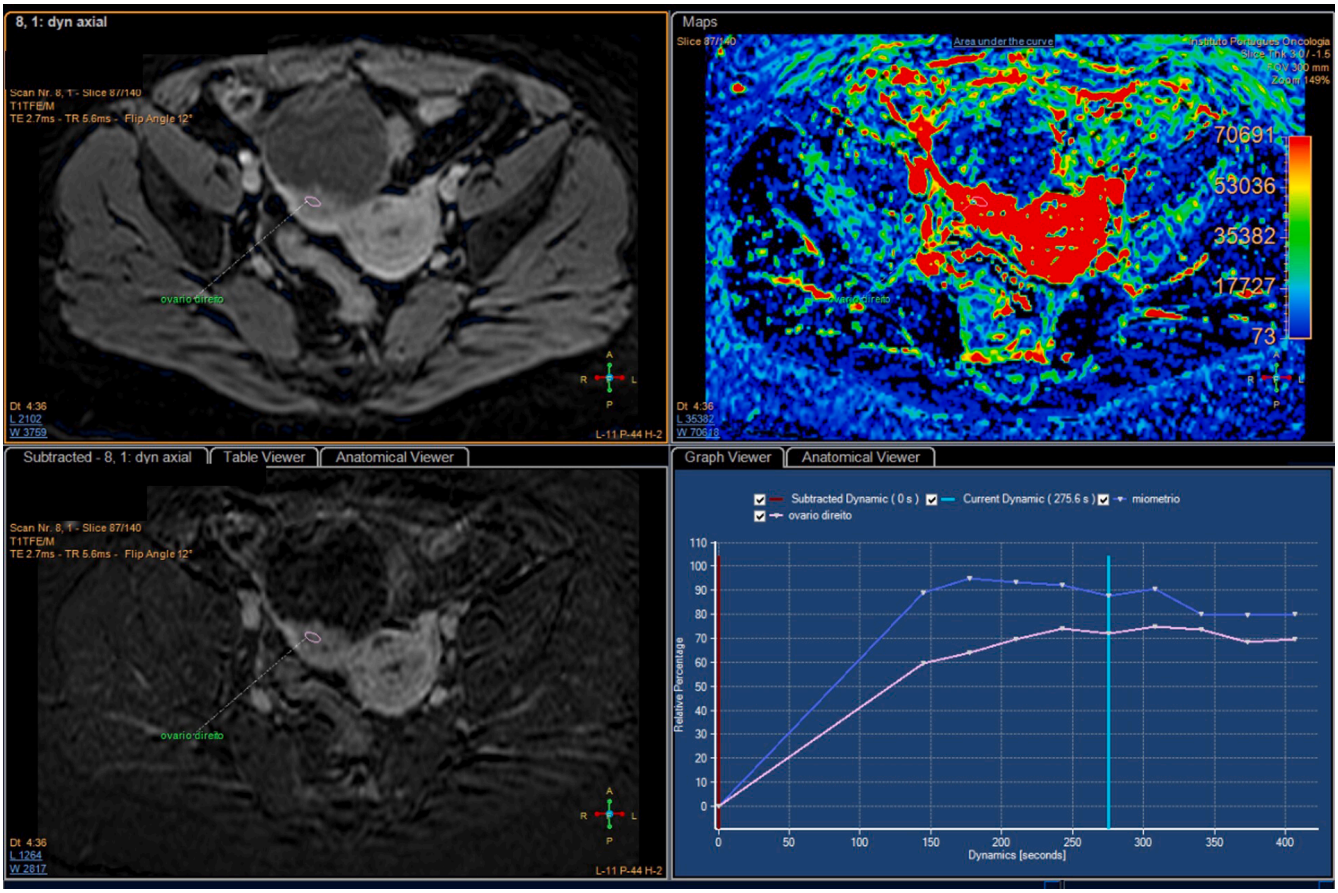

Fig. 2. Type 2 time-intensity curve in a serous borderline ovarian tumour. An early uptake of gadolinium – but less than myometrium – is followed by a plateau.

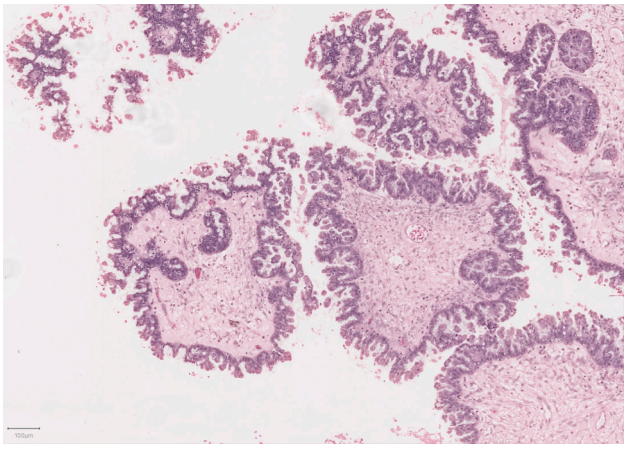

Fig. 3. Serous borderline tumour. Ovarian cystic tumour with papillary growth and serous type cells lining the papillae with light to moderate atypia.

The low signal on T2WI represents the fibrous internal architecture of the papillary projections and the hyperintense regions represent oedematous papillae [13,20]. Papillary projections may restrict on DWI, nevertheless, that restricted diffusion is significantly lower in papillary projections of borderline tumours compared to solid elements of malignant tumours, and the corresponding ADC value is higher [13,20]. Also, although papillary projections are inconspicuous on T1WI, they become more evident with contrast enhancement [20].

