

The role of magnetic resonance imaging in determining the proximal extension of early stage cervical cancer to the internal os

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ABSTRACT

Purpose: To study the interobserver variability of MRI for visualization of the internal os and measuring the distance between tumor and the internal os in patients with early cervical carcinoma and to compare the distance between tumor and the internal os measured on MRI with invasion of the internal os determined by histopathology.

Materials and methods: All T2-weighted MRI examinations between January 2003 and December 2007 of patients who underwent hysterectomy, of ≤ 40 years, with clinical stage IB1 cervix carcinoma and tumor size ≤ 2 cm were retrieved. 27 patients fulfilled these criteria.

Two radiologists retrospectively reviewed the images for visualization of the internal os and the distance between tumor and the internal os; agreement and intraclass correlation coefficients (ICCs) were calculated to determine interobserver variability. The distance between tumor and the internal os measured on MRI was compared with invasion of the internal os determined by histopathology.

Results: In 26 patients, visualization of the internal os was rated as good or moderate by both radiologists (agreement 96%). In 15 patients, both radiologists observed a tumor and the ICC for the distance between tumor and the internal os was 0.752 (95%CI: 0.406–0.909). Assuming 5 mm distance between tumor and the internal os on MRI as criterion for invasion of the internal os, 1 true-positive, 2 false-positives and none false-negatives were observed. Assuming 1 cm as criterion increases the number of false-positives, respectively 3 and 5 by radiologist 1 and radiologist 2.

Conclusion: MRI has high interobserver values for visualization of the internal os and no false-negatives for involvement of the internal os.

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1. Introduction

A large portion (approximately 40%) of the women with early cervical cancer is younger than 45 years [1]. Radical hysterectomy is the most commonly used surgical treatment and has good long term results. Important disadvantage of this treatment in younger patients is that they are no longer able to reproduce naturally. Trachelectomy is a fertility saving procedure which has become established as a possible alternative for surgical management of selected early stage cervical cancers with a tumor diameter ≤ 2 cm in women who wish to conserve their fertility [2,3]. In a recent published overview, Shepherd and Milliken [4], systematically provide data on worldwide experience concerning the complications, reproductive outcomes, premature delivery, recurrence rate and death of all 790 trachelectomy procedures described in published

studies [5–12]. These data suggests that there is a low recurrence rate (3.7%) and low death rate (2%), while keeping the possibility to conceive naturally, resulting in term deliveries. Reproductive outcomes have shown that a large portion of the women who attempt to conceive; up to 63% achieve a live birth with a preterm delivery rate of 9.6%

The relationship of the proximal extent of the tumor to the internal os is a critical consideration in preoperative assessment of patients who may wish to undergo trachelectomy. Extension of tumor approaching the internal os indicates that the patient might not be suitable for trachelectomy.

It is therefore important to determine the distance between the tumor and the internal os. Gynecological examination cannot assess accurately whether there is tumor extension beyond the internal os of the cervix. This is possible with magnetic resonance imaging (MRI), and there are some reports with high sensitivity ranging, up to 100% and specificity up to 98% [13,14].

In these papers, image analyses were performed in consensus by two radiologists and this could explain the high sensitivity

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and specificity values; data on interobserver variability were not reported. Determining the internal os on MRI can be challenging. This can be studied by evaluating interobserver variability, which has not been done in earlier studies. Also, patients with stage IIB or higher and age >40 years were included in these earlier studies while these patients are not representative for patients who will undergo trachelectomy in general practice.

The role of MRI in a representative patient population (age \leq 40 years, clinical stage IB1 and tumor size \leq 2 cm) considered for trachelectomy is still unknown.

In our routine clinical practice all patients with uterine cervical carcinoma undergo MRI for staging of the primary tumor and suitable patients also undergo surgery (Wertheim Okabayashi). Theoretically we can select patients fulfilling the inclusion criteria for trachelectomy and study interobserver variability for visualization of the internal os and for measuring the distance between the tumor and the internal os on MRI and compare the MRI findings with surgical findings.

Therefore the primary aim of this retrospective study was to evaluate the interobserver variability for the visualization of the internal os and for measuring the distance between tumor and the internal os of MRI for two experienced radiologists in a patient population with stage IB1 cervical cancer, with a tumor \leq 2 cm and age \leq 40 years. The secondary aim was to compare the distance between the tumor and the internal os measured by MRI with the presence or absence of invasion of the internal os determined by histopathology findings.

