Efficacy Of Mri In Diagnosis, Staging, And Treatment Response Assessment Of Carcinoma Cervix: A Comprehensive Study

Dr. Koukutla Sri Venkat Reddy*

*Assistant Professor, Department of Radiology, Sri Lakshmi Narayana Institute of Medical Sciences & Hospital, Osudu, Puducherry - 605502

Corresponding Author: Dr. Koukutla Sri Venkat Reddy
*Assistant Professor, Department of Radiology, Sri Lakshmi Narayana Institute of Medical Sciences & Hospital, Osudu, Agaram Village, Koodapakkam Post, Puducherry - 605502

ABSTRACT

All female genital cancers in India have cervical carcinoma as their primary form with incidence rates between 86-90%. The proper evaluation of disease spread together with staging serves as an essential requirement for managing cervical cancer cases. The previous staging procedures including cystoscopy and sigmoidoscopy and pelvic examination yielded insufficient data about the disease. Medical imaging specialists have chosen MRI together with CT as their preferred strategy for cervical cancer clinical staging. The evaluation of disease stage and spread requires the most accurate imaging technique to be MRI. A research investigation sought to assess whether MRI delivered adequate results when detecting and grading cervical cancer. There were 90 cases of newly diagnosed and confirmed histopathologically uterine cervical carcinoma which received chemoradiotherapy before inclusion into this study. The International Federation of Gynecology and Obstetrics (FIGO) staging system was used for tumor assessment on MRI examinations. A 1.5 Tesla magnet served for pelvic MRI examinations of all participants. Newly diagnosed cervical cancer proved to have suspicious masses in 86.84% of cases while recurrent cancer showed these masses in 80.7% of cases. The diagnostic accuracy in new cases reached 89.82% and calculated with sensitivity at 90.20% along with specificity at 18% and PPV at 93.14% while NPV arrived at 95.45%. The diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for recurrent cases were reported at 68.54% while sensitivity reached 91% and specificity reached 42% and PPV reached 72.36% alongside NPV reaching 76%. The superior diagnosis of tumor staging and disease extent along with treatment response evaluation in cervical carcinoma is achieved through MR imaging technology which demonstrates better results than clinical examination.

KEY WORDS: Magnetic resonance imaging (MRI), carcinoma cervix, FIGO staging, diagnostic accuracy

INTRODUCTION

Uterine cervical cancer ranks as the third mortality cause among cancer-related deaths and represents the second most commonly diagnosed female cancer within developing nations at age 45-50. Every year cervical cancer results in about 72,000 deaths throughout India [1, 2]. Two primary types of cervical cancer exist: squamous cell carcinoma along with adenocarcinoma which account for 69% and 25% of cases respectively [3, 4]. Medical reports show cervical cancer recurrence rate reaches 60-70% of patients within two years of treatment and affects 89-98% of patients over five years [5]. The grade and histologic subtype of cancer determine both the treatment management along with the predicted outcomes in patients. Patients diagnose with cervical cancer are assessed using the FIGO staging system which represents the primary framework for staging this condition. FIGO staging system includes MRI and CT as preferred imaging methods according to its revised guidance for cervical cancer examination [6]. MRI demonstrates strong effectiveness as an early-stage invasive cervical tumor diagnostic test with a recorded diagnostic accuracy reaching 94%. MRI stands as the most suitable tool to determine preoperative myometrial invasion depth and cervical involvement [7]. According to the National Comprehensive Cancer Network MRI stands as the only approved diagnostic tool for type II endometrial cancer but the American College of Radiology supports MRI as the principal imaging test for staging and treatment planning in cervical cancer cases [8, 9]. A review of the aforementioned research will determine the diagnostic and staging effectiveness of MRI in cervical cancer.