The mainly cystic SBOT is usually unilocular (Fig. 5). The cystic content has commonly low signal intensity on T1WI and high signal intensity on T2WI, although high signal intensity on both T1WI and T2WI can occur [13,20]. In the cases that cystic SBOT is multilocular, the internal papillary projections may also involve the septa in addition to the cyst walls (Fig. 6) [20].

The solid SBOT presents as a soft tissue mass with exophytic papillary projections [13,20].

The mixed solid and cystic SBOT has both components (Fig. 7), with papillary projections presenting both on the inner and the outer surface walls [13].

The ovarian stroma is generally preserved and identified separately (Fig. 7) [6,13,20].

Serous borderline ovarian tumours can be associated with extra-ovarian deposits known as peritoneal implants [3,4]. By definition, those implants are confined to the peritoneal surface without infiltration of the underlying subperitoneal fat (noninvasive). These are more likely in SBOTs with exophytic papillary projections [20]. Currently, no standardized imaging approach exists to assess the invasive character of peritoneal lesions. Nonetheless, it has been proposed that on CT, regarding the morphologic difference in peritoneal disease patterns, the presence of a nodular pattern and calcifications is associated with invasive peritoneal lesions at histopathology [5,21,22].

B. Mucinous borderline ovarian tumour

Mucinous borderline ovarian tumour (MBOT) is an architecturally complex, mucinous neoplasm with gastrointestinal-type differentiation, that represents the second most common histologic subtype, accounting for 30 to 50% of all borderline ovarian tumours [3]. The mean age at diagnosis is 45 years [3].

These tumours have an association with mature teratomas and Brenner tumours (Fig. 8) [3].

Mucinous borderline ovarian tumours are usually associated with

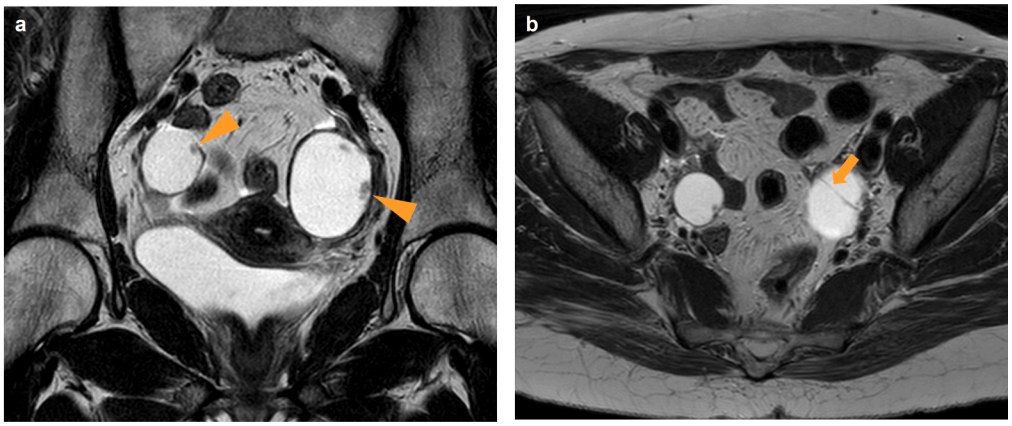

Fig. 4. Bilateral SBOT. Coronal (**a**) and axial (**b**) T2WI show cystic SBOTs with papillary projections (orange arrowheads) and a septae (orange arrow).

