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RESEARCH ARTICLE

Role of T2-weighted and Diffusion-weighted Imaging in Cervical Malignancy in Developing Countries

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Abstract

Cervical cancer is the second most common gynecologic malignancy in Asia and is the leading cause of death in women in developing countries. The cervical cancer stage will significantly affect the prognosis and management. Based on the International Federation of Gynecology and Obstetrics (FIGO) 2018 classification of cervical cancer, magnetic resonance imaging (MRI) has a crucial role in determining cervical cancer staging. This study aimed to evaluate the role of T2-weighted imaging (T2WI) and diffusion-weighted imaging (DWI) sequences in assessing cervical carcinoma, with the pathological diagnosis being taken as the standard for cervical cancer diagnosis. This study was conducted on seven patients diagnosed with cervical cancer from pathological examination in January 2020 to March 2021 in the Department of Radiology Dr. Hasan Sadikin General Hospital Bandung. We detect the presence of locoregional lesions and extensions of cervical carcinoma using MRI with T2WI and DWI sequences in patients who have previously been diagnosed histopathologically. This study involved seven cervical cancer patients. Pelvic MRI with T2WI and DWI sequences was performed. The imaging results in these patients show that one patient has stage IB1 cervical cancer, four patients have stage IIB, one patient has stage IIIA, and one has stage IIIC1 cervical cancer. This study concluded that T2WI and DWI sequences in MRI are essential and sufficient for diagnosing cervical cancer.

Keywords: Cervical malignancy, diffusion-weighted imaging, magnetic resonance imaging, T2-weighted imaging

Introduction

Cervical cancer is Asia's second most common gynecologic malignancy after uterine and ovarian malignancies. According to 2020 Globocan data, in developing countries such as Indonesia, cervical cancer is the second most common cancer after breast cancer and is the leading cause of death in women.[1]

Radiology plays a vital role in the diagnosis of cervical cancer and determining the staging of cervical cancer.[2] Cervical cancer staging will significantly affect the prognosis and management.[3,4] Based on the revised classification from the International Federation of Gynecology and Obstetrics (FIGO) in 2018, cross-sectional imaging, especially magnetic resonance imaging (MRI), has a vital role in determining the staging.[4] MRI can determine the origin of the mass, the size of the masses more accurately, invasion of the parametrium, pelvic wall, vagina, bladder, ureter, and rectum, and see the presence of lymph node involvement.[5–7] The necessary MRI sequences in cervical cancer are T2-weighted imaging (T2WI) and diffusion-weighted imaging (DWI). In T2WI, we can determine if there is tissue edema or necrosis due to cervical cancer. DWI can be used to see the presence of cervical cancer lesions and to evaluate quantitatively the diffusion properties based on the value of the apparent diffusion coefficient (ADC).[8–10]

This study aimed to evaluate the role of T2WI and DWI in assessing cervical carcinoma, with the pathological diagnosis being taken as the standard for cervical cancer diagnosis.

Methods

This study was conducted on seven patients diagnosed with cervical cancer from pathological examination in January 2020 to March 2021 in the Department of Radiology Dr. Hasan Sadikin General Hospital Bandung. They underwent pelvic MRI with T2WI and DWI sequences and had not yet undergone therapy. The processed data is secondary data from patient medical records and picture archiving and communication

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systems (PACS) in Dr. Hasan Sadikin General Hospital Bandung. The Health Research Ethics Committee of Dr. Hasan Sadikin General Hospital Bandung approved this study with a number: LB.02.01/X.6.5/330/2020.

Results

This study consisted of seven cases of cervical cancer, confirmed by histopathological examination. Only one patient who underwent an immunohistochemistry (IHC) examination showed positive for P16 and CK, consistent with cervical cancer. The median patient's age was 49 years. All patients were married, with two having been married twice. The median duration of complaints experienced by patients until diagnosis was four months. MRI examination using T2WI and DWI sequences showed that one patient has stage IB1 cervical cancer, four patients have stage IIB, one patient has stage IIIA, and one patient has stage IIIC1 cervical cancer (Table).

Case 1. A 47-year-old woman came with complaints of vaginal bleeding, especially after sexual intercourse, five months ago. History of using implant contraception dan injections for two years. The patient had menarche at 15 years old and menopause at 45 years old. The patient had 6 children. The patient had never received a cervical cancer vaccination (Figure 1).