2. Materials and methods

2.1. Patients

In our institution, 281 patients diagnosed with cervical cancer underwent MRI between January 2003 and December 2007 for evaluation of the primary cervix cancer. From this population, we included patients for this retrospective studies. The inclusion criteria were as follows: patients who underwent radical hysterectomy, patients with age \leq 40 years, patients with clinical stage IB1 tumor and tumor size \leq 2 cm, as in routine practice these patients would undergo trachelectomy. Approval by the Medical Ethics Committee was waived because of the retrospective nature of this study.

2.2. MR imaging

All MRI examinations were performed on a 1.5T unit (Signa Horizon EchoSpeed, General Electric Medical Systems, Milwaukee, Wisconsin, USA) using a phased array multicoil and identical protocol. Sagittal, axial oblique and coronal oblique fast T2-weighted turbo spin-echo (TR/TE 2500/70 ms) with 4-mm section thickness and 30 cm FOV. Axial and coronal scans were angulated orthogonal and perpendicular to the portio/endocervical canal to minimize partial volume effects. All patients fasted 4 h prior to the examination. No bowel relaxants were routinely administered.

2.3. MRI image analysis

Two abdominal radiologists (JS and AMS) with respectively 14 and 12 years experience in reading pelvic MRI evaluated all images. To define the internal os, the radiologists firstly read MRI examinations of 10 patients in consensus. These patients had a tumor of stage IB1 and size \leq 2 cm, but were older than 40 years. Thereafter, within an interval of 1 month, they independently reviewed the images of patients fulfilling the abovementioned inclusion criteria.

Both were unaware of the findings at the initial reading and the findings from surgery and histopathology, but were aware of the FIGO stage and whether conization was performed, as in general

practice this information is also provided. However no information was available on the histopathology of the conization specimen, thus whether the resection margin was free or not. All images were read from the PACS system. The following characteristics were assessed:

- (1) Quality of images was rated as good, moderate (but adequate) or poor.
- (2) The visualization of the internal os was rated as good, moderate (but adequate) or poor. The internal os, which is the inner border of the cervix, was defined on sagittal images as the waist of the uterine contour where low signal intensity of the cervical stroma changed to the uterine appearance with myometrium of intermediate signal intensity (Fig. 1) [13,14].
- (3) The distance between tumor and the internal os was measured in tenth of mm as shown in Fig. 2. This measurement was performed on the sequences considered most appropriate by the radiologist. In patients where no tumor was observed, the length of the endocervical canal was determined and was used as the distance between tumor and the internal os. The endocervical canal was defined as the passageway between the ectocervix's opening (external os) and the internal os.

2.4. Surgical and pathological findings

All patients underwent surgery (Wertheim Okabayashi) within a range of 1–69 days (mean: 25 days) of the MRI examinations. Two patients underwent surgery after respectively 53 and 69 days, explaining the large range. This large interval between MRI and surgery is explained by the fact that both patients were initially considered to undergo trachelectomy and had second opinions in the meantime.

We retrieved the data on the extension of the tumor to the internal os from the histopathology reports. The pathological reports only mentioned whether the tumor extended beyond the internal os or not. So, in this retrospective study we could not get information about the exact pathological distance between tumor and the internal os.

2.5. Statistical analysis

Quality of MRI and interpretation of radiological internal os: findings of both radiologists were compared by means of descriptive statistics in terms of agreement in percentages.

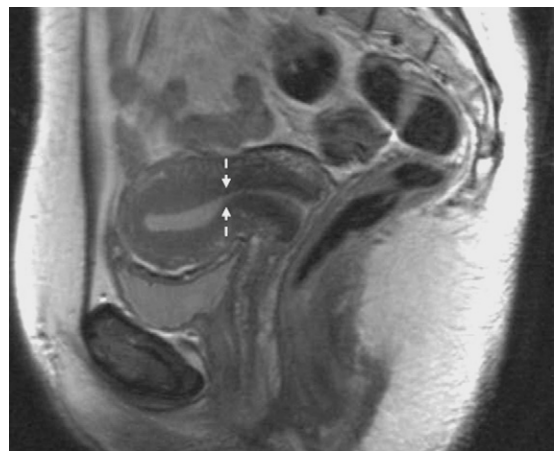


Fig. 1. The location of the internal os. Sagittal T2w TSE [2500/70] in a 30-year-old woman with stage IB1 cervical cancer. The internal os is located at the transition (arrows) of the hypointense (dark area), fibrous cervical stroma and the intermediate signal intensity myometrium.

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