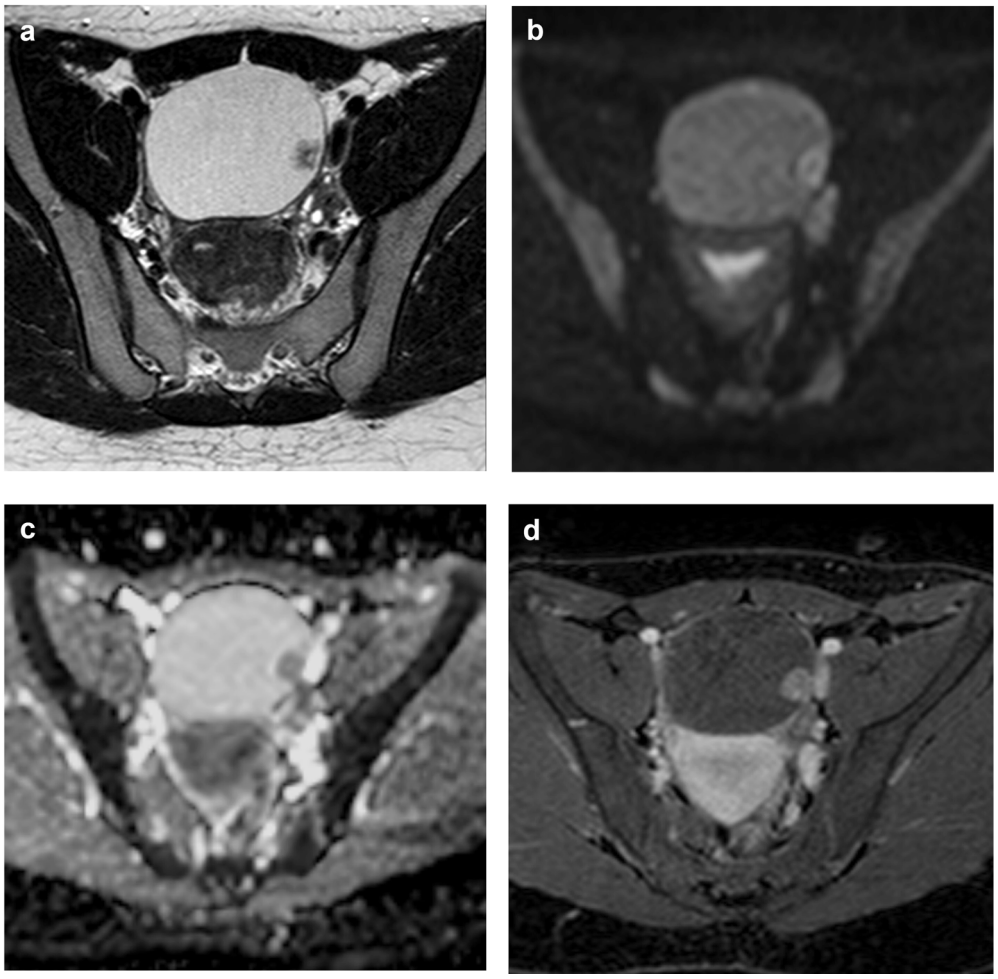

Fig. 5. Unilocular cystic SBOT with papillary projections that show internal low signal intensity branching pattern and an intermediate to high signal intensity nodular outline on T2WI (**a**: axial T2WI), moderate restriction (**b**: axial DWI *b*1000, **c**: axial ADC map) and enhance after contrast (**d**: axial fat-saturated T1WI after contrast).

KRAS mutations. BRAF mutations are rare [3,19].

When a MBOT is suspected on imaging, a CA 19-9 assay may be performed [2].

Histologically, these tumours have gastrointestinal-type mucinous epithelium lining cysts with variable degrees of epithelial stratification, tufting, and villous or slender filiform papillae, low-grade nuclear atypia, but without stromal invasion (Fig. 9) [3].

These tumours are usually large (average diameter of 20 cm), with some cases as large as 50 cm (Fig. 10), and nearly always unilateral [3].

They are mainly cystic, multiloculated, with smooth walls but with a high number of septa (usually more than 10), which are commonly grouped, irregular, and thick (Fig. 10) [23]. The content within the loculi usually has variable signal intensity on both T1WI and T2WI (Fig. 11), also known as *stained glass-like appearance*, and results from the

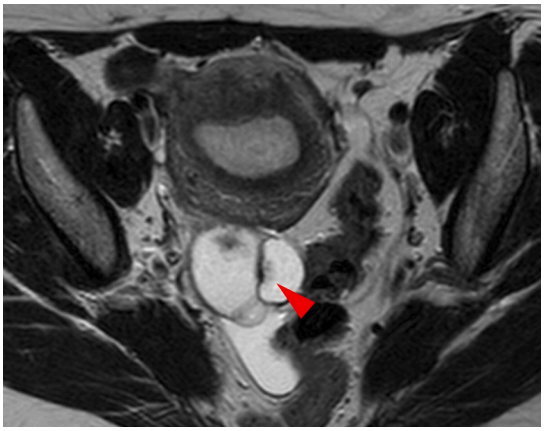

Fig. 6. Multilocular cystic SBOT. Axial T2WI demonstrates a cystic SBOT with endophytic papillary projections, that also involve the septa (red arrowhead).

viscosity of the contents, blood products, or debris [19,23,24]. This is one of the characteristic MRI features of mucinous neoplasms.

Another characteristic feature is the presence of densely aggregated numerous loculi of 5 – 10 mm (honeycomb loculi) (Fig. 12). On contrast-enhanced FS T1WI, the reticular enhancement provides an important clue for the diagnosis of this microcystic structure [19,24,25].

MBOT can occasionally present with well-circumscribed mural nodules, smaller than 5 mm. These mural nodules typically show iso to hyperintensity on T2WI, hypointensity on T1WI, and contrast enhancement after gadolinium administration. The ADC values of mural nodules are also useful to differentiate from their malignant counterparts [3,19,26].

MBOT may coexist with pseudomyxoma peritonei (i.e., ascites with abundant mucoid or gelatinous material) in a small number of cases [4,26,27].

However, if a bilateral mucinous ovarian tumour and pseudomyxoma peritonei are detected, it is important to distinguish between an ovarian primary mucinous neoplasm and metastasis to the ovary from a mucinous adenocarcinoma, most commonly from the gastrointestinal tract, in particular a primary appendiceal mucinous tumour [22,26,27].

C. Seromucinous borderline ovarian tumour

Seromucinous borderline ovarian tumour (SMBOT), formerly known as endocervical-type mucinous BOT and Müllerian mucinous BOT [3], comprises 7.6% of all BOTs [28]. This tumour was categorized as a separate tumour entity in the revised 2014 WHO Classification of Tumours of Female Reproductive Organs.

The mean age of patients with SMBOTs has been reported to range from 34 to 39 years.

KRAS mutations are often present and loss of ARID1A expression is common [3].

This tumour has a strong association with endometriosis and many seromucinous borderline tumours arise within endometriotic cysts [3,28].

Histologically, they are characterized by papillae exhibiting hierarchical branching with oedematous and fibrous stromal cores lined by an admixture of Müllerian cell types with no stromal invasion (Fig. 13) [3].

SMBOTs are bilateral in up to 30% of cases (Fig. 14) and the mean size of the tumour is 9 cm [3].

