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Role of Diffusion Weighted Imaging (DMI) in gynecological pathology

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Abstract
Diffusion Weighted Imaging (DWI) is key in the medical field today as it is used in the detection of tumors in the body. In this study, the sample of patients taken was 137 and were taken through a Magnetic Resonance Imaging. The results obtained revealed that 58 of the patients had DWI, 42 had high tumor grades and 68 LVSI. The patients also had endometrium carcinoma (112), serous carcinoma (19), clear cell (3) and mixed carcinoma (3). DWI has led to improved accuracy in tumor detection, differentiation in residual or recurrent tumors and even the identification of how deep a myometrial invasion is. It has also led to the determination of FIGO staging system for cancer in the endometrium and overall improvement of treatments offered to patients.

Keywords: Diffusion Weighted Imaging, FIGO

Introduction
Today women suffer various diseases that are related to their genitals. These diseases are bacterial, fungal, protozoan and also viral in nature. They suffer various infections such as vaginitis, endometriosis and tumors that are cancerous or malignant in the uterus and ovaries (Dr. Arora, 2017) [4]. Diffusion Weighted Imaging (DWI) is a technique of signal contrast generation that is based on the variances in Brownian motion. This method evaluates the micro-architecture and molecular function of the body of a human being. It also acts as a tool for the treatment response analysis and the assessment of the progression of a disease. It is a tool that is used for assessment of body organs that have a fibre structure that is highly organized (Baliyan, 2016) [2].

The DWI method has also led to the detection and probable prediction of the aggressiveness of tumors and the grades which correlate directly with the management of the prognosis of the patient (Manoharan *et al*., 2016) [8]. DWI could be utilized by patients who reject hysteroscopy or those who have cervical or vaginal stenosis which makes it difficult for medical practitioners to perform a biopsy (Cowell *et al*., 2013) [3]. One of the most common gynecological malignances is endometrial cancer and the purpose of this thesis is to identify the role of diffusion weighted imaging in gynecological pathology while making reference to endometrial carcinoma.

Materials and Methods
Patients
The analysis done was retrospective and 212 patients who had undertaken 1.5-T MR imaging in advance before the medication of endometrial carcinoma was administered were eligible for the research. The identification of the patients was done using the registry database for cancer patients. The patients who were excluded were left out on the basis of the diameter of the maximal tumor being lower than 1 centimeter or the tumors they had were not visualized during the MRI. The actual number of patients used in the study was 137 who had a range of 32 years to 90 years and an average age of 65.3 years.

MRI Imaging
The unit that was used to perform the MR imaging was 1.5-T and a pelvic –phased array surface coil with eight elements. The requirements given to the patients included a four hour fast and 40 milligrams of hyoscine butyl-bromide that was meant to avoid or decrease peristalsis in the bowels. They were also requested to void before they were placed on the table where the MR imaging would be done. The testing done included a standard diagnostic which was T2-weighed imaging, Dynamic Contrast Enhanced (DCE) and DWI imaging.

Image Analysis
The images obtained were analyzed quantitatively using a software. In the images, the region of particular interest was labelled around the noticeable tumor on the biggest cross-sectional region. This was done to the five varied categorizations in either the oblique axial plane or the sagittal. In the analysis the tumors were segmented and calculations were done on the grounds of first order statistics. Mean, standard deviations, entropy, skewedness and kurtosis were all measured. Some of the images obtained are shown in the diagrams used.

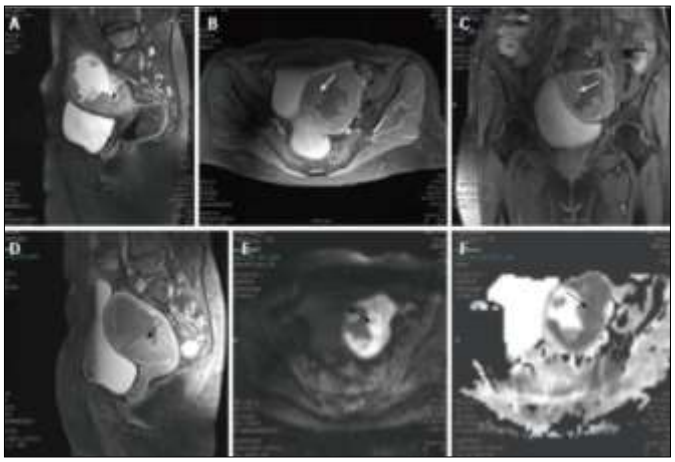

Fig 1

In the diagram, the irregular nodular thickening of the endometrial (shown with an arrow) is shown in image A. In diagram B the lesion on post contrast axial, coronal on image C and sagittal on D indicates enhancement. In images E and F the images display seeming diffusion coefficient and the lesions show significant constraint of diffusion. The conclusion made from the images is that the tumor is restricted to the myometrium in the outer part which suggests a T1c illness which was determined as endometrium carcinoma (Andreano *et al*., 2014) [1]

A B C

Fig 2

Image A displays axial T2-weighted imaging which illustrates a somewhat signal lesion that is high on the right side of vaginal cuff. Axial diffusion-weighted imaging undoubtedly depicts the lesion B and the seeming diffusion coefficient ADC revealed low ADC values ($0.91.10^{-3}$ mm^2/sec). In the last image the lesions are difficult to differentiate on the contrast enhanced and computed tomography.

