MR imaging in the management of trachelectomy

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Carcinoma of the uterine cervix is the second most frequent cancer in women [1]. With delayed childbearing, more and more nulliparous women or women with one child who develop this specific carcinoma hope to preserve future fertility. Most women who present with early stage cervical carcinoma are treated by radical hysterectomy, preventing any future pregnancies. However, for some 1A2 and 1B1 grade tumors, radical vaginal trachelectomy (RVT) combined with pelvic lymphadenectomy can be an alternate option [2]. Preoperative pelvic MR imaging examination plays an important role in selecting women who are eligible for this procedure. MR imaging also helps reduce the number of incomplete RVT that represent 12–17% of cases [3,4].

The goal of this technical note was to define the features that should be identified on preoperative MR imaging examination in women who are possible candidate to trachelectomy and describe post-trachelectomy MR imaging findings to improve detection of complications or recurrence.

Dargent technique

RVT is a treatment option for cervical adenocarcinomas and epidermoid carcinomas. Neuroendocrine tumors or tumors with a clear cell component and poor prognosis are excluded. Eligible tumors include FIGO 1A2 or 1B1, N-tumors that are less than 2 cm, limited to the uterine cervix, without parametrial invasion, vascular emboli or lymph node extension. The estimated risk of recurrence following RVT is 2–5%, and the mortality rate is 3–6% [5]. When frozen sections of pelvic lymph nodes are negative for tumor, the procedure starts with the vaginal step, which consists of circular colpotomy and closure of the cervix and the tumor in a vaginal sleeve. Laterally, 2 cm of the paracolpium and parametrium are excised. The cervix is then resected at least 3–4 mm...
below the arch of the uterine arteries (Fig. 1). Resected tissues are studied by frozen section. If positive or if the surgical margins are insufficient (i.e., less than 5–8 mm), the RVT is abandoned and a radical hysterectomy is performed. If analysis of frozen sections is negative for tumor, the RVT is finished and the body of the uterus with its blood supply is anastomosed to the cervix and a cerclage is performed at the isthmus where the cervix used to be. The procedure needs a clear surgical margin of 5–8 mm. Otherwise, radical hysterectomy or additional radiotherapy is considered.

Role of MR imaging

We reviewed the preoperative and the postoperative MR imaging examinations of 21 and 14 women who underwent trachelectomy. Fourteen women had undergone cervical conization before preoperative MR imaging. Currently, the validated and recommended MR imaging protocol includes T2-weighted MR sequences in at least 3 orthogonal planes, T2- or T1-weighted MR sequence studying the lymph nodes to the renal veins, and T1-weighted MR sequence before and after intravenous administration of a gadolinium-chelate if the tumor is not or poorly visible on T2-weighted MR images [6,7].

Size and signal of the tumor on MRI

On preoperative MR imaging examination, 9/21 women (43%) had positive findings, that were true-positive findings in 7/21 women, corresponding to histopathologically confirmed tumors ranging from 7 to 21 mm in size. Conversely, 2/21 women had findings falsely positive for tumors, with findings consistent with the presence of cervical tumors measuring 12 mm on MR imaging that were not found in surgical specimens. There was no visible tumor on MR imaging in 12/21 women (57%); two women had 4- and 0.7-mm tumors, two had cervical intraepithelial neoplasia (CIN) and eight women had no tumors. We found that 100% of 1B1 and 60% of 1A2 stage tumors were visible on MR imaging. Visible tumors have intermediate signal intensity on T2-weighted MR images. After IV administration of gadolinium chelate they are either hyper- or hypovascularized. A subset of tumors are only visible on dynamic contrast enhanced MR imaging. We recommend that the size of the tumor always be measured on the three orthogonal planes on T2-weighted sequences and that only the largest diameter be recorded. If the tumor is only visible on dynamic contrast enhanced MR sequence, it should be measured on this specific sequence. Togashi et al. have reported that superficially invasive tumors are difficult to identify on T2-weighted MR images [8]. Seki et al. have reported that T2-weighted and dynamic contrast enhanced MR images are useful for detecting tumors between 3 and 5 mm in size. They found a sensitivity of 23% only for T2-weighted sequence, but that reaches 92% when dynamic contrast enhanced MR sequences are used in combination for tumor detection [9]. Thus, to accurately visualize and measure tumor dimensions, T2-weighted MR acquisitions must be obtained in three planes and the largest tumor diameter should be considered. If the tumor is not visible on T2-weighted MR images, dynamic contrast enhanced MR images must be obtained. The tumor must be at least 2 cm and be strictly intra-cervical, with no parametrium invasion. The external fibrous stroma of the cervix should not be modified and should have low signal intensity on T2-weighted MR images. Additional thin section T2-weighted MR sequence perpendicular to the long axis of the cervix can help in doubtful cases.

