International Journal of Biotechnology and Clinical Medicine
Vol.1, No.1, April 2022, pp. 29~36

EVALUATION OF UTERINE MASS LESIONS USING DIFFUSION WEIGHTED IMAGINING

NN. Naik, G. Balachandran, G. Jayalakshmi*
Sri Lakshmi Narayana Institute of Medical Sciences, Kudupakkam Post, Puducherry - 605 502, India

Article Info

Article history:

Received Feb 12th, 2022
Revised March 28th, 2022
Accepted April 4th, 2022

Keyword:

Clinical imaging
Histopathology
Uterine lesions

ABSTRACT

The current descriptive study was designed to detect the role of DWI MR Imaging and measurement of quantitative ADC value for malignant and benign uterine lesions. A total 47 patients recruited in the study. The patients who came to SLIMS with uterine lesions diagnosed on any imaging modality (USG/CT) or referred with clinical presentations/MRI were entered in this study. All patients who were recruited undergone MR pelvis on 1.5 T MRI machine with following sequences as T1,T2 weighted images, T1 post contrast and DWI. Diffusion weighted imaging was done applying multiple b values of 50,400 and 800 sec/mm2. ADC values were automatically generated. Histopathological results (FNAC/BIOPSY) from uterine lesions (if the lesions were benign or malignant) were correlated with ADC values. Well analyzed signal intensity of study groups on DWI and ADC values were calculated by placing ROI in the lesion avoiding vessels and cystic areas.

Corresponding Author:

Dr. G. Jayalakshmi,
Sri Lakshmi Narayana Institute of Medical Sciences,
Kudupakkam Post,
Puducherry - 605 502, India.
Email: jayalakshmi.2k15@gmail.com

How to Cite:

Naik *et. al.* Evaluation of uterine mass lesions using diffusion weighted imagining. IJBTCM. 2022; Volume 1 (Issue 1): Page 29-36.

1. INTRODUCTION

Uterine tumours are commonly seen in postmenopausal women as well as those in the reproductive age range. These are uterine lumps that are either benign or cancerous. Uterine leiomyoma, Adenomyosis, and endometrial polyps are frequent benign uterine lesions, but cervical cancer and endometrial carcinoma are malignant uterine lesions. Uterine leiomyoma is the most frequent benign tumour of the myometrium. It's commonly referred to as "fibroids." The most frequent benign uterine lesions are these. Before menopause, about 70% of women were found to have uterine fibroids [1]. These lesions, which have a significant impact on women's health, are regularly encountered in women of reproductive age, yet they are asymptomatic. The most common symptoms are abdominal discomfort, dysmenorrhea, and heavy menstrual flow. Ultrasound is the recommended imaging modality for the diagnosis of uterine fibroids. Tran abdominal sonography (TAS) or Transvaginal ultrasound sonography (TVS) is one of the sensitive procedures for evaluating uterine fibroids. However, ultrasound has poor sensitivity for small lesions (<5mm) [2]. Computed tomography is another method of detecting uterine fibroids (CT). However, it has a drawback over pelvic ultrasonography (USG) in that it exposes the patient to radiation. For uterine leiomyoma imaging, magnetic resonance imaging (MRI) is a better delineator of soft tissue and is more sensitive.

Adenomyosis is the most frequent benign lesion encountered in people of reproductive age. Dysmenorrhea, menorrhagia, and lower abdomen discomfort are common symptoms. Both uterine fibroids and adenomyosis appear with the same clinical symptoms and might overlap, making diagnosis difficult. It is possible, however, that both can coexist in the same person [3]. Because of its ease of use and low cost, ultrasound is commonly used to identify adenomyosis. Other imaging modalities utilised in the diagnosis of

adenomyosis include CT-Pelvis and MRI-Pelvis [3]. Transvaginal ultrasound sonography (TVS) has the drawback of being unable to distinguish between myometrial / sub-endometrial lesions and endometrial lesions. SHG has been recommended over TVS4 because it can identify elongated fluid travelling from the endometrial cavity into the myometrium [4].

