Diagnostic Accuracy of MRI for Cervical Malignancy with Histopathologic Correlation

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Running title: MRI cervical malignancy

Abstract

Background and Aim: The determination of lymph node metastases, parametrial invasion, and pelvic side wall invasion—all known to be significant prognostic factors—as well as the precise measurement of tumor size present the greatest challenges in cervical cancer. The only gynaecological cancer that is currently primarily staged clinically, according to the FIGO classification, is cervical cancer. The aim of this work is to evaluate the role of MRI in the accurate staging of cancer cervix compared to clinical FIGO staging.

Methods: This prospective study included 21 patients (19 with primarily untreated pathologically proven cervical cancer who underwent pretreatment MRI and 2 post chemo-radiotherapy cases who underwent post-treatment MRI).

Results: This study found that 100% sensitivity and 100% specificity in detecting parametrial invasion contrasts with clinical staging's 20% sensitivity. Vaginal invasion may be detected with 100% sensitivity in both stage IIA and IIIA using MRI, which is very sensitive. A hyperintense vaginal thickening (tumor) or the mass itself next to the vaginal wall are the two most clear indicators of vaginal involvement on high-resolution T2-weighted sequences. These sequences also indicate the segmental discontinuity of the typical hypointense signal of the vaginal wall. Stage IIa is represented by vaginal invasion, and stage IIIa is represented when this invasion reaches the lower vaginal third.

Conclusions: Research has demonstrated that MRI is superior to clinical examinations. When used as the first staging technique, it enables accurate evaluation of the tumor's volume and extension, which improves field planning for external pelvic radiation and brachytherapy.

Key words: MRI; cervical cancer; histopathology.

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Introduction

Following ovarian and endometrial cancers in frequency, uterine cervical cancer is the third most frequent gynaecological malignancy. The majority of individuals with cervical cancer are discovered at an advanced stage and are therefore not candidates for surgical staging because nearly 80% of cases occur in developing nations (1).

Squamous cell carcinoma is the most prevalent kind histologically. Small cell carcinoma, adenoid-cystic carcinoma, and adenoid-basal carcinoma are some more forms that are mentioned (2)

The determination of lymph node metastases, parametrial invasion, and pelvic side wall invasion—all known to be significant prognostic factors—as well as the precise measurement of tumor size present the most difficult clinical examinations of individuals with cervical cancer. Cervical carcinoma is the only gynecological cancer that is now largely staged clinically, despite the inherent limitations of the clinical examination (3).

While preoperative MR imaging criteria are not formally included in the revised FIGO staging system, it is acknowledged that staging based on MR imaging findings has advantages and is encouraged when available. This is because cervical carcinoma is more common in developing countries where imaging resources are limited (4).

The local extent of the disease and the spread of extrauterine tumours can be precisely defined and depicted by MR imaging, it has been demonstrated. MR imaging can show metastatic dissemination, including peritoneal deposits, and can accurately depict the depth of myometrial and cervical stromal invasion. The most frequent way for extrauterine diseases to spread is through lymph nodes, and it is also the best indicator of a disease's propensity to return. (5) .

The purpose of MRI sequences is to identify changes in the thermally induced random (Brownian) mobility of water molecules within tissues. The amount of this motion, also known as diffusion, as determined by diffusion-weighted imaging is related to the average distance covered by water molecules during a given period of time. The amount of signal loss is inversely correlated with the water velocity (mean diffusional route length), with bulk water exhibiting the highest levels of signal loss. (6).

Aim of the work : Comparing clinical FIGO staging with MRI for the purpose of accurately staging cervical cancer

Materials and Methods

Patients' selection:

This prospective study included 21 patients (19 cases with primarily untreated pathologically proven cervical cancer who underwent pretreatment MRI and 2 post chemo-radiotherapy cases who underwent post-treatment MRI).

History and investigation:

All the patients were undergoing:

I. Careful history taking and examination:

II.Investigation:

*Chest x ray.

*US abdomen and pelvis

*CT abdomen and pelvis.

*Cystoscope.

*Biopsy.

*Radiographic evaluation of skeleton was used wherever needed.

Imaging: Using the typical pelvic surface array multichannel coil, an MRI examination was performed on the patients while they were lying flat.

Clinical staging :

Clinical staging was carried out on each patient by gynaecologists with at least five years of expertise using the prior FIGO

staging system, The MRI results were hidden from view by the gynaecologists

Histopathology assessment:

Radical hysterectomy was performed on nine individuals. The remaining patients had pelvic lymph node sampling with CT guidance, colposcopic vaginal biopsy, and laparoscopic staging. A pathologist examined each specimen they collected without consulting the MR pictures.

