Accuracy of Magnetic Resonance Imaging in Diagnosis of Adenomyosis and Endometriosis

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ABSTRACT

Objective: To evaluate the utility of Magnetic Resonance Imaging (MRI) in the diagnosis of adenomyosis and endometriosis.

Methods: Medical records of 38 women who underwent laparoscopy or laparotomy less than 4 weeks after preoperative MRI were reviewed. MRI results were evaluated for the diagnosis of adenomyosis of the uterus, ovarian endometrioma, peritoneal endometriotic implants, endometriosis of bladder, bowel and rectovaginal septum. Surgical and histological findings were used as a gold standard.

Results: Adenomyosis was found in 7 (18.4%) of 38 patients. Endometriosis was diagnosed in 30 (78.9%) of 38 patients. The sensitivity, specificity, and accuracy of MRI for diagnosing adenomyosis were 85.7, 100, and 90.9% respectively. The sensitivity, specificity, and accuracy of MRI for the diagnosis of endometriosis in specific sites were as follows; endometrioma, 81.5, 96.6, and 93.4% respectively; peritoneal implants, 25, 100, and 60.5% respectively; bladder, 66.6, 100, and 97.3% respectively; rectovaginal septum, 90, 100, and 97.3% respectively; bowel, 71.4, 100, and 94.7%, respectively.

Conclusion: MRI provides high accuracy in the diagnosis of adenomyosis and endometriosis with an exception for the diagnosis of peritoneal endometriotic implants.

Keywords: Endometriosis, adenomyosis, MRI, Magnetic Resonance Imaging

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Adenomyosis is a female disorder that is characterized by the presence of ectopic endometrial tissue embedded within the myometrium.[1] Endometriosis is a more common gynecological disorder, defined by the presence of ectopic endometrial tissue outside the endometrium and myometrium.[2,3] It has become evident that both adenomyosis and endometriosis may constitute a common pathophysiological mechanism by the dislocation of basal endometrium.[4] Recently, due to the postponement of pregnancy into the third or fourth decade of life, premenopausal adenomyosis associated with endometriosis might become an important factor for infertility[4] as well as other common presenting symptoms such as dysmenorrhea, dyspareunia, and pelvic pain.

Laparoscopy is a gold standard for the diagnosis of endometriosis,[5] according to its value to directly visualize the presence, site, size, and depth of endometriotic implants, adhesion and degree of Cul de sac obliteration. Moreover, a biopsy can be taken to confirm the diagnosis by histology, and treatment can also be performed laparoscopically. However, due to its invasiveness and the presence of dense adhesion, some areas are inaccessible by laparoscopy. Such areas included the obliterated Cul de sac and the bowel area. Magnetic Resonance Imaging (MRI) is currently used for the diagnosis of endometriosis. MRI is extremely useful for the preoperative evaluation in selected patients with suspected severe endometriosis.[5,6]

The diagnosis of adenomyosis is more difficult, and is often obtained by pathological analysis performed after hysterectomy.[7] Imaging has been used to establish the correct preoperative adenomyosis in order to avoid unnecessary surgical intervention. MRI is a highly accurate noninvasive imaging technique for diagnosing

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and differentiating adenomyosis from other gynecological disorders especially uterine leiomyoma. It is also helpful in planning appropriate treatment.[7-9]

The purpose of this study is to determine the diagnostic performance of MRI for the preoperative diagnosis of the histologically proven adenomyosis and endometriosis.

MATERIALS AND METHODS

Patients

Records of all pelvic MRI examinations performed in female patients at two German institutes, Justus-Liebig university hospital in Giessen and Ammerland hospital in Westerstede, between January 2004 and July 2007 were cross-referenced with medical and surgical records to identify patients who had a preoperative diagnosis of adenomyosis or endometriosis. All patients underwent surgical intervention within 4 weeks after MRI.

The patients had presented with one or more of the following symptoms: dysmenorrhea (n = 30), pelvic pain (n = 28), infertility (n = 7).