MATERIALS AND METHODS

This observational research took place in MNR Medical College and Hospital Department of Radiology throughout April 2018 to September 2019. A total number of 120 patients who received chemoradiation treatment for histopathologically confirmed uterine cervical carcinoma following new diagnosis were selected in this study. The study selected patients who met multiple criteria that included receiving histopathological confirmation of cervical carcinoma and became newly

diagnosed after receipt of treatment authorization from participating patients with adequate renal and blood function and those undergoing post-treatment surveillance. MRI contraindications prevented enrollment of patients yet pregnant or lactating participants and those with cardiovascular conditions and psychiatric disorders were also ineligible for this study. Moreover the research excluded patients who did not want to join. All participants provided their consent after agreeing to participate in the study which received institutional ethics committee approval. Treatment initiation occurred after health history assessment and thorough medical examinations of the patients. The International Federation of Gynecology and Obstetrics (FIGO) staging system served as an assessment method for MRI tumor grading. The study participants received pelvic Magnetic Resonance Imaging examinations through a 1.5 Tesla machine. This investigation used T1W FSE axial and sagittal imaging as well as T2W TSE axial and sagittal imaging and TRUFI coronal imaging and STIR axial imaging and FST1 WTSE imaging in axial, coronal, and sagittal planes. The assessment included tumor measurement along with assessment of its extension, enhancement characteristics and evaluation of rectal wall and urinary bladder wall involvement and parametrial and pelvic wall invasion and post-treatment effects. Health professionals conducted clinical check-ups during every 3 to 6 months period. The data collection was performed through Microsoft Office Excel 2010 software which was later exported to SPSS version 20.0 for statistical evaluation.

RESULTS

Table 1, 2 and 3 give a thorough explanation of the clinical features, MRI results and how stage was set for patients with cervical cancer. Table 1 lists the characteristics of the participants and indicates that abdominal pain occurred most frequently (65.8%), followed by white discharge (42.5%) and per vaginal bleeding (34.2%). Among the respondents, 53.3% were past menopause, 35.8% were pre-menopause and a smaller 10.8% had a hysterectomy. Out of the 64 patients who used radiation therapy and an MRI, 39.1% had imaging done 13 to 60 months after completing treatment and 34.4% had images only in the first six months. MRI images are compared for those with newly developed and recurrent tumors in Table 2. The majority of findings in both groups were squamous cell carcinoma, with over 90% and adenocarcinoma made up less than 10%. In cases where cancer was caught for the first time, 90% had suspected masses shown on MRI, but this decreased to 80.8% for patients with cancer returning. Newer patients showed a much stronger relationship between their MRI results and clinical outcomes (94.2%), whereas this correlation was less noticeable in patients with recurrent disease (45.8%). Lymph node spread was observed in many groups and the iliac lymph nodes were the most commonly affected in both cohorts. Cystoscopy and sigmoidoscopy were mostly done in those who were newly diagnosed and together, they found that the bladder was invaded in 13% of cases, while rectal involvement affected a smaller number. Table 3 reveals that FIGO staging is sometimes different when the disease is found by MRI than when it is found clinically. Importantly, late-stage tumors were better seen on MRI, yet early-stage types were often recognized by symptoms alone and did not always appear on MRI studies. Because of this difference, accurate staging, deciding on treatment and understanding the outlook for patients in cervical cancer call for using both clinical exams and imaging.

Table 1: Descriptive Data of Study Participants

| Parameter	Total Cases	Number	Percentage
Associated Symptoms			
Per vaginal bleeding	120	41	34.2%
Pain abdomen	120	79	65.8%
White discharge	120	51	42.5%
Menstrual Status			
Pre-menopausal	120	43	35.8%
Post-menopausal	120	64	53.3%
Post hysterectomy	120	13	10.8%
Duration Between Radiation Therapy and MRI (n=64)			
Up to 6 months	64	22	34.4%
6-12 months	64	19	29.7%
13-60 months	64	25	39.1%
More than 60 months	64	08	12.5%

Table 2: MRI Findings in Newly Diagnosed and Recurrent Cases (n=120).