The fourth commonest cancer affecting females in the world is Cervical carcinoma and it is second commonest cancer in developing countries [5]. South Asian women have highest incidence of cervical cancer in India and is found to be 22/ 100000 women.5 It is considered as one of major cause of mortality and morbidity in women. The developing countries like India contribute to more than 25% of the global burden of cervical cancer [6]. In around 46% of cervical cancer five year survival rate is seen in India. There are few techniques that are used as screening tool in cervical cancer. Those are visual inspection with acetic acid (VIA), the Papanicolaou test, visual inspection with Lugol's iodine (VILI), magnified VIA (VIAM) and HPV DNA testing. However, USG is most common routinely recommended imaging modality in cervical carcinoma. TVS, is better in detecting the penetration of myometrial and cervical invasion, but being operator- dependant is major disadvantage [7]. MRI is more preferred than CT as it can detect myometrial invasion as CT-pelvis alone is not sufficient [8]. Hence for pre-operative evaluation and staging of cervical carcinoma pelvis-MRI is preferred. However, diagnostic confirmation has been done by histopathology alone.

Endometrial carcinoma is the most frequent gynaecological cancer in industrialised nations, and it is the second most common gynaecological cancer in underdeveloped countries, behind cervical cancer [9]. Endometrial cancer affects 26 out of every 100,000 women worldwide. In poor nations, the frequency is 5.9 per 100,000 women, whereas in India, it is 4.3 per 100,000 women [10, 11]. The most prevalent clinical manifestation of endometrial cancer is postmenopausal bleeding. Fractional curettage is used to diagnose endometrial cancer prior to surgery, followed by histopathological investigation. Because more advanced imaging modalities are available, USG is regarded as a poor technique for evaluating endometrial cancer. With a 90% detection rate, MRI is superior than CT in identifying myometrial invasion and nodal enlargement because it is an excellent delineator of soft tissue and has minimal radiation exposure. For detection of extra uterine disease fluorodeoxyglucose (FDG)-positron emission tomography (PET)/CT is used [12].

It's crucial to distinguish between benign and malignant disorders since therapy differs. Lesions of benign origin are normally treated conservatively or monitored, with surgical intervention only being used in rare cases, but lesions of malignant origin necessitate surgery with or without adjuvant treatment, which is still standard practise in treating these individuals. Despite the availability of several imaging modalities such as pelvic sonography, CT, and MRI of the pelvis, it is still difficult to distinguish between benign and malignant uterine lesions. As a result, improved procedures that are non-invasive and simple to distinguish between benign and malignant uterine disorders must be adopted. A recent MRI method known as Diffusion-weighted imaging sequence is one such sequence. It is based on the diffusion of water molecules in the extracellular space (Brownian motion). It was originally meant to identify lesions in the brain, but it's now being used to assess extra-cranial areas including the female pelvic [13]. Diffusion-weighted Imaging has its uniqueness in being non-invasive and it helps in evaluation of benign conditions and malignant conditions of uterus. Using new technique which is apparent diffusion co-efficient, provides a quantitative data and it has shown to develop the radiological analysis of malignant tumours. ADC values are obtained from DWI [14]. It reflects random thermal motion of protons. Hence ADC values help in discriminating malignant tissues from benign tumours more precisely. Since ADC values depends on factors like density and structure of cells, it may changes with altered physiology and pathology of the tissues [15]. As a result, several studies have been conducted that emphasise the importance of the ADC value in normal uterine layers and varied masses. Few research have been done on the function of ADC in the evaluation of the uterus and uterine lesions using diffusion-weighted MR imaging.

2. METHOD

This was a descriptive research conducted at Sri Lakshmi Narayan Medical College's Department of Radiodiagnosis (SLIMS). Patients with uterine symptoms who were referred from a gynaecology department for additional examination or on any imaging modalities who met the inclusion criteria or were referred for MRI-pelvis were included in the research group with their agreement. Between December 2018 and July 2020, the research was carried out.

2.1. Inclusion parameters

All patients with clinical and ultrasound or Computed Tomography diagnosis of uterine lesion will be included.

Age more than 18 years.