Written informed consent was obtained from all patients of these two institutes for reviewing their records.

MR imaging

MRI was performed using a body coil, Megnetom Avanto; Siemens, Erlangen Germany. Turbo spin-echo T1-weighted and T2-weighted transverse and coronal plane, spin-echo fat-saturated T1-weighted transverse and sagittal plane were scanned.

MRI images review

All of the MRI images were retrospectively reviewed by radiologists who had experience in pelvic MRI interpretation. The radiologists were aware that the patients might have pelvic endometriosis and/or adenomyosis, but they were blinded to the surgical findings and histological results. The results of MRI were interpreted and concluded to the diagnosis of adenomyosis, ovarian endometrioma, peritoneal endometriotic implants and deep pelvic endometriosis which included bladder, bowel, and rectovaginal septum involvement.

Surgical findings and histology review

Of 38 patients, 24 Patients (63.2%) had laparoscopy. 12 Patients (31.6%) had laparotomy and 2 patients (5.2%) had laparoscopy with conversion to laparotomy.

In all of the patients, operative records, pictures and video-records (if available) were retrospectively reviewed. The presence of adenomyosis, endometrioma, peritoneal implants and deep pelvic endometriosis were recorded and were considered a diagnosis if they were correlated with histopathology.

Statistical analysis

The presence or absence of adenomyosis and/or endometriosis was compared sitebysite between the results of MRI and surgico-histopathological findings. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated.

RESULTS

MRI of the pelvis was performed in 145 patients during the study period. Only 38 patients aged 25 to 45 years (mean, 30.7 ± 2 years), met the eligible criteria and were included in our study. The interval between MRI and surgery was 1 to 25 days (mean, 10.6 ± 1 days).

From surgical findings which were confirmed by histology, the diagnosis of adenomyosis were made in 7 patients (18.4%), ovarian endometrioma in 16 patients (42.1%), peritoneal implants in 20 patients (52.6%), bladder endometriosis in 3 patients (7.8 %), bowel endometriosis in 7 patients (18.4%) and endometriosis of rectovaginal septum in 10 patients (26.3 %). The statistical value achieved of MRI in diagnosing adenomyosis and endometriosis is shown in Table 1.

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of gross examination for the diagnosis of adenomyosis are 42.8, 100, 100, 50 and 63.6% respectively. Three cases had a macroscopic aspect resembling to leiomyoma. Two cases were associated with leiomyoma.

DISCUSSION

Adenomyosis is a non-neoplastic condition, characterized by the presence of ectopic endometrial glands and stroma in the myometrium of the uterus with adjacent smooth muscle hyperplasia.[3] The presenting symptoms are pelvic pain, dysmenorrhea and menorrhagia. These symptoms are nonspecific and can also be seen in other gynecological disorders such as leiomyoma. Approximately 35% of the patients are asymptomatic.[4] The accuracy of preoperative diagnosis of adenomyosis based on clinical findings is poor, ranging from 2.6 to 26%.[7,8] The diagnosis can hardly be prior to hysterectomy. Currently, diagnosis of adenomyosis prior to hysterectomy is becoming more and more important, since more women are delaying their pregnancy until later in their reproductive age. Adenomyosis is now encountered more frequently in the infertility work up[10]. With the advantage of high resolution imaging techniques, correct diagnosis can be established without unnecessary intervention.

Sonography is commonly used as the initial imaging modality. Transabdominal sonography does not allow reliable diagnosis of adenomyosis because of the resolution limit. Transvaginal sonography (TVS), which provides better resolution by its high frequency, is known to be a reliable noninvasive diagnostic tool for adenomyosis. However, it has limitations in tissue characterization and the sonographic features of adenomyosis are often subtle and extremely variable.[7-9] Therefore, the accuracy of TVS in the diagnosis of adenomyosis largely depends on the examiner's ex-

TABLE 1. Diagnosis of adenomyosis and endometriosis by MRI in 38 patients.