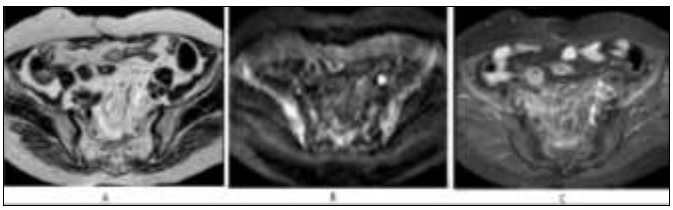

Fig 3

In image (a), the axial T2-weighted MR Imaging displays a left external lilac that is 9 millimeters. A lymph has recurred and the score assigned for protocol A was 3. In (b), the axial DWI illustrates a focal spot that is hyper-intense in the external lilac region on the left which is identical to the one found in (a) and the score that was assigned was 4 for protocol B. In (c), the MR Imaging that is contrast and enhanced shows a relative ring like augmentation of the node. The conclusion made is that there was a recurrent lymph node and 4 is the score assigned. The analysis made confirms the recurrence of the lymph node (Kitajima, 2015) [7].

Surgical Histologic Findings

All the patients studied had undergone total hysterectomy, bilateral pelvic lymph node sampling and salpingo-oophorectomy. The number of patients who had had a sampling of para-aortic lymph node were 5. During the analysis the uterus was contiguously sliced every 3 to 4 millimeters were among the findings found.

Statistical analysis

The method used to build a model for Diffused Weighted Imaging LVSI and grade tumor that was high was the RF method. The method included regression trees and multiple classifications. A program was written to generate a more accurate model. All the models were validated to ensure robustness. Computed areas included positive predictive, specificity, sensitivity and accuracy. Tests done on the 180 features that were analyzed included McNemar test. A k statistic was used and a statistics of less than 0.2 was poor, 0.21 to 0.4 was fair, 0.41 to 0.6 was moderate, 0.61 to 0.08 was strong and above 0.8 was virtually total agreement. The probability value that was less than 0.5 was noted to indicate a noticeable difference in all the analyses made (Yoshiko *et al*., 2017) [9].

Results

Table 1: The result obtained are displayed in the table below

Variable	Data (n=137)
DMI	
Absence	79 (57.7)
Presence	58 (42.3)
LVSI	
Absence	69 (50.4)
Presence	68 (49.6)
Histologic subtype	
Endometrial	112 (81.7)
Serous	19 (13.9)
Clear cell	3 (2.2)
Mixed or undifferentiated	3 (2.2)
Histologic grade	
Low (histologic grades 1 and 2)	95 (69.3)
High (histologic grade 3 and non-endometrial)	42 (30.7

The table reveals that 58 of all the patients had DMI, 68 had LVSI and 42 had a high tumors grade at the histological evaluation. The histological subtype shows that there was endometrium carcinoma in 112 of the patients, 19 patients had serous carcinoma, 3 had clear cell and another 3 had mixed carcinoma. When the McNemar test was applied, the result obtained was that there was no significant difference between the quantitative reviews of the radiologists and the RF model. The reviews included sensitivity, specificity and accuracy whose values were 0.48, 0.99 and 0.59 in reader 1 compared

to the RF model, 0.99 for all the three in reader 2 alongside the RF model and 0.55, 0.99 and 0.69 in reader 3 against the RF model.

Discussion

The results obtained show that MR imaging-based analysis alongside the RF model allowed precise and accurate diagnosis of the availability of DMI, LVSI and high tumor grade. Information is provided for factors of high risk, this may aid in the ideal assortment of patients who require more extensive surgeries whereas they are still able to avoid overtreatment of the patients who have low risk. The role of diffusion weighted imaging in gynecological pathology is that it enhances sufficient benefits it offers the patients. There is accuracy in the analysis which is line with the conclusion made by Andreano *et al*., (2014) [1].

In cases where there is a dilemma in the diagnosis when practitioners are trying to identify how deep the myometrial invasion is, the DWI relieves them of the quandary (Hori, 2014). Detection of tumors has been made easier. This has led to better treatment and the saving of many lives. DWI has also led to the differentiation in residual tumor or recurrent tumors and tissues that are inflamed which will not indicate any restriction. This has also led to the determination of the FIGO staging system for cancer in the Endometrium (Cowell, 2013). This staging has been beneficial to many patients and was also supported by Haldorsen (2017)

Table 2

Stage			Description
I	A		Tumor is confined to the uterus, < 50% myometrial invasion
I	B		Tumor is confined to the uterus, > 50 % myometrial invasion
II			Cervical stromal invasion
III	A		Tumor invasion into the serosa or adnexa
III	B		Vaginal or parametrial association
III	C	1	Pelvic node involvement
III	C	2	Para-aortic node involvement
IV	A		Tumor invasion into bladder or bowel mucosa
IV	B		Distant metastases

Conclusion

DWI is very important today and many have benefited from it. The evolution of science has proven to be useful to mankind in many ways including saving of lives.

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