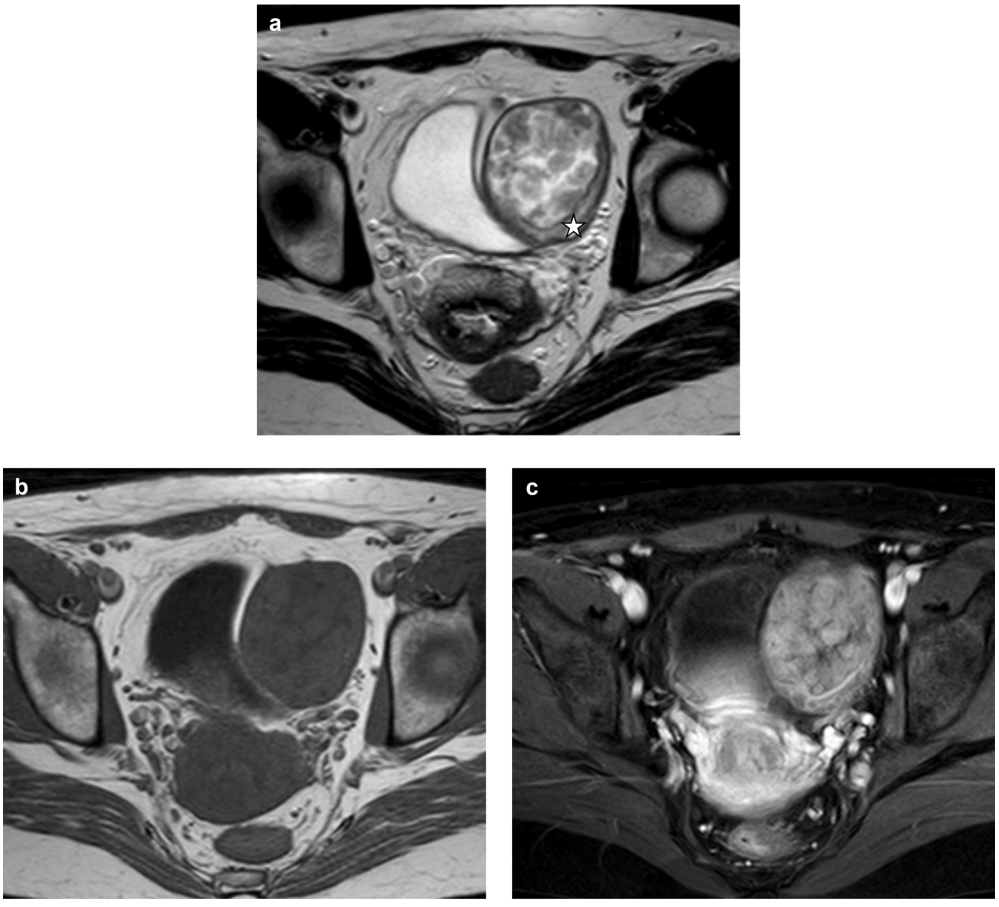

Fig. 7. Mixed solid and cystic SBOT. Axial T2WI (**a**) demonstrates a mixed SBOT with papillary projections that although inconspicuous on axial T1WI (**b**), are evident after contrast administration (**c**). The ipsilateral ovarian stroma is peripherally identified (white star).

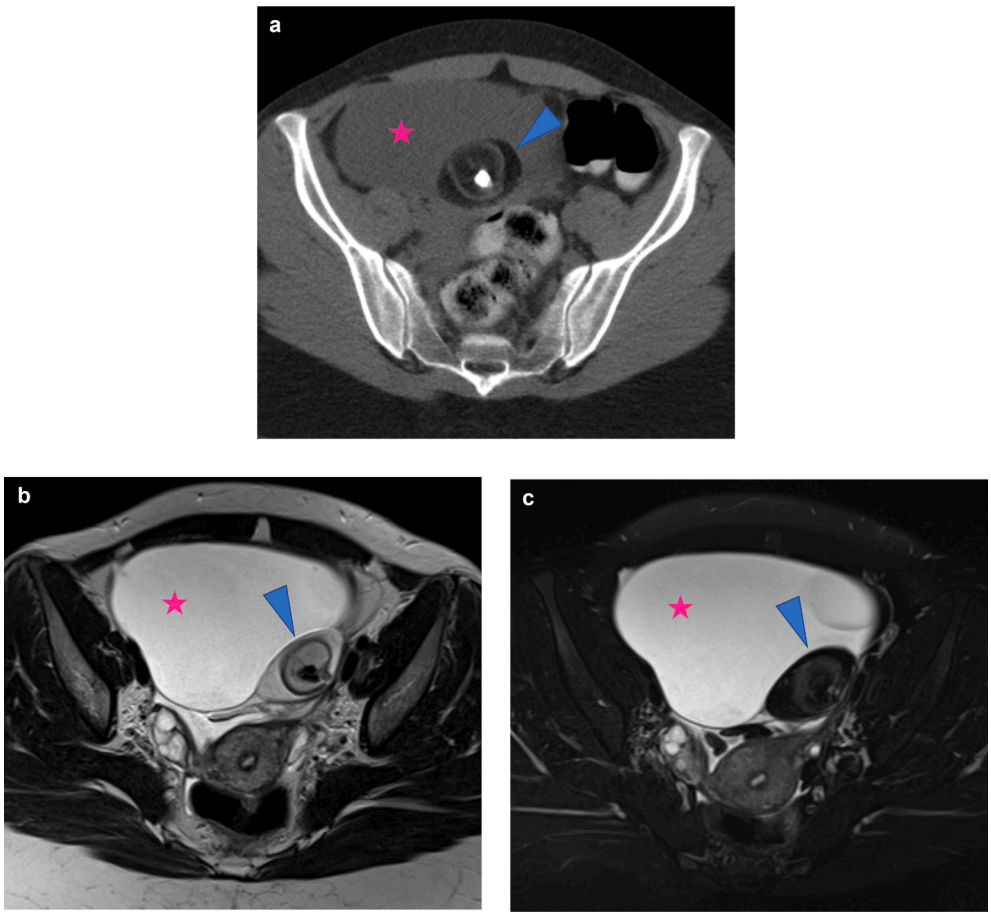

Fig. 8. Mucinous borderline ovarian tumour in association with mature teratoma. Axial pelvic CT (**a**), axial T2WI (**b**), and axial FS T2WI (**c**) demonstrate a MBOT (pink star) in association with mature teratoma (blue arrowhead) with calcifications and macroscopic fat.