MRI diagnosis	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Adenomyosis	85.7	100	100	80	90.9
Endometrioma	81.5	96.6	86.6	95.1	93.4
Peritoneal implants	25	100	100	54.5	60.5
Bladder endometriosis	66.6	100	100	97.2	97.3
Bowel endometriosis	71.4	100	100	93.9	94.7
RV septum endometriosis	90	100	100	96.5	97.3

perience, as there are wide ranges of previous reports in sensitivity (53-89%) and specificity (50-98%).[7,11]

MRI is also an accurate, noninvasive imaging modality for diagnosing adenomyosis. The excellent soft tissue differentiation of MRI makes it an ideal tool for evaluation of uterine pathology. Compared with TVS, MRI is considerably less examiner-dependent and provides images that are standardized and reproducible. MRI is more helpful than TVS in delineating the location and extent of the lesion as well as monitoring the progression or regression of the lesion. MRI is also useful in distinguishing adenomyosis from leiomyoma in patients who have an enlarged uterus[12]. The differentiation between these two diseases is important because uterine preserving operations can be performed in women with leiomyoma, whereas hysterectomy is the definitive treatment for debilitating adenomyosis.[7,12]

Few studies have compared the accuracy of TVS with that of MRI for the diagnosis of adenomyosis. There are controversies about this issue. Some authors reported no significant difference between TVS and MRI in the sensitivity (65-89% vs. 78-86%) and the specificity (89-98% vs. 86-93%),[8,9,13] while others reported that the accuracy of MRI was significantly higher than TVS (88% vs. 53%).[11] In our study, we did not compare the accuracy of TVS and MRI because of inadequate sonographic data.

In our study, the sensitivity, specificity, and accuracy of MRI for diagnosing adenomyosis were 85.7, 100, and 90.9% respectively. These results are in accordance with the previous studies which also reported a high accuracy of MRI for diagnosing adenomyosis, with the sensitivity and specificity ranging from 86 to 100%.[7-9] However, the limited availability and the high cost of MRI make it an impractical tool for the initial evaluation of all patients with symptoms suggestive of adenomyosis. However, it should be used as an important adjunctive tool for selected patients with clinically significant adenomyosis.[7]

Endometriosis is a benign disease, characterized by the presence of endometrial glands and stroma outside the uterus.[1,2] Endometriosis is found almost exclusively in women of reproductive age. The true incidence in the female population is unknown but approximately 8-12% is estimated and the disease accounts for 10-20% of all female infertility.[14]

The two common locations of endometriosis are ovary, also defined as an endometrioma, and peritoneal lesions or implants. Deep endometriosis is a particular form of subperitoneal endometriosis, i.e., ectopic endometrial tissue which penetrates the peritoneum > 5 mm. in depth.[15] Deep infiltration can involve the Douglas pouch, the uterosacral ligaments and the rectovaginal septum. The bowel and bladder are also the less frequent locations of endometriosis.[15]

The selective use of imaging modalities may be helpful in identifying patients with endometriosis, although diagnostic laparoscopy is a gold standard for the diagnosis of endometriosis. Sonography is the most common initial imaging tool used to evaluate women with suspected endometriosis. Ultrasonography is the method of choice to identify endometrioma with diagnostic performance up to 92% sensitivity and 99% specificity.[16] However, it has a limited role in the diagnosis of peritoneal implants.[17] Transrectal sonography is a useful tool in the diagnosis of deep infiltrating endometriosis of the rectovaginal septum and rectum with sensitivity and specificity up to 97 and 96% respectively.[18]

MRI also has a role in the diagnosis of endometriosis. MRI can identify all types of endometriotic lesions which mostly contain blood and its degradation products.[19]

MRI can identify endometrioma by detection of pigmented hemorrhagic lesions. In our study, the sensitivity, specificity and accuracy of MRI were 87.5, 100, and 90.0%, respectively. These results are in accordance with other studies which reported a range of 82-91% sensitivity and 94-98% specificity.[20-22]

