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Review

Ovarian Cancer Management: The role of imaging and diagnostic challenges

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ABSTRACT

Worldwide, ovarian cancer accounts for 4% of all female cancers with over 190,000 new cases diagnosed each year. The incidence rates vary considerably across the globe with the highest rates seen in Europe and the USA and low rates in Africa and Asia. Ovarian cancer has been termed a 'silent' killer with the majority of patients presenting with advanced disease due to the vague, non-specific nature of the presenting symptoms such as abdominal discomfort and bloating in 50%. The most important determinant of survival for ovarian cancer patients is the disease stage at diagnosis. Therefore there is a thrust for early detection and two large screening trials are currently underway in the UK and USA.

Ovarian cancer is most commonly staged using the International Federation of Gynecology and Obstetrics (FIGO) surgical-pathological staging system. Imaging findings are not a formal component of the staging system but in clinical practice they play a significant role in the diagnosis and management of suspected ovarian cancer. Adnexal masses which are shown to have benign features on imaging can undergo simple excision at a local unit by a non-oncological gynaecologist. If a mass has malignant characteristics on imaging, then a radical surgical approach is indicated and this should be performed by a gynaecological oncological surgeon at a specialist cancer centre, as optimal cytoreductive surgery has been reported to improve outcome.

This review article discusses the role of various imaging modalities in the initial assessment of an adnexal mass, the contribution to management planning and to the follow-up of patients with ovarian cancer.

1. Introduction

Ovarian cancer is the second most common gynaecological cancer in the United Kingdom after endometrial cancer with 6806 new cases diagnosed in 2005 and a mortality of 4407 in 2006 (6% of all UK female cancer deaths). Worldwide, ovarian cancer accounts for 4% of all female cancers with over 190,000 new cases diagnosed each year. The incidence rates vary considerably across the globe with the highest rates seen in Europe and the USA and low rates in Africa and Asia [1]. Ovarian cancer has been termed a 'silent' killer with the majority of patients, up to 70% in the USA [2], presenting with advanced disease due to the vague, non-specific nature of the presenting symptoms such as abdominal discomfort and bloating in 50% [3]. The most important determinant of survival for ovarian cancer patients is the disease stage at diagnosis [1].

Ovarian cancer is most commonly staged using the International Federation of Gynecology and Obstetrics (FIGO) surgical-pathological staging system [4] (see Table 1). A TNM (Tumour, Nodes, Metastasis) classification has also been defined by the American Joint Committee on Cancer (AJCC) [5]. The definitions of the T stage categories correspond to several stages accepted by FIGO (see Table 1). For early, FIGO stage I disease, the five-year survival rate is greater than 70%, however only 20% of cases are diagnosed at this stage [1,6]. In the USA, 67% of patients are diagnosed with metastatic disease at presentation and there is a 31% five-year survival [6]. In the UK, approximately 40% of patients present with advanced disease, with distant metastases, with a five-year survival rate of approximately 16% [1].

The World Health Organisation (WHO) has classified ovarian tumours into the broad categories of surface epithelial cell tumours, germ cell tumours and sex cord stromal tumours [7]. These ovarian masses were traditionally classified into benign and malignant lesions. However, a new category of "borderline" epithelial tumours was introduced when a subgroup of tumours were identified that had all the features of malignant neoplasms but no stromal invasion [8]. These tumours behave more aggressively than benign tumours but have a better prognosis than invasive neoplasms. The WHO

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Table 1
International Federation of Gynecology and Obstetrics (FIGO) staging of ovarian cancer [4] with corresponding TNM staging classification [5].