Case 2. A 51-year-old, nulliparous, woman with chief complaints of vaginal bleeding for four months accompanied by vaginal discharge, lower abdominal pain, and postcoital bleeding. The patient has menarche at 14 years old and is married at 18 years old. The patient had never received a cervical cancer vaccination (Figure 2).

Case 3. A 57-year-old woman came with chief complaints of vaginal bleeding for ten months. A foul-smelling vaginal discharge accompanies complaints, lower abdominal pain radiating to the waist. The patient had a history of being married twice, the first marriage when the patient was 17 years old. The patient had menarche at 13 years old and menopause at 49 years old. The patient uses injection contraception every three months. The patient had never received a cervical cancer vaccination (Figure 3).

Case 4. A 40-year-old woman, P1A0, presented with vaginal bleeding for seven months. Complaints are accompanied by pain in the lower left abdomen, radiating to the left thigh, and vaginal discharge mixed with blood. The patient had a history of bilateral ovarian cysts. The cyst was removed in October 2020 with the results of bilateral mucinous ovarian cystadenoma. The patient had menarche at 16, got married at 19, and is not currently menopausal. The patient had no history of contraceptive use. The patient had never received a cervical cancer vaccination (Figure 4).

Case 5. A 60-year-old woman complained of vaginal discharge for four months accompanied by lower abdominal pain. The patient had menarche at 12 years, menopause at 45 years, and there was no history of using contraception. The patient had never received a cervical cancer vaccination (Figure 5).

Case 6. A 60-year-old woman complained of vaginal bleeding for two months. Patients with menarche and married at 14 years old and

Table Patients Characteristics

Characteristics	n=7
Age (years)	
<45	2
46–64	5
>65	0
Marital status	
Married	7
Divorced	0
Not married	0
Total parity	
Have no children	1
Have one children	2
Have children >1	4
Menarche (years)	
<12	0
>12	7
Contraception	
No contraception	0
Hormonal	7
Non-hormonal	
Pathology report	
Adenocarcinoma	1
Squamous cell carcinoma	5
Non-Keratinizing epidermoid cell carcinoma	1
Stage of cervical cancer	
Early (IA, IB, IIA)	5
Advanced (IIB, IIIA, IIIB, IIIC, IVA, IVB)	2
Vaccination	
Yes	0
No	7

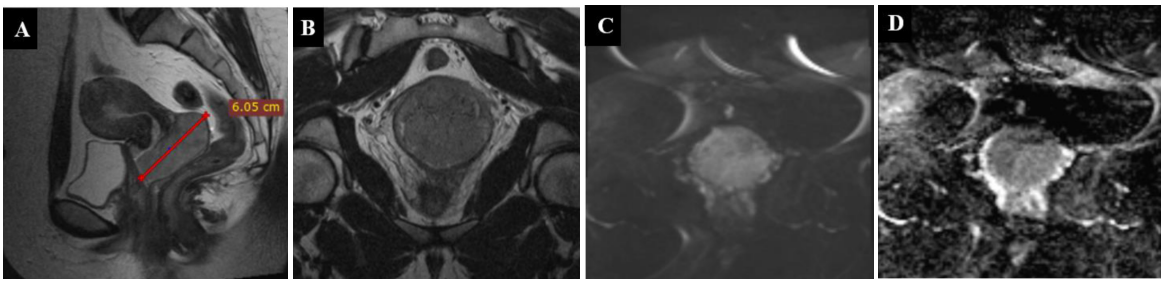

Figure 1 Pelvic MRI Examination of Case 1

The patient showed stage IIB cervical cancer based on the 2018 FIGO. (**A**, **B**) Sagittal and axial T2WI showed a 6.05 cm hyperintense lesion in the cervical region that appeared to infiltrate the left parametrium. Superior vaginal structure, pelvic wall, bladder, and rectum are still intact. Superior vaginal structure, pelvic wall, bladder, and rectum are still intact. (**C**, **D**) DWI and ADC show a restricted area in the cervical region