The histopathological stage was applied to individuals who

had surgical treatment (stage IIA). After connecting with MRI data and other investigations, the two gynecologists reached a consensus evaluation that became the gold standard for patients who did not have surgery. In this patient population, hydronephrosis was seen as conclusive evidence for stage III disease (ureteral involvement/pelvic sidewall invasion). Positive urine cytology test findings and cystoscopy results were accepted as evidence of stage IVA disease.

A team of radiation oncologists and gynecologic oncologists performed the staging workup of the post-radiotherapy cases and evaluated them with rectovaginal inspections while under general anaesthesia.

Each patient's FIGO stage and MRI-based stage were compared to the gold standard stage. patients whose MRI staging was performed correctly and incorrectly was counted, and the causes of incorrect staging were documented.

Statistical analysis: Data were checked, entered and analyzed by using SPSS version 20.

Results

The patient's age ranged from 23 to 80 years with the mean age 58.9±17.9. The most common presenting symptom of the studied group was offensive watery discharge. The final histopathological type of cervical cancer with squamous cell carcinoma (15 cases 78.4 % of the studied group) (table2).

The current study announcing 100% specificity and 100% sensitivity in the identification of parametric invasion in contrast to clinical staging, which only achieved 20% sensitivity.

MRI has 100% sensitivity in identifying vaginal invasion in both stage IIA and IIIA, making it a highly sensitive method. The characteristic hypointense signal of the vaginal wall is segmentally interrupted in high-resolution T2-weighted sequences, exhibiting a hyperintense thickening of the vagina (tumor) or the mass itself in close proximity to the vaginal wall, which helps to better understand the symptoms of vaginal involvement. When it reaches the bottom part of the vagina, it is in stage IIIa, and stage IIa for vaginal invasion, (table 4).

Table (1) shows the age, main presenting symptoms of the studied group.

Item	Average	Mean±SD
Age	25-78	17.9 ±58.9
Symptoms	**Number**	**%**
Post-menopausal bleeding	5	29.7
Offensive watery discharge	7	37.8
Abnormal vaginal bleeding	5	24.3
Pelvic pain and loin pain	2	2.7
Total	19	100

Table (2) shows the pathological types among the studied group.

Pathology	Number	%
Squamous cell carcinoma	15	78.4
Adenocarcinoma	4	21.6
Other rare types		0
Total	19	100

Table (3) shows the number of cases in each stage as detected by golden standard , MRI and clinical FIGO stage.

Stage	Number of cases in each stage by pathology	Number of cases in each stage by MRI	Number of cases in each stage on clinical
IB1	1	1	1
IB2	2	3	2
IIA	1	1	9
IIB	10	10	2
IIIA	1	1	1
IIIB	1	1	2
IVA	1	1	1
IVB	2	1	1
Total	19	19	19

Table (4) shows the validity of MRI in detection of cervical tumor extension.

Stage	Sensitivity	Specificity	PPV	NPV
IB1(limited to the cervix)	100 %	100 %	100 %	100 %
IB2(limited to the cervix)	100 %	96.1%	83.11%	100 %
IIA(upper 2/3 of vagina)	100 %	100 %	100 %	100 %
IIB (parametrium)	100 %	100 %	100 %	100 %
IIIA(lower 1/3 vagina)	100 %	97.13%	50.22%	100 %
IIIB (pelvic side wall)	100 %	100 %	100 %	100 %
IVA (UB invasion)	66.12%	100 %	100 %	94.01%
IVB (Distant metastsis)	50.13%	100 %	100 %	97.01%

Discussion

According to Corinne et al., (1) similar findings were seen in our most recent analysis, where most of our patients (76%) were past stage IIA, the critical threshold for surgical interference.)

According to a study by Nilu et eighty percent of instances of cervical cancer are found in underdeveloped countries, and most individuals are diagnosed at an advanced stage, which precludes them from being surgically staged. al., the researched group had a mean age of 46 years and 51 years, respectively, with typical ages ranging from 28 to 65 years and 21 to 80 years. Comparable information was discovered in the current investigation; the group under analysis had an average age of 58 years, with a range of 23 to 80 years. (3)

Mohammed et al. found that irregular bleeding was the most presenting symptom, accounting for a total percentage of 86.6 percent, but in the current investigation, the

foul watery discharge, accounting for 14.9% of cases among 14 patients. With 29 instances (78.4%) of cervical cancer being squamous cell carcinoma, adenocarcinoma accounted for 8 cases (21.6%) of cervical carcinoma, making it the most common histological type. (7) The incidence was almost in line with the findings of the Nilu et al (2020) research, which showed that 68/75 patients, or 90.7% of the patients, had squamous cell carcinoma and 9.3% had adenocarcinoma. (3)

According to Harpreet et al. (2019), 80–90% of cervical carcinomas originate from squamous cells. (8)

Our study's findings show that the staging abilities of clinical FIGO staging, and MRI differ significantly. This implies that the addition of MR may improve the staging's accuracy and alter the course of treatment.