2.2. Exclusion parameters

Patients who have contraindication for Magnetic Resonance Imaging like those with pacemakers, cochlear implants.

Claustrophobic patients.

2.3. Sampling

Sampling population: All women who attended the department of Obstetrics and Gynaecology/ referred for MRI/ diagnosed to have uterine lesion based on clinical presentation and imaging modalities like Ultrasonography and biopsy between December 2018 and July 2020.

Sampling technique: Convenience sampling of eligible candidates as per inclusion criteria..

2.4. Study period

18 months.

2.5. Equipment details

Machine name: SIEMENS, 1.5 T MAGNETOM ESSENZA MRI Scanner.

2.6. MRI protocol

MRI protocol consisted of the following a phased array body coil was used.

2.7. Sequences

The Siemens 1.5 T MAGNETOM ESSENZA MRI scanner was used to do MR imaging on all 47 patients in the department of radiology. Axial turbo spin echo T1 weighted sequence, sagittal turbo spin echo T2 weighted sequence, and DWI sequences were acquired as MRI sequences. Using software included with the Magnetic Resonance equipment, apparent diffusion co-efficient maps will be created automatically. These photos will be used to recreate apparent diffusion co-efficient maps.

2.8. Parameters

A table below lists the parameters for several sequences (table 3). Gap: 35%; number of slices: 30Averages 5 Acquisition time: 3 minutes; parallel acquisition method factor; free breathing; b values: 50, 400, and 800 s/mm2.

3. RESULTS

In our study, 19 of the 47 patients with uterine lesions received a benign clinical diagnosis, including 5 cases of adenomyosis and 14 cases of fibroids. In 28 individuals, a cytopathological diagnosis of malignancy was obtained, including 19 cases of cervical carcinoma and 9 cases of carcinoma endometrial. A cytopathological diagnosis of benign was obtained in 19 of the 47 individuals with uterine lesions in our investigation, which comprised 5 cases of adenomyosis and 14 cases of fibroids. In 28 individuals, a cytopathological diagnosis of malignancy was obtained, including 19 cases of cervical carcinoma and 9 cases of carcinoma endometrial.

In our study, there were 6 cases of benign uterine lesions among the 47 patients with uterine lesions who were between the ages of 21 and 60. There were 13 cases of benign uterine lesions among the 47 patients with uterine lesions who were between the ages of 41 and 60. There were 21 cases of people diagnosed with malignancy between the ages of 41 and 60, and 7 cases between the ages of 61 and 80. The results are represented graphically (figure 1).

The majority of the leiomyomas among the 19 benign instances with uterine lesions included in the research were multiparous, with 11 (78.57 percent) being multiparous, 2 cases (14.29 percent) being nulliparous, and one case (7.14 percent) being primiparous. In Adenomyosis, however, three instances were primiparous and two cases were multiparous. The majority of the carcinoma cervix (94.74 percent) and carcinoma endometrial (44.44 percent) patients included in the research with uterine lesions were multiparous. There were a few cases of carcinoma endometrial 3 that were nulliparous (33.33 percent). The majority of the 19 benign patients with uterine lesions included in the research had clinical symptoms of dysmenorrhea (78.23 percent) and a few had abnormal uterine bleeding (21.05 percent). The majority of the 28 malignant patients with uterine lesions included in the research presented with clinical symptoms of vaginal discharge (64.29%) and a few with abnormal uterine haemorrhage (28.57 percent).