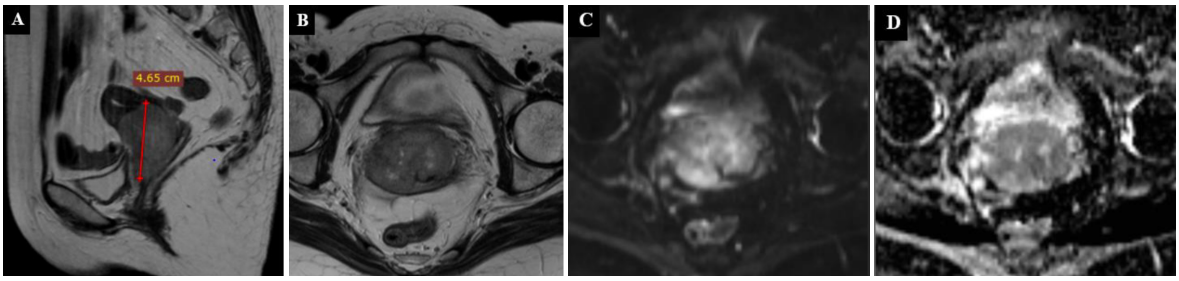

Figure 2 Pelvic MRI Examination of Case 2

The patient showed stage IIB cervical cancer based on the 2018 FIGO. (**A**, **B**) Sagittal and axial T2WI showed an inhomogeneous hyperintense lesion measuring 4.65 cm in the cervical region that appeared to be infiltrating the uterine corpus, superior ⅔ of the vagina, and the right-left lateral parametrium. The ⅓ inferior of the vagina, pelvic wall, bladder, and rectum are still intact. (**C**, **D**) DWI and ADC sequences show it is restricted in the cervical region

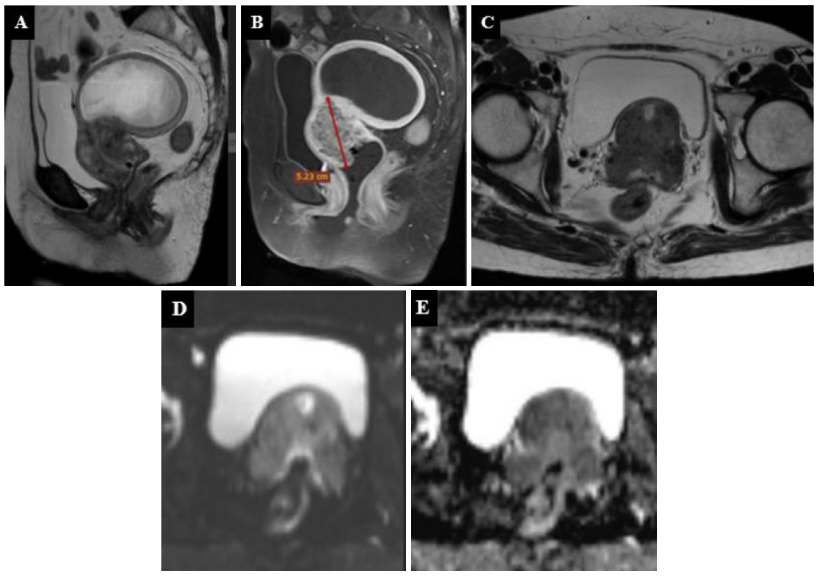

Figure 3 Pelvic MRI Examination with Contrast in Case 3

The patient showed stage IIB cervical cancer based on the 2018 FIGO with endometritis and cervical canal stenosis due to mass effect. (**A**) Sagittal T2WI showed an inhomogeneous mass in the cervical region measuring 5.23 cm, which partially gave a hyperintense signal. The superior vagina, rectum, ureters, and urinary bladder seem intact. (**B**) There was an enhancement in contrast administration. (**C**) The hypodense line that separates the cervix from the parametrium was no longer visible, consistent with parametrium infiltration. (**D**, **E**) DWI and ADC sequences showed restricted areas

