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Original Research Article

A Prospective Study Assessing Diffusion-Weighted Imaging Effects of Intravascular Contrast Agent on Apparent Diffusion Coefficient Measures of Ovarian Neoplasms

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Abstract

Aim: The aim of the present study was to assess the Diffusion-weighted imaging effects of intravascular contrast agent on apparent diffusion coefficient measures of ovarian neoplasms.

Methods: This was a Prospective Study was conducted on 50 patients at department of Radiology, with Study population being women with newly diagnosed ovarian tumors who underwent CEMRI study to evaluate the nature of tumor and extent.

Results: Most of the patients belonged to >60 years of age. 30 were benign and 20 were malignant. Most of the patients had size of tumor from 101-200 mm. In benign ovarian tumors, Pre contrast mean ADC was 1.49± 0.47 and Post contrast mean ADC value was 1.42±0.68 with statistically insignificant P value. In malignant ovarian tumors, Pre contrast mean ADC was 0.91±0.20 and post contrast mean ADC value was 0.94±0.23 with statistically insignificant P value.

Conclusion: ADC measures using our approach were not significantly changed after contrast administration for ovarian tumors at 1.5T. Our findings support the possibility that DWI optimized may be obtained before or after DCE-MRI without compromising important clinical information. Benign ovarian tumors had higher ADC values compared to malignant tumors, consistent with some of the previous studies.

Keywords: DCE-MRI, DWI, ADC, Ovarian tumors, pre and post contrast

Introduction

Dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) is widely used to characterize and delineate the extent of breast malignancies. Malignancies are distinguishable on DCE-MRI due to alterations in microvasculature characteristics, and can be detected with high sensitivity. In a meta-analysis across 44 breast MRI studies, sensitivity ranged from 89 to 100% for invasive cancers. [1] However, specificity was more variable, ranging widely from 21% to 100%, with an overall specificity of 72%. [1] Diffusion-weighted imaging (DWI) is a non-contrast-enhanced MRI technique that has shown promise for improving upon the specificity of DCE-MRI. [2-4] DWI assesses molecular water motion in tissue and complements DCE-MRI because it is sensitive to tissue microstructural features, including cell density and membrane integrity. [5] Multiple studies have indicated that apparent diffusion coefficient (ADC) values measured by DWI are useful for characterizing breast lesions on MRI. [5-8] Typically, malignant breast lesions demonstrate lower ADC values than benign breast tissue, reflecting higher cell density. [5]

Early work by Yamada et al. found statistically significant reductions in ADC values after gadolinium contrast agent administration in normal brain tissue (mean, −1.3%) and brain infarcts (mean, −3.5%). [9] In known breast carcinomas at 1.5T, Yuen et al reported dramatic ADC reductions (mean, −23%) after gadolinium administration. [10] A more recent study by Janka et al. also found a decrease in ADC after contrast in breast lesions [11], although the changes were smaller than reported by Yuen et al (mean, −11%).

The aim of the present study was to assess the Diffusion-weighted imaging effects of intravascular

contrast agent on apparent diffusion coefficient measures of ovarian neoplasms.

Materials and Methods

This was a Prospective Study was conducted on 50 patients at Department of Radiology , Katihar Medical College and Hospital, Katihar, Bihar, India with Study population being women with newly diagnosed ovarian tumors who underwent CEMRI study to evaluate the nature of tumor and extent.

Inclusion Criteria

1. Women referred from gynaec OPD for evaluation of ovarian neoplasms

2. With normal RFT

Exclusion Criteria

1. Failed to follow up in our institute with HPE reports.

2. Pregnant women were excluded from the study.

Protocol

MRI was performed with a Philips Achieve Tx 1.5 tesla (T) scanner using a dedicated abdomino-pelvic protocol. All pelvic MRIs included a T2-weighted fast spin echo sequence, T1-weighted non-fat-suppressed sequence, T1 weighted fat-suppressed DCE-MRI sequences, and DWI sequences before and after the DCE-MRI. Data collection performed according to the hospital regulations, after approval by the hospital authorities and consent by the patient.

Statistical Analysis

The data was entered in the Microsoft office excel 2007 and IBSS version 22 was used for analysis. The data was presented in the form of tables, and percentages. Paired t test was used to assess the statistical significance. P value of < 0.05 was considered significant.

Results

Table 1: Patient characteristics

Age Group of females (in yrs)	**Numbers**
20-40	6
40-60	20
>60	24
Ovarian Tumors	
Benign	30
Malignant	20
Size (in mm)	
<50	0
51-100	6
101-150	15
151-200	20
201-250	6
>250	3

Most of the patients belonged to >60 years of age. 30 were benign and 20 were malignant. Most of the patients had size of tumor from 101-200 mm.