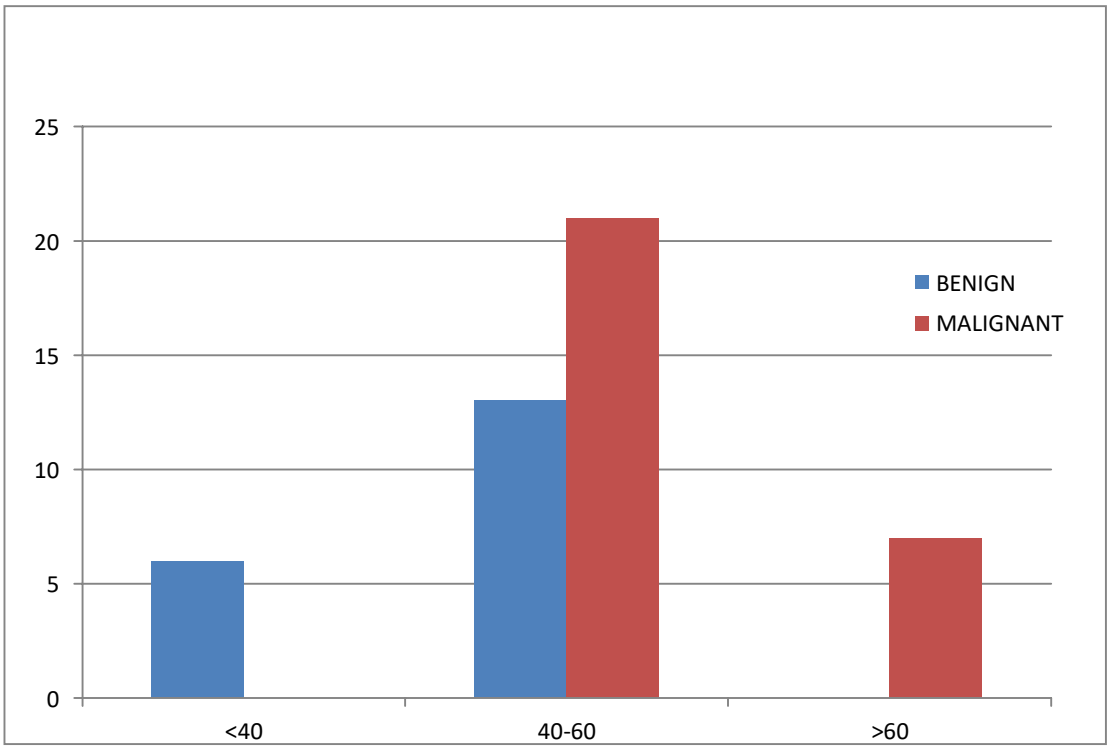

Figure 1. Age distribution

8 (57.14 percent) instances of leiomyoma and 2 (40 percent) cases of adenomyosis were among the 19 benign patients with uterine lesions included in the research. Eight (42.11 percent) instances of carcinoma cervix and four (44.44 percent) cases of carcinoma endometrial were among the 28 malignant patients with uterine lesions included in the research. The results are represented graphically (figure-2).