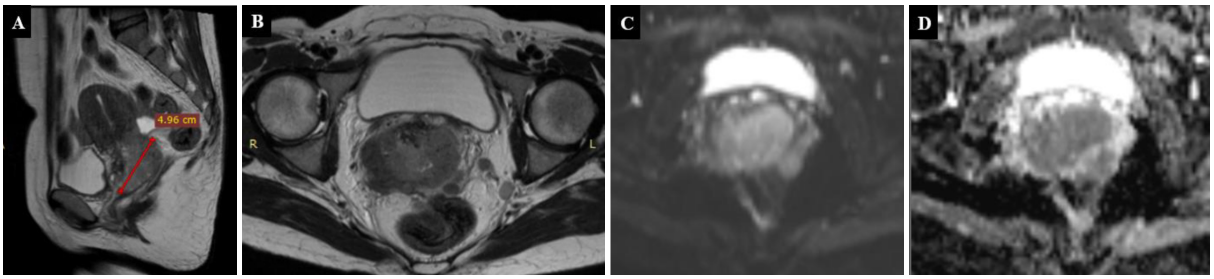

Figure 4 Pelvic MRI Examination of Case 4

The patient showing stage IIIC1 cervical cancer based on the 2018 FIGO. (**A**, **B**) Sagittal and axial T2WI showed an inhomogeneous hyperintense lesion measuring 4.96 cm in the cervical region that infiltrated the uterine corpus, superior ⅔ of the vagina, and parametrium. There were also multiple enlarged lymph nodes in the pelvic area. (**C**, **D**) DWI and ADC sequences showed a restricted area in the cervical region

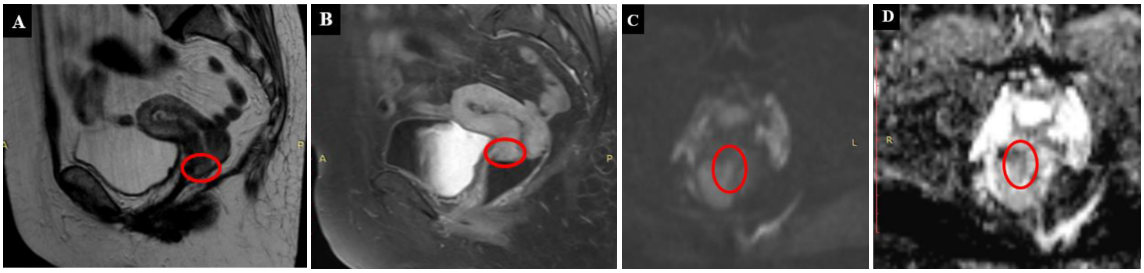

Figure 5 Pelvic MRI Examination of Case 5

The patient showed stage IB1 cervical cancer based on the FIGO 2018. (**A**, **B**) On sagittal T2WI and T1 post-contrast images showed a small lesion that gave a hyperintense signal, measuring 1.36 cm in the cervical region. In contrast administration, minimal enhancement was seen. (**C**, **D**) DWI and ADC sequences showed a restricted area in the cervical region

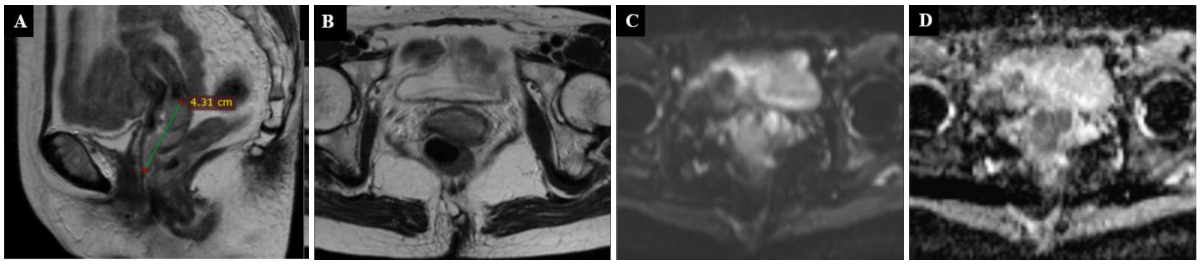

Figure 6 Pelvic MRI Examination of Case 6

The patient showed stage IIIA cervical cancer based on FIGO 2018. (**A**, **B**) Sagittal and axial T2WI showed a 4.31 cm hyperintense lesion in the cervical region that infiltrated the uterine corpus and inferior ⅓ of the vagina. The parametrium appears intact. (**C**, **D**) DWI and ADC sequences showed a restricted area in the cervical region

menopause at 50 years old. The patient had never received a cervical cancer vaccination (Figure 6).

Case 7. A 39-year-old woman came with chief complaints of vaginal discharge for four months, yellowish-white in color. Complaints are accompanied by pain in the lower abdominal area. The patient had menarche at 16 years old and had a history of being married twice, at 23 and 33 years old. The patient was not menopausal and used injectable contraception. The patient had never received a cervical cancer vaccination (Figure 7).