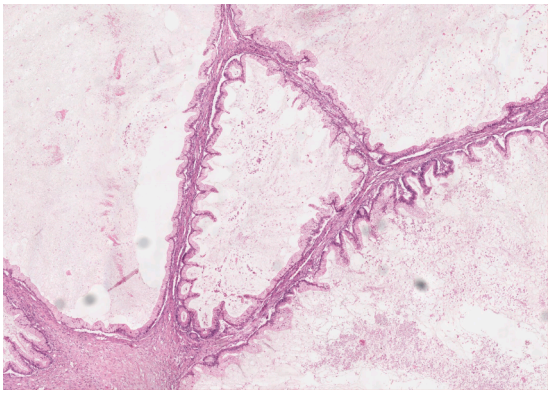

Fig. 9. Mucinous borderline tumour. Ovarian cystic tumour with papillary growth and mucinous type cells, some with intestinal differentiation lining the papillae with light to moderate atypia.

They usually present as unilocular or paucilocular cysts with papillary projections in the inner lining (Fig. 14). These characteristics resemble the appearance of serous BOTs [3,24,28,29].

Indeed, both tumours exhibit papillary projections with an oedematous stroma of high signal intensity on T2WI and a fibrous stalk of low signal intensity on T2WI [28–31].

Regarding the fluid signal intensity in the cystic portion of the tumour, it is often high on T1WI and low on T2WI. This is explainable by the fact that SMBOT is frequently associated with endometriosis and that it often contains blood products in the cystic portion of the tumour, while on SBOT the cystic content has commonly low signal intensity on T1WI and high signal intensity on T2WI [30].

Also, as SBOT, these tumours may be associated with peritoneal implants in up to 20% of cases, but they usually have a good outcome [26,32].

D. Miscellaneous Borderline Ovarian Tumours

Uncommon subtypes encompass 3–4% of all borderline ovarian tumours and include endometrioid, clear cell, and Brenner subtypes [3,26].

Data on these uncommon subtypes is limited due to the small number of reported cases.

They usually occur in postmenopausal patients between 45 and 65 years of age [3,26].

Like seromucinous tumours, endometrioid and clear cell borderline neoplasms, are frequently associated with endometriosis [3].

Endometrioid borderline ovarian tumour is an epithelial tumour composed of crowded endometrioid glands and lacking confluent or destructive invasion. This tumour is commonly associated with synchronous endometrial lesions, including endometrial hyperplasia and/or endometrial endometrioid carcinoma [3,26].

Clear cell borderline ovarian tumour is an adenofibromatous clear cell tumour with glandular crowding and low-grade nuclear atypia but no stromal invasion.

Borderline Brenner tumour is composed of transitional epithelium displaying papillary architecture and lacking stromal invasion.

Miscellaneous borderline ovarian tumours do not show characteristic imaging features and may resemble other borderline ovarian