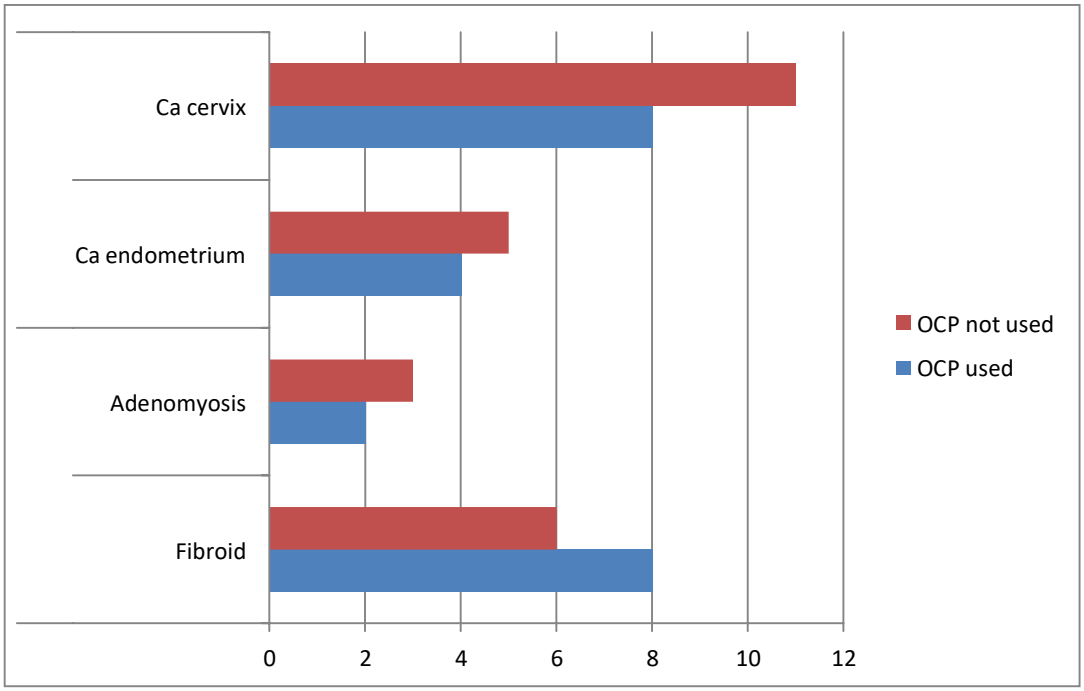

Figure 2. Distribution of OCP usage.

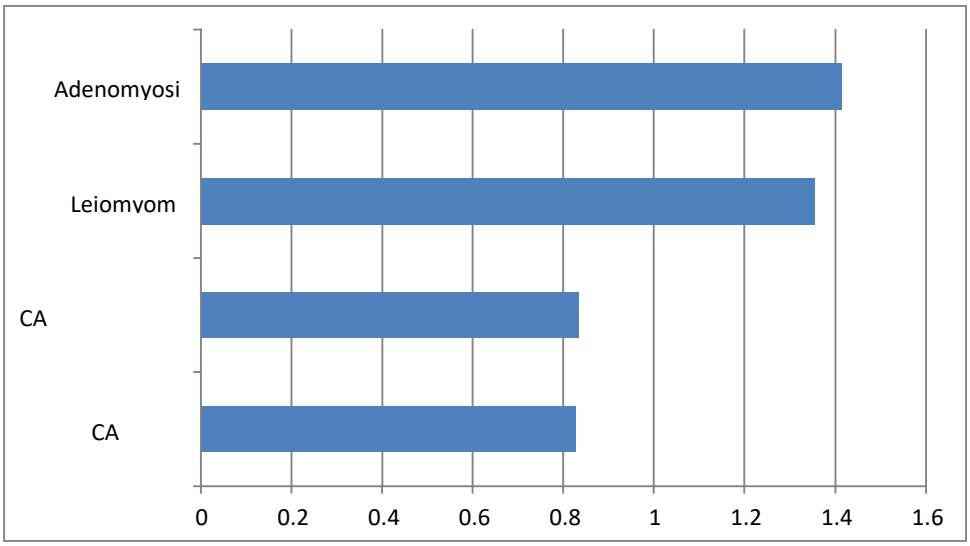

Figure 3. DWI characterization

Of the 47 patients included in study with uterine lesions 27 malignant lesions shows diffusion restriction and 1 lesion not showing restriction. Of the 19 benign lesions all the lesions shows no diffusion restriction. The findings are shown in graph (figure-3).

