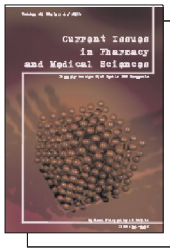

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Principles for magnetic resonance examination in case of the cervical cancer

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ABSTRACT

Magnetic resonance (MR) is the optimal, non-invasive method that allows for precise determination of the degree of cervical cancer progression. It also facilitates the evaluation of tumor volume and structure as well as infiltration of adjacent tissue/organs and enlargement of lymph nodes. Proper qualification and appropriate preparation of patients for the examination is a necessary condition for securing patient's safety and obtaining good quality images. Presently, MR of the lesser pelvis should be performed for most women before any treatment will be initiated. However, an absolute contraindication for the examination is the presence of a pacemaker, cochlear implant, metallic foreign object in the eye ball, metallic surgical clips and lack of verbal contact with the patient, especially deafness. Relative contraindications are pregnancy, especially in the first trimester, claustrophobia, metal foreign objects in soft tissues, metal orthopedic implants, prosthetic heart valve, dental implants, monitoring devices, dosing devices (e.g. insulin pump), permanent make-up or tattoo.

Keywords: cervical cancer, diagnostics, progression, magnetic resonance, contraindications, lymph nodes

INTRODUCTION

In terms of prevalence, cervical cancer occupies the second position among all malignances occurring in women worldwide. Nowadays over 50% of new cases and deaths concern women aged 45–64 years [1]. Only in Poland in 2009, 3102 new cases of cervical cancer were registered, constituting 4.5% of new occurrences of all malignancies [6]. Presently the main risk factor in the cancer is human papilloma virus (mostly type 16, 18 and 45) infection. Accompanying factors are early sexual initiation, large number of sexual partners, multiparity, low socio-economical status, smoking, long-term usage of hormonal contraception, diet deficient in antioxidants, frequent vaginal inflammatory conditions and genetic predisposition [15, 14].

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CLINICAL SYMPTOMS OF CERVICAL CANCER

Early neoplastic cervical lesions are usually asymptomatic and not specific. Typically watery vaginal discharge, grey, yellowish or brownish due to the presence of blood often accompanied by foul smell are observed. Sexual intercourse, vaginal irrigation or gynecological examination may result in local bleeding. They occur irrespective of menstrual cycles and in the early stages of disease progression they occur in the form of persistent spotting [2]. In course of disease progression there may occur abundant bleeding often associated with sexual intercourse, so called postcoital or contact bleeding. In advanced stages of the disease, there occur urination and defecation disorders as well as rectal bleeding resulting from infiltration of adjacent tissues and organs [8].

EVALUATION OF CERVICAL CANCER PROGRESSION

The evaluation of the cervical cancer progression may be based on TNM classification [20], however, FIGO (*International Federation of Gynecology and Obstetrics*) classification (Tab. 1) is more commonly applied. [7].

Both classifications similarly position the tumor (T) value in the I-IV intervals (TX-T4) but they differ in the interval IV. According to FIGO, it is divided into stages IVa and IVb.

Table 1. Classification of cervical cancer progression according to International Federation of Gynecology and Obstetrics (FIGO) and World Helth Organisation (TNM)

FIGO		TNM
–	carcinoma in situ	Tis
I	pre-invasive cancer	T1
IA	invasive cancer identified only microscopically	T1a
IA1	measured invasion of the stroma ≤3 mm in depth and ≥7 mm in diameter	T1a1
IA2	measured invasion of the stroma >3 mm but <5 mm in depth and ≤7 mm in diameter	T1a2
IB	clinical visible lesion, infiltration confined to the cervix or preclinical lesion greater than Stage IA	T1b
IB1	clinically visible lesion ≤40 mm	T1b1
IB2	clinically visible lesion >40 mm	T1b2
II	carcinoma extends beyond the cervix, but does not extend into the pelvic wall; it involves the vagina, but not as far as the lower third	T2
IIA	without parametrial invasion	T2a
IIA1	clinically visible lesion ≤40 mm	T2a1
IIA2	clinically visible lesion >40 mm	T2a2
IIB	with obvious parametrial invasion with no extension to the pelvic wall, with or without involvement of the vagina	T2b
III	tumor extends to the pelvic wall and/or involves lover third of the vagina	T3
IIIA	tumor involves lower third of the vagina, with no extension to the pelvic wall	T3a
IIIB	extension to the pelvic wall and/or hydronephrosis or nonfunctioning kidney	T3b
IVA	carcinoma has extended beyond the true pelvis or has involved the mucosa of the bladder or rectum	T4
	carcinoma has involved the mucosa of the bladder or rectum	N1
IVB	spread to distand organs	M1