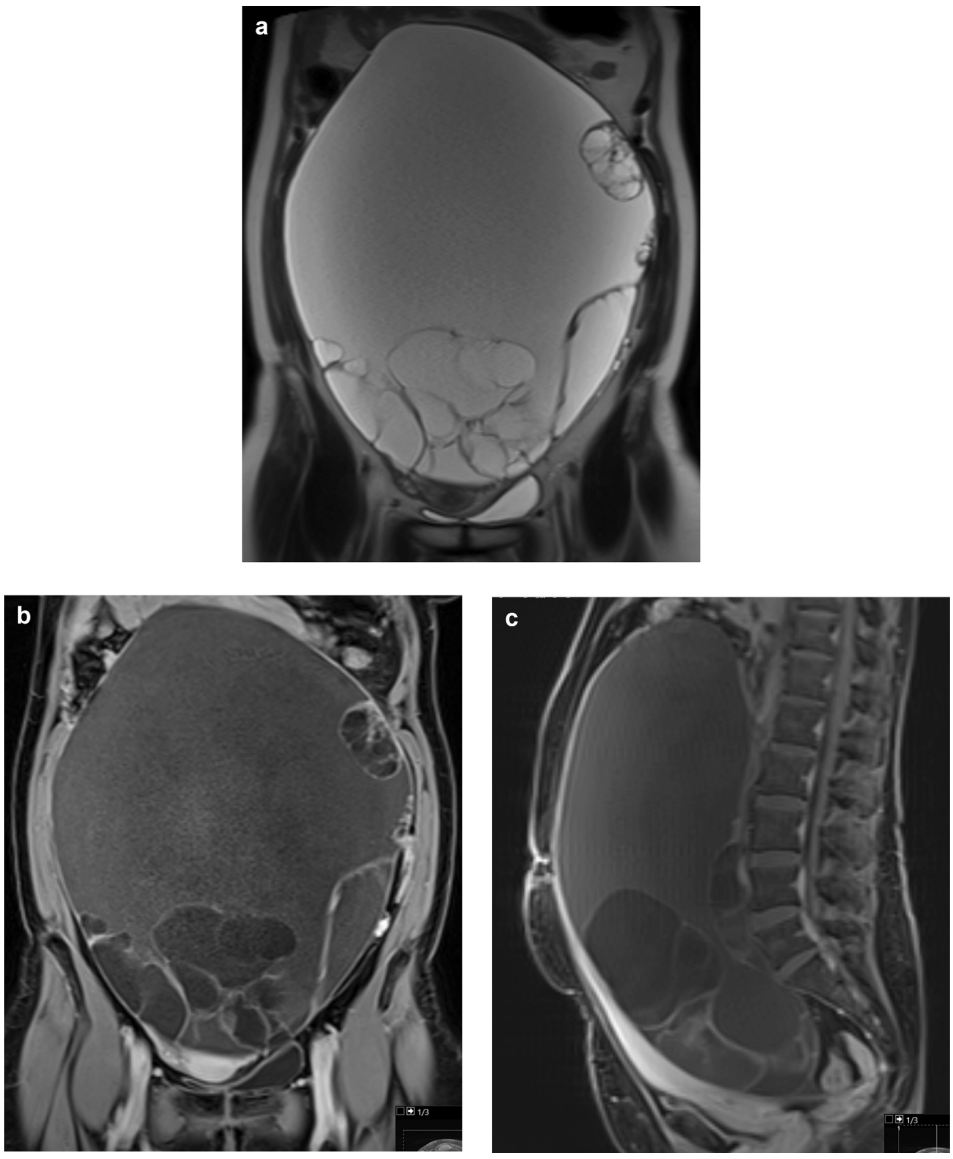

Fig. 10. Large MBOT. Coronal T2WI (**a**), coronal (**b**), and sagittal (**c**) post-contrast fat-saturated T1WI show a large multiloculated MBOT, with a high number of septa.

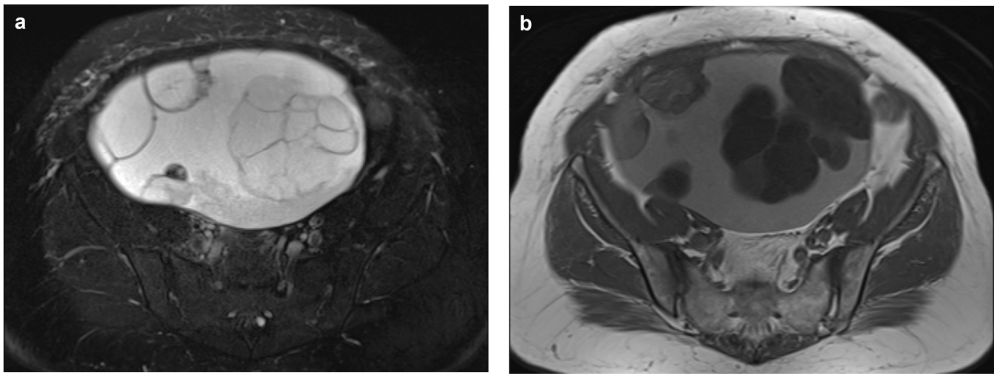

Fig. 11. MBOT. Axial fat-saturated T2WI (**a**) and axial T1WI (**b**) show a multiloculated MBOT. The content within the loculi has variable signal intensity on T2WI and T1WI, also known as *stained glass-like appearance*.

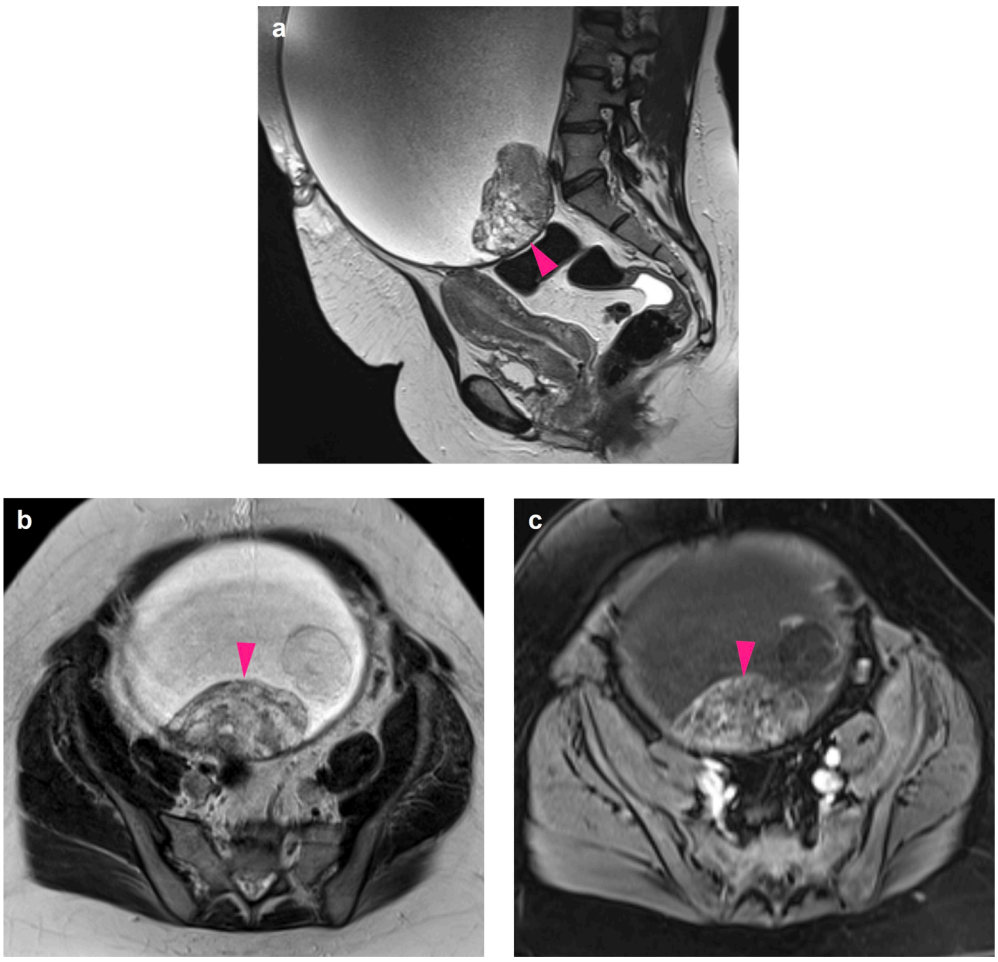

Fig. 12. MBOT with honeycomb loculi. Sagittal (**a**) and axial (**b**) T2WI demonstrate densely aggregated numerous loculi of 5 – 10 mm (honeycomb loculi) (pink arrowheads). Axial fat-saturated contrast-enhanced T1WI (**c**) exhibits reticular enhancement suggesting a microcystic structure.