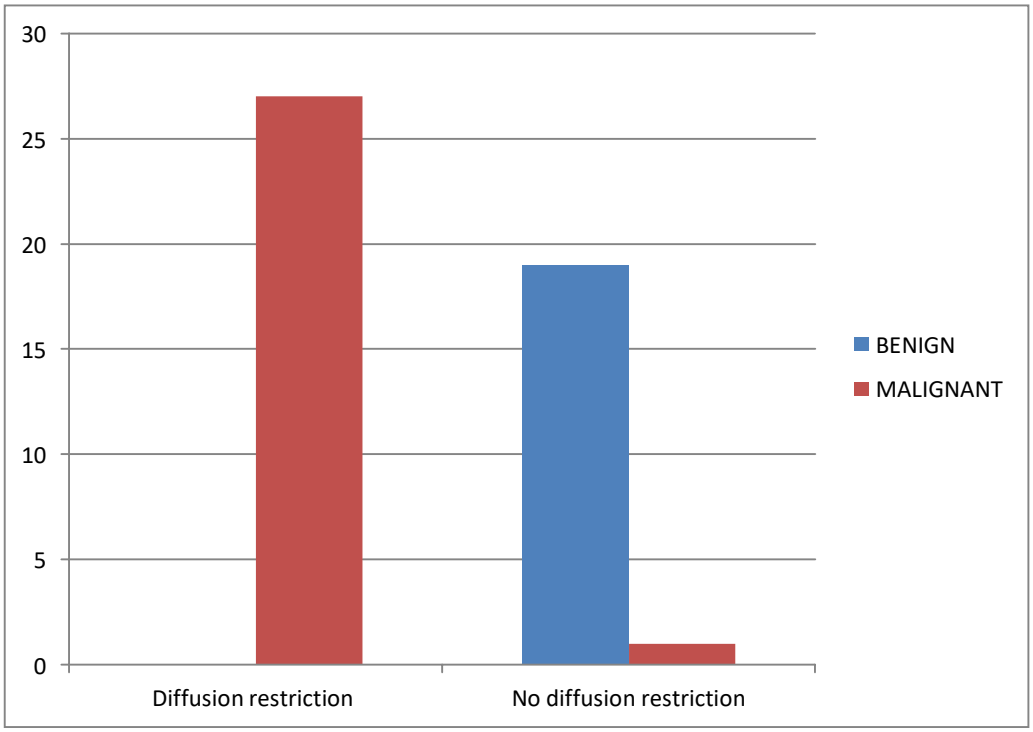

Figure 4. Mean ADC values of different lesions.

The ADC values were calculated from uterine lesions by placing ROI inside the lesion in solid area avoiding cystic areas and vessels. The mean ADC values were 0.827 x10-3 mm2 /sec with a standard deviation of 0.126 for malignant group, mean ADC values of 1.383 x10-3 mm2/sec with standard deviation of 0.152 for benign group (figure 4).

The following table depicts comparison between DWI, ADC values with histopathological correlation. Table 15, describes comparison of DWI, ADC values and histopathological correlation of fibroid lesions. Table 15, describes comparison of DWI, ADC values and histopathological correlation of carcinoma cervix. Table 16, describes comparison of DWI, ADC values and histopathological correlation of carcinoma endometrium. Table 17, describes comparison of DWI, ADC values and histopathological correlation of fibroid lesions. Table 18, describes comparison of DWI, ADC values and histopathological correlation of adenomyosis lesions.

Table 1: Signal intensity in DWI and mean ADC values of uterine lesion in carcinoma cervix.

Carcinoma Cervix	**Signal intensity in DWI**	**ADC values(x 10^{-3} mm^2 /s)**	**Interpretation**	**Histopathology**
1	High signal	0.698	Restricted diffusion	Well differentiated Squamous cell carcinoma of cervix
2	High signal	0.785	Restricted diffusion	Poorly differentiated Squamous cell carcinoma of cervix
3	High signal	0.782	Restricted diffusion	Moderately differentiated Squamous cell carcinoma of cervix
4	High signal	0.836	Restricted diffusion	Moderately differentiated Squamous cell carcinoma of cervix
5	High signal	0.872	Restricted diffusion	Poorly differentiated Squamous cell carcinoma of cervix
6	High signal	0.758	Restricted diffusion	Moderately differentiated Squamous cell carcinoma of cervix
7	Low signal	1.347	No diffusion restriction	Poorly differentiated Squamous cell carcinoma of cervix
8	High signal	0.898	Restricted diffusion	Well differentiated Squamous cell carcinoma of cervix
9	High signal	0.724	Restricted diffusion	Moderately differentiated Squamous cell carcinoma of cervix
10	High signal	0.852	Restricted diffusion	Adenocarcinoma of cervix
11	High signal	0.663	Restricted diffusion	Moderately differentiated Squamous cell carcinoma of cervix
12	High signal	0.718	Restricted diffusion	Well differentiated Squamous cell carcinoma of cervix
13	High signal	0.698	Restricted diffusion	Moderately differentiated Squamous cell carcinoma of cervix
14	High signal	0.926	Restricted diffusion	Adenocarcinoma of cervix
15	High signal	0.762	Restricted diffusion	Moderately differentiated Squamous cell carcinoma of cervix
16	High signal	0.691	Restricted diffusion	Well differentiated Squamous cell carcinoma of cervix
17	High signal	0.879	Restricted diffusion	Well differentiated Squamous cell carcinoma of cervix
18	High signal	0.928	Restricted diffusion	Poorly differentiated Squamous cell carcinoma of cervix
19	High signal	0.892	Restricted diffusion	Poorly differentiated Squamous cell carcinoma of cervix