The ability of MRI to diagnose peritoneal endometriotic implants is low. From our result, we found that the sensitivity, specificity and accuracy of MRI were 25, 100, and 60.5%, respectively. The poor sensitivity may be due to the fact that small implants were difficult to visualize,[20,23] or the limitations of MRI that can detect only brown implants, which contain hemoglobin degradation products.[24] The inflammatory red implants and the white lesions cannot be detected by MRI.[24] These results are compatible with other previous studies which also reported a low sensitivity (13-27%), but high specificity (60-98%) of MRI in the diagnose peritoneal endometriotic implants.[20,22,25]

In our study, we found only 3 (7.8%) of 38 patients with bladder endometriosis. The sensitivity, specificity and accuracy of MRI for diagnosing bladder endometriosis were 66.6, 100, and 97.3%, respectively. Bazot, et al, also reported the sensitivity of 88%, specificity of 99%, and accuracy of 98%.[26,27] There were no specific MR images of bladder endometriosis; MRI can detect morphological and signal abnormality of the bladder which is highly suggestive of endometriosis.[27]

Deep pelvic endometriosis with extension to the uterosacral ligaments and rectovaginal septum is a cause of severe pelvic pain and dyspareunia. The depth of the lesion increases with time and is correlated to pain intensity.[28] Treatment of deep pelvic endometriosis is complete surgical excision;[15,29] therefore preoperative diagnosis of the extent of the lesion is very important. Deep pelvic endometriosis which is located predominantly in the subperitoneal area may be invisible during laparoscopy. The lesion can be hidden by adhesion of the Cul de sac of Douglas.[15,27] MRI was reported to be a valuable tool for the diagnosis of deep pelvic endometriosis, especially in the rectovaginal septum with 84-100% sensitivity and 100% specificity.[30] Our data is also in line with those studies with a sensitivity and a specificity of 90 and 100%, respectively.

Endometriosis of the intestinal tract usually affects the rectosigmoid colon. The ileum, caecum and appendix may also be affected. Unlike a neoplastic lesion, the bowel mucosa is not involved; therefore diagnosis by colonoscopy often gives a false negative result.[27] Several imaging techniques have been used to diagnose bowel endometriosis. Transvaginal and transrectal sonography were reported to be effective in the diagnosis of rectosigmoid endometriosis with a sensitivity of 84% and a specificity of 99%.[27] MRI has also shown high performance in the diagnosis of bowel endometriosis with the sensitivity of 77-93% and the specificity of 94-99%.[26,27] Our study had a lower sensitivity (71%), compared with the previous reports which may be due to the fact that we did not use antiperistalsis drugs before performing

MRI in our patients. Nevertheless, the specificity and accuracy of MRI for the diagnosis of bowel endometriosis from our data are also high.

Several limitations of our study must be considered. First, we had a limited sample size which may affect the accuracy of our results. Second, the prevalence of adenomyosis, endometriosis and deep pelvic endometriosis in our patients were high. This may bias the accuracy of the results to be too high.

However, our work has demonstrated the advantages and the potential value of MRI in the detection of adenomyosis and all sites of endometriosis. MRI can provide an accurate preoperative data of the diseases. Therefore, an appropriate treatment plan, including a multidisciplinary approach, can be made, in order to achieve complete resection of all symptomatic lesions in a one-step surgical procedure.

CONCLUSION

MRI is the optimal imaging modality to diagnose pelvic endometriosis, due to the good visualization of all components in the pelvis and the possibility of exploring all locations of endometriosis within one examination. MRI demonstrates high sensitivity, specificity, positive predictive value, negative predictive value and accuracy in the prediction of the location and extension of endometriosis, with one exception for peritoneal endometriotic implants.

MRI also provides a high accuracy for diagnosing adenomyosis. MRI is recommended for diagnosing adenomyosis in women with an associated uterine lesion such as leiomyoma.

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