In a study of 37 patients, we examined the validity of MRI as a tool, comprehensive method for assigning patients with cervical carcinoma to the proper course of management. accuracy of MRI 94.5 %, was while clinical FIGO staging had an accuracy rate of 51.3% (19/37), meaning that it was inaccurate in 5.4% of cases.

According to Nilu et al. (2020), 1.5T MRI data were used in 67 instances. 89.3% (67/75) of cervical cancer cases were successfully staged by MRI, compared to 61.3% (46/75) of cases by clinical FIGO staging, according to Nilu et al. (2020). The overall staging accuracy of MRI, according to Evis et al. (2018), staging accuracy in MRI varies from 75% to 96%. (3,9)

In line with Yoshikazu et al. (2017) findings that cervical malignancies, regardless of histopathologic type, show as hyperintense masses on T2-weighted images, cervical cancer was diagnosed in our study as a mass of intermediate to hyperintense on T2W(10).

According to a study by Tejinder et al. (2015), when compared to the results of the FIGO clinical stage, MRI can more accurately define the size, location, and extension of cervical tumors into neighboring structures due to its superior soft tissue characterization and multiplanar scanning capabilities. (11) According to Evis et al. (2018). The most difficult clinical evaluations of individuals with cervical cancer involve assessing the invasion of the pelvic sidewall and parametrium. In 48% of the instances (18 out of 37), the present study's FIGO clinical criteria were found to be inaccurate; most of these cases missed the parametrial invasion and underestimated the patient's risk (9)

Comparing the current study's 100% sensitivity and 100% specificity in detecting parametric invasion to clinical staging's 20% sensitivity

The identification of vaginal invasion by MRI is quite sensitive, demonstrating 100% sensitivity in both stage IIA and IIIA. the segmental interruption of the vaginal wall's typical hypointense signal, as well as a hyperintense thickening of the vagina (tumor), or proximity to the vaginal wall. Stage IIa of a vaginal invasion is stage IIa, while stage IIIa of a vaginal invasion is stage IIIa. According to Claudia et al. (2019), MRI has a 93% percentage sensitivity in vaginal invasion diagnosis. (12)

The research conducted by Mohamed et al. (2020) found 100% sensitivity and 100% specificity of UB invasion, while Claudia et al. indicated that MRI has proven to be a reliable approach for detecting bladder invasion with 83% sensitivity and specificity close to 100%. With 100% specificity, our study only had 66% sensitivity (7))

Nodal disease, which is not part of the FIGO staging system, has a significant impact on survival, and the presence of metastatic nodes suggests a worse prognosis within each stage.

According to Choi et al (2013), surgical experience from pelvic lymphadenectomy has verified an error rate due to hidden pelvic lymph nodes, and further metastases

may be discovered in the para-aortic nodes. Unfortunately, FIGO's clinical staging and pelvic investigations cannot identify such conditions. (13)

With 10 mm being the generally Accuracy of MRI in diagnosing pelvic node metastases from uterine cervical cancer was quite high in the current investigation, with an agreed upper limit for the short axis of normal pelvic nodes. Based on our research, 12/12, or 100%, of LN with metastatic evidence that was pathologically verified had a short axis diameter of greater than 10 mm. Not all scientists disagree with our findings Choi et al(2013), Mohammed et al,(2020) Claudia et al (2012) and Nilu et al(2020) .(3,7,12,13)

The current investigation found that the FIGO staging criteria had low sensitivity for assessing lymph node metastases as well as parametrial and pelvic sidewall invasion.

Lastly, we concur that FIGO staging could not accurately reflect the appropriate degree of sickness and, hence, cannot provide prognostic information about the disease's prognosis. This is in line with Tejinder et al. (2015), Evis et al. (2018), and Nilu et al. (2020) (3,9,11).

Conclusion

Although MRI is not commonly used by oncology services for staging cervical malignancies and has not yet received official FIGO approval, it is crucial to the therapy planning process and follow-up.

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