Table 2: Benign tumors

Type of ovarian tumor	**No of lesions**	**contrast ADC range**	**Pre contrast mean ADC**	**Post contrast ADC range**	**Post contrast ADC mean**	**P value**
benign tumors	30	0.49,2.22	1.49±0.47	0.21,2.34	1.42±0.68	0.90
Serous cystadenoma	17	0.48, 2.21	1.54±0.18	0.52, 2.3	1.38±0.22	
Mucinous cyst adenoma	10	1.12, 1.79	1.48±0.20	1.22,1.88	1.52±0.18	
Fibro thecoma	1	1.2	1.2	1.22	1.22	
Cystadeno fibroma	1	0.89	0.89	0.9	0.9	
Brenner's Tumor	1	1.23	1.23	1.48	1.48	

In benign ovarian tumors, Pre contrast mean ADC was 1.49± 0.47 and Post contrast mean ADC value was 1.42±0.68 with statistically insignificant P value.

Table 3: Malignant tumors

Type of ovarian tumor	N	Precontrast ADC range	Pre contrast meanADC	Post contrast ADC range	Post contrast ADC mean	P value
Malignant Tumors	20	0.5,1.45	0.91±0.20	0.54,1.50	0.94±0.23	0.7
Serous Cystadeno carcinoma	10	0.66,1.35	0.97±0.20	0.70,1.37	0.99±0.22	
Mucinous Cystadeno carcinoma	5	0.65,1.31	0.89±0.19	0.68,1.35	0.92±0.23	
Serous borderline tumor	2	0.78,1.45	1.05±0.19	0.80,1.49	1.09±0.24	
Mucinous borderline tumor	1	0.99	0.99	1.31	1.31	
Clear cell adenocarcinoma	1	0.82	0.82	1.12	1.12	
Endometriod adenocarcinoma	1	0.93	0.93	1.23	1.23	

In malignant ovarian tumors, Pre contrast mean ADC was 0.91±0.20 and post contrast mean ADC value was 0.94±0.23 with statistically insignificant P value.

Discussion

Ovarian tumors are one of the main indications for gynecological surgery. Characterization of ovarian tumors preoperatively is important for explaining patients about possible management plan especially for the surgical part.

Magnetic resonance imaging (MRI) is of great help in identifying malignant lesions, particularly when ultrasound findings are not optimal or indeterminate. MRI can reveal imaging features like papillary projections, nodularity, septae, solid component and signal intensity changes on T1- and T2-weighted images, but none of these criteria can accurately distinguish between benign and malignant nature of tumors.

Magnetic resonance (MR) diffusion-weighted imaging (DWI) use will help in better characterization of ovarian tumors. Diffusion-weighted imaging is dependent on micro diffusion of water alterations, in both intracellular as well as extracellular spaces. Differences in the apparent diffusion coefficient (ADC) of benign and malignant adnexal masses are reported to have proven value especially in complex lesions. Typically, malignant ovarian tumors demonstrate lower ADC values compared to the benign neoplasms, reflecting higher cellular density. The effect of gadolinium contrast agents on ADC measurements is not very well understood, and previous literature and studies have shown varied mixed results. [12,13]

Most of the patients belonged to >60 years of age. 30 were benign and 20 were malignant. Most of the patients had size of tumor from 101-200 mm. In benign ovarian tumors, Pre contrast mean ADC was 1.49± 0.47 and Post contrast mean ADC value was 1.42±0.68 with statistically insignificant P value. In malignant ovarian tumors, Pre contrast mean ADC was 0.91±0.20 and post contrast mean ADC value was 0.94±0.23 with statistically insignificant P value. Several factors of our study design may explain why ovarian tumor ADC values were not significantly affected by contrast. These include field strength (3T versus 1.5T), contrast agent type, and repetition time (TR). [14,15] The late timing of the post-contrast DWI acquisition, approximately 9 minutes after injection, may also explain why our study did not identify significant alterations in lesion ADC. At this timing, much of the contrast has leaked from the microvasculature to the extracellular space (and perhaps even washed out of the tumor region). [16] Gadolinium is known to reduce signal-to-noise (SNR). As a result, the diffusion-weighted images may have a lower SNR, closer to the noise floor, and result in an artificially increased (or decreased, at higher b values) ADC calculation. [13]

Conclusion

ADC measures using our approach were not significantly changed after contrast administration for ovarian tumors at 1.5T. Our findings support the possibility that DWI optimized may be obtained before or after DCE-MRI without compromising important clinical information. Benign ovarian tumors had higher ADC values compared to malignant tumors, consistent with some of the previous studies.

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