Discussion

Cervical cancer is the fourth most common cancer in women worldwide.[1] However, in developing countries like Indonesia, cervical cancer is the

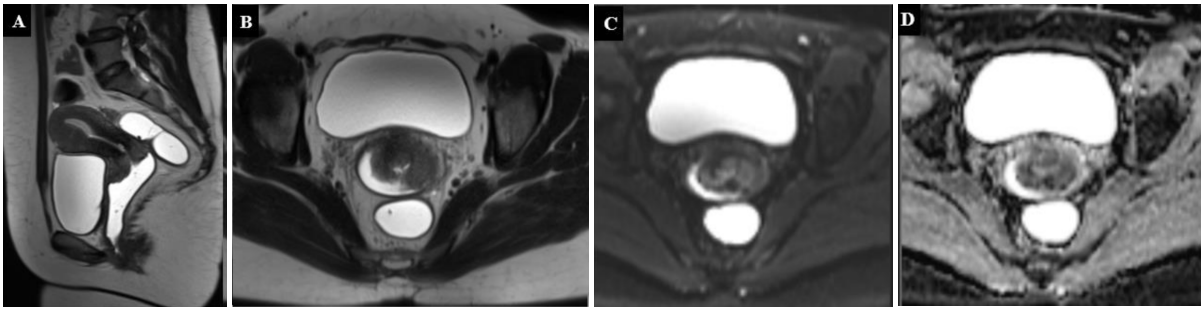

Figure 7 Pelvic MRI Examination of Case 7
The patient showed stage IIB cervical cancer based on the FIGO 2018. (**A**, **B**) Sagittal and axial T2WI showed hyperintense lesions in the cervical region that infiltrated the uterine corpus, the superior part of the vagina, and the left lateral parametrium. (**C**, **D**) DWI and ADC sequences showed the restricted area in the cervical region

most common malignancy.[1] It is the leading cause of death due to malignancy in women. Cervical cancer is a malignancy in the cervical tissue, the most inferior part of the uterus, and is associated with the vagina. Human papillomavirus (HPV) infection is a factor that initiates cell dysplasia and carcinogenesis in cervical cancer.[11–16]

Cervical cancer at an early stage is usually asymptomatic and can only be detected by cytological examination. The initial complaint is usually bleeding after intercourse, outside the menstrual period, and after menopause. At an advanced stage, pelvic pain and symptoms related to micturition and defecation may occur due to the involvement of the bladder and rectum.[3,4,11–13,17]

In October 2018, the International Federation of Gynecology and Obstetrics (FIGO) revised its cervical cancer criteria.[4] Based on this revised classification, cross-sectional imaging, especially magnetic resonance imaging (MRI), has a crucial role in determining cervical cancer staging.[3,4,6,17–19] MRI can determine the origin of the mass, the size of the masses more accurately, invasion of the parametrium, pelvic wall, vagina, bladder, ureter, and rectum, and see the presence of lymph node involvement.[5,17,18] In our study, we highlight the importance of T2WI and DWI-ADC sequences in cervical cancer. In T2WI, we can determine if there is tissue edema or necrosis due to cervical cancer. DWI can be used to see the presence of cervical cancer lesions and to evaluate quantitatively the diffusion properties based on the value of ADC.[20–23]

In our study, the lesion in all seven patients can be seen in T2WI MR sequences and confirmed by the appearance of the restricted area in DWI-ADC. In T2WI, the lesion appeared hyperintense due to water content, either et causa inflammation due to infiltration of a cancer cell or necrosis of the tissue. There was a restricted area in DWI-ADC sequences that gave a hyperintense signal in DWI and hypointense in the ADC map.[24] In our study, contrast agent administration did not play an essential role in diagnosing cervical cancer. In Case 5, contrast enhancement is minimal in a small lesion, and the DWI-ADC had a more vital role in confirming that this was a malignant lesion. Contrast administration was essential in seeing a complication such as endometritis due to cervical stenosis due to mass compression, as seen in Case 3.

Conclusions

In this study, we confirm that T2WI and DWI MR sequences have a significant role and are sufficient for diagnosing cervical cancer. We hope these findings can be implemented in developing countries where the resources are limited to maximize the radiologist's role in diagnosing and staging cervical cancer and improve our services to cervical cancer patients.

Conflict of Interest

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

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