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MRI of the Ovarian Cancer: Staging, Treatment Response, and Detection of Recurrence

Currently, the main role of MRI is characterization of ovarian masses rather than staging of histologically proven ovarian cancer. It is important to recognize that as there are no MRI signal intensity characteristics that are specific for malignant epithelial tumor, such tumors must be distinguished based on morphologic criteria. The MRI features most predictive of malignancy are an enhancing solid component or vegetations within a cystic lesion, presence of necrosis within a solid lesion as well as presence of ascites and peritoneal deposits. The presence of at least one of the primary criteria and an additional single criterion from the ancillary group correctly characterizes 95% of malignant lesions. Both transvaginal US and contrast-enhanced MRI have high sensitivity (97% and 100%, respectively) in the identification of solid components within an adnexal mass. MRI, however, shows higher accuracy (93%).

Peritoneal dissemination is the most common route of spread of ovarian cancer. Peritoneal implants appear as nodular or plaque-like enhancing soft tissue masses of varying size. MRI is very sensitive (95%) for detection of peritoneal metastases, which show delayed enhancement on contrast-enhanced MRI. Ascites is a non-specific finding but, in a patient with ovarian cancer, usually indicates peritoneal metastases. Ascitic fluid may outline small implants, facilitating detection. Peritoneal implants may occur anywhere in the peritoneal cavity, but the most common sites include the pouch of Douglas, paracolic gutters, surface of the small and large bowel, greater omentum, surface of the liver (perihepatic implants) and subphrenic space. MRI is useful in differentiating between subcapsular liver implants and parenchymal liver metastasis, which alters staging and therapy. These implants are best seen on the delayed (5-10min) contrast-enhanced images. DCE-MRI provides data reflective of tumor vascularity and angiogenesis and is one of the phenotypic imaging techniques most often used in clinical trials. Because changes in tumor vascularity tend to occur earlier than changes in tumor size, DCE-MRI is also being used as a surrogate biomarker in early clinical trials of new antivascular drugs.

Although contrast-enhanced CT and MRI have excellent per-patient sensitivity in detecting peritoneal deposits (92% and 95% respectively), their per-lesion performance deteriorates considerably in implants smaller than 1 cm (sensitivity 7-50%) and in certain anatomical areas, such as the right subdiaphragmatic space, greater and lesser omentum, root of mesentery and serosal surface of small bowel and bladder (sensitivity 12-43%) because small serosal implants invaginated within peritoneal reflections are often obscured by their similar attenuation values/signal intensity to adjacent structures. DW-MRI depicts deposits on the visceral peritoneum as foci of high signal intensity against a background of suppressed signal intensity from surrounding ascites, bowel contents and fat, leading to greater conspicuity. Its addition to gadolinium-enhanced MRI was shown to improve the accuracy of tumour detection (accuracy of 84-88% compared to 52-72% for MRI alone and 71-81% for DW-MRI alone and has been reported to achieve 90% sensitivity, 95% specificity in delineating the extent of peritoneal dissemination with satisfactory inter-observer agreement. False-positive results arise from normal hypercellular tissues, such as small bowel mucosa, and non-cancerous lesions, such as tuboovarian abscesses, inflammatory collections, lymphoceles and proteinaceous or haemorrhagic ovarian cysts; false-negative results may occur in malignant lesions of low cellularity, such as mucinous subtypes, and in predominantly cystic or calcified deposits. In the quantitative approach, DW-MRI has been mainly applied in the differential diagnosis of complex adnexal masses with good results in identifying endometriomas and teratomas. Significantly lower ADC values in peritoneal deposits compared to primary ovarian tumours and omental cake have recently been reported. The peritoneal ADCs, in contrast to other sites, correlated positively with the vascular signal fraction (VSF), which describes the perfusional component of the DW signal, indicating that high cellularity (low ADCs) is accompanied by reduced blood flow (low VSF). These findings suggest that site-specific diffusion patterns reflect disease heterogeneity and may predict differential response to treatment.

In patients with ovarian carcinoma, MRI is very useful in the detection of recurrent disease. It is important to realize that second look surgery is no longer routine and imaging diagnosis of recurrence may obviate a second look laparotomy since secondary cytoreduction is only justified if resection is possible with no residual tumour. contrast-enhanced MRI is comparable (sensitivity 90% and specificity 88%) to laparotomy (sensitivity 88% and specificity 100%) but superior to serum CA-125 (sensitivity 65% and specificity 88%) for the detection of residual or recurrent peritoneal and serosal implants in women who have been treated for ovarian cancer. Imaging findings that indicate non-resectable recurrent tumour are pelvic side wall invasion which should be suspected when the primary tumour lies within 3 mm of the pelvic side wall or when the iliac vessels are surrounded or distorted by tumour. Bone invasion from the adjacent pelvic sidewall recurrence also constitutes non-resectable disease.

References

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