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5

Imaging techniques for the evaluation of ovarian cancer

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Women with ovarian cancer often present at advanced stage of disease. The outcome depends mainly on the stage of disease at first diagnosis, but also on the quality of treatment. For individualised tumour treatment, detailed assessment of tumour extension using modern imaging is crucial. Ultrasound remains the initial and most important imaging method for ovarian cancer detection. Although increasing evidence shows that ultrasound is an accurate technique to stage and follow up ovarian cancer, it requires an experienced examiner capable of examining both the pelvis and the abdomen. Computed tomography is the most commonly used imaging modality for preoperative staging and follow up. Magnetic resonance imaging remains a second-line imaging method for solving problems, mainly in the pelvis. Positron emission tomography combined with computed tomography is the optimal imaging technique for suspected recurrence, particularly in women with rising CA 125 levels, but negative results of conventional imaging methods.

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Introduction

Ovarian cancer is the most aggressive gynaecologic malignancy, accounting for about one-half of all deaths related to gynaecological cancer, with a 5-year survival rate of around 40% [1]. Despite advances in surgery, chemotherapy, and intensive ongoing research, survival has not significantly increased. The most important factor for survival is the disease stage at diagnosis. About 70% of women present when the cancer is at an advanced stage (i.e. it has metastasised to the upper abdomen or beyond the abdominal cavity) [2,3]. One of the reasons for late detection of ovarian cancer was thought to be its asymptomatic nature until later stages, and its location deep in the pelvis. It is now recognised that most women diagnosed with ovarian cancer actually have symptoms, but they can easily be confused with those of the gastrointestinal tract (e.g. meteorism, changes in bowel habits, unexplained weight loss, and abdominal swelling) [4,5]. Another important factor influencing the prognosis of women with ovarian cancer is the referral to a gynaecologic oncology centre for further diagnosis and staging, debulking surgery, and interdisciplinary tumour board evaluation [6–9]. Although such centralised care is recommended in many countries, a large proportion of women with ovarian cancer remain treated by general surgeons and clinicians [10].

The goal of preoperative (clinical) staging of ovarian cancer is (1) the confirmation of a malignant adnexal mass and exclusion of a primary tumour in the gastrointestinal tract or pancreas, whose metastatic spread might mimic primary ovarian cancer; (2) assessment of tumour burden and mapping of the distribution of metastases; and (3) diagnosis of possible complications (e.g. bowel obstruction, hydronephrosis, or venous thrombosis) [11]. Ovarian cancers spread mainly by local extension, by intra-abdominal dissemination, and by lymphatic dissemination, and rarely through the blood stream [12]. The International Federation of Gynecology and Obstetrics (FIGO) Committee on Gynecologic Oncology is responsible for the staging system that is used internationally today [13]. It is also useful, however, to be aware of the equivalents TNM (primary Tumour, regional lymph Nodes and distant Metastases) staging system developed within the International Union Against Cancer and the American Joint Commitee on Cancer [14]. The two staging classification systems are presented in Table 1. At present, surgical staging remains the gold standard for staging of ovarian cancer [13]. Operative findings, before tumour debulking, determine the stage that may be modified by histopathologic as well as clinical or radiological findings [14]. Histologic confirmation of the disease should be made on the basis of biopsies of all suspicious sites relevant for staging, such as omentum, mesentery, liver, diaphragm, pelvic, and paraaortic lymph nodes. Imaging studies and serum tumour markers may be helpful in diagnosis and follow up of the tumours. Serum CA-125 results can give some information on the specific nature of an adnexal mass (e.g. the median CA125 value for advanced ovarian cancer has been reported to be more than 400 U/mL compared with 99 U/mL for metastatic cancer) [15]. Measurement of carcinoembryonic antigen should be considered to rule out a primary tumour other than ovarian cancer [13]. If the CA 125 kU/L/carcinoembryonic antigen (ng/mL) ratio is 25 or less, a primary gastric, colon, or breast carcinoma should be excluded using imaging, endoscopy (gastroscopy, colonoscopy), and biopsy [16,17].

The precise assessment of tumour extent is the basis for the evaluation of feasibility of surgery. The ultimate goal of debulking surgery is complete macroscopic tumour resection (i.e. optimal cytoreduction) [18,19]. Postoperative residual tumour is the strongest independent prognostic factor after tumour stage [20]. Imaging aims to identify women unfit for surgery by depicting disease extent beyond the reach of surgery (Table 2) [17]. For those selected women, delayed primary surgery (i.e. interval debulking surgery) after three courses of neoadjuvant chemotherapy is an option [19]. Before starting neoadjuvant chemotherapy, an image–guided tru-cut biopsy of the primary tumour or one of the metastases should prove the presence of an ovarian carcinoma [21,22]. Many scoring systems based on CA 125 levels, ultrasound, computed tomography, magnetic resonance imaging (MRI), positron emission tomography (PET) combined with computed tomography, laparoscopy, performance status, the American Society of Anesthesiologists physical status classification system (ASA score), age, coincidental morbidity, and FIGO stage have been explored to define preoperatively if the woman is suitable for undergoing optimal cytoreduction [23–31]. These studies, however, have at least two limitations. First, with the purpose of minimising the risk of misclassifying woman who potentially could have achieved complete cytoreduction as unsuitable for primary surgery, the studies