The efficiency of treatment depends predominantly on the earliest possible detection of a proliferative lesion. In order to achieve that, prophylactic examinations are conducted evaluating pelvic organs with gynecological, cytological and ultrasonographic examinations [9, 21].

Nowadays the method of choice in such cases is magnetic resonance (MR), since properly conducted diagnostics is very important as it allows for introduction of the optimal treatment method [12]. It is especially important in advanced cases in which surgical procedure is contraindicated. The combined treatment (chemotherapy followed by radiotherapy) has recently gained popularity and it significantly improved the treatment results as well as decreased the risk of late complications in this group of patients. It confirms the importance of the evaluation of the degree of disease progression in order to select the best treatment method [21, 17]. The correct interpretation of the obtained images depends on appropriate qualification and proper preparation of patients for the MR examination.

CONTRAINDICATIONS FOR MR

Contraindications for MR examination are absolute and relative (Tab. 2). First of all it is necessary to retain full contact with the patient. In case of occurrence of adverse effects, the examination should be terminated immediately. MR examination cannot be performed in patients with a pacemaker because magnetic field might interfere with the stimulator operation endangering patient's health and life [13]. Another absolute contraindication is the presence of neurostimulators activated electronically, mechanically or magnetically. This group of devices also includes insulin pumps and cochlear implants [22].

Table 2. Contraindication for magnetic resonance examination

ABSOLUTE	RELATIVE
– pacemaker – cochlear implants – metallic foreign object in the eye ball – no verbal contact with patient (deafness) – metallic surgical clips	– pregnancy, especially first trimester – claustrophobia – metal objects in soft tissues – metal orthopedic treatment elements – prosthetic cardiac valve – dental implants – monitoring devices, dosing devices (e.g. insulin pump) – intrauterine device – permanent make-up or tattoo

Past injuries, especially the ones associated with the presence of metallic foreign objects within vulnerable structures (eye balls, spinal cord, heart, brain) exclude the possibility of using this diagnostic examination method. The influence of the magnetic field may displace the metal elements and thus damage the surrounding tissues and organs [5,19]. Potential risk of complications depends on the ferromagnetic properties of the foreign object, its size and shape, as well as its location in relation to vulnerable internal organs, including big vessels and nerves [18]. Such elements could be preliminary diagnosed using metal detectors that are routinely presented in each MR unit.

Relative contraindications include past orthopedic procedures involving metal elements as well as dental implants. Detailed description of the materials used and the dates of their production are indispensable. The presence of metal elements (prosthesis, implants, intrauterine devices) may interfere with image clarity by causing the appearance of image artifacts or lead to occurrence of thermal reaction. Claustrophobia also largely reduces the possibility of conducting the examination [5].

Conducting MR examination in pregnant patients requires individual approach and caution despite no confirmed adverse effects. It is especially important in the first trimester, which is regarded as relative contraindication [4].

The reaction of patients undergoing MR examination to noise emitted by the MR apparatus constitutes a separate issue. The audio phenomena may lead to irritation, anxiety, problems with speaking and temporary hearing disorder. In order to prevent such complications, ear plugs and/or headphones are used [22].

PREPARING, CONDUCTING AND INTERPRETING MR EXAMINATION

The patient should report for the examination with an empty stomach and moderately filled urinary bladder. Due to intravenously administered paramagnetic contrast agent, it is necessary for the patient to have normal renal function (correct biochemical parameters) and proper hydration level. Nowadays it is a standard procedure to determine the patient's creatinine and urea levels as well as to calculate the glomerular filtration rate (GFR). In order to minimize the artifacts caused by bowel movement, numerous pharmacological preparations are administered immediately before the examination.