| Parameters	Newly Diagnosed Cases (n=120)	Recurrent Cases (n=120)
HPE Findings		
Squamous cell carcinoma	110	111
Percentage	91.7%	92.5%
Adenocarcinoma	10	09
Percentage	8.3%	7.5%
Presence of Suspected Masses		
Not present	12	23
Percentage	10%	19.2%
Present	108	97
Percentage	90%	80.8%
Correlation Between MRI and Clinical Findings		
Correlated	113	55
Percentage	94.2%	45.8%
Not correlated	07	10
Percentage	5.8%	8.4%
Involvement of Lymph Nodes		
Inguinal group	03	07
Percentage	2.5%	5.8%
Para aortic group	03	02
Percentage	2.5%	1.7%
Iliac group	22	18
Percentage	18.3%	15.0%
Obturator group	09	07
Percentage	7.5%	5.8%
Parametrial group	13	11
Percentage	10.8%	9.2%
Cystoscopy Findings		
Normal	98	-
Percentage	81.7%	-
Invasion of bladder	16	-
Percentage	13.3%	-
Not performed	06	-
Percentage	5.0%	-
Sigmoidoscopy Findings		
Normal findings	96	-
Percentage	80%	-
Sigmoid diverticulitis	06	-
Percentage	5.0%	-
Rectal invasion	03	-
Percentage	2.5%	-
Growth rectum	03	-
Percentage	2.5%	-
Not performed	06	-
Percentage	5.0%	-

Table 3: Correlation Between Clinical and MRI FIGO Staging

| FIGO Staging	Clinically Diagnosed (n=120)	MRI Diagnosed (n=120)
IA	04	0
IB	04	06
IIA	06	04
IIB	15	14
IIIA	02	0
IIIB	08	0
IVA	04	12
IVB	0	07