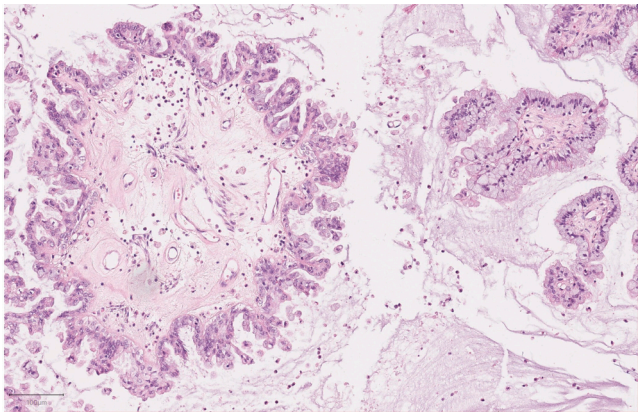

Fig. 13. Seromucinous borderline tumour. Ovarian cystic tumour with papillary growth and serous and mucinous type cells lining the papillae.

tumours as well as early-stage ovarian carcinomas [26].

4. Management of borderline ovarian tumours

Borderline ovarian tumours are staged according to the FIGO staging system used for ovarian carcinoma, carcinoma of the fallopian tube and peritoneum (Table 2) [33].

Most BOTs are limited to the ovaries at presentation, with 75% diagnosed at FIGO stage I, and the remainder 25% diagnosed at FIGO stage $\geq$ II [22,32]. Survival, all stages combined, is 95% at 5 years and 90% at 10 years, although recurrences and malignant transformation can occur [34].

Surgery is the mainstay of treatment for women with borderline tumours of the ovary, however, as mentioned previously, a significant percentage of borderline tumours present in a younger population (mean age $<$ 40 years) who may wish to conserve at least one ovary to preserve fertility and/or avoid the symptoms and effects of premature menopause.

The *Collège National des Gynécologues et Obstétriciens Français* (CNGOF) issued guidelines for clinical best practice and management of BOTs, that are presented here [34].

A. Early stage BOTs

When unilateral or bilateral early stage BOTs are suspected on preoperative imaging in a postmenopausal patient, or when the preservation of fertility and/or endocrine function are not considered, bilateral salpingo-oophorectomy is advised.

In case of treatment with a strategy of fertility and/or endocrine function preservation, for bilateral serous early stage BOTs bilateral cystectomy is recommended, and for mucinous early stage BOTs a unilateral salpingo-oophorectomy is recommended. Tumour rupture should be avoided.

A routine hysterectomy in early stage serous or mucinous BOTs is not associated with improved recurrence-free survival, and therefore it is not recommended. However, in early stage endometrioid BOTs and in

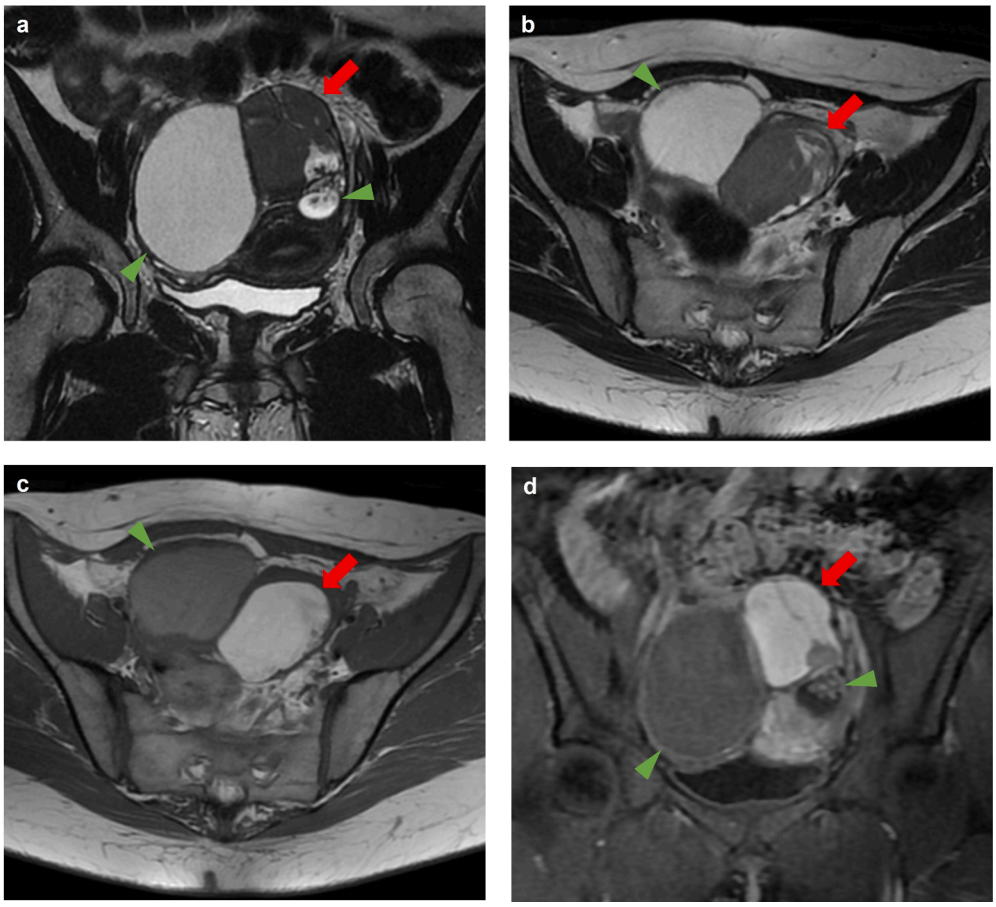

Fig. 14. Bilateral SMBOT. Coronal T2WI (**a**) demonstrates a bilateral SMBOT, the largest one at the right. Both lesions (green arrowheads) are unilocular with papillary projections. An endometrioma is also present in the left adnexal region (red arrow). Axial T2WI (**b**) and axial T1WI (**c**) show the typical signal intensity of the endometrioma with high signal at T1WI and low signal at T2WI. After contrast administration, on coronal fat-saturated T1WI (**d**), the papillary projections become more evident.

the absence of a fertility-sparing strategy, a hysterectomy is advised. If the treatment strategy aims to preserve fertility, a thorough evaluation of the endometrium is required by imaging and endometrial sampling.