FIGO stage	TNM stage	Extent of disease
0	T0	No evidence of primary tumour
I	T1	Tumour confined to the ovaries
IA	T1a	Tumour limited to one ovary, capsule intact. No tumour on ovarian surface. No malignant cells in the ascites or peritoneal washings
IB	T1b	Tumour limited to both ovaries, capsules intact. No tumour on ovarian surface. No malignant cells in the ascites or peritoneal washings
IC	T1c	Tumour limited to one or both ovaries, with any of the following: capsule ruptured, tumour on ovarian surface, positive malignant cells in the ascites or positive peritoneal washings
II	T2	Tumour involves one or both ovaries with pelvic extension.
IIA	T2a	Extension and/or implants in the uterus and/or tubes. No malignant cells in the ascites or peritoneal washings
IIB	T2b	Extension to other pelvic organs. No malignant cells in the ascites or peritoneal washings.
IIC	T2c	IIA/IIB with positive malignant cells in the ascites or positive peritoneal washings
III	T3 ± N1	Tumour involves one or both ovaries with microscopically confirmed peritoneal metastasis outside the pelvis and/or regional lymph node metastasis
IIIA	T3a	Microscopic peritoneal metastasis beyond the pelvis.
IIIB	T3b	Macroscopic peritoneal metastasis beyond the pelvis. 2 cm or less in greatest dimension
IIIC	T3c ± N1	Peritoneal metastasis beyond the pelvis more than 2 cm in greatest dimension and/or regional lymph node metastasis
IV	M1	Distant metastasis beyond the peritoneal cavity

classification can be modified into a radiologically more useful format as shown in Table 2 [9].

Imaging findings are not a formal component of the staging system but in clinical practice they play a significant role in the diagnosis and management of suspected ovarian cancer. Adnexal masses which are shown to have benign features on imaging can undergo simple excision at a local unit by a non-oncological gynaecologist. If a mass has malignant characteristics on imaging, then a radical surgical approach is indicated and this should be performed by a gynaecological oncological surgeon at a specialist cancer centre, as optimal cytoreductive surgery has been reported to improve outcome [10–12]. Radical surgery includes staging laparotomy with total abdominal hysterectomy, bilateral salpingo-oophorectomy, lymph node dissection, infracolic omentectomy and selective biopsies from the pelvis, abdominal peritoneum and diaphragm. Full staging also includes cytology of ascites and peritoneal washings.

2. Imaging in adnexal mass detection and characterisation

2.1. The role of ultrasound

Ultrasound (US) is the most appropriate initial imaging investigation in patients suspected of having adnexal pathology both to determine its site of origin and to characterise it as benign or malignant. Although morphologic (gray scale) US has a high sensitivity (88–100%) for detection of malignancy it has a relatively low specificity (39–87%) [13]. The corollary of this is that US has a high negative predictive value and is an excellent investigation for ruling out ovarian cancer [14]. Transvaginal US has a higher specificity than transabdominal US in the diagnosis of ovarian cancer although it is limited in the evaluation of large adnexal masses and in the presence of enlarged fibroid uteri [15–17]. Thin walled, unilocular cystic structures smaller than 5 cm in diameter are likely to be benign and can be followed with imaging [18,19]. The typical US appearances of endometriomas, haemorrhagic cysts and dermoids are also well described in the literature [13,17]. Sonographic indicators suggestive of malignancy include irregular thickening of cyst walls or septae (>3 mm), vegetations or papillary formations, cystic masses greater than 10 cm diameter, solid components or completely solid lesions (Fig. 1) [18,20,21]. The presence of ascites or peritoneal nodules on US is also suggestive of malignancy.

Table 2
Classification of ovarian tumours by imaging features (modified from [9]).

	No or few solid elements	Some solid elements
Cystic tumours	Serous cystadenoma	
Containing serous fluid		Borderline serous tumour Serous adenofibroma
Containing mucinous fluid	Mucinous cystadenoma	Borderline mucinous tumour Mucinous adenofibroma
Containing blood	Corpus luteum cyst Endometriotic cyst Benign cyst with secondary haemorrhage	Borderline endometrioid tumour Endometrioid adenofibroma Borderline cyst with secondary haemorrhage
Containing lipid	Dermoid cyst	Dermoid cyst
Predominantly solid tumours		
Epithelial	Serous cystadenocarcinoma Mucinous cystadenocarcinoma Endometrioid cystadenocarcinoma Clear cell cystadenocarcinoma Brenner tumour: benign, borderline or malignant	
Lipid containing	Granulosa cell tumour Thecoma and other sex cord stromal tumours Dermoid cyst	
Other	Fibroma Dysgerminoma Yolk sac tumour Lymphoma Metastatic tumours	