Figure.1 Study Participants Data Analysis Comprehensive visualization of 120 study participants
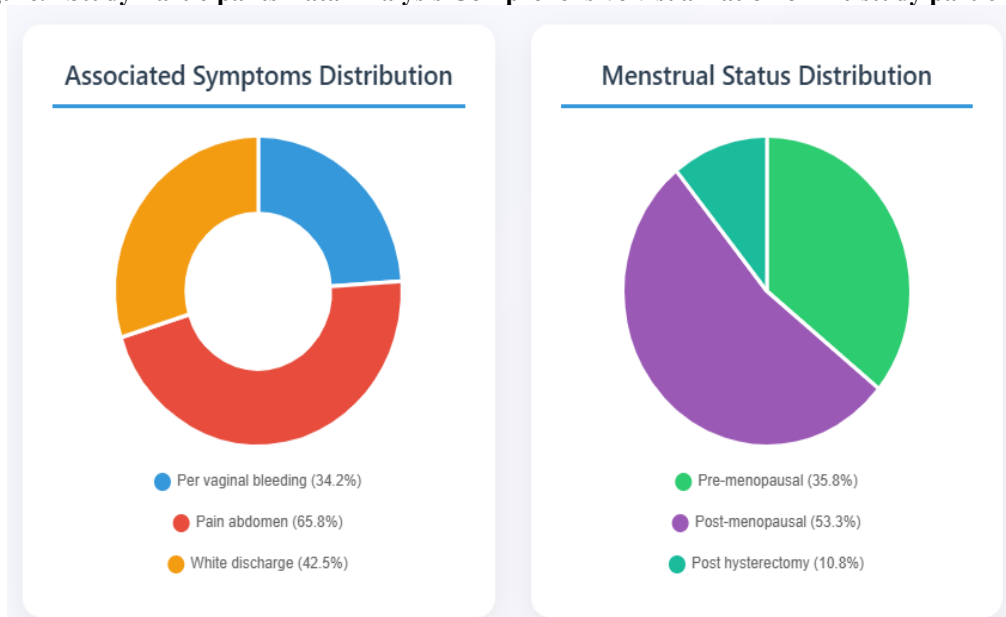
Figure.2 MRI Findings Comparison Newly Diagnosed vs Recurrent Cervical Cancer Cases (n=120 each)
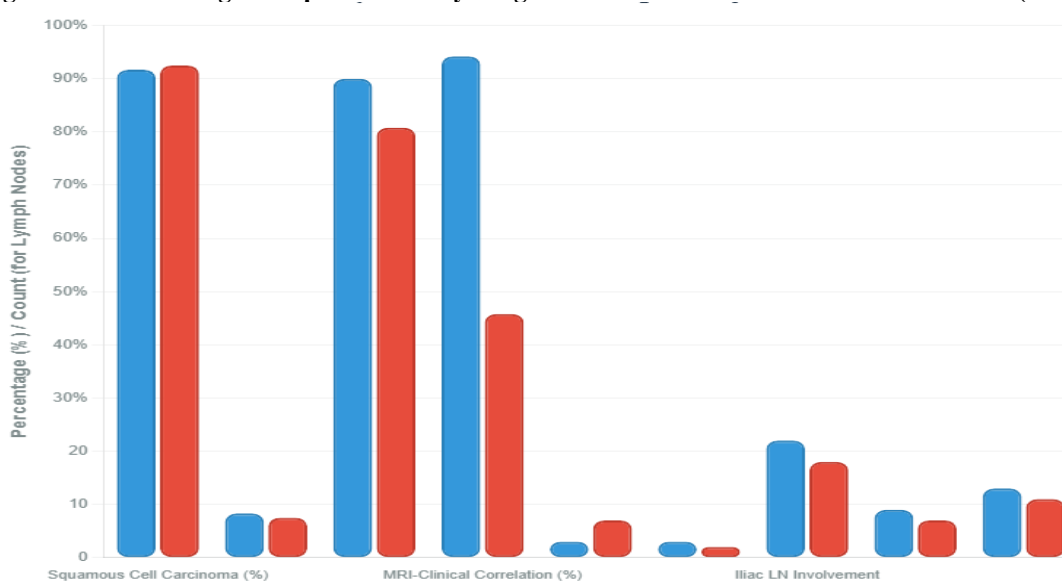
Figure.3 FIGO Staging Comparison Clinical Diagnosis vs MRI Diagnosis Correlation (n=120)
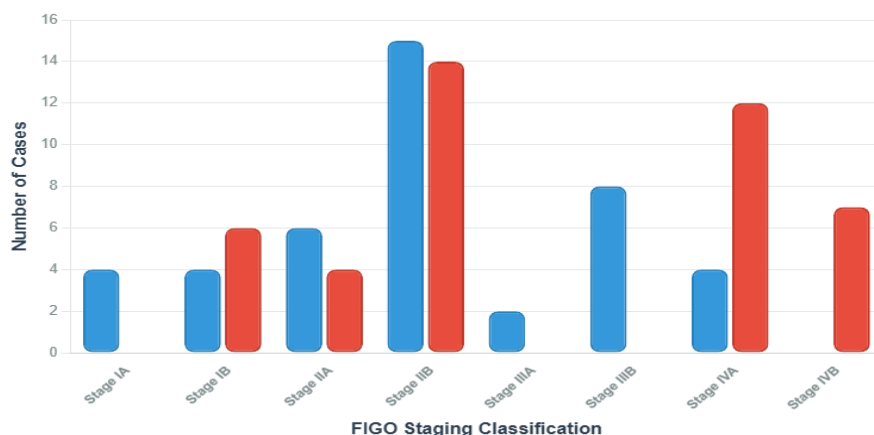
DISCUSSION