4. DISCUSSION

A total of 47 individuals were included in the research, with 19 benign lesions and 28 malignant cases. Five cases of adenomyosis and 14 cases of fibroids/leiomyoma were found among the 19 benign cases. Nine incidences of carcinoma endometrial and 19 cases of carcinoma cervix were among the 28 malignant patients. The findings revealed that benign and malignant illnesses were more prevalent in the 41-60 year old age group, however 6 out of 19 benign cases were in the 20-40 year old age group. The bulk of the leiomyoma patients (78.57 percent) were multiparous women, whereas three instances of Adenomyosis were primiparous. The majority of the carcinoma cervix (94.74 percent) and carcinoma endometrial (44.44 percent) patients among the 28 malignant cases were multiparous.

Around 64.29% benign cases presented with symptoms of vaginal discharge and 28.57% cases presented with symptoms of abnormal uterine bleeding. It was found that around 57.14% cases of leiomyoma/fibroids m 42.11% of carcinoma cervix and 44.44% of carcinoma endometrium used OCP, It was observed that majority of benign lesions were hypointense on T1W and majority of malignant lesions were isointense on T1W sequences. These results were done using Fishers Exact test and it was statistically significant (<P value 0.01). It was observed that majority of malignant lesions were hyperintense on T2W and majority of benign lesions were hypointense on T2W sequences. These results were done using Fishers Exact test and it was statistically significant (<P value 0.01). It was found that 96.55% of malignant conditions showed diffusion restriction, i.e. 28 cases out of 29 cases showed restricted diffusion. Whereas, all benign lesions showed no evidence of diffusion restriction.

This was interpreted using Fishers Exact test and was statistically substantial among benign and malignant groups (<p-value 0.01).The mean ADC values were 0.827 x10-3 mm2 /sec with a standard deviation of 0.126 for malignant group, mean ADC values of 1.383 x10-3 mm2/sec with standard deviation of 0.152 for benign group. Mean ADC values of carcinoma Cervix was 0.826 x10-3 mm2/sec, Carcinoma Endometrium was 0.835 x10-3 mm2/sec, Leiomyoma was 1.356 x10-3 mm2/sec and Adenomyosis was 1.415 x10-3 mm2/sec. The histopathological diagnosis correlation with DWI and Apparent Diffusion Co-efficient values of benign and malignant uterine mass was statistically important (<P value 0.01) was done by using Wilcoxon rank- sum test. The T2 WI results and Apparent Diffusion Co-efficient values were correlation of benign and malignant uterine mass was found to be statistically important (<P value 0.01), was done by using ANOVA test.

5. CONCLUSION

On DWI, benign uterine lesions have a high ADC value, while malignant uterine lesions have a low ADC value. The ADC values of benign lesions were higher than 1.01103 mm2/s, whereas those of benign lesions were less than 1.01103 mm2/s. There was no significant difference in ADC levels between benign and malignant tumours (Adenomyosis and leiomyoma). The ADC values of leiomyoma was found to be 1.36±0.1 x ×10−3 mm2/s and ADC values of adenomyosis was found to be 1.41±0.2 ×10−3 mm2/s. Hence, there was no much difference in their ADC values. There was no significant difference between ADC values of malignant lesions (Carcinoma endometrium and Carcinoma cervix). The ADC values of carcinoma endometrium was found to be 0.835±05 x ×10−3 mm2/s and ADC values of carcinoma cervix was found to be 0.82±0.15×10−3 mm2/s. Hence, there was no much difference in their ADC values. DWI features and histological diagnosis (Benign/ Malignant) were shown to have a strong relationship. There was no evidence of a link between DWI and clinical symptoms. As a result, based on apparent diffusion co-efficient (ADC) values, DWI has the ability to correctly describe the neoplastic potential of uterine lesions.