Distance between the top of the tumor – arch of the uterine arteries

Preoperative MR imaging helps the surgeon anticipate what will be actually done during surgery, where excision of the cervix should be performed to respect functional and oncological safety criteria. Resection must be done to obtain negative surgical margins (5 to 8 mm above the tumor), and the remaining cervix must allow future pregnancy. Researchers have shown the value of measuring the distance from the top of the tumor to the internal os of the cervix [10,11]. However, the internal os cannot be visualized during surgery because there is no hysteroscopy, and the surgeon does not see the tumor that is enclosed in the vaginal sleeve to prevent tumor spreading. On the other hand, the arch of the uterine arteries which marks the junction between the cervix and the isthmus of the uterine body is visible and stationary during the trachelectomy and is therefore an excellent reference point for the surgeon. Indeed, it is located several millimeters below the internal os and...
the surgeon knows that by cutting 3–4 mm below this there will be enough remaining cervical tissue to perform a cerclage and spare fertility. Measuring the distance between the tumor and the uterine arcade therefore seems to be a better choice than the tumor and the internal os. The arcade is identified on MR imaging in virtually all women. T2-weighted MR imaging provides the best morphological visualization of the uterine arcade. Additional sections parallel to the axis of the cervix can be obtained if necessary depending on the degree of flexion of the body of the uterus in relation to the cervix (Fig. 2).

Conization scarring

The most common features are an irregular appearance to the external os, with occasional high intensity linear enhancement due to inflammation. Sometimes there is a more nodular appearance, which is difficult to interpret on MR imaging with a risk of false positive findings. Lackman et al. have reported false positive findings in 2–5% of MR examinations depending on the readers in a series of 63 women [10]. These cases should be discussed in a multidisciplinary meeting with surgeons to decide between performing a follow-up MRI at 3 months to confirm the disappearance of inflammation, or surgery while informing the patient that a more radical procedure may be necessary during the operation. We advocate performing post-conization MR imaging examination at least 5–6 weeks after the procedure to overcome the potential the risk of false positive findings due to inflammation.

Normal features of the pelvis following tracheectomy

The guidelines from the Haute Autorité de santé (French National Health Authority) recommends performing an annual MR imaging examination during the 5 years following tracheectomy in the absence of any abnormal clinical signs and systematically if the patient is symptomatic [12]. The cervix and the fundus of the vagina appear amputated. The features of the anastomosis may vary, with a residual cervix whose size depends on the extent of resection but is isthmus-vaginal at most. In approximately 50% of MR examinations a vaginal neofoinrix can be seen [13]. The cerclage is visible on sagittal T2-weighted MR images, usually in the form of a thin submillimeter area with low signal intensity below the isthmus, and sometimes as a hyperintense artifact. In one third of MR examinations the vaginal wall is diffusely thickened due to the paravaginal and parametrial excision during resection of the vaginal cuff. This is visible on the first postoperative MR examination and may persist up to 3 years after surgery.
Abnormal MR imaging features of the pelvis following trachelectomy

Tumor recurrence or tumor progression should be carefully searched for and, when present, may appear as areas of intermediate signal intensity on T2-weighted MR images across from the anastomosis. When no abnormalities are detected on T2-weighted MR images, we recommend performing dynamic-contrast enhanced MR sequences. MR images must be scrutinized for presence of enlarged lymph nodes or peritoneal carcinomatosis. Postoperative MR imaging is not useful when performed too early because of substantial post-therapeutic inflammation.

Conclusion

For appropriate indications, RVT results in recurrence rate of 2–4% of the initial disease. In addition, after RVT, 60% women become pregnant and 77% of pregnancies reach term. The Dargent procedure is currently the reference technique to preserve fertility in young women who fulfill eligibility criteria for RVT. MR imaging is essential for the surgeon to best select potential candidates and provide them with appropriate information.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References