The third most common gynecological cancer exists in females worldwide and carcinoma of the cervix makes up 9% of newly detected malignancies [10, 11]. Cervical carcinoma cases primarily involve squamous cell carcinoma since it represents 69% of cases and adenocarcinoma follows at 25% [3, 4]. Carcinoma cervix recurring diseases affect between 60% to 70% of treated patients within two years then repeat between 89% and 98% during the five-year period [5]. Different areas of recurrence development include the vaginal vault along with the parametrium and cervix and pelvic wall and paraaortic lymph nodes [12, 13]. Recurrent disease becomes likely when tumors reach sizes exceeding 3cm along with lymphovascular space invasion (LVSI) and deep stromal invasion and when adenocarcinoma histology becomes present [14]. All patients undergoing International Federation of Gynecology and Obstetrics (FIGO) staging for cervical carcinoma need tissue biopsy in combination with urine analysis and chest radiographs and cystoscopy and proctoscopy and dilatation and curettage and barium enema studies according to FIGO recommendations [15, 16]. The purpose of this study focused on examining MRI's effectiveness for managing carcinoma cervix cases. Among the 90 cases analyzed the population split consisted of 57.78 percent recurrent cases while 42.2 percent represented new diagnoses. A total of 42.2% of cases belonged to the 41-50 years age bracket while 26.67% fell into the 51-60 years age group (Figure 1). According to Narender Reddy P et al.'s findings the patient population with carcinoma cervix most commonly fell within the 40-65 age bracket and experienced their peak incidence at 45-50 years [17]. Among patients with associated symptoms pain in the abdomen stood as the most frequent complaint at 65.5%, after which white discharge came at 42.2% and per vaginal bleeding at 34.4%. The survey included 53.3% postmenopausal patients and 35.5% premenopausal patients alongside 11.1% participants who had undergone hysterectomy. The MRI examinations took place fewer than six months following radiation therapy for 26.5% of all cases with another 39.06% receiving their scans at least 13 months but no longer than 60 months (table 1). The analysis of tissue samples through histopathological examination demonstrated that squamous cell carcinoma appeared in 92.1% of fresh diagnoses and 7.9% indicated adenocarcinoma status, but among repeat cases squamous cell carcinoma developed in 92.3% of individuals and 7.6% presented with adenocarcinoma (Table 2). In both newly diagnosed patients and recurrent patients doctors identified suspicious masses in 86.84 percent and 80.7 percent respectively. Cervical masses received a diagnostic accuracy of 89.82% and sensitivity of 90.20% together with specificity of 18% along with a positive predictive value (PPV) of 93.14% and a negative predictive value (NPV) of 95.45% during newly diagnosed evaluations. During recurrent assessments FIGO stage diagnostic accuracy ranked at 68.54% while sensitivity measured at 91% and the PPV equaled 42% and specificity met 72.36% alongside NPV reaching 76% (Figure 2). Mangal Mahajan and colleagues proved through their study that FIGO stage IA cannot be detected by MRI yet stage IB and higher tumors show visible indications [18]. The spread of early stage tumors remains inside the cervix area. This research showed that MRI did not detect stage IA cervical tumors. Stage IIA tumors can be detected on MRI by revealing areas where the T2 hypointense vaginal wall mysteriously disappears in the upper two-thirds of this region. Stage IIB tumors appeared as hypointense peripheral stroma on T2W images that spread into the parametrium according to both [19] and [20]. Stage III tumors that expanded into the lower third of the vagina or lateral pelvic wall led to hydronephrosis according to studies [21 and 22]. The diagnosis of Stage IIIB required MRI findings that included tumors infiltrating within 3mm of pelvic wall tissues or identification of partial or complete muscular disintegration in pelvic walls through T2W sequences. Stage III tumors were absent from the analysis recorded in this research report [23]. Stage IVA tumors appeared as breast cancer invasions of bladder or rectal mucosa on MRI whereas stage IVB tumors showing liver, spleen, pancreas, kidney, and GI tract involvement could also be identified [24]. Stage IB tumors accounted for the majority of cases at 9 instances while stage IVA occurred in 8 patients according to Narender Reddy P et al. [17]. The analysis of