ACKNOWLEDGEMENTS

The encouragement and support from Bharath University, Chennai is gratefully acknowledged. For provided the laboratory facilities to carry out the research work.

FUNDING

Nil

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

COMPETING INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Stewart EA, Cookson CL, Gandolfo RA, Schulze-Rath R. Epidemiology of uterine fibroids: a systematic review. BJOG: An International Journal of Obstetrics & Gynaecology. 2017; 124(10): 1501-1512.
[2] Wise LA, Laughlin-Tommaso SK. Epidemiology of uterine fibroids–from menarche to menopause. Clinical obstetrics and gynecology. 2016; 59(1): 2.
[3] Taran FA, Stewart EA, Brucker S. Adenomyosis: epidemiology, risk factors, clinical phenotype and surgical and interventional alternatives to hysterectomy. Geburtshilfe und Frauenheilkunde. 2013; 73(09): 924-931.
[4] Verma SK, Lev-Toaff AS, Baltarowich OH, Bergin D, Verma M, Mitchell DG. Adenomyosis: sonohysterography with MRI correlation. American Journal of Roentgenology. 2009; 192(4): 1112-1116.
[5] Yang Q, Al-Hendy A. The Regulatory Functions and the Mechanisms of Long Non-Coding RNAs in Cervical Cancer. Cells. 2022; 11(7): 1149.
[6] Bobdey S, Sathwara J, Jain A, Balasubramaniam G. Burden of cervical cancer and role of screening in India. Indian Journal of Medical and Paediatric Oncology. 2016; 37(04): 278-285.
[7] Alcazar JL, Pineda L, Corral TM, Orozco R, Utrilla-Layna J, Juez L, Jurado M. Transvaginal/transrectal ultrasound for assessing myometrial invasion in endometrial cancer: a comparison of six different approaches. Journal of Gynecologic Oncology. 2015; 26(3): 201-207.
[8] Faria SC, Sagebiel T, Balachandran A, Devine C, Lal C, Bhosale PR. Imaging in endometrial carcinoma. Indian Journal of Radiology and Imaging. 2015; 25(02): 137-147.
[9] Ravegnini G, Gorini F, De Crescenzo E, De Leo A, De Biase D, Di Stanislao M, Hrelia P, Angelini S, De Iaco P, Perrone AM. Can miRNAs be useful biomarkers in improving prognostic stratification in endometrial cancer patients? An update review. International Journal of Cancer. 2022; 150(7): 1077-1090.
[10] Xia C, Dong X, Li H, Cao M, Sun D, He S, Yang F, Yan X, Zhang S, Li N, Chen W. Cancer statistics in China and United States, 2022: profiles, trends, and determinants. Chinese Medical Journal. 2022; 135(05): 584-590.
[11] Balasubramaniam G, Sushama S, Rasika B, Mahantshetty U. Hospital-based study of endometrial cancer survival in Mumbai, India. Asian Pacific Journal of Cancer Prevention. 2013; 14(2): 977-980.
[12] Kitajima K, Yamasaki E, Kaji Y, Murakami K, Sugimura K. Comparison of DWI and PET/CT in evaluation of lymph node metastasis in uterine cancer. World Journal of Radiology. 2012; 4(5): 207.
[13] Sethi N, Sharma R, Khunteta N, Vijay MK, Mehrol C, Yadav ML. Synchronous uterine serous carcinoma and ovarian sex cord stromal tumor (thecoma)–A rare first case report. Indian Journal of Pathology and Microbiology. 2022; 65(2): 437.
[14] Milman T, Shivji A, Edwards D, Solnik MJ. Myometrial Abscess in the Noninstrumented Uterus. Journal of Minimally Invasive Gynecology. 2022; 29(2): 190-192.
[15] Cicinelli E, Romano F, Anastasio PS, Blasi N, Parisi C, Galantino P. Transabdominal sonohysterography, transvaginal sonography, and hysteroscopy in the evaluation of submucous myomas. Obstetrics & Gynecology. 1995; 85(1): 42-47.