When a BOT is suspected on preoperative imaging or diagnosed on intraoperative consultation, omentectomy, multiple peritoneal biopsies, and cytology of peritoneal washings are recommended to achieve a complete surgical initial staging. Also, regardless of the histological subtype, it is recommended to assess the macroscopic aspect of the appendix during surgery, and to perform an appendectomy only in case of a pathological macroscopic appearance.

Given the low prognostic value of the lymph nodal involvement in early stage BOTs, lymphadenectomy of pelvic and/or *para*-aortic lymph nodes is not recommended.

B. Advanced stage BOTs

These are defined as tumours with a FIGO stage $\geq$ II. In the event of a preoperative suspicion or a postoperative diagnosis of an advanced stage BOT, patients should be referred to an expert centre in ovarian cancer treatment.

There is no established preferred surgical approach for advanced stage BOTs. Also, the literature does not provide sufficient data to conclude whether hysterectomy should routinely be performed for serous and mucinous advanced stage BOTs, the goal of the surgery being no tumour residue.

Complete removal of peritoneal implants is necessary. In advanced stage BOTs, peritoneal carcinomatosis should be described before any cytoreduction and tumour residue must be noted at the end of surgery (size, location, and reason for non-extirpation). The use of a peritoneal carcinosis score to objectively assess the tumour burden is advised.

Lymphadenectomy is not recommended as a routine procedure as it has no impact on overall survival.

In patients concerned with fertility, conservative treatment involving the preservation of the uterus and all or part of the ovary may be proposed after a multidisciplinary meeting.

Guidelines have not been issued regarding indications for chemotherapy in advanced stage BOTs.

The risk of recurrence increases with the initial stage of the disease. Tumour residue is a risk factor for recurrence in advanced stage BOTs.

C. Follow-up

Since the time to recurrence is highly variable, a long-term follow-up (beyond 5 years) is recommended.

A systematic clinical examination should be carried out during the follow-up of a treated BOT. In case of initially elevated serum levels of CA 125, it is recommended to monitor CA 125 levels. After conservative treatment, it is recommended to use transabdominal and transvaginal ultrasonography during the follow-up to detect recurrences. There is insufficient data in the literature to specify the timing of these examinations.

5. Conclusion

Given the good prognosis of BOTs and the young age of patients at presentation, issues related to ovarian function and fertility preservation are of increased importance.

Gynaecologists often determine the surgical approach based on the results of intraoperative frozen section diagnosis. However, as BOTs are usually large and internally heterogeneous, the intraoperative histology may lead to misdiagnosis.

Therefore, an accurate characterization of BOTs with preoperative

Table 2
FIGO staging classification for cancer of the ovary, fallopian tube, and peritoneum.

FIGO staging classification for cancer of the ovary, fallopian tube, and peritoneum (2014)
Stage I: Tumour confined to ovaries or fallopian tube(s)
IA: Tumour limited to 1 ovary (capsule intact) or fallopian tube
IB: Tumour limited to both ovaries (capsules intact) or fallopian tubes
IC: Tumour limited to 1 or both ovaries or fallopian tubes, with any of the following:
IC1 – Surgical spill
IC2 – Capsule ruptured before surgery or tumour on ovarian or fallopian tube surface
IC3 – Malignant cells in the ascites or peritoneal washings
Stage II: Tumour involves 1 or both ovaries or fallopian tubes with pelvic extension (below pelvic brim) or peritoneal cancer
IIA: Extension and/or implants on uterus and/or fallopian tubes and/or ovaries
IIB: Extension to other pelvic intraperitoneal tissues
Stage III: Tumour involves 1 or both ovaries or fallopian tubes, or peritoneal cancer, with cytologically or histologically confirmed spread to the peritoneum outside the pelvis and/or metastasis to the retroperitoneal lymph nodes
IIIA1: Positive retroperitoneal lymph nodes only (cytologically or histologically proven):
IIIA1(i) Metastasis up to 10 mm in greatest dimension
IIIA1(ii) Metastasis more than 10 mm in greatest dimension
IIIA2: Microscopic extrapelvic (above the pelvic brim) peritoneal involvement ± positive retroperitoneal lymph nodes
IIIB: Macroscopic peritoneal metastasis beyond the pelvis up to 2 cm in greatest dimension, ± metastasis to the retroperitoneal lymph nodes
IIIC: Macroscopic peritoneal metastasis beyond the pelvis more than 2 cm in greatest dimension, ± metastasis to the retroperitoneal lymph nodes (includes extension of tumour to capsule of liver and spleen without parenchymal involvement of either organ)
Stage IV: Distant metastasis excluding peritoneal metastases
IVA: Pleural effusion with positive cytology
IVB: Parenchymal metastases and metastases to extra-abdominal organs (including inguinal lymph nodes and lymph nodes outside of the abdominal cavity)

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MRI can be extremely helpful. Radiologists play a major role in the assessment of adnexal masses and thus should be familiar with the key imaging findings of the different subtypes of BOTs, to facilitate optimal patient management.

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