recently detected cervical cancer revealed paramedial and iliac group lymph nodes involvement in 14 patients in combination with inguinal and paraaortic lymph node spread among single individual cases. During recurrent stages of disease lymph nodes became included in the analysis through 15 cases which affected inguinal nodes as well as single cases involving the paraaortic nodes (Table 2). Lymph node involvement has unique importance in diagnosing cervical cancer and performing staging and evaluating treatment and understanding patient outcomes [25-27]. People with carcinoma cervix tend to spread lymphatic disease to nodes that include obturator together with external iliac and internal iliac and common iliac and paraaortic nodes [28]. A cystoscopy examination performed within newly detected cases showed normal bladder tissue in 81.5% of patients but bladder wall invasion in 13.1% while 5.26% did not undergo cystoscopy. Thirty-one point three percent of participants received normal results from sigmoidoscopy examinations but medical staff detected sigmoid diverticulitis in 5.26 percent of patients as well as rectal invasion and growth in 2.6 percent of participants. The sigmoidoscopy procedure failed to take place in 5.26% of instances (Table 2). The research found bone marrow changes spreading across 23.3% of patients together with proctitis and cystitis which both developed in 20% and 16.67% of treatment recipients.

CONCLUSION

For disease staging purposes MRI serves as an important diagnostic tool when examining tumor lymph node spread at both local and distant locations. The research shows that MRI produces better diagnostic results than clinical examination when staging tumors and determining carcinoma cervix spread and therapy effectiveness. The research shows that using MRI guidance to plan radiotherapy diminishes geographic errors in comparison to standard radiotherapy planning approaches.

REFERENCES

1. Aravindh SA, Mintu MA, Vipin GK. MRI versus clinical assessment in staging and response evaluation in locally advanced cervix cancer patients treated with concurrent chemo-radiation in a tertiary cancer center: a prospective study. Int J Reprod Contracept Obstet Gynecol. 2017; 6:392-9.
2. Kaur H, Silverman PM, Iyer RB, Verschraegen CF, Eifel PJ, Charnsangavej C. Diagnosis, staging and surveillance of cervical carcinoma. Am J Roentgenol. 2003; 180:1621-32.
3. World Health Organization. Latest world cancer statistics. Available at: https:// www.iarc.fr/wp-content/uploads/2018/07/pr223_E.pdf. Accessed 23 Dec 2018.
4. Kurman RJ, Cargangiu ML, Herrington S, Young RH. World Health Organization classification of tumours of female reproductive organs. IARC Press. Lyon, 2014.
5. Maria Milagros Otero-Garcia, Alicia Mesa-Alvarez, Olivera Nikolic, Patricia Blanco-Lobato, Marijana Basta-Nikolic, Rafael Menendez de Llano-Ortega, Laura Paredes-Velazquez, Nikola Nikolic and Magda Szewczyk-Bieda. Role of MRI in staging and follow-up of endometrial and cervical cancer: pitfalls and mimickers. Otero-García et al. Insights into Imaging. 2019; 10(19):1-22.
6. Narayan K, McKenzie AF, Hicks RJ, Fisher R, Bernshaw D, Bau S. Relation between FIGO stage, primary tumor volume, and presence of lymph node metastases in cervical cancer patients referred for radiotherapy. Int J Gynecol Cancer. 2003; 13:657-63.
7. Rizzo S, Calareso G, Maccagnoni S, Angileri SA, Landoni F, Raimondi S et al. Pre-operative MR evaluation of features that indicate the need of adjuvant therapies in early stage cervical cancer patients. A single-centre experience. Euro J of Radiology. 2014; 83(5):858-64
8. Lalwani N, Dubinsky T, Javitt MC et al. ACR appropriateness criteria (R) pretreatment evaluation and follow-up of endometrial cancer. Ultrasound Q. 2014; 30(1):21-28
9. Koh WJ, Abu-Rustum N, Bean S et al. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®). Cervical Cancer Version 1. 2018. Available at: https://oncolife.com.ua/doc/nccn/Cervical_Cancer.pdf.
10. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. CA Cancer J Clin. 2011; 61(2):69-90.
11. World Cancer Research Fund International. 2012 September 22nd, 2015]. Available from: http:// www.wcrf.org/int /cancer-facts-figures/worldwide-data.
12. Babar S, Rockall A, Goode A, Shepherd J, Reznek R. Magnetic resonance imaging appearances of recurrent cervical carcinoma. Int J Gynecol Cancer. 2007; 17(3):637-645.
13. Bhatla N, Aoki D, Sharma DN, Sankaranarayanan R. Cancer of the cervix uteri. FIGO Cancer report. Int J Gynaecol Obstet. 2018; 143(2):22-36.
14. Patel-Lippmann K, Robbins J, Barroilhet L, Anderson B, Sadowski E, Boyum J. MR imaging of cervical cancer. Magn Reson Imaging Clin N Am. 2017. https://doi.org/10.1016/j.mric.2017.03.007.