Due to the impact of magnetic field, such devices as mobile phones, credit cards as well as pieces of clothing and jewelry which might include metal non-gold elements must be left outside [18].

The examination should be conducted on at least 1.5T apparatus in three principal anatomical planes using basic sequences that allow for obtaining T1- and T2-weighted images with and without fat and water saturation [14, 23]. According to guidelines of European Society on Urogenital Radiology (ESUR), MR examination in patients with cervical cancer should be extended with DWI (*Diffusion Weighted Imaging*) using 4 or more *b* values. Currently, it is also recommended to perform dynamic examination and delayed scan evaluation after contrast administration. Some centers prefer conducting MR imaging using vaginal tampon moistened with ultrasound gel.

The description of the examination should include tumor evaluation: its size (linear dimensions and volume), structure, the character of contrast enhancement and tumor's relation to adjacent organs for their infiltration (Fig. 1-2). According to the latest reports, the tumor's volume is a significant prognostic factor for patients with cervical cancer because patients with large tumor volume (30 ml; 39-87 ml) are at much higher risk of relapse than patients with smaller tumors (ml) [10, 11, 9].

MR examination also allows for the evaluation of the number and size of pelvic lymph nodes. According to

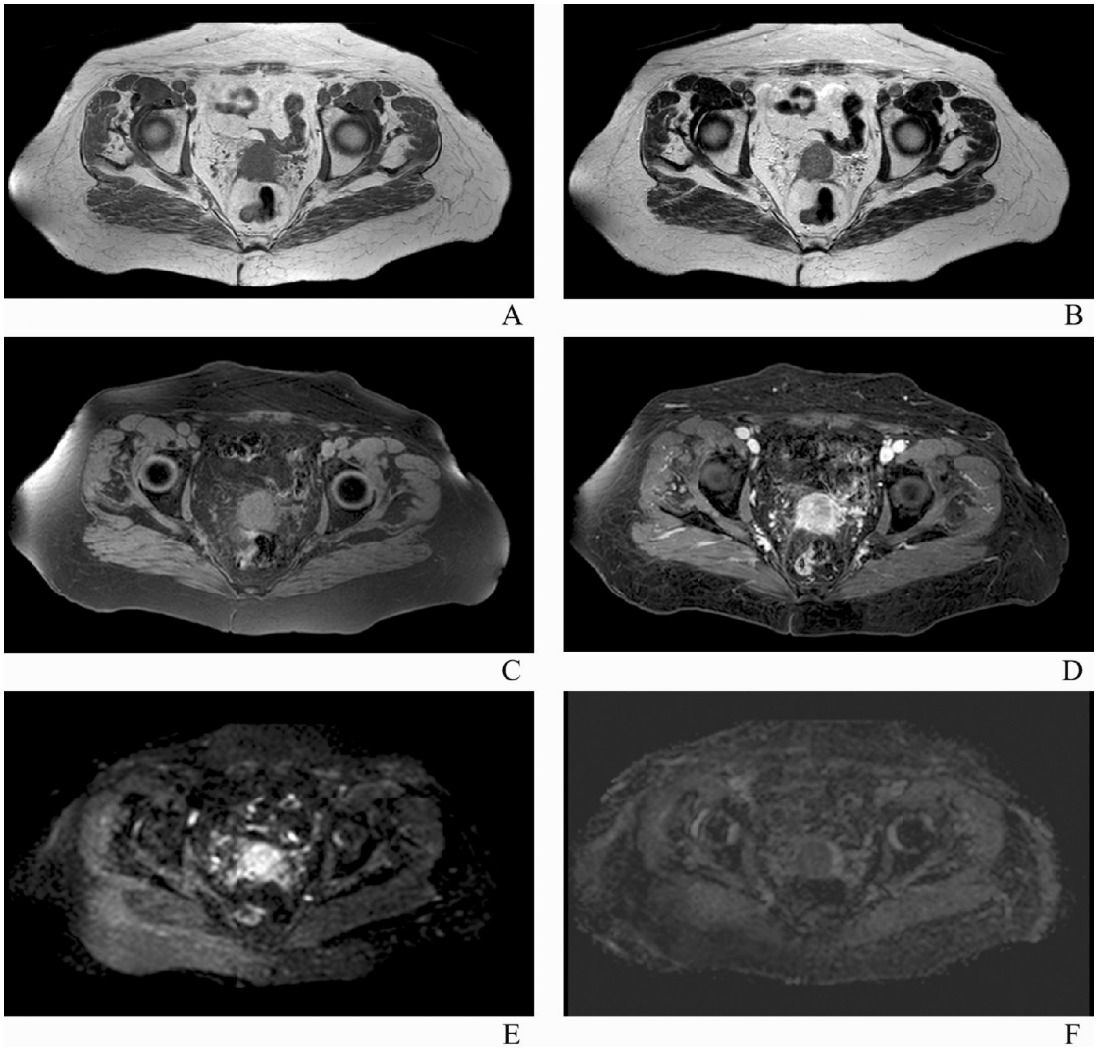

Fig. 1. Cervical cancer on axial sections in T1-weigted (A), T2-weighted (B), WAVE and T1-weigted post contrast images (D), DWI (E) and ADC map (F)

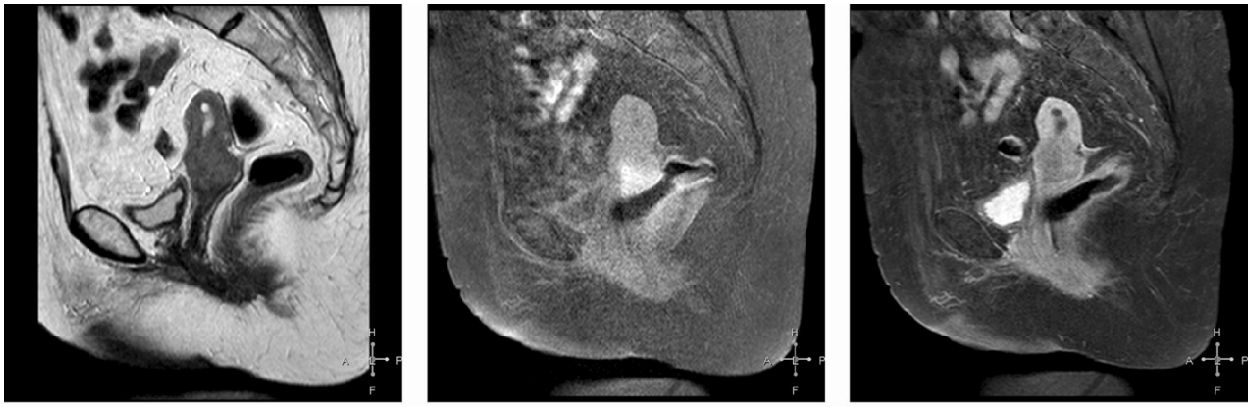

Fig. 2. Cervical cancer on sagittal sections in T1-weigted (A), WAVE and T1-weigted post contrast images (D)

various reports, the borderline value of node size is 10 mm in the short axis, depending on location. Lower values are also mentioned in case of common, internal and external iliac lymph nodes. In their case the short axis dimensions must not exceed 9, 7 and 10 mm respectively [3,16]. The sequences after administration of paramagnetic contrast agent allow for highlighting areas of pathological enhancement within bone structures and significantly aid in the evaluation of tumor's internal structure.

SUMMARY

Cervical cancer diagnosis is based on clinical and histopathological examination. In order to precisely evaluate the degree of progression of the proliferative process, the diagnostics includes magnetic resonance, which is very helpful in selecting appropriate therapeutic method. Correct qualification and appropriate preparation of patients for the MR check up guarantees their safety and is decisive for proper course of examination and diagnostic value of the obtained images.

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