15. McCarthy S, Hricak H. The uterus and vagina. In: Higgins CB, Hricak H, Helms CA, eds. Magnetic resonance imaging of the body. 3rd ed. New York, NY: Lippincott-Raven, 1997, 761-814.
16. Togashi K, Morikawa K, Kataoka ML, Konishi J. Cervical cancer. J Magn Reson Imaging. 1998; 8:391- 397.
17. Narender Reddy Peddareddy, Santhosh Babu Rendla, Sumalatha Kasturi and Narender GajulA. MR Imaging of Carcinoma Cervix. Int. J Curr. Microbiol. App. Sci. 2016; 5(7):619-626.
18. Mangal Mahajan, Rajesh Kuber, Chaudhari KR, Prashant Chaudhari, Pravin Ghadage, Rushikesh Naik. MR imaging of carcinoma cervix. Indian J Radiol Imaging. 2013; 23(3):247-252.
19. Nicolate V, Carignan L, Bourdon F, Prosmanne O. MR imaging of cervical carcinoma: A practical staging approach. Radio Graphics. 2000; 20:1539-49.
20. Okamoto Y, Tanaka YO, Nishida M, Tsunoda H, Yoshikawa H, Itai Y. MR Imaging of the uterine cervix: Imaging-pathologic correlation. Radio Graphics. 2003; 23:425-45.
21. Follen M, Levenback CF, Iyer RB, Grigsby PW, Boss EA, Delpassand ES et al. Imaging in cervicalcancer. Cancer Suppl Suppl. 2003; 98:2028-38.
22. Pannu HK, Corl FM, Fishman EK. CT evaluation of cervical cancer: Spectrum of disease. Radio Graphics. 2001; 21:115568.
23. Pannu HK, Corl FM, Fishman EK. CT evaluation of cervical cancer: spectrum of disease. Radio-Graphics 2001; 21:1155-1168.
24. Feong YY, Kang HK, Chung TW, Seo FF, Park FG. Uterine cervical carcinoma after therapy: CT and MRI imaging findings. Radio Graphics. 2003; 23:969-81.
25. Colombo N, Creutzberg C, Amant F et al. ESMO- ESGO-ESTRO consensus conference on endometrial cancer: diagnosis, treatment and follow-up. Radiother Oncol. 2015; 117(3):559-581.
26. Nougaret S, Horta M, Sala E et al. Endometrial cancer MRI staging: update guidelines of the European Society of Urogenital Radiology. Eur Radiol. 2019; 29:792 https://doi.org/10.1007/s00330-018-5515-y.
27. Patel-Lippmann K, Robbins J, Barroilhet L, Anderson B, Sadowski E, Boyum J. MR imaging of cervical cancer. Magn Reson Imaging Clin N Am, 2017. https://doi.org/10.1016/j.mric.2017.03.007.
28. Bhatla N, Aoki D, Sharma DN, Sankaranarayanan R. Cancer of the cervix uteri. FIGO Cancer report 2018. Int J Gynaecol Obstet. 2018; 143(2):22-36.